MANAV RACHNA
vidyanatariksha

AY 2022-23

6.5
Water in the Community

6.5.3 Off-Campus Water Conservation Support

MRIIRS Weblink to SDG 6:

https://mriirs.edu.in/sdg06-clean-water-and-sanitation/

Off-Campus Water Conservation Support by MRIIRS:

Manav Rachna Centre for Advance Water Technology & Management (**MRCAWTM**), MRIIRS, was established in 2017 to pursue teaching, research, consultancy and impart training programmes in hydrogeology, water resources engineering and management, water quality and collateral environment and ecology issues. The Centre forms a pool of professionals and researchers from the field of hydrology, hydrogeology, hydrochemistry, eco-hydrology and environment management. Besides, the Center has also developed a skill set on community centric water resource development, socio-hydrology and watershed based sustainable management. The Center aims to address real challenges faced by the stakeholders and also provides a platform for science and technology-based solutions through non-invasive investigation, water quality analysis, recycling of waste water,surface and Ground Water flow and resource analysis, satellite databased interpretation, local and regional scale hydro-statigraphic analysis, mathematical modeling of water resources and GIS based applications.

MRCAWTM is having five field units, one each at Barmer, Ballabhgarh, Khol-Rewari, Palwal and Panchkula where 2-10 field specialists are working. MRCAWTM in its short period of journey, has been able to achieve significant milestones in the form of projects obtained, executed, and completed. So far 16 projects have been successfully completed between June 2018 and June 2023 of worth ~Rs2.63 Cr. Further, 07 more projects of Rs 12.34 Cr are in progress as on 1st July 2023.

MRCAWTM is working for its vision of **clean water for all forever.** The major area of work is divided into 1. R&D Studies, 2. **Technical Interventions, 3. Training and Capacity Building**, 4**. Outreach programs,** 5. Product and Innovation. The Center has also established linkage with various Governmental, academic, and non- Governmental agencies through MoUs.

- **Ongoing Projects of MRCAWTM, MRIIRS leading to Off-Campus Water Conservation Support**

Sn.	Ongoing Projects of MRCAWTM, MRIIRS	Funding Agency	From Date & Period	Objective
1	Co-solving Water logging and Groundwater depletion issue in parts of Faridabad Smart City	WTI, DST, GOI	21 .05. 21 36 months	DST Project on solution to flash flood and groundwater (GW) depletion
2	Hydro Geological Survey for Aquifer Monitoring in Barmer Area, Rajasthan,	Cairn Oil & Gas Vedanta Ltd	02.07.21 36 months	Industrial project on impact study on GW use
3	Haryana Atal Bhujal Yojna-Cluster 06 (Faridabad-Rewari Districts)	IWRD Haryana	11.8.2021 48 months	Haryana Govt Project on improving sustainability of GW through participatory approach at Gram panchayat level in Haryana
4	Haryana Atal Bhujal Yojna-Cluster 07 (Palwal District)	IWRD Haryana	11.8.2021 48 months	
5	Haryana Jal Jeevan Mission – State Implementation Support Agency (SISA)	PHED Haryana	27.09.2021 24 months	Haryana Govt Project on assured household water supply in rural Haryana
6	Haryana Jal Jeevan Mission – Energy Audit State Implementation Support Agency	PHED Haryana	01.11.2022 12 months	Haryana Govt project on auditing energy consumption for GW abstraction
7	Groundwater condition study in core and buffer zone of proposed Iron ore mine around Villages, Eklama, District Kabirdham, CG	WCS Bhubaneswar	01.07.2023 04 months	Impact assessment of mining on GW for NOC under CGWA accreditation.

• Completed Projects of MRCAWTM MRIIRS leading to Off-Campus Water Conservation Support

S.N.	Completed Projects of MRCAWTM till year 2022	Funding Agency	Sanction Amount Rs in lakh	Completion Date & Period
1	Technical guidance in construction of Rainwater Harvesting Structures in Faridabad City	M/s Navjoti Foundation, Gurugram	29.03.2023	Rainwater conservation
2	Impact assessment of mining of Iron ore on Ground Water in and around Raikela Sundargarh Odisha.	M/s WCS Bhubaneshwar, Odissa	08.10.2022 04 months	Impact assessment ofMining on Ground Water
3	Impact assessment of mining of Iron ore on Ground Water in and around Dholta Pahar, Sundergarh, Odissa	M/s WCS Bhubaneshwar, Odissa	04.4.2022 08 months	Impact assessment ofMining on Ground Water
4	Impact assessment of mining of Iron ore on Ground Water in and around Netrabandh Pahar, Sundergarh,	M/s WCS Bhubaneshwar, Odissa	04.4.2022 04 months	Impact assessment ofMining on Ground Water
5	Study for Rainwater harvesting around Iron oremine of Dholta Pahar, Sundergarh, Odissa	M/s WCS Bhubaneshwar, Odissa	04.4.2022 04 months	Study for Rainwater harvesting in Miningarea
6	Study for Rainwater harvesting around Iron oremine of Netrabandh Pahar, Sundergarh, Odissa	M/s WCS Bhubaneshwar, Odissa	04.4.2022 04 months	Study for Rainwater harvesting in Miningarea
7	Biodiversity study around Iron ore mine of DholtaPahar, Sundergarh, Odissa	M/s WCS Bhubaneshwar, Odissa	04.4.2022 04 months	Study for Biodiversity in Mining area
8	Biodiversity study around Iron ore mine ofNetrabandh Pahar Sundergarh, Odissa	M/s WCS Bhubaneshwar, Odissa	04.4.2022 04 months	Study for Biodiversity in Mining area
9	Impact assessment of underground mining of Manganese on Ground Water in and around Miragpur, MP.	M/s D P Rai, BalaghatMP	April 2022 3 months	Impact assessment ofMining on Ground Water
10	Impact assessment of underground mining of Manganese on Ground Water in and around Pandarwani,MP.	M/s D P Rai, BalaghatMP	April 2022 3 months	Impact assessment ofMining on Ground Water
11	Hydro Geological Survey for Aquifer Monitoring in Barmer Area, Rajasthan (2018-21).	Cairns O&G Vedanta Ltd	June 2021 36 months	Industrial project on impact study on Ground Water use
12	Communicating Science through Model Waterand Eco-Health Clinic for quality of life.	NCSTC, DST, GOI	May 2020 15 months	Water literacy through hands on experiments for students
13	USAID URBAN WASH Innovation Lab,	USAID-NIUA	Dec 2019 30 months	Awareness on water and sanitation
14	Detailed investigations in Khoh Village for Rainwater Harvesting,	MSF, Gurgaon	April, 2019 3months	Sustainable solutions of groundwater use
15	ISP system for treating saline Groundwater- Techno-Commercial, **abandoned** due to Changein policy of State of Haryana on saline water use	Maharani Innovative Paints Pvt Ltd. Prithla	Sept 2020 12 months	Use of saline water through eco-friendlytechnology
16	Reconnaissance survey for Water prospect in 10adopted villages of Maruti-Suzuki Foundation	MSF, Gurgaon	Dec 2018	Sustainable solutions of groundwater use

Sample Reports

of the Projects detailing the Off Campus Water Conservation Support provided by MRIIRS through the projects mentioned on page no. 3 and 4.

SDG 6- CLEAN WATER AND SANITATION

1. **Co-Solving of Water Logging and Depletion Of Ground Water in District Faridabad- Click to view**
2. **Impact assessment of mining of Iron ore on Ground Water in and around Raikela Sundargarh Odisha - Click to view**
3. **Impact assessment of mining of Iron ore on Ground Water in & around Dholta Pahar, Sundergarh, Odissa- Click to view**
4. **Impact assessment of mining of Iron ore on Ground Water in and around Netrabandh Pahar, Sundergarh- Click to view**
5. **Study for Rainwater harvesting around Iron ore mine of Dholta Pahar, Sundergarh, Odissa- Click to view**
6. **Study for Rainwater harvesting around Iron ore mine of Netrabandh Pahar, Sundergarh, Odissa- Click to view**
7. **Impact assessment of underground mining of Manganese on Ground Water in and around Miragpur, MP- Click to view**
8. **Impact assessment of underground mining of Manganese on Ground Water in and around Pandarwani, MP- Click to view**

1. Co-Solving of Water Logging and Depletion Of Ground Water in District Faridabad

MRIIRS with the funding of Department of Science and Technology, Government of India, has created rainwater recharge structure at **Sector 16 A and Sector 15 A Faridabad, Haryana, India** for **water co-solving logging and groundwater depletion** as a pilot project and with the hope to replicate it in entire city area.

As evidence in support to 6.5.3 **details of the project, photographs and video of constructed structure to solve the water logging problem is available. Feedback of local resident about the effectiveness of structure** is presented, All the data are available in public domain through, newspaper & web site of MRIIRS.

- ✓ **Video of Construction of Structures for Co-solving of Water Logging and Ground Water Depletion Issues in Sector 15A of Faridabad City of Haryana State of India:**

- ✓ **Video of interview of one of the residents of Sector 15A of Faridabad City of Haryana State of India:**

- **Introduction**

Urban waterlogging and groundwater depletion are two diverse but major challengesof Indian cities under changing climatic conditions. The enhanced extreme events of rainfall in recent years along with rapidly altered hydrological conditions in urban environment pose conducive situation for urban water logging. On the other hand, intense and large withdrawal of groundwater, higher than the natural annual recharge has depleted the groundwater level severely in many Indian cities. **A pilot project is executed in Faridabad Smart City of National Capital Region India, to combat water logging and to rejuvenate groundwater resource.**

In the study all steps were undertaken meticulously, beginning from hydrogeological study, site selection, rainfall analysis, calculations of runoff generation, framing well design after identification of suitable recharge zones within depleted aquifer and determination of its intake capacity. It further elucidates estimation of suitable dimension of desilting chamber, fixing suitable dose of ferric chloride for coagulation and assessment of recharge volume. The constructed recharge system is tested whether it is working effectively as per the feedback obtained from independent sources. It has high scalability in similar hydrogeological situation in other parts of India.

Picture of Actual Waterlogging in the Officer's Colony Area of Sec-15A, Faridabad City of Haryana State of India

- **Details of Project:**

The project of 36 months duration with 0.7012 crore budget, submitted with the title "**Co-solving water logging and groundwater depletion issues in parts of Faridabad Smart City using Underground Taming of Flood Water for Aquifer Storage and Recovery**" to the Department of Science and Technology, Government of India, got sanctioned to Manav Rachna CAWTM in May 2021.

- **Motivation and Problem Statement:**

Groundwater over extraction due to urbanization and growing population of Faridabad city of India area has depleted its aquifers. In the recent past, increasing extreme events of rainfall and growing paved area has witness huge waterlogging in low lying parts of city particularly in areas with shallow impervious layers.

Urban waterlogging is a major concern growing fast in India due to an increase in climate-change-related extreme rainfall events. The National Disaster Management Authority has classified urban foods as separate disasters. Urban waterlogging happens in parts of Faridabad Smart City on such a scale that the residents are bound to remain under house arrest for days during heavy pores in monsoons each year. Streets remain submerged under 2-3 feet of water for several hours; transport and movement are totally abandoned. Even if water is removed, mud and dirt persist for several days creating an unhealthy atmosphere and enhancing the risk of waterborne and communicable diseases. A smart solution to a smart city addressing these two critical issues of Faridabad Smart City (FSC) is the need of the hour.

- Under this investigation it was proposed to divert the urban flash flood creating water logging condition and is hampering day-to-day life during monsoon period to improve the groundwater condition within the depleted aquifer. This **aquifer** st**orage and recovery project of taming urban flood water is addressing two critical issues of urban hydrology to improve the sustainability.**
  - ✓ Developing solutions to the street water logging and groundwater depletion through Underground Taming of Flood water (UTF) for Aquifer Storage Recovery (ASR) in Faridabad Smart City.

- ✓ Identification of suitable aquifer zones for recharge in the Faridabad Smart City

- **Impact Assessment**: Under this sponsored project, MRIIRS with the funding of Department of Science and Technology, Government of India, has created rainwater recharge structure at officer's colony, sector 15A Faridabad, Haryana, India for water co-solving logging and groundwater depletion as a pilot project and with the hope to replicate it in entire city area.
  - ✓ Real time monitoring of groundwater level, temperature, and electrical conductivity for impact assessment on the ground water system.
  - ✓ Periodic monitoring of groundwater quality to assess the impact of Aquifer Storage and Recovery through comparison of the source water and product water.
  - ✓ To study the reduction in energy consumption for groundwater pumping due to UTF & ASR
- Two locations were identified under FSC area in sector 16A (PWD, B&R colony) and 15A (Officers' colony) in consultation with FSCL and PWD, Faridabad. Here, streets remain submerged under 2-3 feet of water for several hours; transport and movement are totally abandoned. Even if water is removed, mud and dirt persist for several days creating an unhealthy atmosphere and enhancing the risk of waterborne and communicable diseases.
- The newly constructed systems at Officers Colony, Sector 15A, and B&R Colony Sector 16A Faridabad are working absolutely fine and has been tested during last two monsoons. First during 73mm of rainfall on 30th Aug 2022 and is reconfirmed during last two days wide spread rain of 22nd and 23rd Sept 2022 (110mm in 24hr on 22 Sept 2022, IMD). The system collects water first in a de-siltation chamber through a gutter having a baffle wall to reduce silt load and provide laminar flow transfers to the coagulation chamber by gravity for pretreatment of storm water to reduce suspended particles, the water moves further to filtration cum recharge well by gravity flow. From where the silt-free storm water enters to recharge well and transfer to the vadose zone just above the water table by passing a large dry zone to release water through a slotted casing. The water moves to the aquifer travelling through a small part of the vadose zone. It provides a faster absorption rate and safer discharge of rainwater to the aquifer to co-solve two critical water issues in gainful manner.

- Project Investigators: Dr. Arunangshu Mukherjee (Principal Investigator- PI)
  Dr. Nidhi Didwania (Co- PI)
  Ms. Alifia Ibkar, Research Assistant

- **Capacity Building for Replication:** Capacity building of Urban Local Body (ULB) officials such as Municipal Corporation Faridabad (MCF), Haryana Shehri Vikas Pradhikaran (HUDA) & Faridabad Smart City Limited (FSCL) etc related to Underground Taming of Flood water (UTF) for Aquifer Storage Recovery (ASR).

SDG 6- CLEAN WATER AND SANITATION

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DEPARTMENT OF SCIENCE & TECHNOLOGY
Ministry of Science & Technology
Government of India

Department of Science and Technology
Technology Missions Division,
Water Technology Initiative Programme
WTI - (Action Research)

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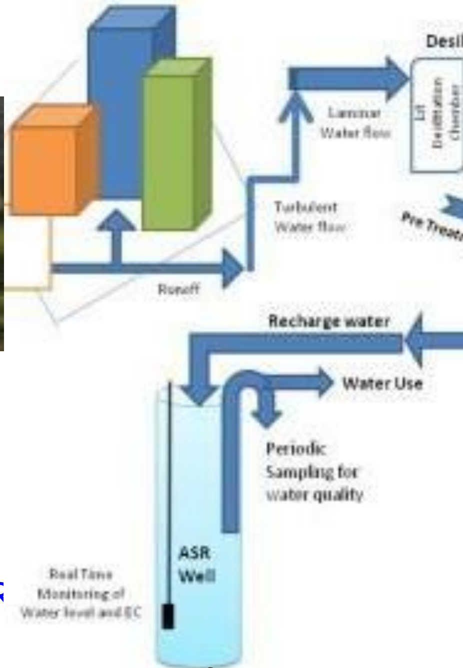
Co–solving Water logging and Groundwater depletion issue in parts of Faridabad S using Underground Taming of Flood water for Aquifer Storage and Recover

- Topograpnic survey and DvPX elevation mapping of tne area of interest
- Micro level nydrological and nydrogeological study for designing for UTFW during pre monsoon and monsoon period

- Xurface geopnysical Investigation-s VEX & Profiling
  - Xtudy for construction of connecting drain, d-esiltation cnambers, coagulation cnamber
  - Experiments for selection of suitable Iron based coagulant
  - Xtudy for Optimization of flow rate and dosing of coagulan
  - Auger nole drilling and slug testing- Vadose zone study

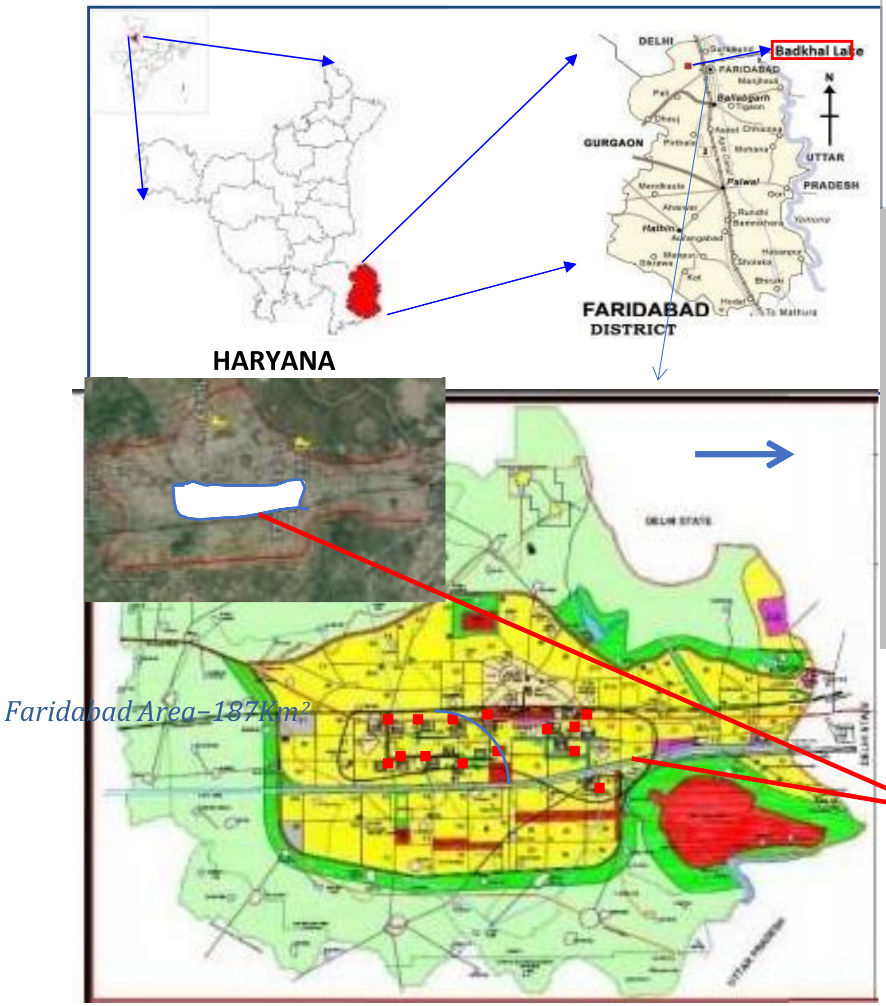


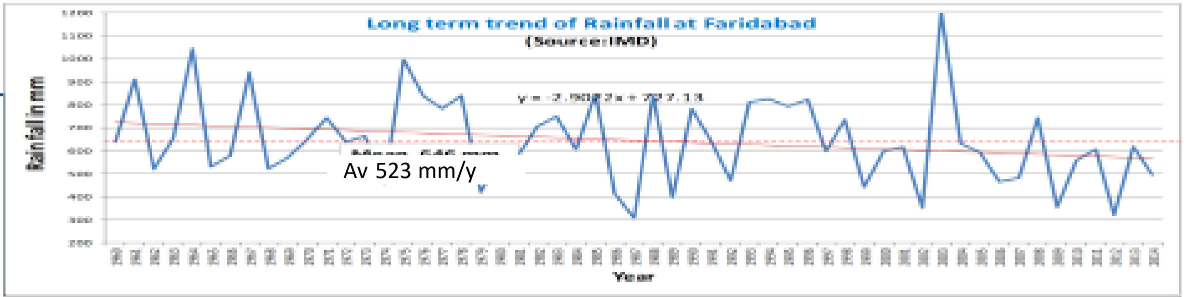
- Drilling of bore nole andlitno sampling
  - Xubsurface geopnysical logging
  - Well completion and development
  - Pumping test for aquifer cnaracterization and well efficiency test
  - Collection and analysis of groundwater samples for base level data acquisition

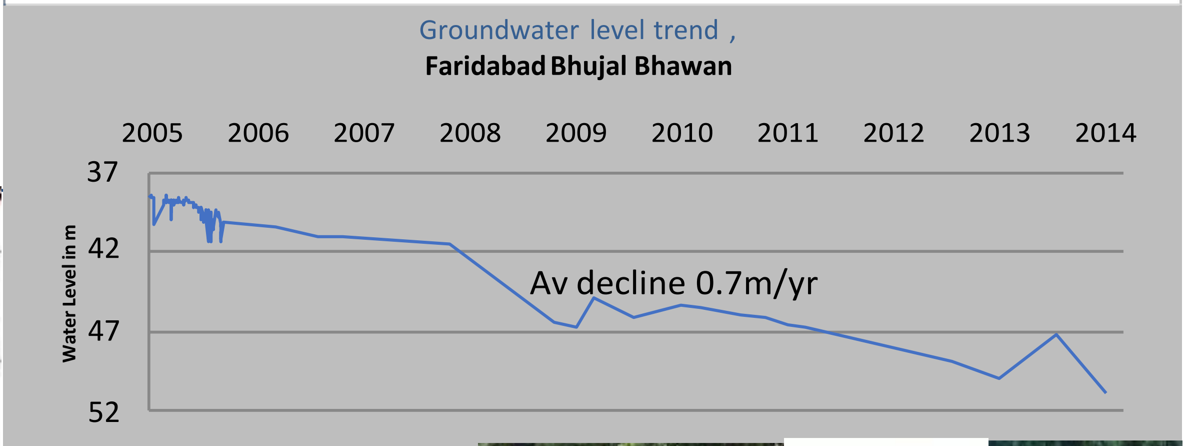
- DWLR witn EC and Temp sensor and installation
  - Installation of UTFW system by connection civil construction and drilled well for AX R
  - Installation of energy meter and pump
  - Water sampling for analysis of regular and emerging pollutants /contaminants, Impact assessment of UTFW

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEACH AND STUDIES, FARIDABAD

Faridabad Smart City







Population– 16 lakh
Water logging area–17Km^2
Effected population–~3lakh
Present av DTW+40mbgl

Construction of Structures for Co-solving of Water Logging and Ground Water Depletion Issues in Officer's Colony, Sector 15A of Faridabad City of Haryana State of India

Inspection of site - Officer's Colony, Sector 15A of Faridabad City of Haryana State of India

Constructed Structure at Officer's Colony, Sector 15A of Faridabad City of Haryana State of India

Salient features of the project

1. The project is own by MRCAWTM, MRIIRS through Principal Investigator Dr Arunangshu Mukherjee and Co PI Dr Nidhi Didwania
2. The total cost of Project is Rs 70.12 lakh
3. Duration of project is 36 months and the project started in May 2021
4. It is proposed to construct 04 Aquifer Storage and Recovery Structures to co-solve urban water logging and groundwater depletion.
5. Locations were identified considering the waterlogging due to near surface impervious layer in the depleted groundwater areas of Faridabad
6. The area is having over exploited unconfined to semi confined alluvial aquifer
7. In the first phase, two such structures are created in sector 15A and 16A in last two years.
8. Catchment area for each structure is about 3.25ha
9. The suitable subsurface recharge zone has been identified through drilling, well logging and water quality analysis.
10. Each structure has been deigned to absorb maximum up to 2000m3/day rain
11. There are three chambers in this structure (i) de-siltation chamber (ii) coagulation chamber and (iii) filtration cum recharge well
12. The filtered water is released above groundwater table in vadose zone for further natural filtration for safe disposal of recharge water.
13. The structures were tested during the last 2 monsoon period. With about 100mm rainfall in 24 hrs time these structures were able to absorb all generated runoff within few hours.
14. Positive impact has been observed on EC concentration of groundwater in the vicinity of created ASR system
15. The structures have been constructed in the land of PWD and will be handed over to PWD after completion of the project for further maintenance. Faridabad

Smart City Limited (FSCL)has helped to obtain NOC for the construction of structures in PWD premises.

16. Positive Feedback has been recorded from the residents of respective colony area about the working of these structures.
17. The success of this pilot project has already created buzz in the area and FMDA (Faridabad Metropolitan Development Authority) shown its keen interest to replicate these systems in about 20 places in Faridabad. A concept note has been submitted by Manav Rachna in this regard.
18. NIUA (National Institute of Urban Affair), New Delhi also keen in replicating the project at suitable localities in Delhi –NCR, discussions are in progress.

Fig Actual pictures of site at Sector 16A B&R Faridabad, before and after construction of ARS System and inauguration event.

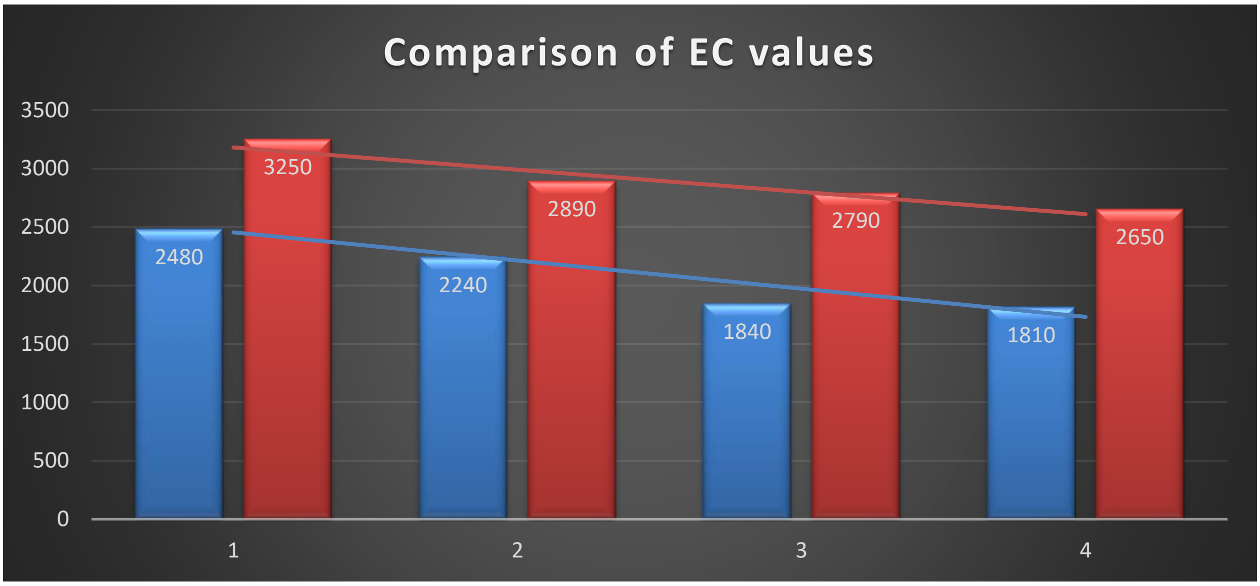


Fig Comparison EC values of two conjunctive years at Officers colony (blue) and B&R Colony (Orange)

Media Coverage:


english.jagran.com/india/dc-faridabad-inaugurates-aquifer-storage-and-recovery-structure-constructed-by-mcawtm-

ENGLISH Jagran

SHARE MARKET TOP DEALS

JE SPECIALS HOME WORLD CUP 2023 ISRAEL-HAMAS WAR LATEST NEWS ENTERTAINMENT LIFESTYLE SPIRITUAL INDIA BUS

DC Faridabad Inaugurates Aquifer Storage And Recovery Structure Constructed By MCAWTM

The silt-free stormwater enters to recharge well and transfers to the vadose zone just above the water table by passing a large dry zone to release water through a slotted casing.

By JE News Desk Published: Sun, 09 Jul 2023 03:51 PM (IST) Source:JND

Facebook Twitter Whatsapp Google News

https://english.jagran.com/india/dc-faridabad-inaugurates-aquifer-storage-and-recovery-structure-constructed-by-mcawtm-10086767

https://indiaeducationdiary.in/manav-rachna-launches-acqufer-storage-recovery-structure-in-presence-of-dc-faridabad/#google_vignette

2. **Impact assessment of mining of Iron ore on Ground Water in and around Raikela Sundargarh Odisha -**

Click to view the relevant page

Comprehensive Report on:

Groundwater Condition in both core and buffer zone of Raikela Iron Ore Mining Project of M/s. Geetarani Mohanty Koira Tehsil, Sundargarh District, Odisha.

[Report submitted for renewal of NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

M/s Geetarani Mohanty
House No – 96, Station Road,
Keonjhar, Odisha, Pin-758035
geetarani.mines@gmail.com

Comprehensive Report on:

Groundwater Condition in both core and buffer zone of Raikela Iron ore Mining Project of M/s. Geetarani Mohanty, KoiraTehsil, Sundargarh District, Odisha.

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

M/s Geetarani Mohanty, House No – 96, Station Road, Keonjhar, Odisha, Pin-758035
E-MAIL ID: geetarani.mines@gmail.com

By MRCAWTM – November, 2022

Executive summary

Raikela Iron ore Mining Project of M/s. Geetarani Mohanty spread over an area of 67.586 Ha is under operation with the production capacity of Iron Ore @ 0.864 MTPA in village Raikela under Bonai Sub-Division of Sundargarh district was initially executed for a period of 20 years w.e.f. 02.07.1991 in favour of Smt. Geetarani Mohanty.As per the Supplementary lease deed, the validity of the lease period is now extended up to 01.07.2041. The study area falls under survey of Indiatoposheet no F45N1 (73G/1).The existing iron Ore Mining project is in running condition and consent to operate has been obtained from State Pollution Control Board (SPCB) Govt. of Odisha. The Ministry of Environment and Forest has granted the Environmental Clearance for the production capacity of 0.864MTPA capacity vides the letter No-J- 11015/380/2006-IA.II dated 02.07.2008.

The lessee has obtained all the statutory clearances like Mining Plan approval from IBM, Forest and Environment Clearance from MoEF, Consent to Operate from SPCB.

The mine has been developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc.

The present production capacity of the Iron Ore Mine is @ 2.99 MTPA will increase upto 4.99.The present study is made for renewal of NOC from CGWA for extraction of maximum 170KLD of groundwater during mining operation as per the approved mine plan and previous NOC. The present report is based on the Hydrogeological investigation made within core zone and its 10km radius i.e buffer zone for assessment of impact of dewatering of groundwater by the mine and will be submitted to CGWA for obtaining NOC. The area is drained by IB and Brahmani River and its tributaries. The easterly flowing Sankh and westerly flowing Koel River join at Vedavyas near Rourkela to form the Brahmani River. The river, IB a tributary of Mahanadi controls the drainage of the western parts of the district. The drainage pattern of the area is dendritic. The study area is located in Koira Tehsil of Sundargarh District, Odisha which falls under **safe blocks** as per the report on Dynamic Groundwater Resource of India, published by CGWB in 2019-20. The study area is having largely one geological formation name Singbhum-Keonjhar-Bonai group of iron ore of Precambrian age. These constitute hard rock's includes schist, tuffs, phyllite, basic rock, BHQ/BHJ have been classified as Iron Ore Series (IOS). Aquifers are developed only in the low lying area and valley parts of the study area. Groundwater quality is fresh and potable in both core and buffer zone area and EC remains below 1900 ppm and TDS varies from 10 to 310 ppm in the core zone & buffer zone both. As per the approved mine plan the dewatering of groundwater is maximum 170KLD is required for mining operations. Rainwater is harvested within the ML area through construction of water conservation pond, and earth bunds to meet the complete requirement. There is no long term impact on groundwater because the area is under safe zone. For the running of mine 281.30KLD water is required, 170KLD from ground water and 98 KLD will be from RWH and 13.3 from recycle water from ETP& STP. Thus, the study recommends NOC may be provided for next 5 yr with maximum 170 KLD extractions from groundwater.

Acknowledgments and Certificate

Impact assessment and report preparation work as per the CGWA guideline is carried out by Manav Rachna Centre for Advance water Technology and Management (MRCAWTM), an accredited Groundwater Institution of CGWA. The work order is provided by **My world consultancy services (WCS), Bhubaneswar.**

Discussions with Mr. Pradeept Mohapatra, Director WCS, regarding the geology of lease area and plan our investigations according to scope of work is gratefully acknowledged. Help rendered by Mr. Pradeept Mohapatra and Diganta Ray, WCS in every stage of planning and Field verification, investigations in and around lease area and report preparation is thankfully acknowledged. He also provided all the available relevant data and records; many of them are reproduced in this report and forms part of annexure section.

The report has been prepared by Ms. ShehaRai, Assistant Professor and Sandeep Kumar Research Assistant, MRCAWTM under the supervision of Prof. (Dr) Arunangshu Mukherjee, Director MRCAWTM.

It is to certify that MRCAWTM have investigated the area of Raikela Iron ore Mining Project of M/s. Geetarani Mohanty, village Raikela of Koira Tehsil of Sundargarh District, Odisha. Based on actual data collected from field, available documents and literature survey done, has prepared the report as per the format of CGWA.

(Dr Arunangshu Mukherjee)
Director, MRCAWTM

MR Centre for Advance Water Technology & Management
Manav Rachna International Institute of Research & Studies
(Deemed to be University under section 3 of the UGC Act, 1956)
Sector-43, Delhi – Surajkund Road, Aravali Hills, Faridabad - 121004

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURE

Report on
Hydrogeological Investigation and Impact Assessment for Raikela Iron ore Mining, village Raikela, KoiraTahasil of Sundergarh District, Odisha.

1. SALIENT FEATURES OF THE PROPOSAL

1.1	Application No	
1.2	Accredited by	CGWA
1.3	Date of Accreditation	01/10/2021
1.4	Validity upto	30/09/26
1.5	Work Order Date (Attach copy of the Work Order with masking details of charges)	8/10/2022, Attached as annexure 3.
1.6	New/ Existing Project	Existing Project
1.7	CTE issued date	19-08-2022
1.8	Alluvium/ Non-alluvium	Non-Alluvium
1.9	Block Name & Category (GWRA, 2020)	**Koira Block,** Safe category
1.10	Ground water requirement	170KLD
1.11	Date of NOC issued & Authority	31/01/2021, CGWA
1.12	Date of NOC validity	30/01/2023, Annexure 1
1.13	Ground water Modelling Required (Yes/No)	NO
1.14	In case the report is prepared jointly by accredited Institute and Individual consultant, name/details of chapters prepared by the Individual consultant	NO
1.15	Signature of the Consultant(s)	(Dr Arunangshu Mukherjee) Director, MRCAWTM

2.0 ABOUT THE PROJECT

Raikela Iron ore Mining Project of M/s. Geetarani Mohanty spread over an area of 67.586 Ha is under operation with the production capacity of Iron Ore @ 0.864 MTPA located in Raikela village in Koira Tahasil of Bonai sub-division in Sundergarh district of Odisha. The lessee is a partnership firm. The latest lists of partners areas 1.Sri Srinibash Sahoo, 2.Duhshasan Sahoo, and 3.Smt Suprassana Sahoo. The existing iron Ore Mining projects was executed for a period of 20 years w.e.f. 02.07.1991 in favour of Smt. Geetarani Mohanty and as per the Supplementary lease deed, the validity of the lease period is now extended up to 01.07.2041. The Mine is in running condition and consent to operate has been obtained from State Pollution Control Board (SPCB) Govt. of Odisha. The lessee has applied for enhancing production capacity EC for a capacity of 4.99 MTPA, which is in due process.

Out of the 67.586Ha of Mining Lease area, forest land under DLC category is 66.671Ha and 0.915Ha is non-forest land. Out of the 66.671Ha, DLC Forest land, 43.033Ha had been broken prior to 12.12.1996 and mining operation in this area was being continued. Ministry of Environment and Forest, Govt of India has accorded the Stage-II Forest Clearance over an area of 66.671Ha vide letter No. F No.8-37/2007-FC dated 22.10.2014.

There is no environmental sensitive zone in core and buffer zone. There is no reserve forest in the core zone. However, the reserve forest found in the buffer zone is as follows:
Sarkunda R.F - 2.5 Km (South), Tohra R.F - 3.3km (South),Tohra R.F - 5.9km (North), Karo R.F - 9.5km (North-east) Kathmal R.F - 8.2km(East)

The Review of Mining Plan under Rule 17(2) of MCR 2016 was approved vide letter no MRMP/A/05-ORI/BHU/2021-22 dated.01.07.2021 for the production capacity of 4.99 MTPA. The validity of the Review of the Mining plan is up to dt.31.03.2026.

As per the approved mining plan, the mineral processing like screening and crushing will be suggested by deploying mobile screening and crushing plant for future. Now the lessee proposed a fixed 1000TPH Central processing unit (CPU) for screening and crushing of iron ore of required sizes. As a result of installation of CPU the mining operation will be in a systematic and scientific manner.

In present there is no beneficiation proposal. The lessees will directly sale the product in open market. Total mineral reserve is 74455138 T, mineral resource is 13980220 T and total reserve resource is 88435358 T.

NOC for withdrawal of 64.5 m3/day of Ground water has been obtained from CGWA vide ltr no 21-4(83/3ER/CGWA/2008-1723 dt 18.12.2008.

NOC for drawl of 180 m3/day of Ground water has been obtained from CGWA vide ltr no CGWA/NOC/MIN/ORIG/2021/10588 dt 31.01.2021 **(Annexure 1).** The water requirement will be met from own bore wells situated in the lease area. The area falls under safe category as far as stage of development is concerned.

The mining lease area is approachable from Koira town covering a distance of 8 km by Bhadrasahi – Rourkela NH–215. The area can also be approachable from Tensa town ship which is on NH – 215 at a distance of 2 km. Nearest Rail Head is at Barsuan (both Passenger and goods train) located adjacent to several working mines connected by road from Bhadrasahi-Koira-Rajamunda NH-215. District headquarter is at Sundergarh – 110 km from lease area.

The lease area comes under the toposheet no F45N1 (73 G/1) is delineated between latitude 21^0 51' 54.47556'' to 21^0 52 35.39676"N and longitude 85^0 10'32.27952" to 85^0 11'05.16660"E. List of the co-ordinates of the pillars are shown in table no 2.1.

DGPS SURVEYED CO-ORDINATES OF ML PILLARS					
SL.NO.	PILLAR NO.	LONGITUDE	LATITUDE	UTM COORDINATE	
		DD-MM-SS	DD-MM-SS	EASTING	NORTHING
1	1	85°10'43.50432"	21°52'35.39676"	311823.778	2420271.88
2	2	85°10'39.17784"	21°52'29.73648"	311697.506	2420099.257
3	3	85°10'37.58988"	21°52'26.27508"	311650.661	2419993.342
4	4	85°10'38.32032"	21°52'23.63160"	311670.664	241991.785
5	5	85°10'34.63140"	21°52'19.69536"	311563.326	2419791.972
6	6	85°10'32.83140"	21°52'14.74932"	311509.848	2419640.454
7	7	85°10'32.27952"	21°52'10.05348"	311492.283	2419496.223
8	8	85°10'33.52152"	21°52'06.88260"	311526.783	2419398.267
9	9	85°10'34.38336"	21°52'04.17540"	311550.546	2419314.709
10	10	85°10'36.46488"	21°52'02.64468"	311609.746	2419266.922
11	11	85°10'39.38772"	21°51'58.90212"	311692.296	2419150.811
12	12	85°10'41.23128"	21°51'57.16728"	311744.587	2419096.834
13	13	85°10'44.15304"	21°51'54.47556"	311827.492	2419013.045
14	14/1	85°10'45.80220"	21°51'56.04840"	311875.406	2419060.887
15	14/2	85°10'53.13144"	21°52'02.65296"	312088.239	2419261.509
16	14/3	85°10'54.26796"	21°52'03.72828"	312121.256	2419294.194
17	14/4	85°10'57.69120"	21°52'07.64724"	312220.964	2419413.570
18	14/5	85°10'58.70136"	21°52'08.72364"	312250.350	2419446.339
19	14/6	85°11'01.76964"	21°52'11.13960"	321339.315	2419519.603
20	14/7	85°11'05.16660"	21°52'14.84508"	312438.184	2419632.414
21	15	85°11'03.56748"	21°52'13.55592"	312391.814	2419593.315
22	16	85°11'02.36508"	21°52'13.99512"	312357.453	2419607.226
23	17	85°11'01.46004"	21°52'14.17908"	312331.528	2419613.191
24	18	85°11'01.24008"	21°52'14.68596"	312325.402	2419628.856
25	19	85°11'04.52400"	21°52'19.85520"	312421.555	2419786.728
26	20	85°11'03.56640"	21°52'20.56224"	312394.325	2419808.807
27	20/1	85°10'58.73592"	21°52'24.30696"	312257.012	2419925.620
28	21	85°10'54.24600"	21°52'27.80904"	312129.385	2420034.856
29	22	85°10'49.64196"	21°52'31.53756"	311998.567	2420151.094

Table-2.1: Pallor coordinates of the lease boundary

Location:

Raikela Iron ore Mining Project of M/s. Geetarani Mohanty spread over an area of 67.586 Ha is under operation, located in Raikela village in Koira Tahasil of Bonai sub-division in Sundergarh district of Odisha. Location Map and Satellite Image of the Project area is shown in Figure no.2.1 &2.2.

The mining lease area is approachable from Koira town covering a distance of 8 km by Bhadrasahi – Rourkela NH–215. Tensa Township by NH – 215 at a distance of 2 km. Nearest Railway station is at Barsuan (both Passenger and goods train) located adjacent to several working mines connected by road from Bhadrasahi-Koira-Rajamunda NH-215. District headquarters is at Sundergarh – 110 km from lease area.

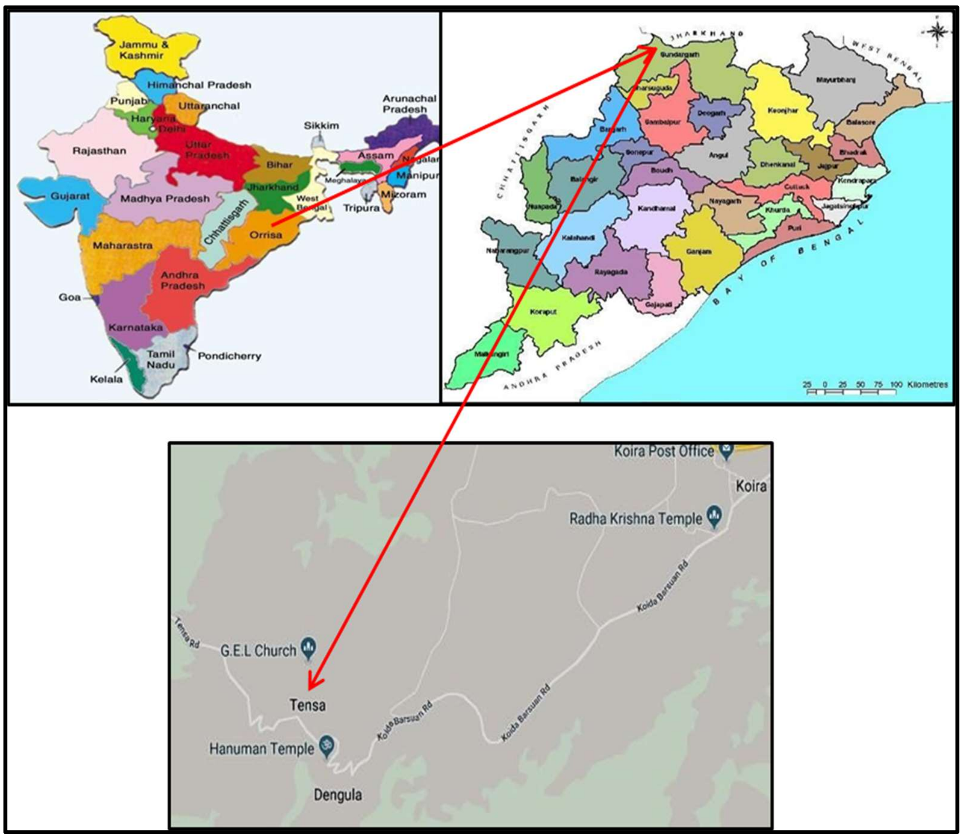


Fig-2.1. Location Map of Raikela Iron ore mine, Sundergarh district, Odisha

Fig-2.2. Satellite Image of the Project area

2.1Land Use Land Cover of surrounding area

“Land use” is the term used to describe the human use of land. It represents the economic and cultural activities (e.g., agricultural, residential, industrial, mining, and recreational uses) that are practiced at a given place. Land use and land management practices have a major impact on natural resources including water, soil, nutrients, plants and animals. Land use information can be used to develop solutions for natural resource management issues. The major effect of land use on land cover is deforestation more recent significant effects of land use include urban sprawl, soil erosion, soil degradation, salinization, and desertification. Land-use change, together with use of fossil fuels, is the major anthropogenic sources of carbon dioxide, a dominant greenhouse gas. In the present study, land use and land cover within 10Km buffer area covering area is 347.16 sq.km, using remote sensing satellite data and LULC within the Core Zone (CZ) has been carried out for obtaining environmental clearance for Iron ore mining lease (66.587 Ha) of M/s Geetarani Mohanty near Raikela village of Sundargarh district, Odisha. 3.4.3.1 Terrain Description of the study area. The study area is mostly an undulating rugged mountain terrain except a relatively flat and gently undulating terrain in the northwestern part. The hills are trending from northeast to southwest. Most of the terrain is covered with forest ranging from dense through open and degraded forest cover. The rugged terrain has the highest elevation range of approximately 1000m above MSL and 400m above MSL as the lowest elevation. Plains are also seen, which are narrow and very small in spatial extent. Such places are inhabited with settlements that are scattered in nature and seasonal agricultural activities are seen. There are many first order nallas are seen in the hilly area which act as overland flow of precipitation. These seasonal nallas join to form minor streams and later confluence with major rivers. There are two major nallas flowing in the study area are Kuradhi Nadi, Karo river and Sarkanda nalla with former flowing in the northeast and latter in southwest direction. Villages are scattered and seen along the foothills and along the narrow valleys between the hills. Because of the natural constraints on land availability and lack of proper storage mechanism for water, only seasonal agriculture cropping is practiced in this area.

2.1.1 LULC Pattern within 10 Km Radial Buffer around the ML

Map showing various LULC categories is prepared using visual interpretation technique based on image elements such as spectral band width colour, tone, texture, size, shape and association of elements. Categorization of LULC and their nomenclature is based on the national level land use classification system, which is adopted for the entire country as recommended by National Remote Sensing Centre (NRSC), Department of Space, and Government of India. Also as mentioned in the previous section, LULC , LISS IV image thus prepared for 10 Km radial buffer of the ML area is finalized after carrying out limited field checks for accuracy of classification. Post field visit of the study area includes incorporation of necessary corrections and modification of boundary elements wherever required. The geo-referenced LULC map in GIS environment has the advantage of updating information temporally to locate changes around specific locations and features within the study area apart from acting as base reference for periodical monitoring for EIA studies

Sl.No	Major LULC Category	Land use unit
1.	Built-up Land Settlement	Industries / Mining, Infrastructures
2.	Agricultural Land Crop land	Plantation
3.	Forest Dense Forest	Open Forest, Scrub Forest
4.	Waste Land Land with Scrub	Land without scrub
5.	Water bodies Tanks / Ponds	Rivers / Streams

LULC map showing 10 Km radial buffer around the mining lease (ML) area and major LULC categories such as built-up, agriculture, forest, and wasteland and water bodies along with their spatial estimation are discussed below. Settlements: About 18.06 km2 is under habitation comprising villages, settlements. Since, the buffer area is mostly a rugged mountainous terrain, habitation settlements – villages - are numerous, small in size and scattered in nature. From the satellite image, built-up / settlements are identified by their typical image elements such as light grayish green color, medium to coarse tone, medium to coarse texture and close association with vegetative cover (red color). They are small and scattered in nature and there is one larger settlement Koida town in the study area. There are some mining related industrial activities in the buffer area apart from some infrastructure buildings such as temporary shelters - camps and schools). Agricultural Land Agricultural land covers of 55.65 Sq.km. Cultivation is seasonal, Kharif crops, are grown along with maize, pulses like Ragi, Mango, Biri are grown to substantiate the household requirements and provide some form of earning to the local people. Owing to mountainous terrain, cultivation practice is limited and restricted to a few pockets in the study area. Plantation Area is very meagre with presence of teak, mango, neem trees occupying an area of 0.24 Sq.km of the buffer area. Forest is the major land cover in the study area and most of the area is covered with forest of varying density covered with deciduous trees, shrubs and scrubs with trees such as Sal, Sidha, Mahula, kendu Champa. Based on the image elements such as colour, tone and textural variations, forest is delineated qualitatively as "dense forest", "open forest" and "scrub forest" cover. Cumulatively, LULC of forest category covers an area of 203.92 Sq.km of the study are.

Wasteland is another important LULC where land lie unproductive in terms of agricultural activity even after sustained conservation practices but could be used for other land utilization or land use such industrial activities and mining activities. Some of the category that comes under this LULC is "land with scrub", "land without scrub". The total wasteland is 43.42sq km. Water bodies Water bodies include features such as tanks, ponds, streams and rivers. This is an important LULC that indicates the terrain condition and agricultural resource of an area. There are many ponds and tanks existing near settlements. They are identified by their typical blue colour. The water bodies cover 1.59sq km.

Sl No	Landuse Category	Area In Sq.Km
1	Settlement	4.66
2	Road	0.19
3	Railway	0.33
4	Mining / Industries	12.88
5	Agricultural land	55.43
6	Land with Scrub	24.49
7	Land without Scrub	43.42
8	Dense Forest	116.31
9	Open Forest	73.63
10	Scrub Forest	13.99
11	Plantation	0.24
12	River / Stream	1.44
13	Reservoir / Tank / Pond	0.15
	Total Area	347.16

Table-2.2: LULC units within 10 Km Buffer zone and their Spatial Extent

2.1.2 LULC Pattern within core zone

Total ML area covers 67.586Ha. Out of the 67.586Ha of Mining Lease area, forest land under DLC category is 66.671Ha and 0.915Ha is non-forest land. Out of the 66.671Ha, DLC Forest land, 43.033 Ha had been broken prior to 12.12.1996 and mining operation in this area was being continued. In present, during mining land use pattern is given in table 2.3.

Table-2.3: A Present Land use of the ML area

Sl No	Patternofutilization	Area put on use at start of Plan period (Ha)
1	Mining	33.593
2	Overburden dump	2.000
3	Mineral storage	3.799
4	Infrastructure	0.200
5	Road	1.900
6	Mineralseparationplant	0
7	Greenbelt	2.477
Subtotal		**43.054**
8	Safetyzone	2.523
9	Area undisturbed	21.094
Total		**67.586**

2.2 DEM / TOPOGRAPHY

M/s Geetarani Mohanty Raikela iron ore mine of over an area of 67.586 hectares is located in village Raikela, PO-Tensa in the district of Sundergarh of Odisha state. The area contains both forest and non-forest land. Out of total lease area, 66.671 ha come in forest land which is falls under in "DLC Forest" and rest 0.915 ha area is under non-forest area. The mining lease area is approachable from Koira town covering a distance of 8 km by Bhadrasahi – Rourkela NH – 215. The leasehold area falls under Survey of India Toposheet No. 73 G/1 and is delineated between latitude 21^0 51' 54.47556'' to 21^0 52 35.39676" N and longitude 85^0 10'32.27952" to 85^0 11'05.16660" E.Topography map including core zone and Buffer Zone is shown in Fig-3.4.

The lease area presents an undulating topography. The highest and lowest elevation is 845m and 625m above M.S.L. respectively. Digital elevation map of the area is showing in Fig-2.3.

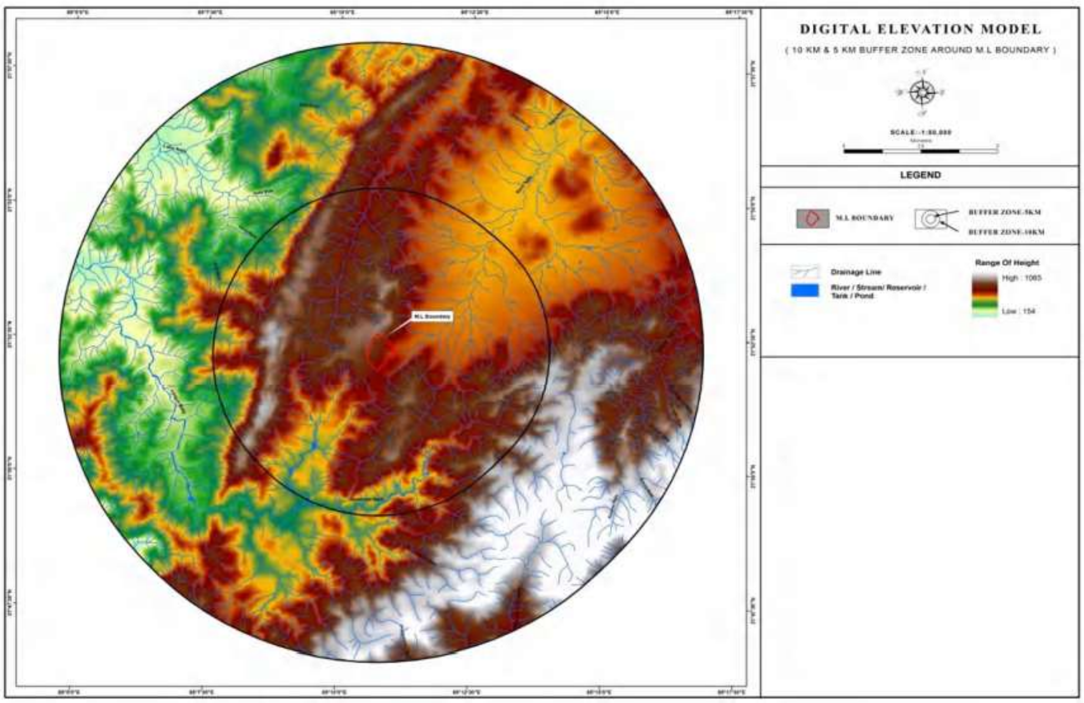


Fig-2.3: Digital Elevation Model of the Study area showing highest and lowest altitudes

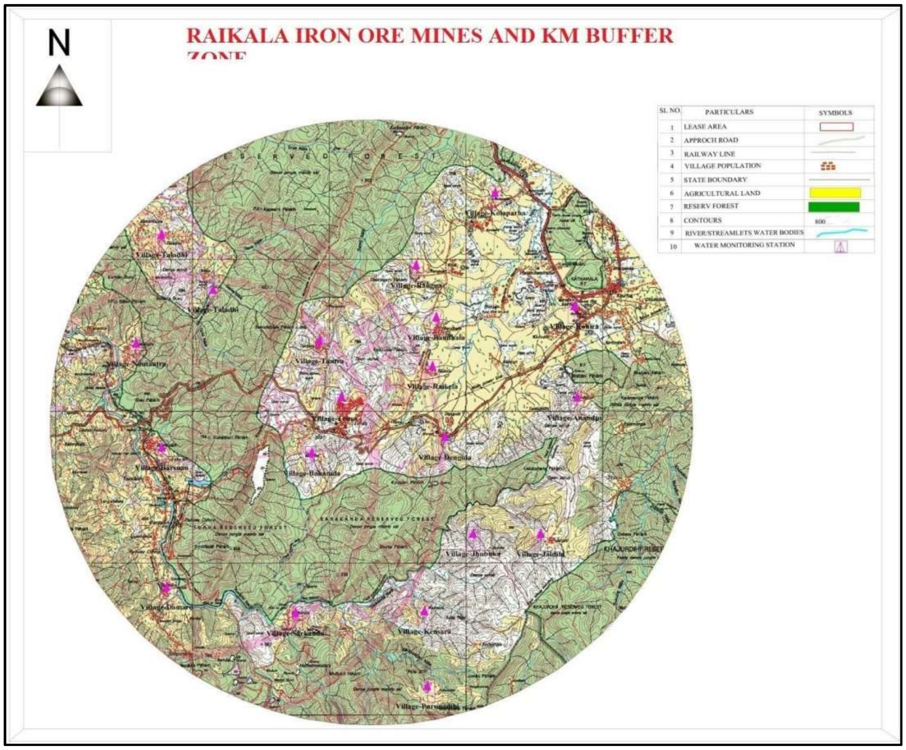


Fig-2.4:. Topography map including core zone and Buffer Zone

2.3 GEOMORPHOLOGY AND DRAINAGE

As far as drainage pattern is concerned, dendritic pattern can be observed regionally in the lease area and its surrounding area. There is no perennial nala flowing within the lease area. Only some seasonal nala flowing due east along the valley. The KurahiNadi is flowing due North West in the western part of the lease area at a distance of 8km. Geomorphological map of the buffer zone is shown in fig-2.5.

Drainage system of the area is dendritic type controlled river Baitarani (outside the buffer zone) andits tributaries like Kuarhi Nadi, Marda Nadi, Burghar Nadi, Kiri Nadi etc. Kuarhi Nala a perennial source, starting near village Basada, drains the north-western part of the buffer zone similarly, southeastern and southwestern part of the buffer zone is drained by MardaNadi and Burgharnadi respectively. Drainage density is very high indicating the hilly nature of the land-form.

The rainfall runoff is generated through drainage of different orders, which flows in general from north-west towards south-east. Besides there are other prominent seasonal nallas, the whole area dendritic drainage pattern can be observed that generally follows physiography as shown in Drainage map (Fig. 2.6). Vegetation is sparse with deep-rooted trees at number of places especially along the nallas. The area has deciduous forest which spread over hills. The area comes within Micro-watershed of sub basin is given in fig 2.7.

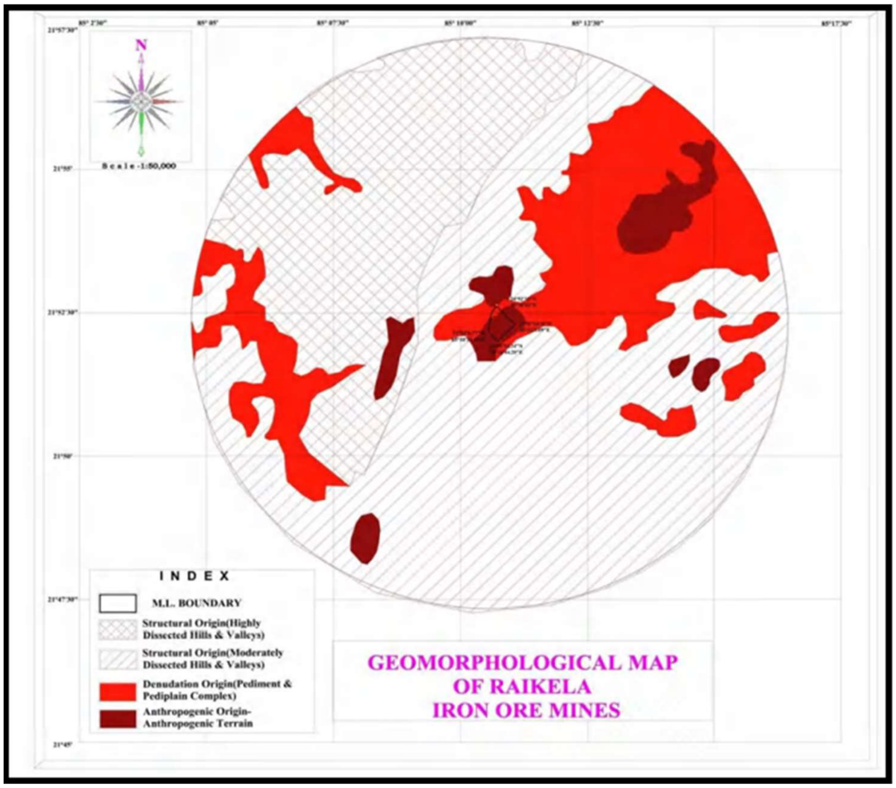


Fig-2.5:. Geomorphological Map of the study area

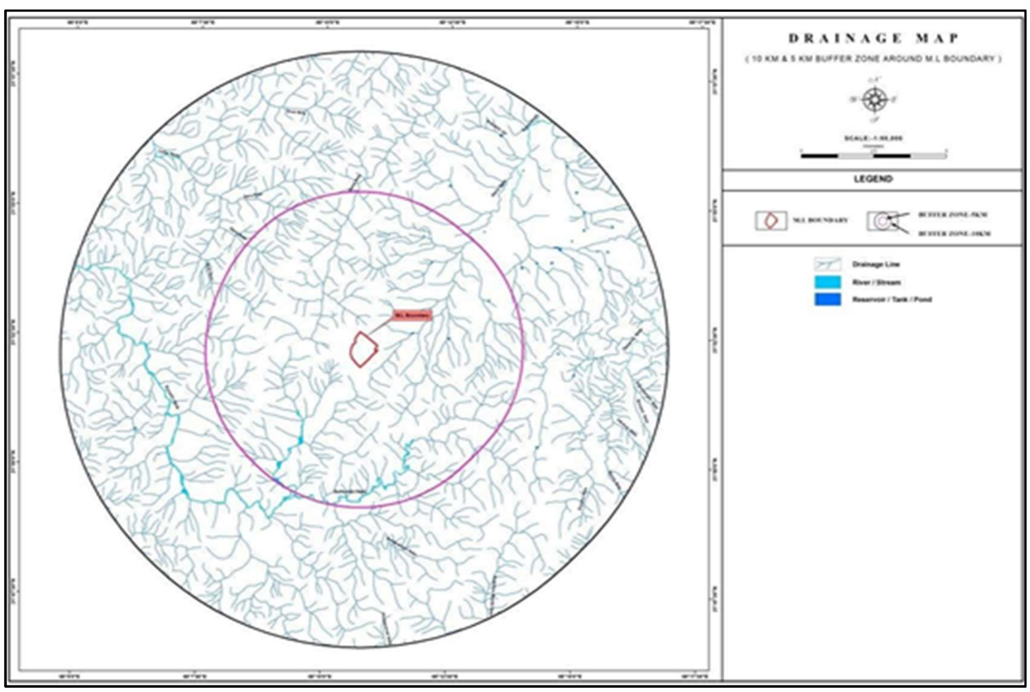


Fig-2.6:. Drainage map of core Zone and buffer Zone

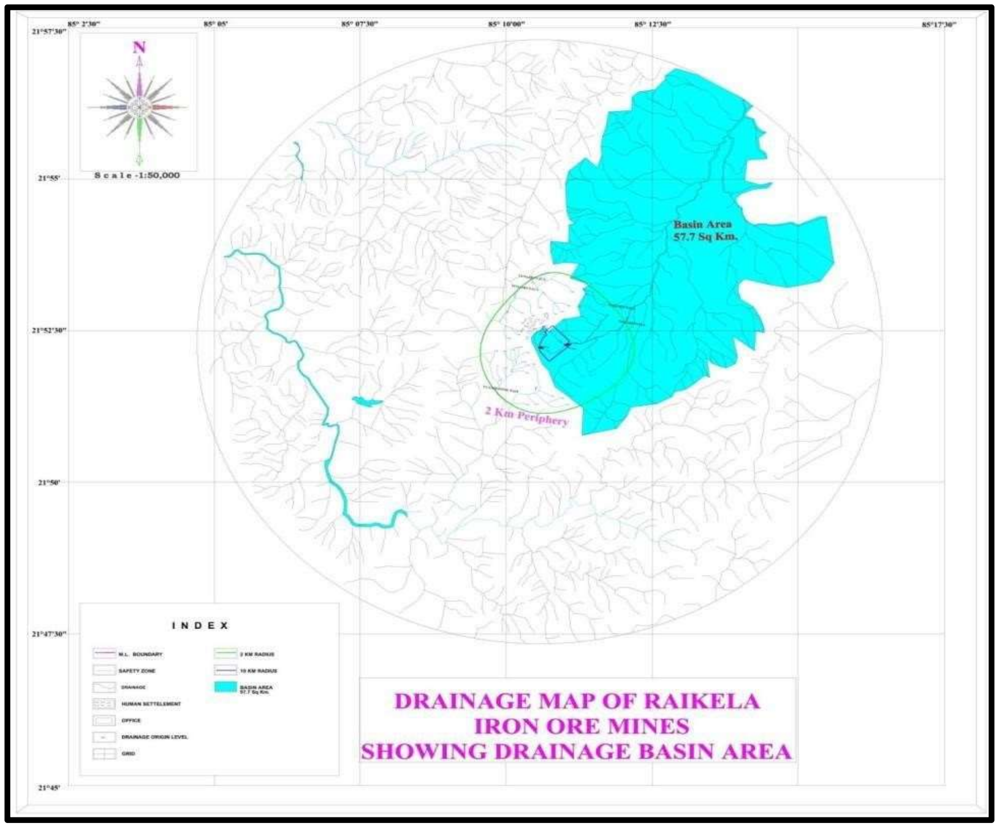


Fig-2.7:. Drainage Map showing drainage basin area

2.4 DETAILS OF WETLANDS/ MAJOR WATER BODIES

The drainage pattern is dendritic generally but since the region is fracture controlled, trellis pattern is also observed. The drainage density is moderately high indicating more run-off than infiltration. The drainage system is predominately controlled by Karo River flowing at a distance of 7km in North eastern side and Kurahi Nadi, flowing due North West in the western part of the lease area at a distance of 8km. Similarly, Sarkunda Nala flowing at a distance of 4.20 km in the southern side joins Kuradi Nadi at a distance of 5.0 km in the southwestern direction. Drainage density is moderate indicating the hilly nature of the land-form. The slope is generally towards west and southwest. The drainage map of the study area is shown in Fig- 2.6.

3. HYDROGEOLOGY

Sundergarh district is North Western part of Odisha state. Sundargarh is recognized as an industrial district in the map of Odisha. Steel Plant, Fertilizer Plant, Cement factory, Ferro Vanadium Plant, are some of the major industries of this District.Large part of the study area belongs to Raikela Village, Koira Tehsil of Sundargarh District, Odisha. Ground water is the main source of drinking as well as industrial and domestic purpose. However, the requirement of water in irrigation and agriculture is fulfilled mainly by river, canals as well as by rainwater. The rainwater also is the main source for recharge of groundwater of the area. The following major subtopics that are covered in this particular chapter are:

3.1 GEOLOGICAL SETUP
3.2 HYDROGEOLOGICAL SETUP
3.2.1Aquifer characteristics
3.2.2 Groundwater flow & aquifer interaction with surface water bodies.
3.2.3. Depth of water level
3.2.4Long term water- level data analysis
3.2.5 Groundwater quality

3.1GEOLOGICAL SETUP

3.1.1. Regional Geology

Sundergarh district is rich in Iron ore, limestone, manganese, dolomite, and fire clay. Banded Iron Formation (BIF) and Iron ore deposit occupy three distinct provinces surrounding the North Odisha Iron Ore Craton (NOIOC). They are Bonai-Keonjhar belt in the western side of the Craton, Badampahar Gorumahisani- Suleipat belt in the eastern flank and Daitari-Tomka belt in the southern side of the Craton. All of these three belts having best preserved basin of Precambrian age that form Iron Ore Super Group (IOSG) of Odisha. Sundergarh district lies under Western flank by the Bonai – Keonjhar (BK) belt forming U shaped synclinorium which is known as the Horseshoe belt. Iron Ore Super Group (IOSG) Odisha, rock assemblages is belonging to Singhbhum – North Odisha Iron Ore Craton. There are three or more Iron Ore Group existing in the IOSG such as Badampahar Group, Noamundi Group and Koira Group. These groups are separated by unconformity, different metamorphic grade, distinct sedimentary and igneous assemblages and ore types (Fig: 2.1).

The Mayurbhanj granite occurring along the eastern fringe of the Singhbhum granite was dated to be 3100Ma. The A type Mayurbhanj Granite Pluton (3.09Ga) occurring along the eastern margin of the Singhbhum – OdishaCraton, eastern India, represent the final phase of acid plutonism in this crustal block of Archaean age.

I. BIF-1: Badampahar – Gorumahisani – Sulpet Belt

The BIF-1 comprising of iron formation of Badampahar- Gorumahisani – Sulpet (BGS) Belt. The litho assemblage of this oldest Iron Ore Group consists of banded cherty quartzite, tremolite-actinolite schist and fuchsite quartzite. The Badam Quartzite is well exposed in the western side of BGS. Banded magnetite quartzite is the dominant litho unit in the BIF-1. The major mineral constituents are Magnetite, martite, hematite, specularite, goethite, grunerite, and quartz. The BIF-1 has suffered amphibolitesfacies of metamorphism.

II. BIF – II: Daitari- Tomka Belt

The BIF-II lying in the southern portion of the North Odisha Iron Ore Craton is confirmed to Daitari – Tomka belt. It is underlain and overlain by Badampahar quartzite and Dhanjori quartzite. The litho assemblage of this belt consists of banded magnetite/hematite quartzite, banded magnetite/hematite jasper, quartz sericite schist, phyllite, slate and banded chert. The rocks of BIF –II attain green schist facies of metamorphism.

III. BIF – III: Bonai- Keonjhar Belt:

BIF-III is a U- shaped pattern in the western flank of the NOIOC that rests over the Dhanjori Quartzite. The litho association of this area forms the youngest Iron Ore Group comprising of banded hematite jasper, banded hematite quartz/cherty, banded shale, banded manganese formation and ferruginous shale. The banded iron formation consists of predominantly iron oxide mineral such as hematite, martite, specularite, and magnetite. The litho assemblage of this youngest iron ore belt is un-metamorphosed and lack of intrusive Fig (3.1).

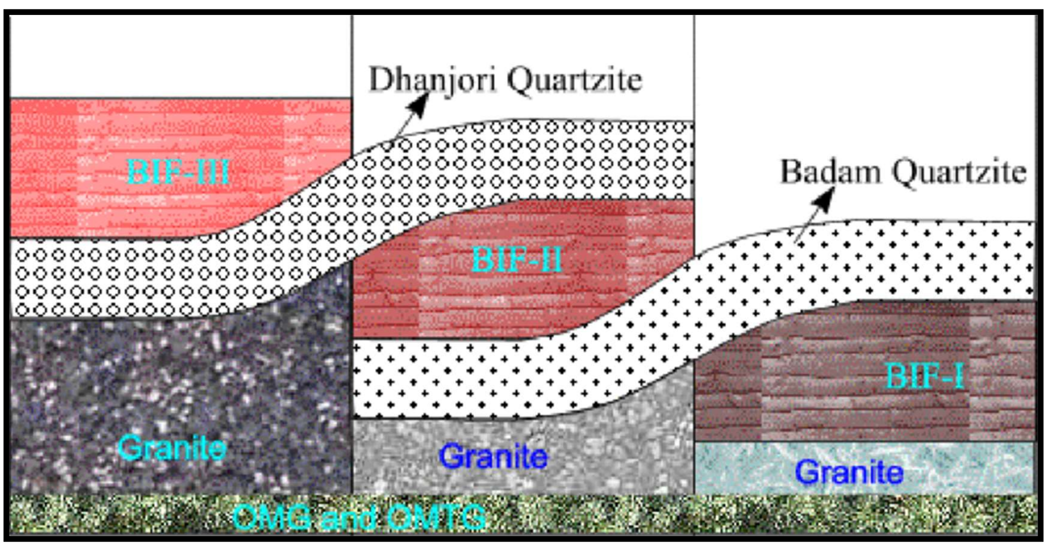


Fig -3.1: Schematic diagram of stratigraphic setting of three BIF of IOSG (Beura et al.2016)

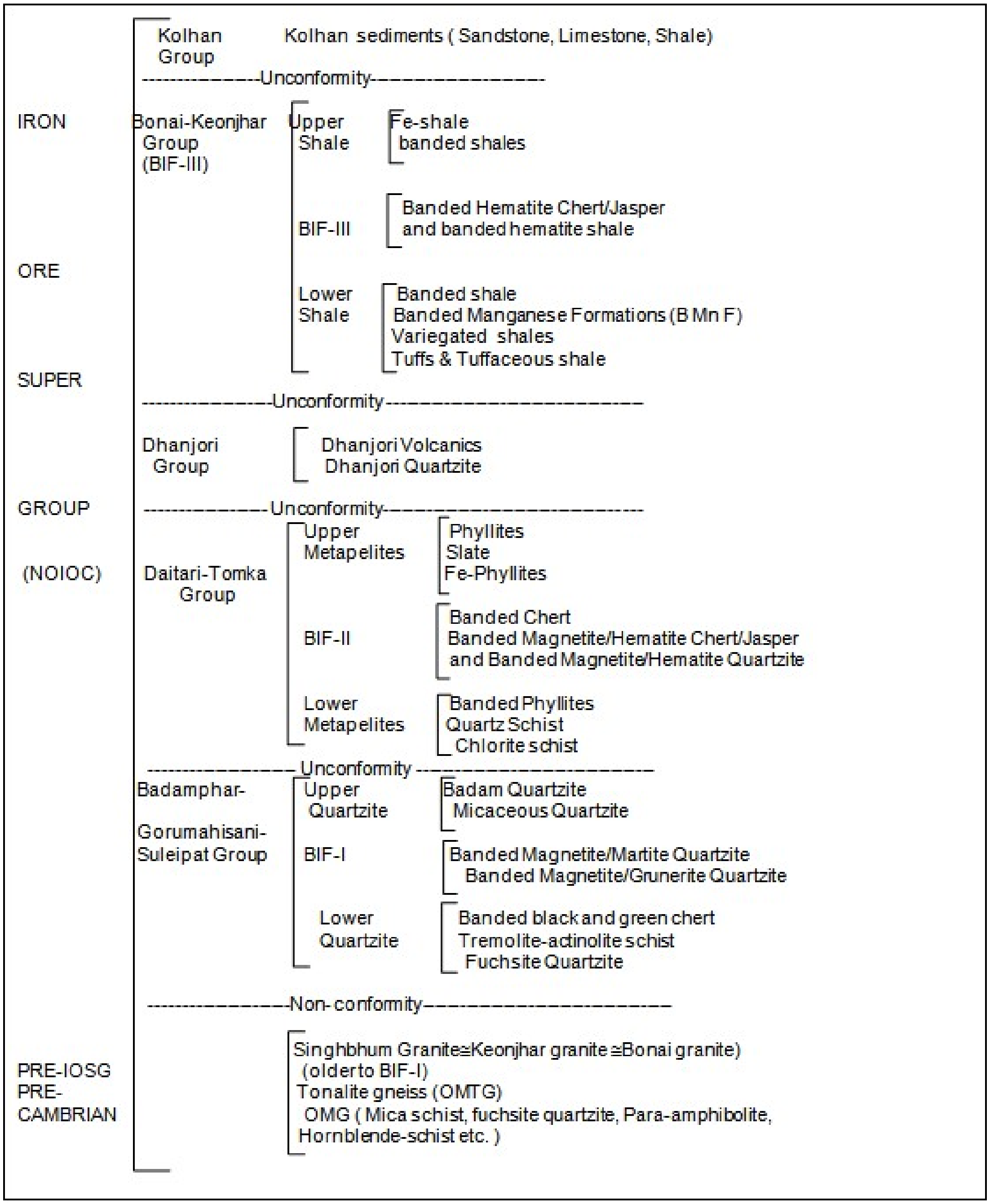


Fig 3.2: Stratigraphic Succession of Iron Ore Super Group of Odisha (Beuraet al.2016).

3.1.2. Local Geology

The study area is occupied by the rock of Koira group Table (2.1). This belt is 60km long and 25 km wide extending from south of Malangtoli in Keonjhar district up to Chakra Dhrampurin West Singhbhum district (Jharkhand). The western syncline known as Koira syncline, due to steep dip and overturned nature of its limb form a deeper basin with thick sequence of younger shales in the core region. On the other hand, the eastern syncline known as Bamberi syncline is a shallower basin and exposes younger litho members within the core region as outliers. The Upper shale unit within the Koira syncline is more or less continuous. The general strike of the beddings in N100W- S100E direction with occasional swings to N300E-S300W and having 20° - 40° dip towards west in the area. The area under investigation lies within the Upper Shale Formation of the Koira group described by Murthy & Acharya (19975)

Table 2.3: Startigraphy of Koira Group in Sundergarh district, Odisha		
Soil Laterite		
Koira Group	Upper Shale Formation	Shale's of different color like purple, yellow with inter beds of Iron ore
	Banded Iron Formation	Coarsely banded BHJ followed up by finely banded BHJ and iron ore in the eastern block.

M/s Geetarani-Mohanty-Raikela iron ore mine is belonging to Singhbhum iron ore series and main rock type in the study area are Laterite, Hematite, and Shale. Geologically, the area is underlain by Pre – Cambrian crystalline rocks like Granite, Granitic Gneiss, Banded Hematite Jasper, Quartzite, Slate, Phyllite, and Mica Schist.

Laterite

Laterites are observed in the study area including ML area that has been the resulted from a process of residual weathering. Laterite has been developed mostly over the shale unit or low grade iron ores of the area. The shale rich in alumina has given rise to aluminous laterite and those rich in iron have developed ferruginous laterites. Ferruginous laterite occupies most of the high lands in the vicinity of iron ore of central ridge while aluminous laterite occurs in the extreme east of the area.

Shale

Western side study area has occupied with fine laminated rock having different shades of colors ranging from brownish to purple grey. Different colors of the Shale are largely dependent of minerals compositions. It is mostly composed of clayey micaceous minerals, with lenses of chert.

Iron Ore

Iron ore formation are economically important meta sedimentary rocks that occur most commonly in Precambrain sedimentary succession Based on surface exposures and sub-surface geology 4 (four) types of iron ore are recorded in the explored block.(Fig 2.1).These are Hard Laminated Ore (HLO), Soft Laminated Ore (SLO), blue dust (powdery ore), lateritic ore and float ores. . The general strike of the beddings in N100W- S100Edirection with occasional swing to N300E-S300W, having 20° - 40° dip towards west in the study area

3.1.3 Geomorphology & Soil Type

Geomorphology: The district has varied geomorphological features. The geomorphic units are (I) Plain (ii)Deep Buried Pediment (iii) Shallow buried pediment (iv) Intermontane valley (v) Inselberg, (vi) Mesa & Butte, (vii) Residual Hills, (viii) Intermontane Valleys, (ix) Structural hills. The soil characteristics of the district show wide variation depending upon their occurrence, physical and chemical properties. The soil of the district is broadly grouped into (I) Alfisols (II) Ultisols (CGWB Report).

I. Alfisol and Red Soil

The study area is covered with red sandy soils and red loamy soils. These soils predominantly occupy high and medium land throughout the Sundargarh district. The characteristics feature of Red soil is porous and fragile in structure. These are usually deficient in nitrogen, phosphate, organic matter and lime. These soils are suitable for cultivation of paddy and other crops.

II. Ultisols

The ultisols comprises mainly of lateritic soils and red and yellow soils. These soils are mildly acidic in nature and deficient in nitrogen, phosphorous and potassium and organic matters. Soils of the district are generally having average to good fertility status. All common types of crops can be grown in the district.

3.2 HYDROGEOLOGICAL SETUP

The climate of the district is sub-tropical climate characterized with hot and dry summer, cold winter and erratic in rainfall. The winter season extends from November to end of February, which is followed by summer season from March to the middle of June, and rainy season from middle of June to middle of October. During summer months the maximum temperature rises up to 43° C and May is the hottest month. December is the coldest month of the year when the average daily temperature drops down to 8° C. Relative humidity is around 60-70% throughout the year. The highest and lowest monthly mean relative humidity so far recorded is 97% (Dec) and 26% (April). The annual rainfall of last decade is given in Table 2.2.

Table 3.1Decadal Rainfall in Sundergarh District (Source: WRIS online portal) 2011-2020

Year	Actual Rainfall (mm)	Deviation (%)	Year	Actual Rainfall (mm)	Deviation (%)	Average Rainfall (mm)
2011	1788.35	20.87	2016	1098.51	-28.82	1415.126
2012	1435.18	1.39	2017	1323.91	-6.8	
2013	1537.77	7.97	2018	1396.59	-1.32	
2014	1335.09	-5.99	2019	1387.02	-2.02	
2015	1286.6	-9.9	2020	1562.24	9.4	

3.2.1Aquifer Characteristics

The study area comprises 10km radius zone in Raikela iron ore Mines, located in Koira Tehsil of Sundargarh district of Odisha.Detailed hydrogeological study of both core and buffer zone of mine area is carried out.The hydrogeological condition varied from place to place due to different litho unit of aquifer.The hydrogeological units of the study area are broadly categorized into twogroups namely.

1. Consolidated formations.
2. Unconsolidated formations
3. Semi-consolidated

1. Consolidated formations

The study areais occupied by the consolidated formations comprising of Precambrian metasediments of Gangpur series and Iron ore series and also granite gneiss, metasediments like amphibolite, epidiorite etc. Ground water is stored mainly in the secondary porosity resulting from weathering and fracturing of the rocks. Ground water occurs under confined to semi-confined condition in the deeper fractured zones. Wateryielding capacity is mainly depend on the extent of fracture, depth, opening and size of fracture. Mica schist, quartzite and phyllite are the formation in the study area.

2. **Unconsolidated formations-** Unconsolidated sand and gravel aquifers are characterized by intergranular porosity and all contain water primarily under unconfined, or water-table, conditions. They are grouped into four categories: basin-fill, blanket sand and gravel, glacial-deposit, and stream-valley aquifers. All four types have intergranular porosity, and all contain water primarily under unconfined or water-table conditions. The hydraulic conductivity of the aquifers is variable, depending on the sorting of aquifer materials and the amount of silt and clay present, but generally it is high. Aquifer thickness ranges from a few meters or tens of meters. Groundwater in these aquifers flows along relatively short flow paths typical of local flow systems.

3. **Semiconsolidated aquifers** consist of semiconsolidated sand interbedded with silt, clay, and minor carbonate rocks. Porosity is intergranular, and hydraulic conductivity is moderate to high.

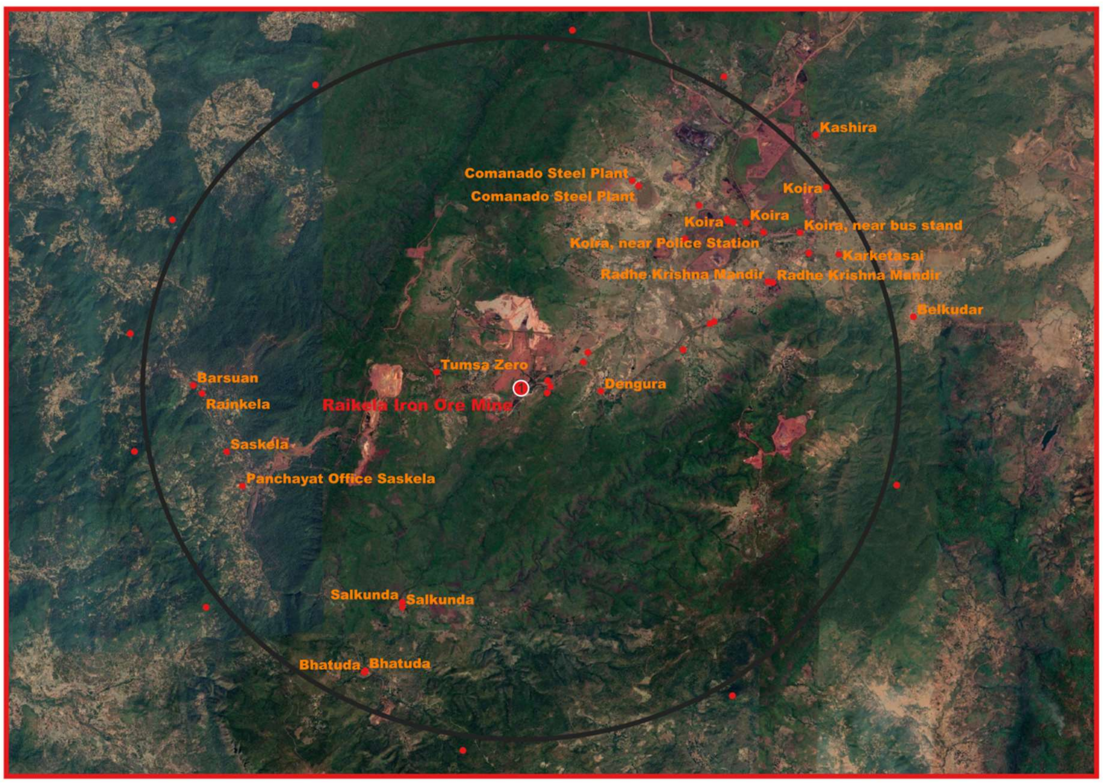


Fig-3.3: Map showing Location of groundwater Monitoring

3.2.2 Ground water flow and aquifer interaction with surface water bodies

As per the field investigation it has been observed that the main source of water is from River and groundwater. Groundwater is withdrawal from bore well as well as from hand pump (Fig-2.4). Most of dug well having water level from 3.7 to 7.5m in pre monsoon period. Total depth of dug well is from 9 to 12m. It has been observed that the bore wells are often from 16 to 30m in depth. Ground water is lying in weathered part of hard rock aquifer (2.5). Hard rock comprises Precambrian met sediments like Mica schist, quartzite, phyllite, conglomerate along with granite. The movement of the ground water in deeper rocks is controlled by the nature, size opening and continuity of joints & fracture present in them. Wells in hard rock generally yield 50 to 70 m3 /day of all the rock types. Schist, phyllite and their variants form very poor aquifers yielding 10 to 30 m3 /day for heavy drawdown. Well inventory of study area (Fig:2.5) in Pre Monsoon (April 2022) period showing ground water level varies within the range from 3.7 m to 36.3m bgl (Table 2.3). In Post Monsoon water level rises up to 2-3m and some places it is 5m.

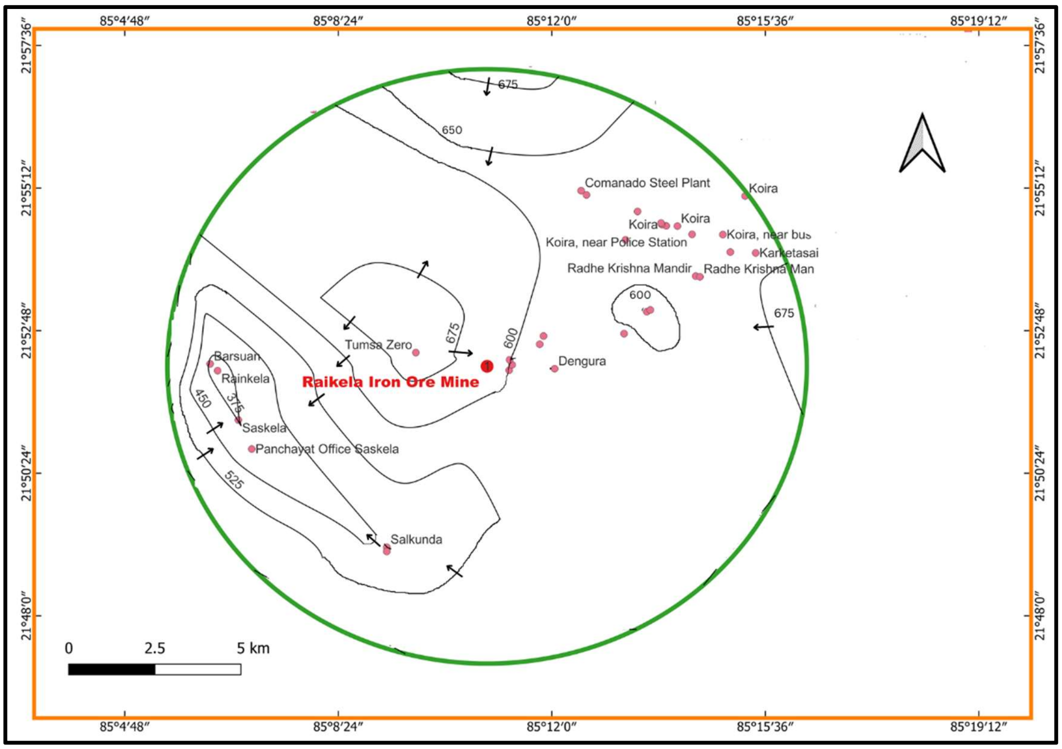


Fig3.4: Natural groundwater flow Direction's in Buffer Zone

3.2.3 Depth of water Level

Various location points have been selected for groundwater data collection in Buffer zone and core zone, some points from outside of the boundary were also taken for clear picture and modelling purpose. The details of quality and water level are given below.

Sl No.	Location	Latitude	Longitude	Elevation (m)	EC (mS)	pH	TDS(ppt)	Water Level (m)	Type of water body
1	Barsuan	21.885964	85.304356	622.85	130	6.8	70	22	Dug well
2	Belkudar	21.886949	85.304342	623.11	120	6.8	60	16.5	Bore well
3	Bhatuda	21.881586	85.314718	614.34	240	6.7	130	8	Hand pump
4	Bhatuda	21.879735	85.314745	623.34	480	6.9	225	7	Hand pump
5	Comanado Steel Plant	21.87555	85.308419	617.73				8	Pond
6	Comanado Steel Plant	21.875081	85.308162	623.8	100	6.4	50	8.5	Bore well
7	Dengura	21.863644	85.293346	664.9				8	Pond
8	Karketasai	21.904283	85.305595	608.55	90	6.5	50	22	Hand pump
9	Kashira	21.904144	85.305645	607.9	95	6.5	45		Hand pump
10	Koira	21.952008	85.320045	567.21	450	7.2	220	8	Bore well
11	Koira	21.963844	85.317	577				5	Mine pit
12	Koira	21.950576	85.255734	562.95	40	7.6	20	22	Bore well
13	Koira, near bus stand	21.93019	85.251827	565.3	40	6.5	20	25	Hand pump
14	Koira, near Police Station	21.917759	85.2543	568.87	65	6.5	25	5	Hand pump
15	New Colony	21.871817	85.188111	611				4	Bore well
16	Panchayat Office Saskela	21.913434	85.224078	559.84	60	6.5	25	25	Hand pump
17	Radhe Krishna Mandir	21.886959	85.274977	646.48	340	6.9	180	22	Hand pump
18	Radhe Krishna Mandir	21.901799	85.257257	581.28	85	6.9	40	18	Hand pump
19	Rainkela	21.895306	85.240408	588.94	70	6.6	30	25	Hand pump
20	Rainkela Iron ore Mines	21.86858	85.17598	680	190	6.57	113	10	Borewell
21	Rengalbeda	21.868889	85.187991	619.85	20	5.9	10	surface	
22	Tumsa Zero	21.838361	85.336098	865.3	210	7.03	120	11	Hand pump
23	Salkunda	21.819241	85.153618	449.78	340	6.7	170	8	Hand pump
24	Salkunda	21.818068	85.153606	431.39	260	6.7	140	7.5	Bore well
25	Saskela	21.878866	85.314424	591.85	110	6.6	60	12	Hand pump
26	A1	21.84094	85.34045	867.2					Pond
27	A2	21.868772	85.10608	370.59	300	7.1	160	27.27	Bore well
28	A3	21.854939	85.111915	373.46	290	6.7	150		Hand pump
29	A4	21.846799	85.115667	379.11	190	6.9	100		Hand Pump
30	A5	21.876188	85.196579	572.02					Pond
31	A6	21.878495	85.197651	571.44	20	6.3	10	surface	
32	A7	21.909329	85.235269	574.88	20	6.4	10		Bore well
33	A8	21.910184	85.230684	578.12	120	6.5	60		Bore well
34	A9	21.918085	85.209714	573.27					Pond

Table3.2: Post monsoon Monitoring points in Buffer Zone

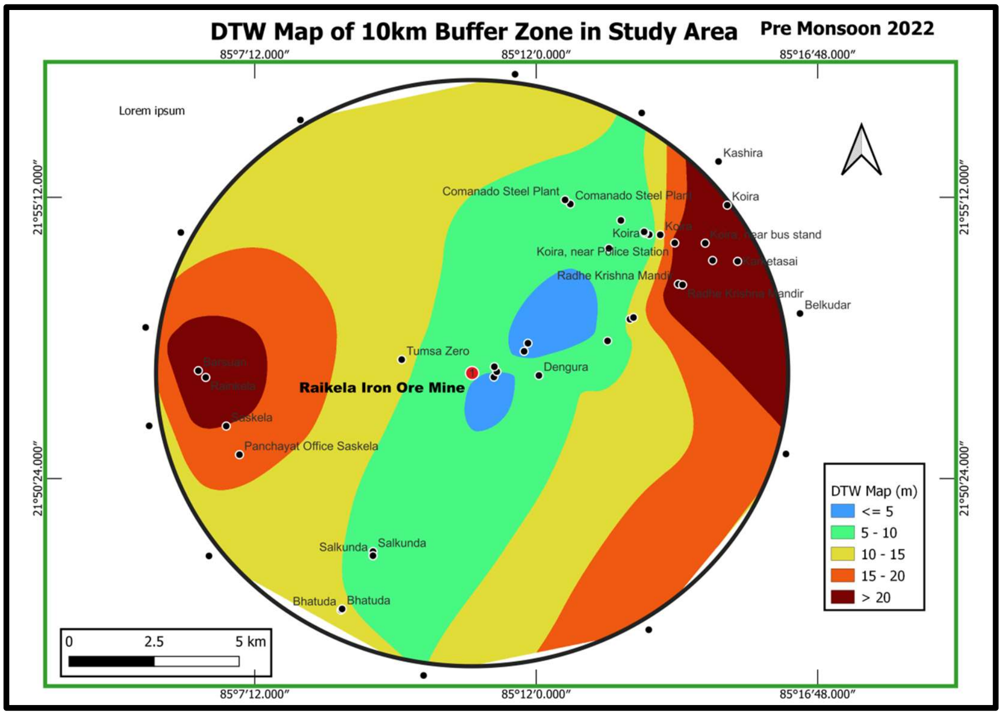


Fig3.5: DTW map of buffer zone of RaikelaIorn ore Mines (Pre- Monsoon)

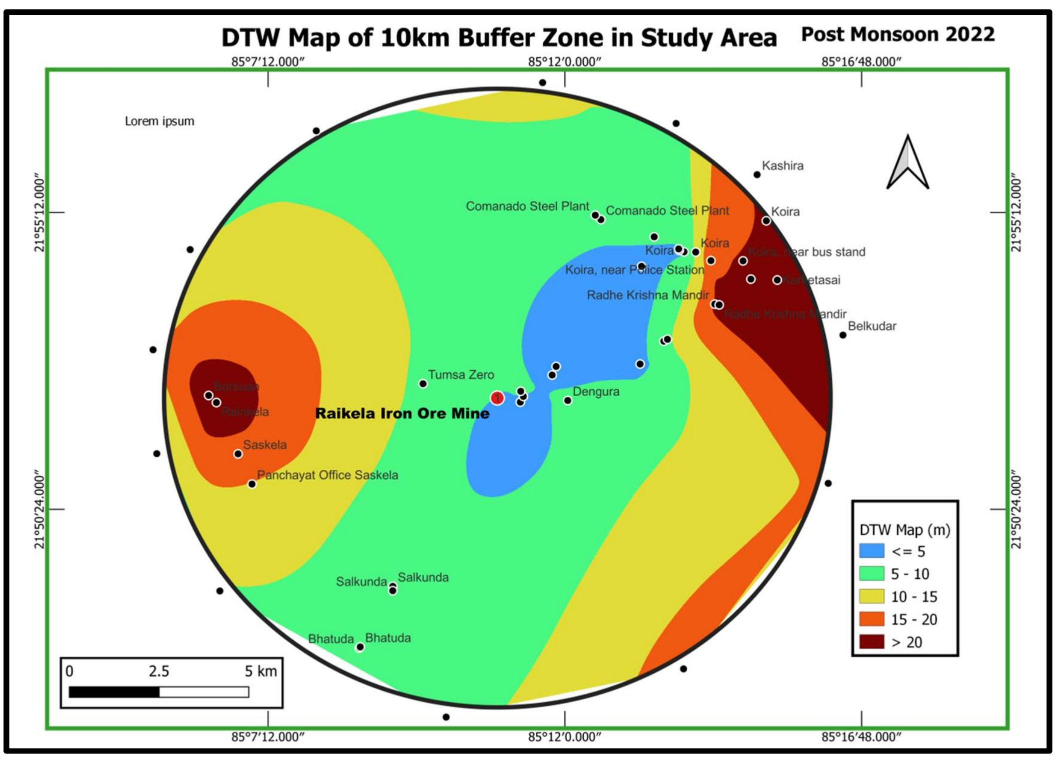


Fig 3.6: DTW map of buffer zone of RaikelaIorn ore Mines (Post Monsoon)

3.2.4 Long term water level data analysis

The study area comprises 10km radius zone in Raikela Iron Ore Mines that largely fall under Koira tehsil, Sundergarh district, Odisha. In the core zone village the source of ground water such as bore well; hand pump and pond are used for domestic, irrigation and drinking where out of 3 observation location of dug well, it has been observed that the water level (Pre monsoon 2022) varying from 3 to 7.5m bgl. Long term trend analysis of data obtained from WRIS shows no significant change-rise or fall as depicted in **Fig: 3.7.**

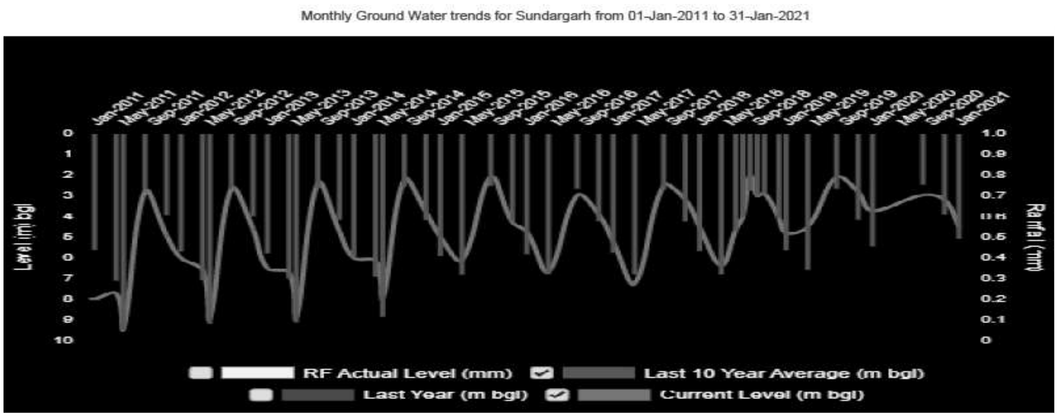


Fig 3.7: Long term well hydrograph of wells of Sundergarh district, Odisha (source: WRIS portal)

Dynamic Groundwater Resource of study area

The groundwater resource as estimated by CGWB (2020) is presented in the table 3.3 for Koira block of Sundargarh district Odisha and is in safe category.

Table: 3.3 Block wise Dynamic Groundwater Resources of Koira block, Sundergarh district

District	Block	Ground water Recharge (Ham)				Total Ground water Recharge (Ham)	Total Natural Discharge (Ham)	Annual Extractable ground water resources (Ham)
		Monsoon Season		Non Monsoon Season				
		Recharge from Rainfall	Recharge from other sources	Recharge from Rainfall	Recharge from other sources			
Sundergarh	Koira	4777.33	139.58	572.73	172.14	5661.78	283.09	5378.69
Annual Extractable Ground water Resources (Ham)	Annual Groundwater Draft (Ham)				Annual GW allocation for Domestic use as on 2025 (Ham)	Net Groundwater availability for future use (Ham)	Stage of Ground water Extraction (%)	Categorization (over exploited/ Critical/semi critical/ safe/ saline)
	Irrigation	Industrial	Domestic	Total Extraction				
5378.63	873.45	290.16	265.25	1428.8	304.71	3910.38	26.57	Safe

3.2.5 Groundwater Quality

Based on the above study, different ground water parameters were computed, which include pH, TDS, EC, and Temperature. Ground water in study area is potable with pH ranging 5.9 to 7.6 and total dissolved solid (TDS) ranging from 10 to 310 ppt and EC ranging from 20 to 600 µS. (Fig 2.9 and 2.10) Groundwater quality in the study area is fresh and all major and trace elements are found within the BIS 10500 permissible limit. Thus is suitable for all domestic, industrial and irrigational use. The general parameters of groundwater in study area as analyses are given in Table 3.2.The comparison of data reveals that the area mining (Project Area) is having less TDS.TDS and EC map of the Buffer zone is shown in Figure--3.8 & Figure 3.9.

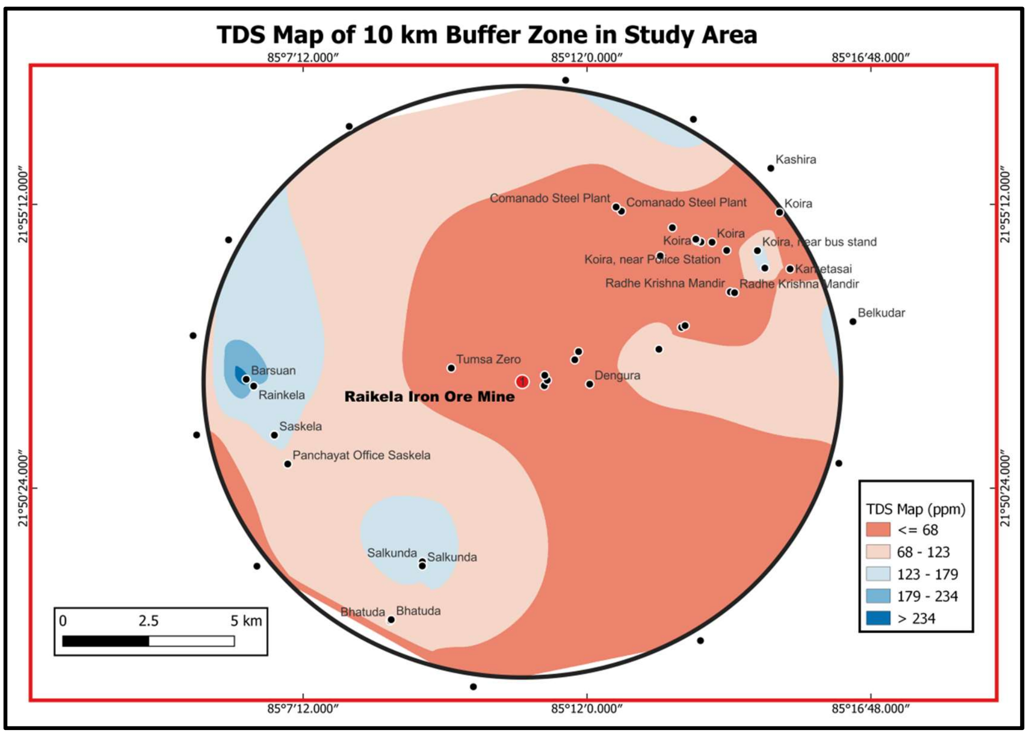


Fig 3.8: TDS map of Raikela Iron Ore mine

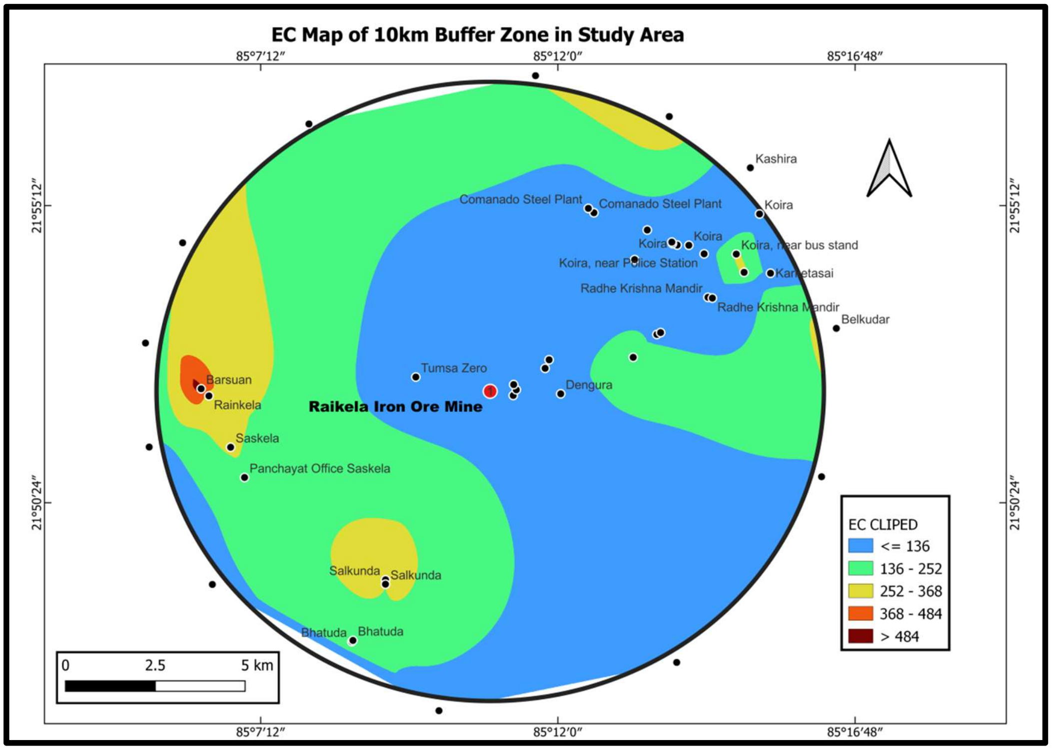


Fig-3.9: EC map of 10km of Buffer Zone of Raikela Iron Ore Mines

3.2.6 Water Quality of nearby water bodies

Data in Piper Trilinear Diagram: Different graphical methods can be adopted for representing geochemical variation which gives a better insight into the groundwater quality monitoring. One such efficient method of representation is plotting of Hill Piper Trilinear diagram in which data are plotted in two triangle fields and one diamond field. The diamond is then classified under various categories emphasizing their characteristics.

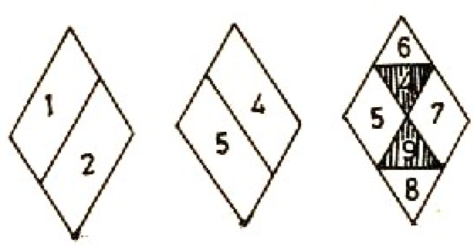


Fig 3.10: Sub-divisions of the diamond field

On the basis of data collection from CGWB report (2020-2021). It has been observed that out of 63 samples are concentrated in Area 6 indicating that: Non-carbonate hardness exceeds 50% i.e., Ca + Mg - (SO4 + Cl + NO3). 50% samples are lies under area 4 representing strong acids (SO4 + Cl + NO3) exceed weak acids (CO3 + HCO3). Few samples can be noticed under Area 7: Non-carbonate alkali exceeds 50% i.e., Na + K- (SO4 + Cl + NO3).

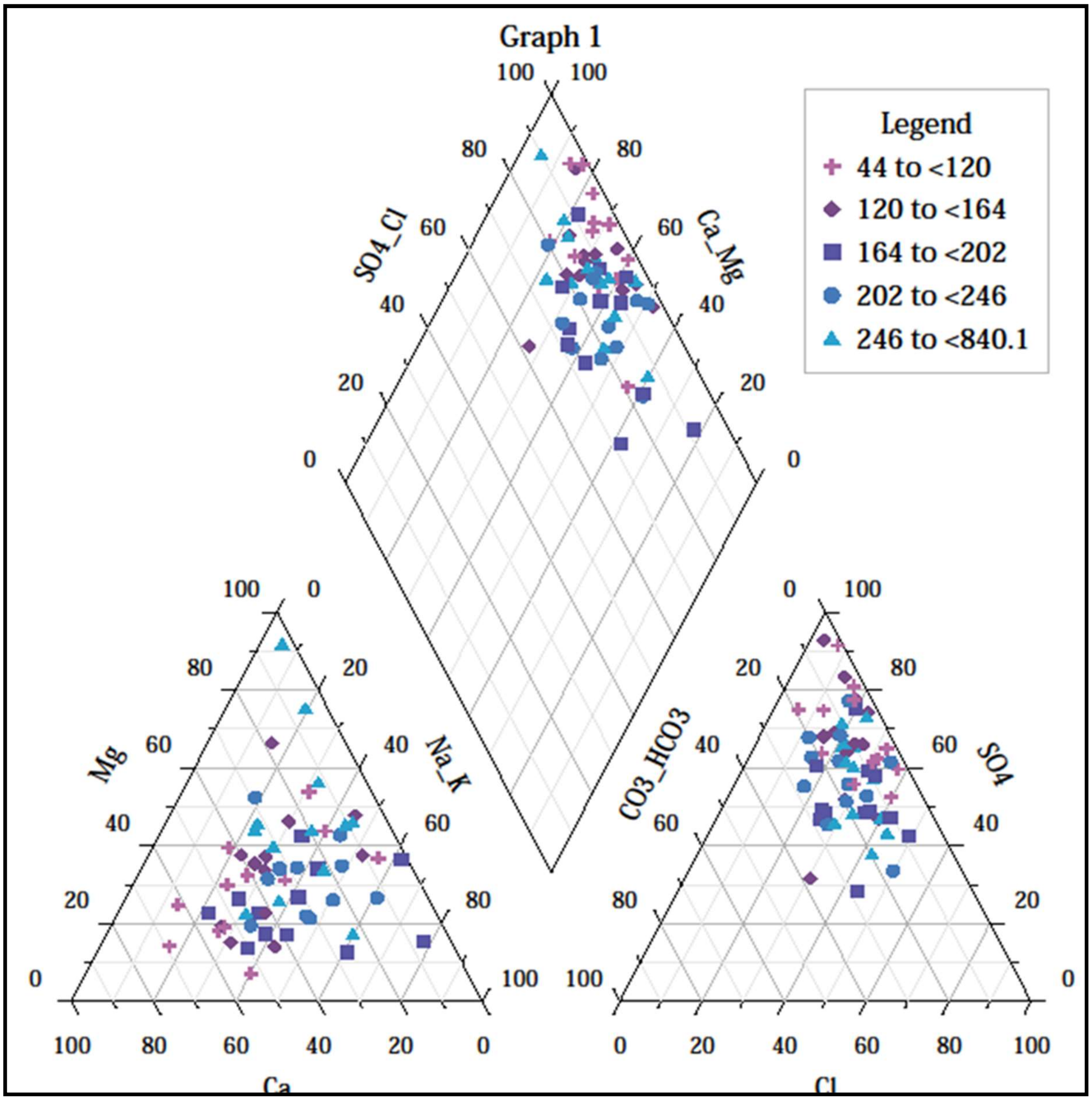


Fig 3.11 Piper Trilinear diagram

USSL Diagram: The United States Salinity Laboratory (USSL) (1954) and Wilcox (1955) established standards for irrigation water quality classification. The Fig.7.5 is a simple scatter chart of sodium hazard (SAR) on the Y-axis versus salinity hazard (EC) on the X-axis. Using the SAR and the EC value of 41 water samples of Balaghat area determines the quality classification of the water.

Based on the EC, irrigation water can be classified into four categories; include:

I. Low-salinity water (C_1) can be used for irrigation with most crops on most soils with little likelihood that **soil salinity** will develop.

II. Medium-salinity water (C_2) can be used if a moderate amount of leaching occurs. Plants with moderate salt- tolerance can be grown in most cases without special practices for salinity control.

III. High-salinity water (C_3) cannot be used on soils, special management for salinity control may be required and plants with good salt tolerance should be selected.

IV. Very high salinity water (C_4) is not suitable for irrigation under ordinary conditions.

Sodium Adsorption Ratio: High sodium in irrigation water reduces the permeability of soil.The USSL diagram based on SAR divided to four categories included:

$$SAR = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$$

I. Low-sodium water (S_1) can be used for irrigation on almost all soils.

II. Medium-sodium water (S_2) will present an appreciable sodium hazard in certain fine-textured soils. This water may be used on coarse-textured or organic soils with good permeability.

III. High-sodium water (S_3) may produce harmful levels of exchangeable sodium in most soils and will require special soil management.

IV. Very high sodium water (S_4) is generally unsatisfactory for irrigation unless special action is taken, such as addition of gypsum to soil (Lyerly and Longenecker, 1957).

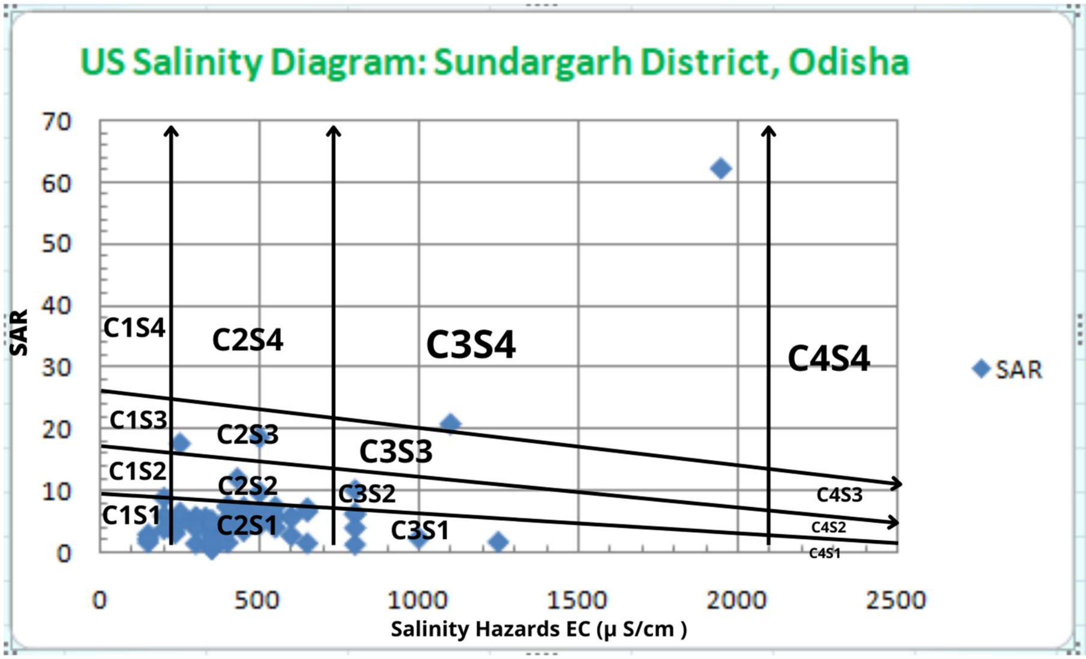


Fig 3.12: US Salinity diagram, Sundergarh district , Odisha

Data Analysis

On the basis of data collection from CGWB report (2020-2021). It has been observed that out of 63 sample, most of the samples are concentrated under C2S1, C2S2 and C3S2 categories indicating low to medium sodium hazards with medium salinity. Out of these, few samples are scattered under C3S1 and C3S2 categories representing high salinity with low to medium sodium hazard. Few samples are scattered in C1S1 indicating low sodium hazards with low salinity.

4. APPROVED MINE PLAN

4.1 DETAILS OF APPROVED MINING PLAN/SCHEME OF MINING.

Date and reference of earlier approved Mining Plan/Scheme of mining

The details of approved Mining Plan/Scheme of Mining in chronological order are as summarized in **Table 4.1.**

Documents approved	Under Rule	Period	Approval
Mining Plan	22 of MCR 1960	1993-94 to 1998-1999	Approved vide letter No RQP/ CAL/ 006/ 87/A/MO-94 dated 27.06.1990
1st Mining Scheme	12 of MCDR' 1988	1999-2000 to 2003-04	Approved vide their letter No BBS/SNG/Fe/MS-7 dated 11.10.1999.
Modification in the Approved Scheme of Mining	10 of MCDR' 1988	2002-2003 to 2003-04	Approved vide their letter No BBS/ SNG/Fe/MS-7 dated 08.05.2003.
2nd Mining Scheme	12 of MCDR' 1988	2004-05 to 2008-09	Approved vide letter No 314(3)/2004/MCCM(C)/MS-14 dated 17.02 .2005.
3rd Scheme of Mining	12 of MCDR' 1988	2009-10 to 2011 -12 (up to 01.07.11)	Approved vide letter No 314(3)/2009 /MCCM/ (CZ)/ MS / 36 dated 22.03.2010.
Mining Plan	24A of MCR 1960	01.07.2011- 2012 to 2015-16	Approved vide letter No 314(3)/ 2011/MCCM/(CZ)/MP/10 dated 03.08.2011.
1st Scheme of Mining	12 of MCDR' 1988	2016-17 to 2020-21	Approved vide letter No MPM / FM/07-ORI/BHU/2015-16 dated 15.06.2016.
Modification of Review of the Mining Plan	17(3) of MCR,M2016	2019-20 to 2020-21	Approved vide letter No. MSM/FM/10-ORI/BHU/2019-20/1087 dated 20.09.2019
Review of Mining Plan	17(2) of MCR,M2016	2021-22 to 2025-26	Approved vide letter No. RMP/A/30-ORI/ BHU/2020-21 dated 18.11.2020

Table 4.1: List of Approved Mine plans

4.2 Mining Method

Opencast fully mechanized method will be adopted to achieve the targeted production. The existing quarries namely Top quarry, Middle quarry and South Pit shall be developed by deploying shovel and dumper combination during the mining operation. Mining operation will be done on the Top quarry on the northern side, bottom quarry on the south eastern side and South pit on the South eastern side with lateral and depth ward extensions with top slicing method. The details of salient description of present mining method in table no 4.2.

Method of Mining	Opencast mechanized method (A-FM).
Type of ore	Laminated hard and soft ore, massive boulder type
Laminated hard and soft ore , massive boulder type	With the help of excavator and Dumper combination.
Bench height and width	10m height with 15m width.
Overall slope angle	28^{O}
Transportation of Ore	By dumper through haulage road to the Crusher at 1:16 gradient.
Blasting	Drilling of 11.0m drill holes with Crawler mounted DTH drill and blasting by using Class 3 explosives. Since the formations are mostly soft, drilling & blasting is done only for 75% of the volume. One hydraulic rock breaker is used for reducing the size of the large boulders instead of secondary blasting.

Table 4.2: Jest of Mining Method

The ROM produced is fed to the Screening unit for the production of 0-10mm, 10-30mm, and +30mm sized ore. The +30 mm ore sent to the crushing unit for production of 5-18mm, 0-5mm. So, the various finished products are 0-5mm, 0-10mm, 5-18mm and 10-30mm.

(i) Recovery factor:

Considering the available borehole data, different litho unit has been demarcated on the Geological section. Based on this updated geological sections different grade wise resource calculation i.e 45 to 55% Fe and +55% Fe has been made. Further waste as BHJ, Shale and Laterite has been demarcated in each geological section, which has been calculated separately. As the grade wise resource and waste calculation carried out separately for each section, 100% recovery factor has been considered for the estimation of resource.

(ii) Cutoff grade

The threshold value is considered at 45%Fe and calculation of reserves is done under different range of Fe% i.e. 45 to 55% Fe and +55% Fe. While above 55% Fe ore is termed as saleable iron ore, below that up to 45% Fe is termed as Mineral Reject. Ore containing less than 45% Fe is considered as mineral waste.

(iii) Ultimate pit depth proposed.

The maximum depth up to which the quarry can be developed economically is considered as the ultimate or conceptual extent of the quarry. Based on the present geological information and mine ability of ore the ultimate pit limit has been marked. The depth of ultimate pit limit has been shown up to the probable limit in the iron ore zone.

(iv) Mineral/ ore blocked dues to benches, safety zone:

During mining operation certain resources have been blocked under UPL, lease boundary safety zone and blocked area within bench slope. The ore in these blocked areas are non-mineable. Although feasibility study has been carried out and the quantity is established, because of the above mentioned blockages the quantity falls under F-2 category. By considering these blockages, due to above mention various factors, the mineable resource has been estimated.

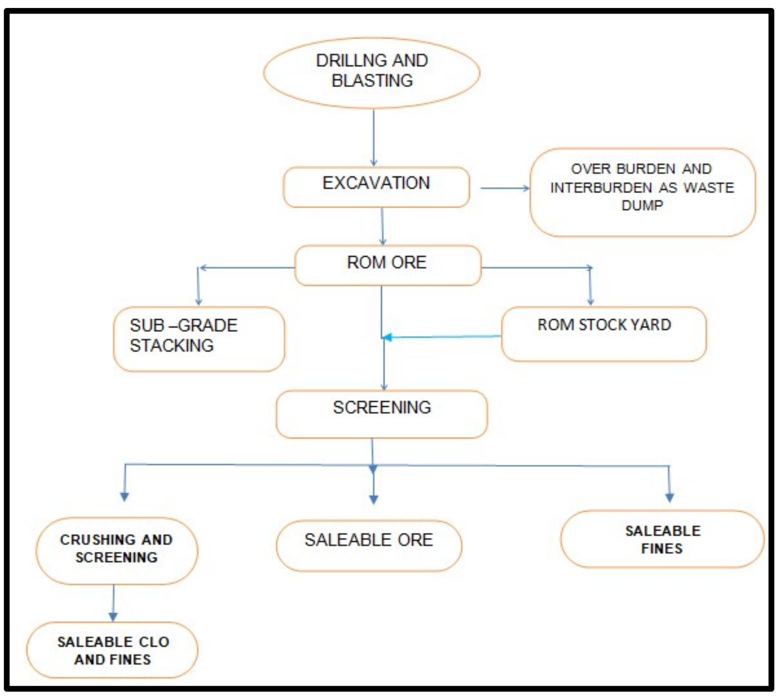
(v) Tonnage Factor

As per the approved Scheme of Mining, the tonnage factor of saleable ore has been considered as 3.0MT/m3 and for sub-grade ore as 2.5MT/m3. The tonnage factor of waste has been considered as 2.0MT/m3. For tonnage factor the lessee has undertaken a bulk density study through a NABL Accredited Laboratory. The copy of the report is enclosed as **Annexure- XXV.**

Sequence of mining operation

Based on earlier mining operation can be observed that three pits have been formed within the lease area. The dimension of the quarries has been mentioned in the table below in the next page. The following flow chart depicts the entire process of mining which is in-vogue at present in Raikela Iron ore Mine.

Fig 4.1: Flow chart of mining operation



As per guidelines of IBM threshold value of iron ore is considered as 45% Fe. While above 55 % Fe ore is termed as saleable iron ore (cutoff grade), and 45-55% Fe is termed as Mineral Reject iron ore. Ore containing less than 45% Fe is considered as waste.

4.3 PRODUCTION DETAILS.

As per guidelines of IBM threshold value of iron ore is considered as 45% Fe. While above 55 % Fe ore is termed as saleable iron ore (cutoff grade), and 45-55% Fe is termed as Mineral Reject iron ore. Ore containing less than 45% Fe is considered as waste.

Table 4.3: Details of production Plan of iron ore (+55%Fe and 45-55%Fe)

YEAR	IRON ORE(MT) (+55%Fe)	MINERAL REJECT (MT) (45-55%Fe)	ROM(MT) (+45%Fe)
2021-22	2023052	966948	2990000
2022-23	4411541	578459	4990000
2023-24	4598847	391153	4990000
2024-25	4680387	309613	4990000
2025-26	4990000	NIL	4990000
TOTAL	20703827	2246173	22950000

As per the approved mining plan total production of +55%Fe will be 20703827 T. Before dispatch to the consumers, grade wise stacking will be undertaken at specified location proposed in the mining plan. This product will be dispatched as per the requirement of consumers.

Table 4.4: Generation of off grade material/mineral reject (45 – 55 % Fe)

Year	Mineral rejects(MT)		
	Total Generation	**Storage @ 30%**	**Blending@ 70% with high grade**
2021-22	966948	290084	676864
2022-23	578459	173538	404921
2023-24	391153	117346	273807
2024-25	309613	92884	216729
2025-26	Nil	0	0
Total	**2246173**	**673852**	**1572321**

Beyond plan period about 5730731cum of Mineral Reject i.e. 45-55%Fe will be generated. The mineral reject generated will be stored for a short period as per requirement. Further, it is also planned to evacuate the mineral reject by blending with the high grade ore so that stacking of mineral reject during conceptual period will not arise.

5. ESTIMATION OF MINE SEEPAGE AND ADVANCED DEWATERING PLAN

Minimum and Maximum depth of water table based on observations from the nearby well-

The nearest habitations from the mine are Raikela, Dengula, Tantra, Tensa town etc. The wells at village Raikela, and Dengula is indicating that the water level is encountering at 610MRL.

Indicate Maximum and Minimum depth of working

Mining operation in this lease area is going on after the lease was executed. Continuation of mining operation in the area has opened up three quarries i.e. Top Quarry, Middle Quarry and South Pit. The detail of the quarry is as follows in Table no 5.1.

Nameofthe pit	Location	Length (m.)	Breadth (m.)	Depth(m)	Top RL(m.)	Botto mRL (m.)	No of Benches In Ore	No of Bencs In OB	Pit angle	Areaback filled	Areareclai med& rehabilitate d
TopQuarry	N2419636to 2420236 & E 311610to 312070	553.27 01	376. 502	115.778	843.944	728.166	15	0	37°	Nil	Nil
MiddleQuarr y	N2419500to 2420017 & E 311900to 312252	676.61 1	267. 964	90.197	728.685	638.488	16	0	37°	Nil	Nil
SouthPit	N2419237to 2419310 & E 311795to 311925	75.957	59.4 43	23.551	688.551	665.000	4	0	25°	Nil	Nil

Table 5.1:.depth of working in existing lease quarries

It has been proposed to develop the existing pits i.e. Top Quarry and Middle Quarry. At present the existing bottom RL of Top quarry is 730.497m and Middle quarry is 638.488m. During ensuing plan period the working will be done up to 690m.RL in Top quarry, 620m.RL in Middle quarry.

Table 5.2: Ultimate Pit limit within Plan Period

Name of the Quarry	At the end of plan period (m.RL)	
	Top	Bottom
Top Quarry	843.944	690
Middle Quarry	730.497	620

5.1 Rain water accumulation within Open Mine Pit Area

The open pit area in Raikela Mines is 33.593ha. The average rainfall receive in the area as per record is 1415.126mm, i.e. 1.415m (Table 3.1), that occurs in about 75days. The maximum daily rainfall ever recorded at Koida was 110 mm on 12.08.2022. The Iron ore Mines is located on the hill slop and garland drains were constructed along the boundary of the Mine pit, hence no runoff water enters within the open pit area.

Considering above facts of rainfall, the total volume of water can be generated within the mine area has been calculated and present below.

Duration	Open Mine area in Ha	Rainfall in m	Volume in ham	Volume in m3	Considering Rainy days	Total volume in m3
Annual	33.593	1.415	47.5341	475341	75	6338
Max/day(110mm)	33.593	0.11	3.6952	36952	1	36952

Table 5.3. Rain water accumulation within the Pit area

As per the above table of calculation the maximum volume of water that can be generated within the open mine pit annually is about 47.53ham. However, the per day rain fall is 6338m3/d only and in extreme case it will be 36952m3.

Considering evaporation and percolation losses per day, it will insignificant quantity of water left for discharge by pumping.

It is therefore concluded that there is no adequate rain water accumulation in pit bottom nor it cut the groundwater table. Hence no mine water discharge generated from Raikela Iron Ore Mines.

5.2 Estimation of Mine seepage – NA

5.3 Advance Dewatering Plan in case of Coal/Lignite Mines – NA

5.4 GW modelling- NA

6.0Mine water Management

6.1 WATER REQUIREMENT:

The project proponent should submit the quantity of surface water or ground water to be used in this project. The complete water balance cycle needs to be used for this project. The complete water balance cycle needs to be submitted. In addition to this the project proponent should submit a detailed plan for rain water harvesting measures to be taken. PP should submit the year wise target for reduction in consumption of the ground/surface water by developing alternative source of water through rain water harvesting measures. The capital and recurring expenditure to be incurred need to be submitted.

The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the project should be indicated.

Total water management including domestic use were sourcing from bore well, rain water harvesting and recycling of waste water from ETP/STP, both for monsoon and non-monsoon be submitted of the existing mines and propose expansion. Total makeup water requirement for production of 4.99 MTPA

Iron Ore is 281.3 KLD, 170KLD is sourced from bore well, and 98 KLD from rain water harvesting and 13.3 KLD recycling water from STP & ETP.

The water requirement for the Project, its availability and source should be furnished. A detailed water balance has been al provided in Table no 6.1. Fresh water requirement for the project should be indicated. Total water requirement for production of 4.99 MTPA of Iron Ore is281.3KLD. Out of this requirement from groundwater withdrawal is only 170KLD. The water required will be sourced from bore well existing within the lease area. The proponent has proposed to draw the required quantity from bore well for 8 months excluding summer season. During summer season the required quantity will be met from rain water harvesting pond. The details of breakup of 281.3 m3 /day are as follows:

Sl. No	Purpose	Ground Water (KLD)	RWH (KLD)	Recycled STP &ETP (KLD)	Total from all source (KLD)
1	Dust Suppression	127.4	90	5.1	222.5
2	Domestic Use	14.0			14.0
3	Plantation	16.3	8.0	8.2	32.5
4	ETP & Workshop, Wheel Washing System	12.3	-	-	12.3
Total		**170**	**98**	**13.3**	**281.3**

Table 6.1: Details of water requirement in mining operation

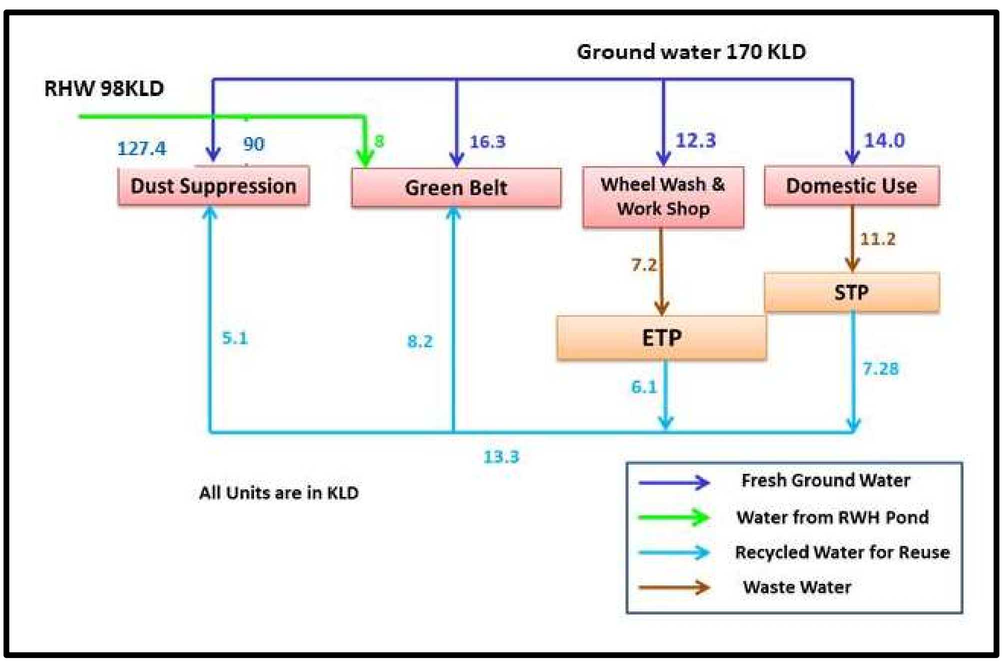


Fig- 6.1 Flowchart for Mine water utilization

There will be reduction of 10 KLD of groundwater in total consumption of water in the mining activates. The necessary requirement has been fulfilled through rain water harvesting and recycled water. The flowchart of water utilization is shown in Fig 6.1.

1st NOC for drawl of 64.5 m3/day of Ground water has been obtained from CGWA vide ltr no 21-4(83/3ER/CGWA/2008-1723 dt 18.12.2008. After that, NOC for drawl of 180 m3/day of Ground water has been obtained from CGWA vide ltr no CGWA/NOC/MIN/ORIG/2021/10588 dt 31.01.2021 **(Annexure 1)** for expansion of productivity**. The** water requirement will be met from own bore wells situated in the lease area. The area falls under safe category as far as stage of development is concerned.

7. Impact of mine Dewatering/ Abstraction and Mitigation Measures

Piezometric well has been established to monitor the ground water Table/water depilation in the lease area due to withdrawal of groundwater. After observing the detail Piezometric reading from April to July 2022 (Pre-monsoon) no Impact has been seen in water level in the area because of Abstraction of the ground water for the smooth running of the Mines in the lease (Shown in Table 7.1).Detail of the reading has been attached in Annexure5. Rain water harvesting and recharge structures were established for minimise the ground water extraction and recharge the area.

Sl. No	Date	Time	Water Level
1	30 March 2022	06:00 AM	10.61
2	30 May 2022	06:00 AM	10.74
3	30 June 2022	06:00 AM	10.74
4	30 July 2022	06:00 AM	10.74
5	August 2022	06:00AM	5.25
6	30 September 2022	06:00 AM	5.3
7	30 October 2022	06:00 AM	10.75

Table 7.1: Pre-monsoon and Post-monsoon water level within the lease area

7.1 Impact on ground water regime

As discuss above no major/Serious Impact has been reported in the area because of groundwater withdrawal. The lease area is lies within the Safe zone for groundwater. Groundwater flow is in the outside direction from the lease area hence no or very less effect of groundwater regime will be reported because of the mining activities.

7.2 Impact on Surface water sources

Retaining wall is already present partly around the existing waste dump. Further it is proposed to construct a retaining wall at the bottom periphery of the waste dump mineral reject stack followed by a garland drain during the plan period,showing in Fig 7.1.

Water during rainy season that percolates through the wastes in the waste/overburden dump shall be drained to the garland drain and the retaining wall shall help in arresting movement of waste materials. Garland drain shall be channelized in such a way that the water flows to an area which should be on non-ore bearing and a wasteland. Regular cleaning of the drain shall be done for easy flow of water. Besides the garland drain and the retaining wall, six (6) settling pond of 10 m x 8 m x 2 m size will be constructed at the end of garland drain, which will accumulate water. Alum shall be added here for settlement of suspended solids. After suspended solids are settled, the water shall be discharged outside the lease area. In the rainy season the water from the pits shall be pumped out to the garland drain at the top of the quarry so that entire water flows to outside the working area keeping the bottom of the pit in dry condition. A rain water harvesting pond has been constructed and this pond water will be used for different purposes within the mines.

The proposed year wise protective measures are furnished in table no 7.2 & 7.3.

Location	Retaining wall			Garland drain			Settling pond			
	L(m)	W(m)	H(m)	L(m)	W(m)	D(m)	Nos	L(m)	W(m)	D(m)
Proposed Mineral reject stack -1	620	1.0	2.0	620	1.0	1.5	3	10	8	2
Proposed Mineral reject stack -2	188	1.0	2.0	468	1.0	1.5	1	10	8	2
Proposed Mineral reject stack -3	230	--	--	230	1.0	1.5	1	10	8	2
Total	1038	1.0	2.0	1318	1.0	1.5	5	10	8	2

Table 7.2: Protective Measures around the Mineral reject stack

Year	Retaining wall			Garland drain			Settling tank/Pond			
	L(m)	W(m)	H(m)	L(m)	W(m)	D(m)	Nos	L(m)	W(m)	D(m)
2021-22	888	1.0	1.5	1010	1.0	1.0	3	10	8	2
							1	200	30	5
2022-23	415	1.0	1.5	690	1.0	1.0	2	10	8	2
2023-24	500	1.0	1.5	670	1.0	1.0	2	10	8	2
2024-25	120	1.0	1.5	120	1.0	1.0	--	10	8	2
2025-26	Maintenance			Maintenance			Maintenance			
Total	1923	1.0	1.5	2490	1.0	1.0	8	10	8	2

Table 7.3: Year wise proposal of retaining wall, garland drain & settling pond

Coir matting over proposed dump: It has been proposed to prevent waste dump from water cutting in rainy season. Detail year wise construction shown in Table 7.4.

Period	Area of coir matting	No of sapling
2021-22	4000 sq.m	grass seedlings
2022-23	2500 sq.m	grass seedlings
2023-24	4100 sq.m	grass seedlings
2024-25	3700 sq.m	grass seedlings
2025-26	2900 sq.m	grass seedlings
Total	**17200** sq.m	

Table 7.4: Year wise proposal of coir matting

Fig 7.1: Retaining Walls and Garland Drain in Mining area

7.3 Impact on water quality

Continuous monitoring has been taken care by the mines authority. Quarterly ground water sample of the lease area and nearby places has been collected and send for testing at NABL aggregated Laboratory at Bhubaneswar. In Laboratory 43 parameters have tested. Till now no serious Impact/issues has been reported in the groundwater quality.

According to the Report Groundwater is safe for drinking and other activates. The test report of NABL accredited Laboratory, conducted in moth of October, 2022 is shown in Fig 7.2. Also the analysis report of surrounding three 3 wells is attached as Annexure4.

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GTEEPL/LQR/56

TEST REPORT

TC-10101

NABL ULR NO	:	TC1010122000000203P
Report No.	:	GTEEPL/09/22/GW/203F
Name of the Client	:	Raikela Iron Ore Mines of M/s Geetarani Mohanty
Address	:	Raikela, Koira, Sundargarh, Odisha,
Date of Sampling	:	06.09.2022
Date of Testing	:	08.09.2022 to 14.09.2022
Sampling Location	:	Office Bore Well (Inside Mines Office)
Identification of Sample	:	Ground Water
Quantity of Sample	:	1LTR X 2
Sampling procedure	:	GTEEPL/LSOP/09

Issue Date: 07.10.2022

Date of Receiving: 07.09.2022

Sl. No.	Parameters	Unit	Testing Method	Requirement as per IS 10500:2012RA 2018	Analysis Result
Physical Parameters					
1	pH	.....	IS 3025(Part-11)1983 RA 2017	6.5 to 8.5	6.57
2	Odour	.....	IS 3025(Part 5) 2018	Agreeable	Agreeable
3	Colour	Hazen	IS 3025(Part 4) 2021	5(max)	<1.0
4	Electrical Conductivity	µs/cm	IS 3025(Part-14) :2021	......	190
5	Total Dissolved solids	mg/l	IS 3025(Part-16)1984 RA 2017	500 (max)	113
6	Total Suspended Solids	mg/l	IS 3025(Part-17):1984 RA 2017	....	<1.0
7	Turbidity	NTU	IS 3025(Part-10)1984 RA 2017	1.0(max)	<0.5
Chemical Parameters					
8	Total Hardness as $CaCo_3$	mg/l	IS 3025(Part-21)2009 RA 2019	200(max)	62.8
9	Calcium Hardness as $CaCO_3$	mg/l	IS 3025(Part-40)1991 RA 2019	---	40.2
10	Magnesium Hardness as $CaCO_3$	mg/l	IS 3025(Part-46)1994 RA 2003	-----	22.6
11	Total Alkalinity as CaCo3	mg/l	IS 3025(Part-23) 1986 RA 2019	200(max)	46.4
12	Calcium as Ca	mg/l	IS 3025 (Part-40) 1991 RA 2019	75(max)	16.12
13	Magnesium as Mg	mg/l	APHA 3500Mg B	30(max)	5.49
14	Chloride as Cl	mg/l	IS 3025(Part-32)1988 RA 2019	250(max)	9.8
15	Sulphate as SO4	mg/l	IS 3025(Part-24)1986 RA 2019	200(max)	2.1
16	Fluoride as F	mg/l	APHA F 4500 C-D	1.0(max)	0.34
17	Nitrate as NO3	mg/l	APHA 4500 NO3-B	45(max)	1.4
18	Total Ammonia	mg/l	IS 3025(Part-34)1988RA2019	0.5(max)	<0.3
19	Free Residual Chlorine	mg/l	IS 3025: (Part-26) 2021	0.2(min)	<0.1
20	Mineral Oil	mg/l	IS 3025(Part-39) 2021	0.5(max)	<0.4
21	Iron as Fe	mg/l	IS 3025(Part-53)2003 RA 2019	1.0(max)	0.45
22	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025(Part-52)2003 RA 2019	----	<0.01

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Report No: GTEEPL/0/22/GW/203F

23	Phosphate as PO_4	mg/l	APHA 23rd Ed (4500-P-D): 2017	----	<0.05
24	Silica	mg/l	APHA 23rd Ed (4500-SiO_2-C): 2017	-----	0.3
25	Sodium as Na	mg/l	IS 3025: (Part-45) 1993 RA 2019	-----	18.6
26	Potassium as K	mg/l	IS 3025: (Part-45) 1993 RA 2019	-------	4.9
27	Total Chromium as	mg/l	IS 3025(Part-52) 2003 RA 2009	0.05(max)	<0.01
28	Phenolic Compounds as C_6H_5OH	mg/l	IS 3025(Part-43)1992 RA 2019	0.001 (max)	<0.001
29	Sulphide as H_2S	mg/l	IS 3025(Part-29)1986 RA 2019	0.05(max)	<0.05
30	Aluminium as Al	mg/l	IS 3025(Part-55)2003 RA 2019	0.03 (max)	<0.02
31	Boron as B	mg/l	IS 3025(Part-57)2005 RA 2017	0.5 (max)	<0.1
32	Cyanide as CN	mg/l	IS 3025(Part-27)1986 RA 2019	0.05(max)	<0.01
33	Arsenic as As	mg/l	IS 3025(Part-37)1988 RA 2019	0.01(max)	<0.01
34	Copper as Cu	mg/l	IS 3025(Part-42)1992 RA 2019	0.05(max)	<0.01
35	Manganese as Mn	mg/l	IS 3025(Part-59)2006 RA 2017	0.1(max)	<0.05
36	Lead as Pb	mg/l	IS 3025(Part-47)1994 RA 2019	0.01(max)	<0.01
37	Selenium as Se	mg/l	IS 3025(Part-56)2003 RA 2019	0.01(max)	<0.001
38	Nickel	mg/l	IS 3025(Part-54)2003 RA 2019	0.02(max)	<0.01
39	Zinc as Zn	mg/l	IS 3025(Part-49)1994 RA 2019	5 (max)	0.06
40	Cadmium as Cd	mg/l	IS 3025(Part-41)1992 RA 2019	0.003(max)	0.001
41	Mercury as Hg	mg/l	IS 3025(Part 48) 1994 RA 2009	0.001(max)	<0.001
42	Anionic detergent as MBAS	mg/l	Annex K of IS 13428	0.2(max)	<0.2
Bacteriological Quality					
43	Total Coliform Bacteria	MPN/100ml	IS 1622:1981 RA 2019	Shall not be detected in any 100 ml sample	< 2

-END OF REPORT-

Authorised Signatory
Global Tech Enviro Experts Pvt. Ltd

N.B.:
- ❶ The results relate to the sample received in respect to the Parameters tested.
- ❷ Liability for return of sample ceases after 15 days from the date of Test certificate.
- ❸ The report cannot be reproduced either in full or in part, without prior written consent of Director.
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Fig7.2: Quality Report from NABL accredited Lab for Office Bore-well in October, 2022

7.4 Mitigation Measures

The rain fall data has been obtained from WARIS online portal for the financial year 20011-2020. Based on the data the rain minimum Annual rainfall is 1098.51mm in 2016 and the maximum rain fall is 1562.24mm in 2020. However, the average rain fall data is calculated to be 1415.126 mm. Since the proposed waste dumps are located in areas which is a steep slope, maximum flow of water in rainy season will endanger the retaining walls. Therefore, concrete wall were construct along the toe of the proposed/existing dump. However, the following precautionary measures shall be taken while designing the retaining walls and garland drains.

Retaining Walls

Retaining boulder wall (2.0m high and 1.0m width) of substantial strength shall be constructed all around the bottom periphery of waste dumps with locally available boulders mixed with sand and cement, to arrest any rolling down of the dump materials. Perforation shall be left at around 10 m intervals to allow for passage of water.

Garland drains

Garland drains of 1.5 m deep and 1.0 m wide shall be constructed all along the bottom periphery of waste dumps followed by the retaining wall to prevent any wash off or leaching of dump materials during heavy rains. Side walls and the base shall be pitched with locally available boulders. Joints shall be filled up with cement and sand mixture so that water cannot percolate.

Settling Tank

The garland drain shall be channelized to settling tank of 10m long, 8m width and 2.0m deep. Side walls and base shall be packed with locally available boulders mixed with cement and sand.

RWH Ponds

Fig-7.3: Rainwater Harvesting Pond

Fig-7.4: Roof Top Rainwater Harvesting in Lease area.

Piezometric Well

Piezometric wells were established for continuous monitoring of groundwater level. It is helpful for keep an eye on ground water fluctuationdue to extraction for various mining activates. Day wise three readings has been collected i.e, at 00.00hrs, 06.00hrs, 12.00hrs and 18.00hrs Post Monsoon and Pre-monsoon is attached in Annexure 5.

Rainwater Harvesting Pond and Bunds

The average annual rainfall is around 1278 mm per annum. The maximum daily rainfall ever recorded at Koida was 110 mm on 12.08.2022. Out of which 36% is lost as the surface runoff, 44% is lost through evapotranspiration and only 20% is enter into the subsoil and recharge the aquifer. To harvest the rain water in the lease area, one Pond is constricted and one is proposed for future. Two nala bunds are also constricted for catch the flood and recharge the groundwater. Figure 7.3 and Fig 7.5 is showing the Pond in Lease area.

Roof Top Rainwater Harvesting in Lease area

To catch the roof top water during rainy days and roof top rain water harvesting structures has been established in the lease area to direct recharge the groundwater. The established structure is shown in Figure 7.4.

Regularly Plantation:

Regular plantation has been planned in lease area to protect forest, environment and soil cutting. After closer of the mines the complete leasehold will be afforested. As shown in fig. 7.6.

ETP/STP:

ETP is constricted within the lease hold to recycle the wastage water and again make it usable. Shown in Fig7.7.

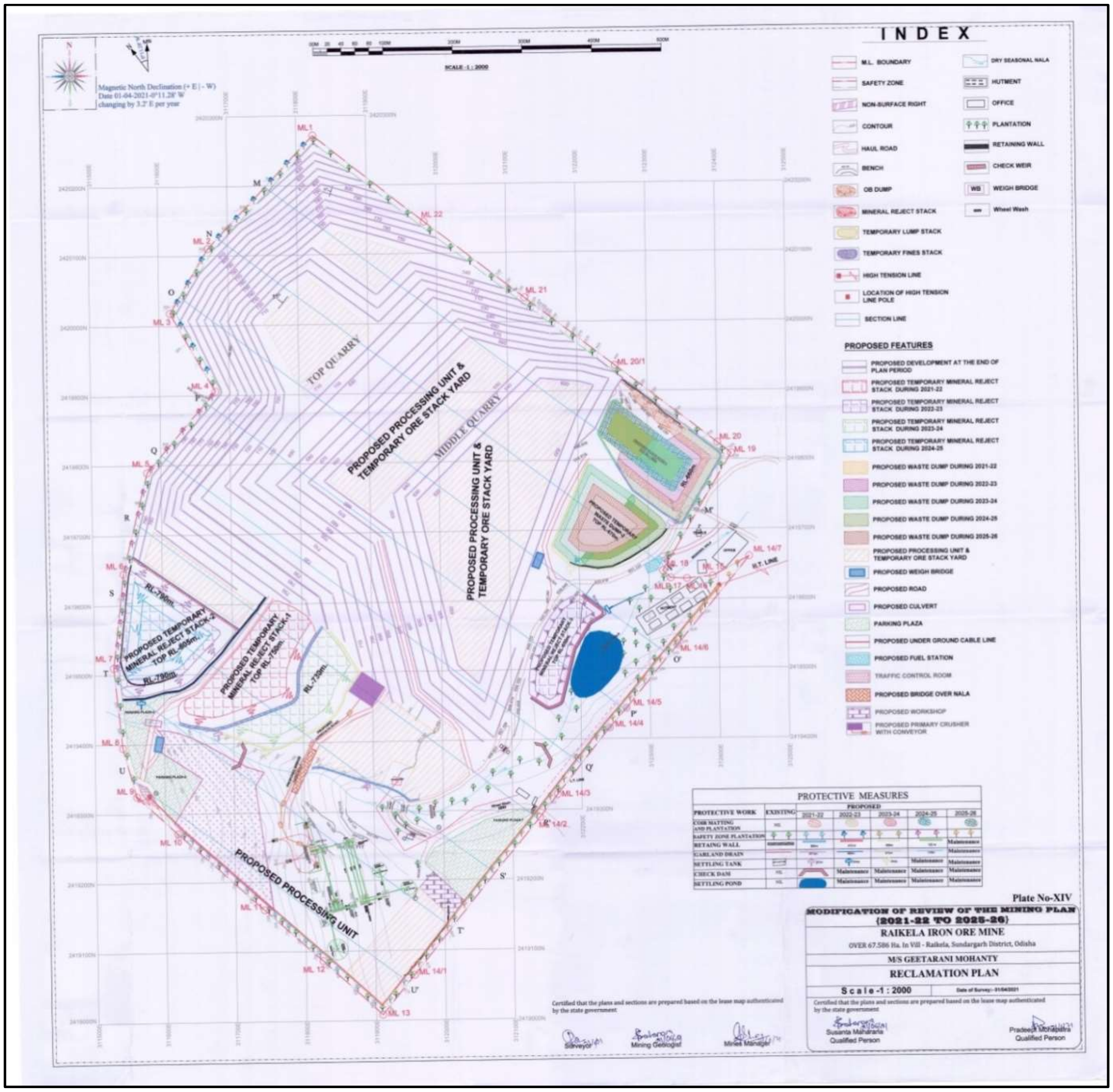

Fig 7.5: Section showing reclamation and restoration of mined out areas

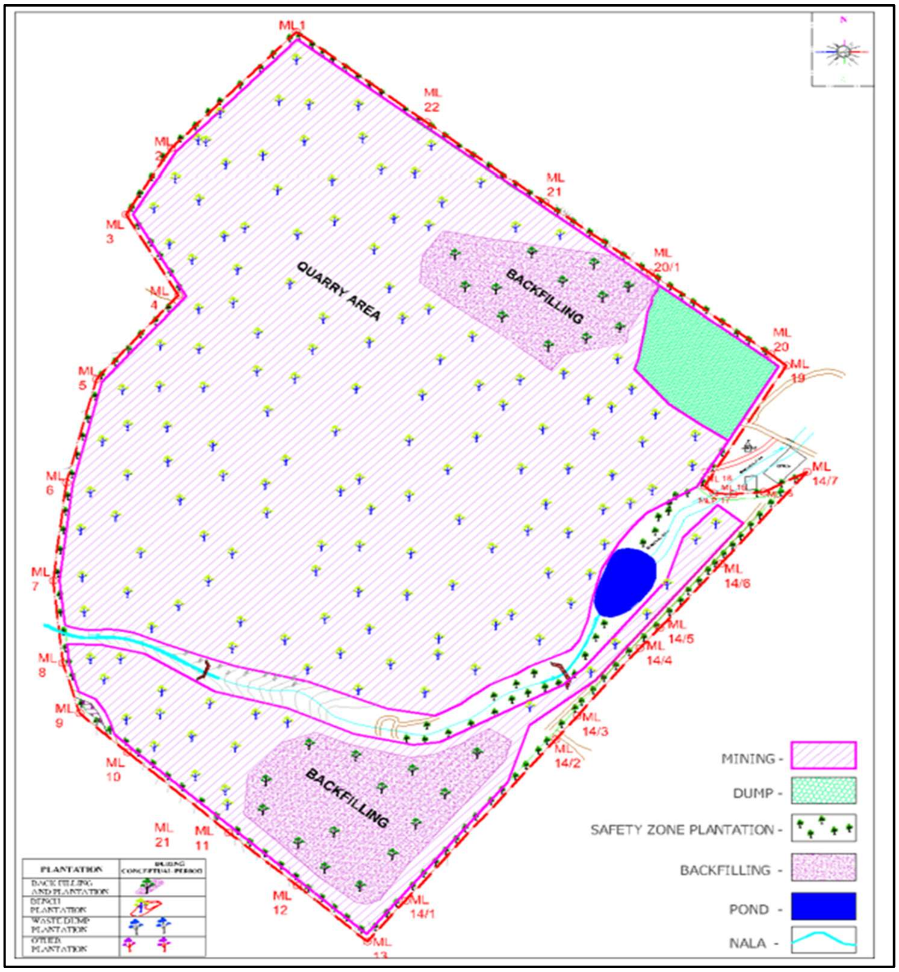

Fig 7.6: Post mining land use plan with reclamation and restoration of mined out areas

Fig 7.7:. ETP for recycle of water is established in Lease area.

7.5 Saline water Disposal- NA

8. Summery and conclusion

The groundwater resource as estimated by CGWB (2020) is presented in the table 3.3 for Koira block of Sundargarh district Odisha and is in safe category. The total estimated recharge in this block is 5661.78(Ham) and the Discharge is 283.09Ham. The total available extractable water is 5378.69 Ham. At present, area is having huge surplus reserves. Hence, no adverse impact on ground water regime of the area is envisaged. Further, area comes under safe category.

However, the RWH structure have been constructed and proposed to be constructed further to augment ground water resource of the area. It reduces the cost for pumping of ground water, reduces soil erosion in urban areas, and Provides self-sufficiency to your water supply.

The slope of groundwater flow is apart from the mine. Hence, with reference to our field study, earlier NOC and GCWB report, it has been safely concluded that the area is under safe zone and the extraction of water for the mining activates will not affect groundwater in adverse. The available and proposed measure of RWH and groundwater recharging also play the key role in fulfilling the requirement and sustain the groundwater.

Annexure 1: Copy of Present NOC for Groundwater Abstraction by CGWA

ANNEXURE 12

सत्यमेव जयते

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

Project Name:	Raikela Iron Ore Mine		
Project Address:	Village-raikela		
Village:	Raikela	Block:	Koida
District:	Sundargarh	State:	Odisha
Pin Code:			
Communication Address:	Bomikhal, Plot No 380, Rasulgarh, Bhubaneswar, Bhubaneswar, Khordha, Odisha - 751010		
Address of CGWB Regional Office :	Central Ground Water Board South Eastern Region, Bhujal Bhawan, Khandagiri Square, Nh-5, Bhubaneshwar, Khordha, Odisha - 750001		

1.	**NOC No.:**	CGWA/NOC/MIN/ORIG/2021/10588			
2.	Application No.:	21-4/2466/OR/MIN/2020	3.	Category: (GWRE 2017)	Safe
4.	Project Status:	Existing Project	5.	NOC Type:	New
6.	**Valid from:**	31/01/2021	7.	**Valid up to:**	30/01/2023
8.	Ground Water Abstraction Permitted:				

Fresh Water		Saline Water		Dewatering		Total	
m^3/day	m^3/year	m^3/day	m^3/year	m^3/day	m^3/year	m^3/day	m^3/year
180.00	55592.50						

9. Details of ground water abstraction /Dewatering structures

	Total Existing No.:2						Total Proposed No.:0					
	DW	DCB	BW	TW	MP	MPu	DW	DCB	BW	TW	MP	MPu
Abstraction Structure*	0	0	2	0	0	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

10. Ground Water Abstraction/Restoration Charges paid (Rs.): 111185.00

11. 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	1	0	1	0

(Compliance Conditions given overleaf)

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

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

Mandatory conditions:

1) Installation of digital water flow meter (conforming to BIS/ IS standards) having telemetry system in 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 through the web-portal.

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.

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) The firm shall submit the water audit report in case of water requirement is in excess of 100 m3/day through certified auditors within three months of completion of the same to CGWA.

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.

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

Annexure 2: Copy of Accreditation of MRCAWTM, Faridabad

Accreditation Board of CGWA

Certificate of Accreditation

M/s. Manav Rachna Centre for Advance Water Technology and Management, (MRCAWTM) of (MRIIRS)

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

- Impact Assessment Report without Modelling.
- Hydrogeological Report for mining projects.

Valid from : 01.10.2021

Valid thru : 30.09.2026

Certificate No. : CGWA/RGI/025

Dated : 30.11.2021

क्षेत्रीय निदेशक
Regional Director
आरजीएनजीडब्ल्यूटीआरआई
RGNGWT&RI

सदस्य
Member
आरजीएनजीडब्ल्यूटीआरआई
RGNGWT&RI

Annexure 3: Work Order copy to MRCAWTM from Raikela Iron Ore Mines

WCS
World Consultancy Services

MY WORLD CONSULTANCY SERVICES PRIVATE LIMITED
GST NO: 21AADCT4043N1ZE

Ref No. WCS/44/2022-23/HG **Date.08.10.2022**

To

The Director,

Manav Rachna Centre for Advanced Water Technology & Management (CAWTM)

Manav Rachna International Institute of Research and Studies,

Faridabad 121004, Haryana

Subject: Work Order for carrying out hydrogeological study and preparation of Hydrological study report in respect of Raikela Iron ore mine of M/s Geetarani Mohanty in Koira Tahasil of Sundargarh district of Odisha.

Ref: "MOU" between My WCS and MRIIS, Dated. 01.03.2022

Dear Madam/Sir,

As per the discussion held with you, we are herewith authorizing your valued organization to carry out Hydrogeology Study of the above depicted subject with following scope of work.

Scope for MRIIS:

- Comprehensive report on ground water conditions in both core and buffer zones of the mine.
- Depth wise and year wise mine seepage calculations.
- Impact assessment of mining and dewatering on ground water regime and its socio-economic impact.
- Details of recycling reuse and recharge reduction of pumping with use of technology for mining and water management to minimize and mitigate the adverse.
- Report will comprise Introduction Project description Background Objectives and scope regional setting Location.
- Land use Climate.
- Topography and drainage Geology
- Regional and Local General Hydrogeology (aquifer types, aquifer depth, zone tapped etc.)
- Groundwater condition (In core and buffer zones)

WCS
World Consultancy Services

MY WORLD CONSULTANCY SERVICES PRIVATE LIMITED
GST NO: 21AADCT4043N1ZE

- Spatial and temporal variations in water levels Groundwater quality (Shallow and deep aquifer)
- Impact of groundwater extraction on local groundwater
- Hydrograph of water level/piezometer in monitoring wells
- Trend analysis of historical water levels
- Flow net analysis (groundwater flow direction) Year wise/ bench wise mine dewatering computation as per approved mine plan Conclusions.

Scope for WCS:

- Providing details of location, area, and brief description about the project
- Approved Mining Plan & Plates
- Maps and figures.
- Site Visit, conveyance, fooding & lodging for the experts

Completion Period:

Submission of Draft report - Within three months from issue of work order

[redacted]

We believe this will be an opportunity for us to be associated with your esteemed organization and knowledge partner.

Kindly acknowledge this work order as a token of acceptance.

Thanking You
Yours Faithfully

Pradeept Mohapatra
Authorized Signatory

Reach us at Telengapetha, Cuttack, Odisha - 754001
+91 79787 24154
wcs@theworld.co.in
www.worldconsultancyservices.in

Annexure 4: Water Quality Analysis by NABL Accredited Laboratory

GLOBAL TECH ENVIRO EXPERTS PVT. LTD.
(FORMERLY GLOBAL EXPERTS)
An ISO 9001:2008 Certified Company

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GTEEPL/LQR/56

TEST REPORT

TC-10101

NABL ULR NO	:	TC1010122000000203P
Report No.	:	GTEEPL/09/22/GW/203F — Issue Date: 07.10.2022
Name of the Client	:	Raikela Iron Ore Mines of M/s Geetarani Mohanty
Address	:	Raikela, Koira, Sundargarh, Odisha,
Date of Sampling	:	06.09.2022 — Date of Receiving: 07.09.2022
Date of Testing	:	08.09.2022 to 14.09.2022
Sampling Location	:	Office Bore Well (Inside Mines Office)
Identification of Sample	:	Ground Water
Quantity of Sample	:	1LTR X 2
Sampling procedure	:	GTEEPL/LSOP/09

Sl. No.	Parameters	Unit	Testing Method	Requirement as per IS 10500:2012RA 2018	Analysis Result
Physical Parameters					
1	pH	.....	IS 3025(Part-11)1983 RA 2017	6.5 to 8.5	6.57
2	Odour	....	IS 3025(Part 5) 2018	Agreeable	Agreeable
3	Colour	Hazen	IS 3025(Part 4) 2021	5(max)	<1.0
4	Electrical Conductivity	µs/cm	IS 3025(Part-14) :2021	......	190
5	Total Dissolved solids	mg/l	IS 3025(Part-16)1984 RA 2017	500 (max)	113
6	Total Suspended Solids	mg/l	IS 3025(Part-17):1984 RA 2017	....	<1.0
7	Turbidity	NTU	IS 3025(Part-10)1984 RA 2017	1.0(max)	<0.5
Chemical Parameters					
8	Total Hardness as $CaCo_3$	mg/l	IS 3025(Part-21)2009 RA 2019	200(max)	62.8
9	Calcium Hardness as $CaCO_3$	mg/l	IS 3025(Part-40)1991 RA 2019	---	40.2
10	Magnesium Hardness as $CaCO_3$	mg/l	IS 3025(Part-46)1994 RA 2003	-----	22.6
11	Total Alkalinity as CaCo3	mg/l	IS 3025(Part-23) 1986 RA 2019	200(max)	46.4
12	Calcium as Ca	mg/l	IS 3025 (Part-40) 1991 RA 2019	75(max)	16.12
13	Magnesium as Mg	mg/l	APHA 3500Mg B	30(max)	5.49
14	Chloride as Cl	mg/l	IS 3025(Part-32)1988 RA 2019	250(max)	9.8
15	Sulphate as SO4	mg/l	IS 3025(Part-24)1986 RA 2019	200(max)	2.1
16	Fluoride as F	mg/l	APHA F 4500 C-D	1.0(max)	0.34
17	Nitrate as NO3	mg/l	APHA 4500 NO3-B	45(max)	1.4
18	Total Ammonia	mg/l	IS 3025(Part-34)1988RA2019	0.5(max)	<0.3
19	Free Residual Chlorine	mg/l	IS 3025: (Part-26) 2021	0.2(min)	<0.1
20	Mineral Oil	mg/l	IS 3025(Part-39) 2021	0.5(max)	<0.4
21	Iron as Fe	mg/l	IS 3025(Part-53)2003 RA 2019	1.0(max)	0.45
22	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025(Part-52)2003 RA 2019	----	<0.01

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Report No: GTEEPL/0/22/GW/203F

23	Phosphate as PO_4	mg/l	APHA 23rd Ed (4500-P-D): 2017	----	<0.05
24	Silica	mg/l	APHA 23rd Ed (4500-SiO_2-C): 2017	-----	0.3
25	Sodium as Na	mg/l	IS 3025: (Part-45) 1993 RA 2019	-----	18.6
26	Potassium as K	mg/l	IS 3025: (Part-45) 1993 RA 2019	-------	4.9
27	Total Chromium as	mg/l	IS 3025(Part-52) 2003 RA 2009	0.05(max)	<0.01
28	Phenolic Compounds as C_6H_5OH	mg/l	IS 3025(Part-43)1992 RA 2019	0.001 (max)	<0.001
29	Sulphide as H_2S	mg/l	IS 3025(Part-29)1986 RA 2019	0.05(max)	<0.05
30	Aluminium as Al	mg/l	IS 3025(Part-55)2003 RA 2019	0.03 (max)	<0.02
31	Boron as B	mg/l	IS 3025(Part-57)2005 RA 2017	0.5 (max)	<0.1
32	Cyanide as CN	mg/l	IS 3025(Part-27)1986 RA 2019	0.05(max.)	<0.01
33	Arsenic as As	mg/l	IS 3025(Part-37)1988 RA 2019	0.01(max)	<0.01
34	Copper as Cu	mg/l	IS 3025(Part-42)1992 RA 2019	0.05(max)	<0.01
35	Manganese as Mn	mg/l	IS 3025(Part-59)2006 RA 2017	0.1(max)	<0.05
36	Lead as Pb	mg/l	IS 3025(Part-47)1994 RA 2019	0.01(max)	<0.01
37	Selenium as Se	mg/l	IS 3025(Part-56)2003 RA 2019	0.01(max)	<0.001
38	Nickel	mg/l	IS 3025(Part-54)2003 RA 2019	0.02(max)	<0.01
39	Zinc as Zn	mg/l	IS 3025(Part-49)1994 RA 2019	5 (max)	0.06
40	Cadmium as Cd	mg/l	IS 3025(Part-41)1992 RA 2019	0.003(max)	0.001
41	Mercury as Hg	mg/l	IS 3025(Part 48) 1994 RA 2009	0.001(max)	<0.001
42	Anionic detergent as MBAS	mg/l	Annex K of IS 13428	0.2(max)	<0.2
Bacteriological Quality					
43	Total Coliform Bacteria	MPN/100ml	IS 1622:1981 RA 2019	Shall not be detected in any 100 ml sample	< 2

-END OF REPORT-

Authorised Signatory
Global Tech Enviro Experts Pvt. Ltd

GLOBAL TECH ENVIRO EXPERTS PVT. LTD. BHUBANESWAR C-23, B.J.B NAGAR

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GTEEPL/LQR/56

TEST REPORT

TC-10101

NABL ULR NO	:	TC1010122000000203P
Report No.	:	GTEEPL/09/22/GW/203G
Name of the Client	:	Raikela Iron Ore Mines of M/s Geetarani Mohanty
Address	:	Raikela, Koira, Sundargarh, Odisha,
Date of Sampling	:	06.09.2022
Date of Testing	:	08.09.2022 to 14.09.2022
Sampling Location	:	Tensa Tube Well
Identification of Sample	:	Ground Water
Quantity of Sample	:	1LTR X 2
Sampling procedure	:	GTEEPL/LSOP/09

Issue Date: 07.10.2022

Date of Receiving: 07.09.2022

Sl. No.	Parameters	Unit	Testing Method	Requirement as per IS 10500:2012RA 2018	Analysis Result
Physical Parameters					
1	pH	.....	IS 3025(Part-11)1983 RA 2017	6.5 to 8.5	6.81
2	Odour	.....	IS 3025(Part 5) 2018	Agreeable	Agreeable
3	Colour	Hazen	IS 3025(Part 4) 2021	5(max)	<1.0
4	Electrical Conductivity	µs/cm	IS 3025(Part-14) :2021	......	178
5	Total Dissolved solids	mg/l	IS 3025(Part-16)1984 RA 2017	500 (max)	104
6	Total Suspended Solids	mg/l	IS 3025(Part-17):1984 RA 2017	....	<1.0
7	Turbidity	NTU	IS 3025(Part-10)1984 RA 2017	1.0(max)	<0.5
Chemical Parameters					
8	Total Hardness as $CaCo_3$	mg/l	IS 3025(Part-21)2009 RA 2019	200(max)	54.6
9	Calcium Hardness as $CaCO_3$	mg/l	IS 3025(Part-40)1991 RA 2019	---	36.7
10	Magnesium Hardness as $CaCO_3$	mg/l	IS 3025(Part-46)1994 RA 2003	-----	17.9
11	Total Alkalinity as CaCo3	mg/l	IS 3025(Part-23) 1986 RA 2019	200(max)	41.8
12	Calcium as Ca	mg/l	IS 3025 (Part-40) 1991 RA 2019	75(max)	14.72
13	Magnesium as Mg	mg/l	APHA 3500Mg B	30(max)	4.35
14	Chloride as Cl	mg/l	IS 3025(Part-32)1988 RA 2019	250(max)	22.2
15	Sulphate as SO4	mg/l	IS 3025(Part-24)1986 RA 2019	200(max)	16.8
16	Fluoride as F	mg/l	APHA F 4500 C-D	1.0(max)	0.39
17	Nitrate as NO3	mg/l	APHA 4500 NO3-B	45(max)	3.7
18	Total Ammonia	mg/l	IS 3025(Part-34)1988RA2019	0.5(max)	<0.3
19	Free Residual Chlorine	mg/l	IS 3025: (Part-26) 2021	0.2(min)	<0.1
20	Mineral Oil	mg/l	IS 3025(Part-39) 2021	0.5(max)	<0.4
21	Iron as Fe	mg/l	IS 3025(Part-53)2003 RA 2019	1.0(max)	0.58
22	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025(Part-52)2003 RA 2019	----	<0.01

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visit us: www.globaltechenvexpt.com

Report No: GTEEPL/09/22/GW/203G

23	Phosphate as PO_4	mg/l	APHA 23rd Ed (4500-P-D): 2017	----	<0.1
24	Silica	mg/l	APHA 23rd Ed (4500-SiO_2-C): 2017	-----	<0.4
25	Sodium as Na	mg/l	IS 3025: (Part-45) 1993 RA 2019	-----	18.6
26	Potassium as K	mg/l	IS 3025: (Part-45) 1993 RA 2019	-------	6.2
27	Total Chromium as	mg/l	IS 3025(Part-52) 2003 RA 2009	0.05(max)	<0.01
28	Phenolic Compounds as C_6H_5OH	mg/l	IS 3025(Part-43)1992 RA 2019	0.001 (max)	<0.001
29	Sulphide as H_2S	mg/l	IS 3025(Part-29)1986 RA 2019	0.05(max)	<0.05
30	Aluminium as Al	mg/l	IS 3025(Part-55)2003 RA 2019	0.03 (max)	<0.02
31	Boron as B	mg/l	IS 3025(Part-57)2005 RA 2017	0.5 (max)	<0.1
32	Cyanide as CN	mg/l	IS 3025(Part-27)1986 RA 2019	0.05(max.)	<0.01
33	Arsenic as As	mg/l	IS 3025(Part-37)1988 RA 2019	0.01(max)	<0.01
34	Copper as Cu	mg/l	IS 3025(Part-42)1992 RA 2019	0.05(max)	<0.01
35	Manganese as Mn	mg/l	IS 3025(Part-59)2006 RA 2017	0.1(max)	<0.05
36	Lead as Pb	mg/l	IS 3025(Part-47)1994 RA 2019	0.01(max)	<0.01
37	Selenium as Se	mg/l	IS 3025(Part-56)2003 RA 2019	0.01(max)	<0.001
38	Nickel	mg/l	IS 3025(Part-54)2003 RA 2019	0.02(max)	<0.01
39	Zinc as Zn	mg/l	IS 3025(Part-49)1994 RA 2019	5 (max)	0.05
40	Cadmium as Cd	mg/l	IS 3025(Part-41)1992 RA 2019	0.003(max)	0.001
41	Mercury as Hg	mg/l	IS 3025(Part 48) 1994 RA 2009	0.001(max)	<0.001
42	Anionic detergent as MBAS	mg/l	Annex K of IS 13428	0.2(max)	<0.2
Bacteriological Quality					
43	Total Coliform Bacteria	MPN/100ml	IS 1622:1981 RA 2019	Shall not be detected in any 100 ml sample	< 2

-END OF REPORT-

Authorised Signatory
Global Tech Enviro Experts Pvt. Ltd

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visit us: www.globaltechenvexpt.com

GTEEPL/LQR/56

TEST REPORT

TC-10101

NABL ULR NO	:	TC1010122000000203P
Report No.	:	GTEEPL/09/22/GW/203H — Issue Date: 07.10.2022
Name of the Client	:	Raikela Iron Ore Mines of M/s Geetarani Mohanty
Address	:	Raikela, Koira, Sundargarh, Odisha.
Date of Sampling	:	06.09.2022 — Date of Receiving: 07.09.2022
Date of Testing	:	08.09.2022 to 14.09.2022
Sampling Location	:	Tentulidihi Dug Well
Identification of Sample	:	Ground Water
Quantity of Sample	:	1LTR X 2
Sampling procedure	:	GTEEPL/LSOP/09

Sl. No.	Parameters	Unit	Testing Method	Requirement as per IS 10500:2012RA 2018	Analysis Result
Physical Parameters					
1	pH	.....	IS 3025(Part-11)1983 RA 2017	6.5 to 8.5	6.58
2	Odour	.....	IS 3025(Part 5) 2018	Agreeable	Agreeable
3	Colour	Hazen	IS 3025(Part 4) 2021	5(max)	<1.0
4	Electrical Conductivity	µs/cm	IS 3025(Part-14) :2021	......	95
5	Total Dissolved solids	mg/l	IS 3025(Part-16)1984 RA 2017	500 (max)	57
6	Total Suspended Solids	mg/l	IS 3025(Part-17):1984 RA 2017	....	<1.0
7	Turbidity	NTU	IS 3025(Part-10)1984 RA 2017	1.0(max)	<0.5
Chemical Parameters					
8	Total Hardness as $CaCo_3$	mg/l	IS 3025(Part-21)2009 RA 2019	200(max)	45.6
9	Calcium Hardness as $CaCO_3$	mg/l	IS 3025(Part-40)1991 RA 2019	---	29.6
10	Magnesium Hardness as $CaCO_3$	mg/l	IS 3025(Part-46)1994 RA 2003	-----	15
11	Total Alkalinity as CaCo3	mg/l	IS 3025(Part-23) 1986 RA 2019	200(max)	28.4
12	Calcium as Ca	mg/l	IS 3025 (Part-40) 1991 RA 2019	75(max)	11.87
13	Magnesium as Mg	mg/l	APHA 3500Mg B	30(max)	3.65
14	Chloride as Cl	mg/l	IS 3025(Part-32)1988 RA 2019	250(max)	11.9
15	Sulphate as SO4	mg/l	IS 3025(Part-24)1986 RA 2019	200(max)	26.2
16	Fluoride as F	mg/l	APHA F 4500 C-D	1.0(max)	0.17
17	Nitrate as NO3	mg/l	APHA 4500 NO3-B	45(max)	4.5
18	Total Ammonia	mg/l	IS 3025(Part-34)1988RA2019	0.5(max)	<0.3
19	Free Residual Chlorine	mg/l	IS 3025: (Part-26) 2021	0.2(min)	<0.1
20	Mineral Oil	mg/l	IS 3025(Part-39) 2021	0.5(max)	0.3
21	Iron as Fe	mg/l	IS 3025(Part-53)2003 RA 2019	1.0(max)	0.21
22	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025(Part-52)2003 RA 2019	----	<0.01

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Report No: GTEEPL/09/22/GW/203H

23	Phosphate as PO_4	mg/l	APHA 23rd Ed (4500-P-D): 2017	----	0.05
24	Silica	mg/l	APHA 23rd Ed (4500-SiO_2-C): 2017	-----	<0.4
25	Sodium as Na	mg/l	IS 3025: (Part-45) 1993 RA 2019	-----	13.7
26	Potassium as K	mg/l	IS 3025: (Part-45) 1993 RA 2019	-------	3.8
27	Total Chromium as	mg/l	IS 3025(Part-52) 2003 RA 2009	0.05(max)	<0.01
28	Phenolic Compounds as C_6H_5OH	mg/l	IS 3025(Part-43)1992 RA 2019	0.001 (max)	<0.001
29	Sulphide as H_2S	mg/l	IS 3025(Part-29)1986 RA 2019	0.05(max)	<0.05
30	Aluminium as Al	mg/l	IS 3025(Part-55)2003 RA 2019	0.03 (max)	<0.02
31	Boron as B	mg/l	IS 3025(Part-57)2005 RA 2017	0.5 (max)	<0.1
32	Cyanide as CN	mg/l	IS 3025(Part-27)1986 RA 2019	0.05(max.)	<0.01
33	Arsenic as As	mg/l	IS 3025(Part-37)1988 RA 2019	0.01(max)	<0.01
34	Copper as Cu	mg/l	IS 3025(Part-42)1992 RA 2019	0.05(max)	<0.01
35	Manganese as Mn	mg/l	IS 3025(Part-59)2006 RA 2017	0.1(max)	<0.05
36	Lead as Pb	mg/l	IS 3025(Part-47)1994 RA 2019	0.01(max)	<0.01
37	Selenium as Se	mg/l	IS 3025(Part-56)2003 RA 2019	0.01(max)	<0.001
38	Nickel	mg/l	IS 3025(Part-54)2003 RA 2019	0.02(max)	<0.01
39	Zinc as Zn	mg/l	IS 3025(Part-49)1994 RA 2019	5 (max)	<0.05
40	Cadmium as Cd	mg/l	IS 3025(Part-41)1992 RA 2019	0.003(max)	0.001
41	Mercury as Hg	mg/l	IS 3025(Part 48) 1994 RA 2009	0.001(max)	<0.001
42	Anionic detergent as MBAS	mg/l	Annex K of IS 13428	0.2(max)	<0.2
Bacteriological Quality					
43	Total Coliform Bacteria	MPN/100ml	IS 1622:1981 RA 2019	Shall not be detected in any 100 ml sample	< 2

-END OF REPORT-

Authorised Signatory
Global Tech Enviro Experts Pvt. Ltd

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Annexure 5: Groundwater Level monitoring data of Pre-monsoon and Post Monsoon in Mining Lease Area

RAIKELA IRON ORE MINES OF M/S GEETARANI MOHANTY (Pre-Monsoom)				
PIEZOMETRIC DATA OF MAY-2022				
DATA	TIME	Ground Water Level (m)	Water Temprature (degC)	Barometric Pressure (hPa)
01-05-2022	06.00 AM	10.67	25.06	93.674
	12.00 PM	10.69	25.01	93.683
	06.00 PM	10.42	25.08	94.685
	00.00 AM	10.12	25.01	92.54
02-05-2022	06.00 AM	10.69	25.52	93.775
	12.00 PM	10.68	25.42	93.717
	06.00 PM	10.71	25.24	93.70
	00.00 AM	10.31	26.36	93.699
03-05-2022	06.00 AM	10.84	25.3	93.723
	12.00 PM	10.73	25.08	93.71
	06.00 PM	10.84	25.09	94.287
	00.00 AM	10.42	25.05	92.358
04-05-2022	06.00 AM	10.24	25.42	93.966
	12.00 PM	10.69	25.01	93.962
	06.00 PM	10.42	25.36	95.424
	00.00 AM	10.71	25.61	93.90
05-05-2022	06.00 AM	10.83	25.59	93.823
	12.00 PM	10.64	25.23	93.249
	06.00 PM	10.75	25.06	93.90
	00.00 AM	10.80	25.11	93.809
06-05-2022	06.00 AM	10.65	25.41	93.73
	12.00 PM	10.82	25.52	93.82
	06.00 PM	10.78	25.24	93.68
	00.00 AM	10.62	25.41	93.48
07-05-2022	06.00 AM	10.19	25.32	93.856
	12.00 PM	10.55	25.18	93.829
	06.00 PM	10.75	25.15	93.885
	00.00 AM	10.42	25.01	94.287
08-05-2022	06.00 AM	10.3	25.11	94.30
	12.00 PM	10.36	25.41	94.28
	06.00 PM	10.01	25.42	94.36
	00.00 AM	10.67	25.27	94.33
09-05-2022	06.00 AM	10.22	25.75	93.51
	12.00 PM	10	25.98	93.63
	06.00 PM	10.75	25.01	93.69
	00.00 AM	10.72	25.61	93.73
10-05-2022	06.00 AM	10.16	25.08	94.30

	12.00 PM	10.36	25.41	94.27
	06.00 PM	10.76	25.01	93.62
	00.00 AM	10.72	25.41	93.63
11-05-2022	06.00 AM	10.76	25.01	93.69
	12.00 PM	10.76	25.06	93.73
	06.00 PM	10.48	25.43	93.43
	00.00 AM	10.48	25.05	92.59
12-05-2022	06.00 AM	10.78	25.33	93.68
	12.00 PM	10.77	25.01	93.67
	06.00 PM	10.81	25.70	93.43
	00.00 AM	10.47	25.31	93.43
13-05-2022	06.00 AM	10.73	25.42	93.50
	12.00 PM	10.83	25.52	93.46
	06.00 PM	10.52	25.33	93.43
	00.00 AM	10.63	25.34	93.43
14-05-2022	06.00 AM	10.48	25.42	93.46
	12.00 PM	10.63	25.51	93.64
	06.00 PM	10.87	25.42	93.35
	00.00 AM	10.52	25.34	93.39
15-05-2022	06.00 AM	10.63	25.34	93.45
	12.00 PM	10.87	25.24	93.62
	06.00 PM	10.60	25.24	93.47
	00.00 AM	10.51	25.42	93.44
16-05-2022	06.00 AM	10.50	25.23	93.62
	12.00 PM	10.84	25.24	93.70
	06.00 PM	10.61	25.34	93.64
	00.00 AM	10.52	25.70	93.67
17-05-2022	06.00 AM	10.61	25.42	93.63
	12.00 PM	10.83	25.61	93.63
	06.00 PM	10.85	26.07	93.35
	00.00 AM	10.25	25.60	93.34
18-05-2022	06.00 AM	10.89	25.01	93.69
	12.00 PM	10.88	25.44	93.73
	06.00 PM	10.89	25.01	93.53
	00.00 AM	10.93	25.01	93.63
19-05-2022	06.00 AM	10.78	25.01	93.46
	12.00 PM	10.89	25.58	93.57
	06.00 PM	10.88	25.44	93.57
	00.00 AM	10.79	25.01	93.46
20-05-2022	06.00 AM	10.76	25.01	93.46
	12.00 PM	10.86	26.26	93.47
	06.00 PM	10.25	25.01	93.45
	00.00 AM	10.28	25.42	94.32
21-05-2022	06.00 AM	10.48	25.33	93.43
	12.00 PM	10.87	26.07	93.45

	06.00 PM	10.50	25.60	93.23
	00.00 AM	10.25	25.42	93.23
22-05-2022	06.00 AM	10.74	25.52	93.36
	12.00 PM	10.79	25.01	93.63
	06.00 PM	10.80	25.61	93.00
	00.00 AM	10.74	25.61	93.02
23-05-2022	06.00 AM	10.82	25.42	93.13
	12.00 PM	10.81	25.89	93.91
	06.00 PM	10.25	25.41	93.92
	00.00 AM	10.17	25.60	93.90
24-05-2022	06.00 AM	10.67	25.39	93.85
	12.00 PM	10.88	25.01	93.59
	06.00 PM	10.81	25.01	93.56
	00.00 AM	10.61	25.01	93.54
25-05-2022	06.00 AM	10.81	25.42	93.84
	12.00 PM	10.81	25.42	93.76
	06.00 PM	10.25	25.62	93.55
	00.00 AM	10.05	25.42	93.56
26-05-2022	06.00 AM	10.90	25.70	93.74
	12.00 PM	10.88	25.42	93.58
	06.00 PM	10.89	25.42	93.58
	00.00 AM	10.82	25.01	93.59
27-05-2022	06.00 AM	10.8	25.01	93.57
	12.00 PM	10.81	25.01	93.56
	06.00 PM	10.18	25.52	93.40
	00.00 AM	10.73	25.05	93.44
28-05-2022	06.00 AM	10.39	25.02	93.41
	12.00 PM	10.84	25.01	93.50
	06.00 PM	10.85	25.01	93.27
	00.00 AM	10.93	25.01	93.40
29-05-2022	06.00 AM	10.74	25.06	93.39
	12.00 PM	10.88	25.01	93.42
	06.00 PM	10.47	25.02	93.41
	00.00 AM	10.42	25.42	93.46
30-05-2022	06.00 AM	10.74	25.44	93.44
	12.00 PM	10.88	25.01	93.64
	06.00 PM	10.81	25.11	93.68
	00.00 AM	10.25	25.18	93.68
31-05-2022	06.00 AM	10.75	25.01	93.67
	12.00 PM	10.89	25.51	93.38
	06.00 PM	10.78	25.01	93.68
	00.00 AM	10.87	25.02	

RAIKELA IRON ORE MINES OF M/S GEETARANI MOHANTY PIEZOMETRIC DATA OF AUGUST 2022		
DATA	**TIME**	**Ground Water Level (m)**
01-08-2022	06.00 AM	5.04
	12.00 PM	5.11
	06.00 PM	5.15
	00.00 AM	5.22
02-08-2022	06.00 AM	5.29
	12.00 PM	5.40
	06.00 PM	5.05
	00.00 AM	5.02
03-08-2022	06.00 AM	5.08
	12.00 PM	5.07
	06.00 PM	5.14
	00.00 AM	5.16
04-08-2022	06.00 AM	5.10
	12.00 PM	5.20
	06.00 PM	5.03
	00.00 AM	5.08
05-08-2022	06.00 AM	4.99
	12.00 PM	5.01
	06.00 PM	4.99
	00.00 AM	5.26
06-08-2022	06.00 AM	5.00
	12.00 PM	5.02
	06.00 PM	5.04
	00.00 AM	5.01
07-08-2022	06.00 AM	5.13
	12.00 PM	5.02
	06.00 PM	5.07
	00.00 AM	5.09
08-08-2022	06.00 AM	5.05
	12.00 PM	5.09
	06.00 PM	5.12
	00.00 AM	5.06
09-08-2022	06.00 AM	5.08
	12.00 PM	5.12
	06.00 PM	5.18
	00.00 AM	5.13
10-08-2022	06.00 AM	5.06
	12.00 PM	5.07
	06.00 PM	5.11
	00.00 AM	5.13
11-08-2022	06.00 AM	5.01

	12.00 PM	5.05
	06.00 PM	5.08
	00.00 AM	5.26
12-08-2022	06.00 AM	5.11
	12.00 PM	5.07
	06.00 PM	5.10
	00.00 AM	5.01
13-08-2022	06.00 AM	5.03
	12.00 PM	5.11
	06.00 PM	5.12
	00.00 AM	5.15
14-08-2022	06.00 AM	5.09
	12.00 PM	5.05
	06.00 PM	5.13
	00.00 AM	5.02
15-08-2022	06.00 AM	5.04
	12.00 PM	5.10
	06.00 PM	5.14
	00.00 AM	5.12
16-08-2022	06.00 AM	5.09
	12.00 PM	5.10
	06.00 PM	5.21
	00.00 AM	5.13
17-08-2022	06.00 AM	5.10
	12.00 PM	5.15
	06.00 PM	5.13
	00.00 AM	5.11
18-08-2022	06.00 AM	5.11
	12.00 PM	5.13
	06.00 PM	5.10
	00.00 AM	5.11
19-08-2022	06.00 AM	5.10
	12.00 PM	5.14
	06.00 PM	5.21
	00.00 AM	5.34
20-08-2022	06.00 AM	5.15
	12.00 PM	5.20
	06.00 PM	5.18
	00.00 AM	5.13
21-08-2022	06.00 AM	5.08
	12.00 PM	5.18
	06.00 PM	5.18
	00.00 AM	5.09
22-08-2022	06.00 AM	5.09
	12.00 PM	5.13

	06.00 PM	5.04
	00.00 AM	5.11
23-08-2022	06.00 AM	5.25
	12.00 PM	5.38
	06.00 PM	5.03
	00.00 AM	5.09
24-08-2022	06.00 AM	5.04
	12.00 PM	5.40
	06.00 PM	5.28
	00.00 AM	5.37
25-08-2022	06.00 AM	5.14
	12.00 PM	5.34
	06.00 PM	5.25
	00.00 AM	5.17
26-08-2022	06.00 AM	5.15
	12.00 PM	5.25
	06.00 PM	5.28
	00.00 AM	5.23
27-08-2022	06.00 AM	5.20
	12.00 PM	5.26
	06.00 PM	5.27
	00.00 AM	5.39
28-08-2022	06.00 AM	5.16
	12.00 PM	5.35
	06.00 PM	5.32
	00.00 AM	5.38
29-08-2022	06.00 AM	5.14
	12.00 PM	5.33
	06.00 PM	5.28
	00.00 AM	5.37
30-08-2022	06.00 AM	5.24
	12.00 PM	5.28
	06.00 PM	5.31
	00.00 AM	5.40
30-08-2022	06.00 AM	5.25
	12.00 PM	5.29
	06.00 PM	5.30
	00.00 AM	5.41

RAIKELA IRON ORE MINES OF M/S GEETARANI MOHANTY PIEZOMETRIC DATA OF SEPTEMBER 2022		
DATA	**TIME**	**Ground Water Level (m)**

01-09-2022	06.00 AM	5.21
	12.00 PM	5.23
	06.00 PM	5.35
	00.00 AM	5.32
02-09-2022	06.00 AM	5.41
	12.00 PM	5.33
	06.00 PM	5.35
	00.00 AM	5.12
03-09-2022	06.00 AM	5.36
	12.00 PM	5.25
	06.00 PM	5.29
	00.00 AM	5.34
04-09-2022	06.00 AM	5.14
	12.00 PM	5.45
	06.00 PM	5.20
	00.00 AM	5.49
05-09-2022	06.00 AM	5.32
	12.00 PM	5.40
	06.00 PM	5.42
	00.00 AM	5.33
06-09-2022	06.00 AM	5.32
	12.00 PM	5.4
	06.00 PM	5.42
	00.00 AM	5.33
07-09-2022	06.00 AM	5.08
	12.00 PM	5.4
	06.00 PM	5.42
	00.00 AM	5.33
08-09-2022	06.00 AM	5.52
	12.00 PM	5.48
	06.00 PM	5.43
	00.00 AM	5.39
09-09-2022	06.00 AM	5.37
	12.00 PM	5.46
	06.00 PM	5.61
	00.00 AM	5.39
10-09-2022	06.00 AM	5.39
	12.00 PM	5.48
	06.00 PM	5.59
	00.00 AM	5.39
11-09-2022	06.00 AM	5.33
	12.00 PM	5.52
	06.00 PM	5.4
	00.00 AM	5.29
12-09-2022	06.00 AM	5.44

	12.00 PM	5.48
	06.00 PM	5.32
	00.00 AM	5.49
13-09-2022	06.00 AM	5.45
	12.00 PM	5.32
	06.00 PM	5.43
	00.00 AM	5.51
14-09-2022	06.00 AM	5.39
	12.00 PM	5.56
	06.00 PM	5.59
	00.00 AM	5.39
15-09-2022	06.00 AM	5.42
	12.00 PM	5.58
	06.00 PM	5.65
	00.00 AM	5.41
16-09-2022	06.00 AM	5.56
	12.00 PM	5.66
	06.00 PM	5.65
	00.00 AM	5.41
17-09-2022	06.00 AM	5.58
	12.00 PM	5.63
	06.00 PM	5.62
	00.00 AM	5.61
18-09-2022	06.00 AM	5.43
	12.00 PM	5.32
	06.00 PM	5.65
	00.00 AM	5.53
19-09-2022	06.00 AM	5.59
	12.00 PM	5.63
	06.00 PM	5.68
	00.00 AM	5.42
20-09-2022	06.00 AM	5.27
	12.00 PM	5.66
	06.00 PM	5.68
	00.00 AM	5.66
21-09-2022	06.00 AM	5.62
	12.00 PM	5.25
	06.00 PM	5.58
	00.00 AM	5.53
22-09-2022	06.00 AM	5.54
	12.00 PM	5.59
	06.00 PM	5.62
	00.00 AM	5.87
23-09-2022	06.00 AM	5.42
	12.00 PM	5.83

	06.00 PM	5.59
	00.00 AM	5.81
24-09-2022	06.00 AM	5.62
	12.00 PM	5.38
	06.00 PM	5.54
	00.00 AM	5.50
25-09-2022	06.00 AM	5.41
	12.00 PM	5.83
	06.00 PM	5.50
	00.00 AM	5.77
26-09-2022	06.00 AM	5.59
	12.00 PM	5.69
	06.00 PM	5.61
	00.00 AM	5.67
27-09-2022	06.00 AM	5.56
	12.00 PM	5.49
	06.00 PM	5.67
	00.00 AM	5.35
28-09-2022	06.00 AM	5.6
	12.00 PM	5.61
	06.00 PM	5.75
	00.00 AM	5.61
29-09-2022	06.00 AM	5.64
	12.00 PM	5.72
	06.00 PM	5.60
	00.00 AM	5.43
30-09-2022	06.00 AM	5.59
	12.00 PM	5.69
	06.00 PM	5.56
	00.00 AM	5.08

RAIKELA IRON ORE MINES OF M/S GEETARANI MOHANTY PIEZOMETRIC DATA OF OCTOBER 2022

DATA	TIME	Ground Water Level (m)
01-10-2022	06.00 AM	5.08
	12.00 PM	5.52
	06.00 PM	5.5
	00.00 AM	5.8
02-10-2022	06.00 AM	5.8
	12.00 PM	6.0
	06.00 PM	6.01
	00.00 AM	6.01
03-10-2022	06.00 AM	6.02
	12.00 PM	6.4
	06.00 PM	6.6
	00.00 AM	6.6
04-10-2022	06.00 AM	6.8
	12.00 PM	6.9
	06.00 PM	7.0
	00.00 AM	7.01
05-10-2022	06.00 AM	7.02
	12.00 PM	7.3
	06.00 PM	7.4
	00.00 AM	7.5
06-10-2022	06.00 AM	7.8
	12.00 PM	7.8
	06.00 PM	7.9
	00.00 AM	7.9
07-10-2022	06.00 AM	8.01
	12.00 PM	8.02
	06.00 PM	8.5
	00.00 AM	8.6
08-10-2022	06.00 AM	8.5
	12.00 PM	8.4
	06.00 PM	8.8
	00.00 AM	9.1
09-10-2022	06.00 AM	9.2
	12.00 PM	9.01
	06.00 PM	9.05
	00.00 AM	9.4
10-10-2022	06.00 AM	9.5
	12.00 PM	9.6
	06.00 PM	9.5
	00.00 AM	9.6
11-10-2022	06.00 AM	9.8
	12.00 PM	9.9
	06.00 PM	9.7

	00.00 AM	9.8
12-10-2022	06.00 AM	9.9
	12.00 PM	9.7
	06.00 PM	10
	00.00 AM	10.02
13-10-2022	06.00 AM	10.05
	12.00 PM	10.11
	06.00 PM	10.2
	00.00 AM	10.3
14-10-2022	06.00 AM	10.5
	12.00 PM	10.4
	06.00 PM	10.2
	00.00 AM	10.01
15-10-2022	06.00 AM	10.4
	12.00 PM	10.3
	06.00 PM	10.60
	00.00 AM	10.51
16-10-2022	06.00 AM	10.50
	12.00 PM	10.84
	06.00 PM	10.61
	00.00 AM	10.52
17-10-2022	06.00 AM	10.61
	12.00 PM	10.83
	06.00 PM	10.85
	00.00 AM	10.25
18-10-2022	06.00 AM	10.89
	12.00 PM	10.88
	06.00 PM	10.89
	00.00 AM	10.93
19-10-2022	06.00 AM	10.78
	12.00 PM	10.89
	06.00 PM	10.88
	00.00 AM	10.79
20-10-2022	06.00 AM	10.76
	12.00 PM	10.86
	06.00 PM	10.25
	00.00 AM	10.28
21-10-2022	06.00 AM	10.48
	12.00 PM	10.87
	06.00 PM	10.50
	00.00 AM	10.25
22-10-2022	06.00 AM	10.74
	12.00 PM	10.79
	06.00 PM	10.80
	00.00 AM	10.74

23-10-2022	06.00 AM	10.82
	12.00 PM	10.81
	06.00 PM	10.25
	00.00 AM	10.17
24-10-2022	06.00 AM	10.67
	12.00 PM	10.88
	06.00 PM	10.81
	00.00 AM	10.61
25-10-2022	06.00 AM	10.81
	12.00 PM	10.81
	06.00 PM	10.25
	00.00 AM	10.05
26-10-2022	06.00 AM	10.90
	12.00 PM	10.88
	06.00 PM	10.89
	00.00 AM	10.82
27-10-2022	06.00 AM	10.8
	12.00 PM	10.81
	06.00 PM	10.18
	00.00 AM	10.73
28-10-2022	06.00 AM	10.39
	12.00 PM	10.84
	06.00 PM	10.85
	00.00 AM	10.93
29-10-2022	06.00 AM	10.74
	12.00 PM	10.88
	06.00 PM	10.47
	00.00 AM	10.42
30-10-2022	06.00 AM	10.74
	12.00 PM	10.88
	06.00 PM	10.81
	00.00 AM	10.25
31-10-2022	06.00 AM	10.75
	12.00 PM	10.89
	06.00 PM	10.78
	00.00 AM	10.87

3. **Impact assessment of mining of Iron ore on Ground Water in & around Dholta Pahar, Sundergarh, Odissa-**
   Click to view the relevant page

Comprehensive Report on:

Groundwater Condition in both core and buffer zone of Dholta Pahar Block Iron Ore Mine, Koira Block, Sundargarh District, Odisha.

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

M/S KASHVI POWER AND STEEL PVT LTD
PLOT NO 1234/P, GOVINDA PRASAD, BOMIKHAL, BHUBANESWAR- 751006
E-MAIL ID: groupkashvi@gmail.com

Comprehensive Report on:

Groundwater Condition in both core and buffer zone of DholtaPaharBlock Iron Ore Mine, Koira Block, Sundargarh District, Odisha.

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

M/S KASHVI POWER AND STEEL PVT LTD

PLOT NO 1234/P, GOVINDA PRASAD, BOMIKHAL, BHUBANESWAR- 751006

E-MAIL ID: groupkashvi@gmail.com

By MRCAWTM – May 2022

Executive summary

M/s Kashvi Power & Steel pvt Ltd is located in Dengula Village, Koira Tehsil of Sundargarh District, Odisha. Dengula village is located in north east part of Sundergarh district. The study area falls under survey of India toposheet no F45N1N and F45N5N. Kashvi Power & Steel Private Limited operates as a manufacturer of spongeiron, billet and ingots and exporter of minerals. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc. During the plan period, it has been proposed to produce2.0 MTPA iron ore per annum. The present study is made for obtaining NOC from CGWA for extraction of maximum 200KLD groundwater during mining operation as per the approved mine plan. The present report is based on the Hydrogeological investigation made within core zone and its 10km radius buffer zone for assessment of impact of dewatering of groundwater by the mine and will be submitted to CGWA for obtaining renewal of NOC. The area is drained by IB and Brahmani River and its tributaries. The easterly flowing Sankh and westerly flowing Koel River join at Vedavyas near Rourkela to form the Brahmani River. The river, IB a tributary of Mahanadi controls the drainage of the western parts of the district. The drainage pattern of the area is dendritic. The study area is located in Dengula Village, Koira Tehsil of Sundargarh District, Odisha whichfalls under safe blocks as per the report on Dynamic Groundwater Resource of India, published by CGWB in 2019-20. The study area is having largely one geological formation name Singbhum-Keonjhar-Bonai group of iron ore of Precambrian age. These constitute hard rock's includes schist, tuffs, phyllite, basic rock, BHQ/BHJ have been classified as Iron Ore Series (IOS). Aquifers are developed only in the low lying area and valley parts of the study area. The total lease area of the proposed Dholtapahar Fe ore block is 60.508 ha (605080 m²). Groundwater quality is fresh and potable in both core and buffer zone area and TDS remains below 1900 ppm varies from 10 to 310 ppm in the study area. As per the approved mine plan the dewatering of groundwater maximum 200KLD as the mine is generating no water discharge and only 97 KLD will be extracted from ground water for mine use. Rainwater is harvested within the ML area through construction of water conservation pond, check dam, and earth bunds. The annual conservation through RWH is about 26500m³/anm. There is no long term impact on groundwater because of open cast mining. For the running of mine 200KLD water is required, 97KLD from ground water and 103 KLD will be purchase from other site. Thus, the study recommends NOC may be provided for next 5 yr with maximum 97 KLD extractions from groundwater.

Acknowledgments and Certificate

Impact assessment and report preparation work as per the CGWA guideline was entrusted to MRCAWTM, Manav Rachna as accredited Groundwater Institution of CGWA by M/S. Kashvi Power and Steel Pvt. Lmt, Odisha is thankfully acknowledged.

Discussions with Mr. Pradeept Mohapatra, Director WCS, regarding the geology of lease area and plan our investigations according to scope of work is gratefully acknowledged. Help rendered by Shri Shubham, Geologist, M/S. Kashvi Power and Steel Pvt. Lmt, Odisha in every stage of planning and Field verification, investigations in and around lease area and report preparation is thankfully acknowledged. He also provided all the available relevant data and records many of them are reproduced in this report and forms part of annexure section.

At lease area, during days of field investigation we have received warm welcome and all hospitality and requisite support from mine team. We thankfully acknowledge Mr. Pradeept Mohapatra, Director WCS and his team for their cooperation.

The report has been prepared by Ms Sheha Rai, Asstt Prof MRCAWTM and Sandeep Kumar Research Assistant, MRCAWTM under the supervision of Prof (Dr) Arunangshu Mukherjee, Director MRCAWTM. Ms Alifia Ibkar, RA MRCAWTM helped Mr Sandeep Kumar in the field work and data collection.

It is to certify that MRCAWTM have investigated the area of Dholtapahar Fe ore block of Dengula Village, Koira Tehsil of Sundargarh District, Odisha. Based on actual data collected from field and literature survey done, has prepared the report as per the format of CGWA.

(Dr Arunangshu Mukherjee)
Director, MRCAWTM

MR Centre for Advance Water Technology & Management
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CONTENTS

LIST OF TABLES

LIST OF FIGURES

Report on
Hydrogeological Investigation and Impact Assessment Report for Dholtapahar Fe Iron Ore Block, Sundergarh District, Odisha

Introduction

The report is prepared as per the format prescribed by CGWA for impact assessment study, the Introductory chapter comprises the following subtitle for describing its

1.1 Objectives
1.2 Scope of the study
1.3 Project description-Plant, process, product and location
1.4 Land Use Land Cover and percentage of LULC categories
1.5 Topography and drainage

1.1 Objective

The Central Government had constituted the Central Ground Water Board as Authority vide notification number S.O. 38 (E), dated the 14th January,1997 to exercise powers under sub section (3) of section 3 of the Environment (Protection) act, 1986 (29 of 1986) for the purposes of regulation and control of Ground Water Management and Development. The Authority has been regulating ground water development and management by the way of issuing 'No Objection Certificates' for ground water extraction to industries or infrastructure projects or Mining Projects etc., and framed and issued guidelines in this connection from time to time. The entire process of grant of No Objection Certificate shall be online through a web based application system. The latest guideline issued by Gazette Notification no 2941 on 24th September 2020 supersedes all earlier guidelines issued by the Central Ground Water Authority (CGWA). As per the CGWA instruction the M/S. Kashvi Power and Steel Pvt. Ltd. has to submit Impact assessment report along with undertaking for processing their application for regularization of groundwater abstraction for mining. There by M/S. Kashvi Power and Steel Pvt. Ltd. Bhubaneswar engaged MRCAWTM, CGWA Accredited Groundwater Institution (Certificate No.-CGWA/RGI/025) vide work order dated 4th April 2022 to carry out the Hydrogeological investigation along with impact assessment study incorporating socio-economic assessment study on groundwater regime due to withdrawal/ dewatering of groundwater by Dholta Pahar Block for Iron Ore mine (Fig **1.1**) as per the prescribed format of CGWA.

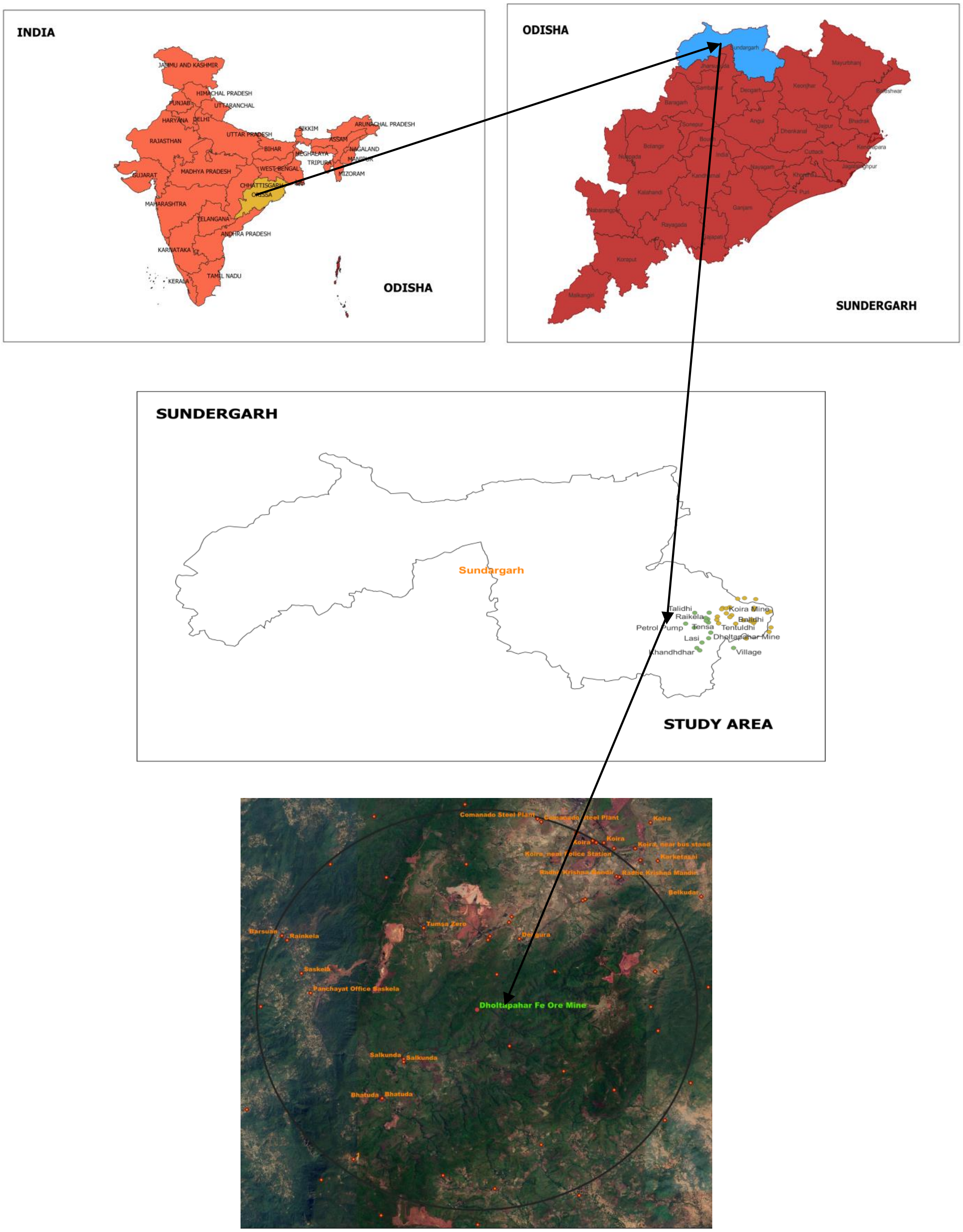


Fig 1.1: Location Map of Dholta Pahar Fe Ore Mine, Odisha

1.2. Scope of the study

The scope of study includes hydrological study around mine and providing certificated report along with providing guidance on techno-legal aspects and compliance for obtaining NOC for CGWA as per latest guidelines. Detailed hydro geological investigations within core and buffer zones (10km radius study area) of Dholta Pahar Fe Ore Block leased to M/S. M/S. Kashvi Power and Steel Pvt. Ltd. Bhubaneswar and assessment of impact of mining on groundwater regime in the study area which covers parts of Koira Tehsil of Sundergarh district, Odisha. As the mine is generating no water discharge and only 97 KLD will be extracted from ground water for mine use, thus groundwater modeling is not required along with impact assessment report for this case as per the CGWA guideline.

1.3. Project description

M/S. Kashvi Power and Steel Pvt. Ltd, Bhubaneswar is a registered firm under Minerals (Development and Regulation) ACT, 1957 and The Mineral (Auction) Rules, 2015, Govt of Odisha. Dholtapahar Fe Ore Block located in Koira Tehsil of Sundargarh district of Odisha. The IBM company number is IBM/7815/2011. The total lease area of Dholtapahar Fe ore block is 60.508 ha. As part of the statutory clearance, the Mining Plan and Progressive Mine Closure Plan is prepared under Rule 16(1) of MCR, 2016 and Rule 23 of MCDR, 2017 respectively for a period of 5 years from the date of opening of the mine for grant of Mining Lease in favor of M/S. Kashvi Power and Steel Pvt. Ltd. The registered office is situated at State of Maharashtra (Mumbai) having is registered office at 503, 5th floor, Greenland Apartment, Building no.3, JB Nagar, Andheri East, Mumbai- 400059, Maharashtra to carry on all or any of the business as manufacturers, buyers, sellers, suppliers, traders, exporters, minerals, metals etc. M/s Kashvi Power & Steel pvt Ltd is a part of Kashvi group and one of the growing company in Odisha. Kashvi Power & Steel Private Limited operates as a manufacturer of sponge iron, billet and ingots and exporter of minerals. Iron ore produced from the Dholta Pahar block will mostly be utilized in their sponge iron plant. However, as per the market demand, part of the iron ore may be sold to the consumers. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc. During the plan period, it has been proposed to produce2.0 MTPA iron ore per annum.

Location

M/s Kashvi Power & Steel pvt Ltd is located in Dengula Village, Koira Tehsil of Sundargarh District, Odisha. Dengula village is located in north east part of Sundergarh district. The study area falls under survey of India toposheet no F45N1N and F45N5N. Taldihi village is 1.5 km away from the study area. Nearest railway station is Barsuan which is 23 km away from the lease area. The lease area of mine is not located within 10km radius of National Park /Wild Life

Sanctuary / Protected area and don't falls under Coastal Regulation Zone (CRZ). Many shallow depth open cast pits mine are present in the study area.

Fig 1.2: Google Image showing Dholtapahar mine lease Pillars location

1.4. Land use and Land cover (LULC) change in the study area

The total lease area of the proposed Dholtapahar Fe ore block is 60.508 ha (605080 m²). The mine is situated in outer part of the Dengula village surrounded by hills and forest area. The land use of the mining area is given in Table no 1.1 and the percentage has been represented through a pie diagram in Fig 1.2. The nearest village is Taldihi located 1.5 km away from Dholtapahar Fe ore block. Around 40 villages are located under 10 km radius zone of the study area. (Annexure-1)

Comparison of LULC during 2017 and 2021 within the 10 kms radius of mine area show marginal changes in agriculture use, forest cover, built up area, as shown in figs and tables 1.1 & 1.2, however area under water body has increased from 5.062 ha to 5.900 ha due to accumulation of water into some abandon mine pit sand due to construction of water conservation structures in the area.

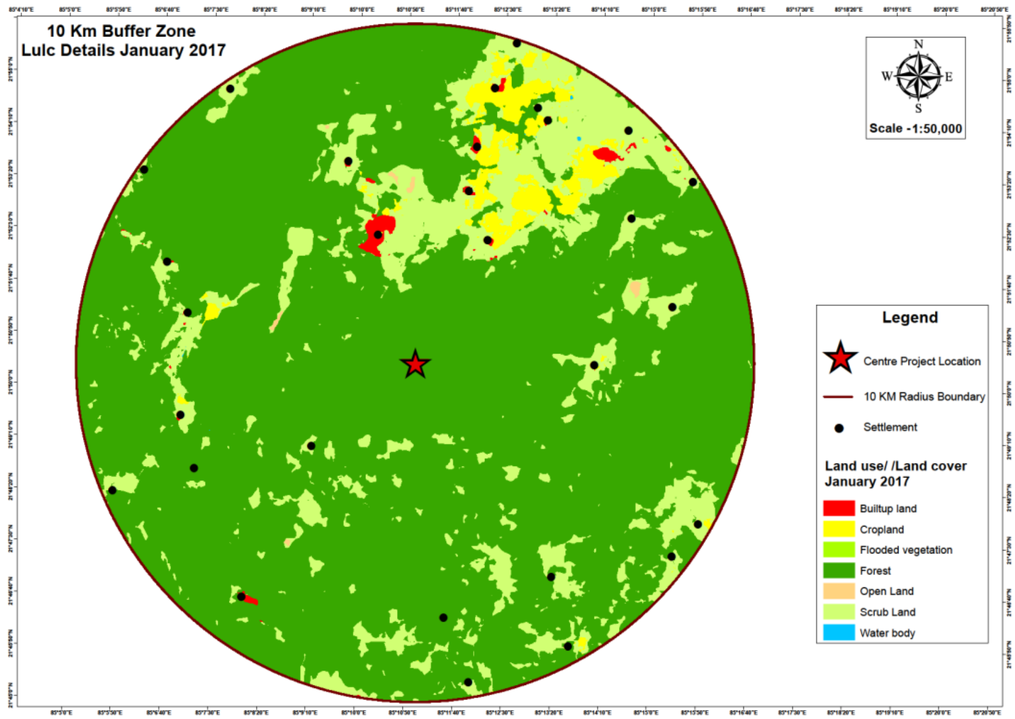


Fig 1.3: Map showing LULC of Dholtapahar Fe Ore Mine of 10km buffer zone (Jan 2017)

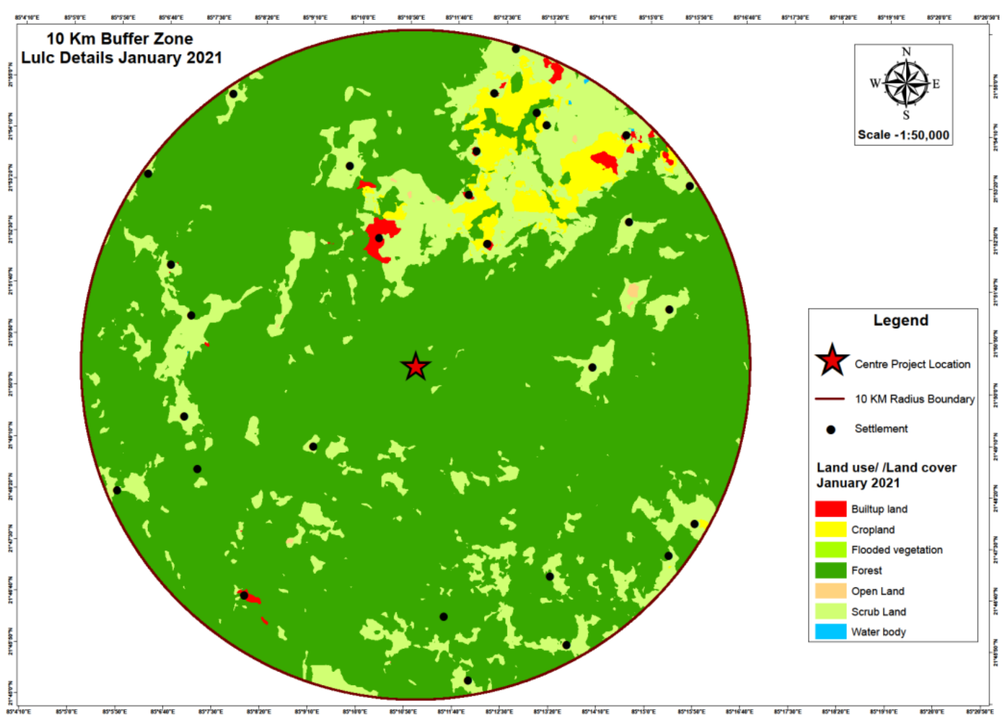


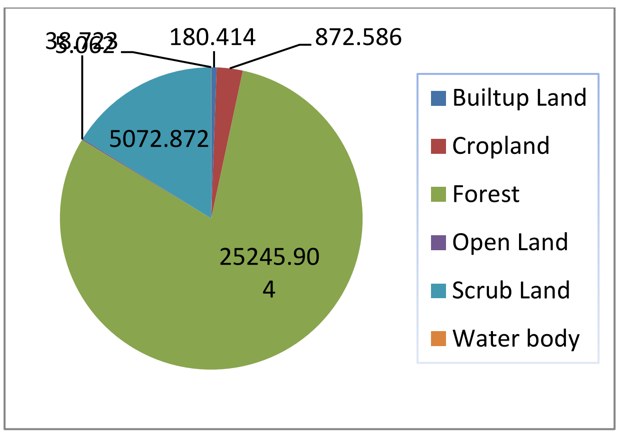
Fig 1.4: Map showing LULC of Dholtapahar Fe Ore Mine of 10km buffer zone (Jan 2021)

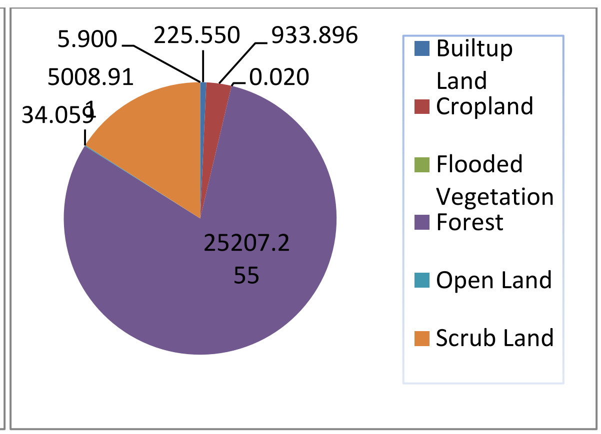
Table 1.1: LULC 2017 of study area

Sl.no	LULC Type 2017	Area(Ha)
1	Builtup Land	180.414
2	Cropland	872.586
3	Forest	25245.904
4	Open Land	38.723
5	Scrub Land	5072.872
6	Water body	5.062
Total Area(10km Buffer Zone)		**31415.560**

Table 1.2 LULC 2021 of study area

Sl.no	LULC Type 2021	Area(Ha)
1	Builtup Land	225.550
2	Cropland	933.896
3	Flooded Vegetation	0.020
4	Forest	25207.255
5	Open Land	34.059
6	Scrub Land	5008.911
7	Water bodies	5.900
Total Area(10km Buffer Zone)		**31415.591**





1.5. Topography and Drainage

Dholtapahar block is a part of Koira group of upper Shale formation. Study area having steep rising hills with intervening steep gorge and narrow valley. The geomorphic sub-units like the pediments, pediplains, buried pediments, valley fills, and lineaments are the predominant in the hard rock areas in study area. The highest elevation is 825m amsl and lowest elevation is 550m amsl (Fig 1.5 &1.6).

Study area is covered with different hills with intervening intermontane valleys, isolated hillocks and flat to gently undulating plains. The area is drained by IB and Brahmani River and its tributaries. The easterly flowing Sankh and westerly flowing Koel River join at Vedavyas near Rourkela to form the Brahmani River. The river, IB a tributary of Mahanadi controls the drainage of the western parts of the district. The drainage pattern of the area is dendritic (Fig: 1.7).

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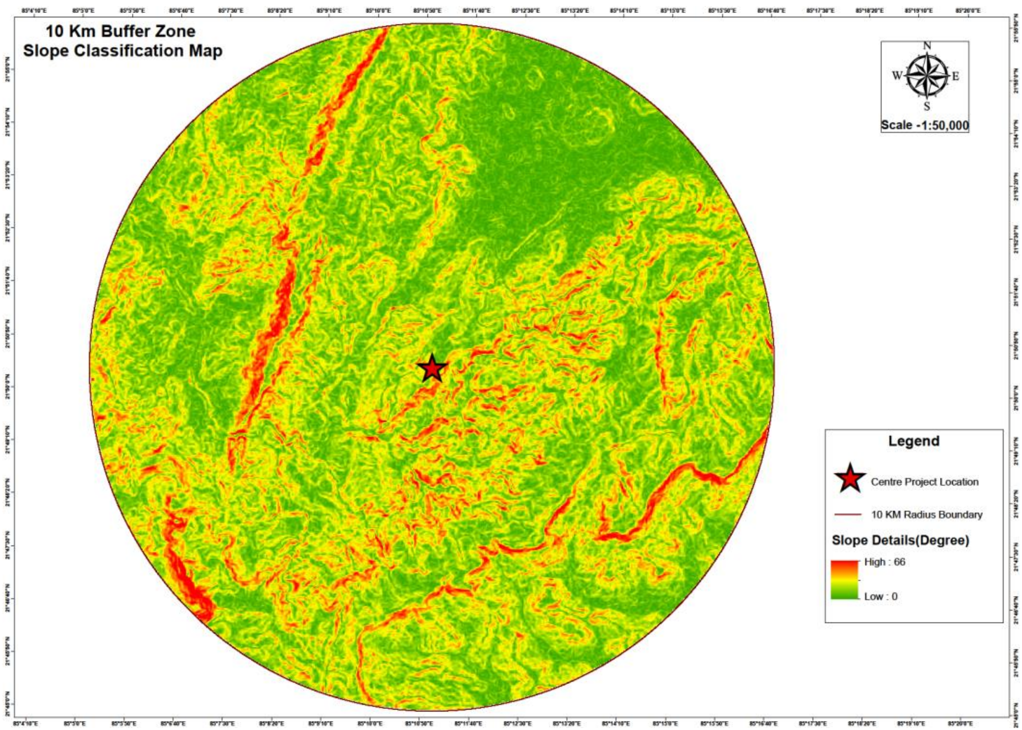


Fig 1.5: Slope map in 10km buffer zone

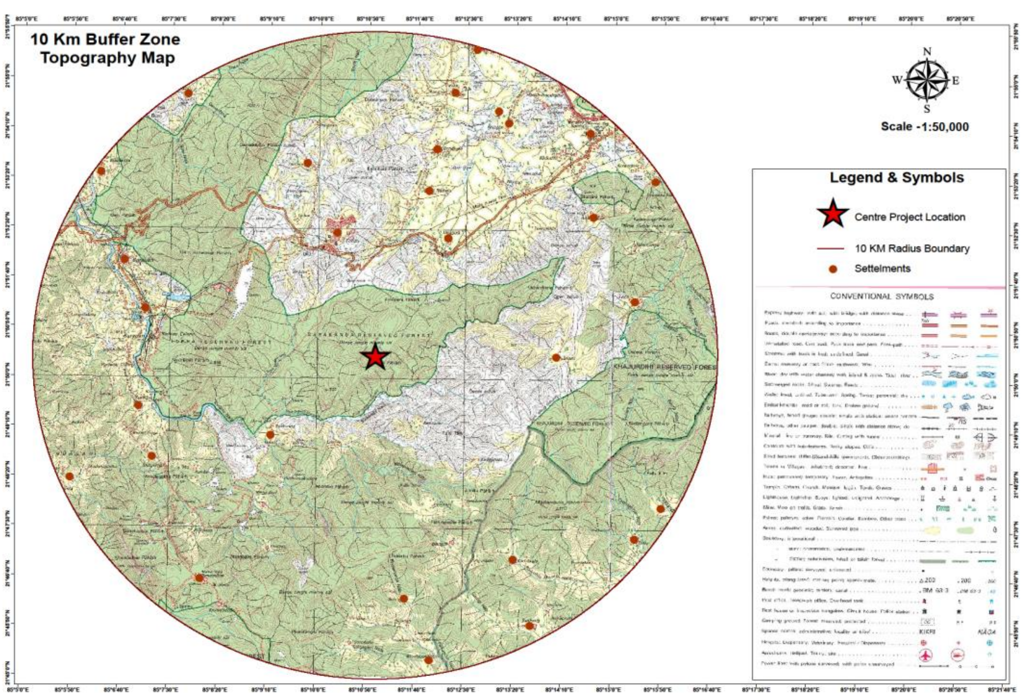


Fig 1.6: Topography Map of 10km buffer zone.

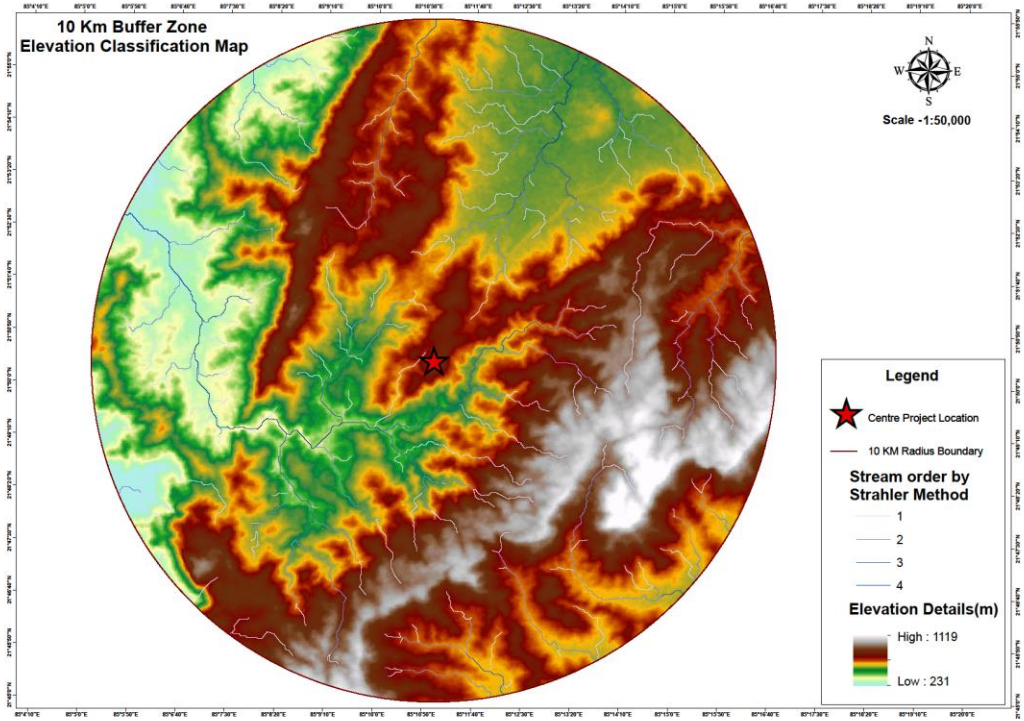


Fig 1.7: Digital elevation map in 10km buffer zone.

2. Groundwater Situations

Sundergarh district is North Western part of Odisha state. Sundergarh is recognized as an industrial district in the map of Odisha. Steel Plant, Fertilizer plant and Cement factory. Ferro Vanadium Plant. Machine building factory, Glass and China clay factory and Spinning mills are some of the major industry of this district. Large part of the study area belongs to Dengula Village, Koira Tehsil of Sundargarh District, Odisha. Ground water is the main source of drinking as well as industrial and domestic purpose. However, the requirement of water in irrigation and agriculture is fulfilled mainly by river, canals, as well as by rainwater. The rainwater also is the main source for recharge of groundwater of the area. The following major subtopics that are covered in this particular chapter are:

2.1 Geology and Geomorphology
2.2 Climate and Rainfall pattern
2.3 Groundwater regime monitoring
2.4. Long term groundwater trend
2.4 Groundwater resources
2.5 Groundwater quality

2.1 Geology and Geomorphology

2.1.1. Regional Geology

Sundergarh district is rich in Iron ore, limestone, manganese, dolomite, and fire clay. Banded Iron Formation (BIF) and Iron ore deposit occupy three distinct provinces surrounding the North Odisha Iron Ore Craton (NOIOC). They are Bonai-Keonjhar belt in the western side of the Craton, Badampahar Gorumahisani- Suleipat belt in the eastern flank and Daitari-Tomka belt in the southern side of the Craton. All of these three belts having best preserved basin of Precambrian age that form Iron Ore Super Group (IOSG) of Odisha. Sundergarh district lies under Western flank by the Bonai –Keonjhar (BK) belt forming U shaped synclinorium which is known as the Horseshoe belt. Iron Ore Super Group (IOSG) Odisha, rock assemblages is belong to Singhbhum – North Odisha Iron Ore Craton. There are three or more Iron Ore Group existing in the IOSG such as Badampahar Group, Noamundi Group and Koira Group. These groups are separated by unconformity, different metamorphic grade, distinct sedimentary and igneous assemblages and ore types (Fig: 2.1).

The Mayurbhanj granite occurring along the eastern fringe of the Singhbhum granite was dated to be 3100Ma. The A type Mayurbhanj Granite Pluton (3.09Ga) occurring along the eastern margin of the Singhbhum – Odisha Craton, eastern India, represent the final phase of acid plutonism in this crustal block of Archaean age.

I. **BIF-1: Badampahar – Gorumahisani – Sulpet Belt**

BIF-1 comprising of iron formation of Badampahar Gorumahisani – Sulpet (BGS) Belt. The litho assemblage of this oldest Iron Ore Group consists of banded cherty quartzite, tremolite- actinolite schist and fuchsite quartzite. The Badam Quartzite is well exposed in the western side of BGS. Banded magnetite quartzite is the dominant litho unit in the BIF-1. The major mineral constituents are Magnetite, martite, hematite, specularite, goethite, grunerite, and quartz. The BIF-1 has suffered amphibolites facies of metamorphism.

II. **BIF – II: Daitari- Tomka Belt**

The BIF-II lying in the southern portion of the North Odisha Iron Ore Craton is confirmed to Daitari – Tomka belt. It is underlain and overlain by Badampahar quartzite and Dhanjori quartzite. The litho assemblage of this belt consists of banded magnetite/hematite quartzite, banded magnetite/hematite jasper, quartz sericite schist, phyllite, slate and banded chert. The rocks of BIF –II attain green schist facies of metamorphism.

III. **BIF – III: Bonai- Keonjhar Belt:**

BIF-III is a U- shaped pattern in the western flank of the NOIOC that rests over the Dhanjori Quartzite. The litho association of this area forms the youngest Iron Ore Group comprising of banded hematite jasper, banded hematite quartz/cherty, banded shale, banded manganese formation and ferruginous shale. The banded iron formation consist of predominantly iron oxide mineral such as hematite, martite, specularite, and magnetite. The litho assemblage of this youngest iron ore belt is unmetamorphosed and lack of intrusive Fig (2.2).

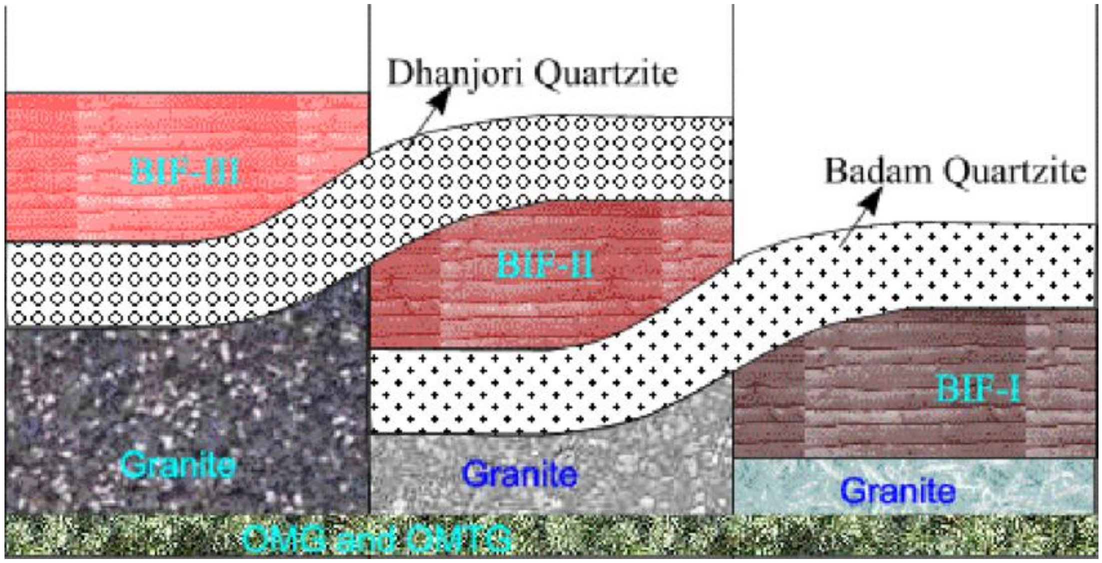


Fig 2.1: Schematic diagram of stratigraphic setting of three BIF of IOSG (Beura et al.2016

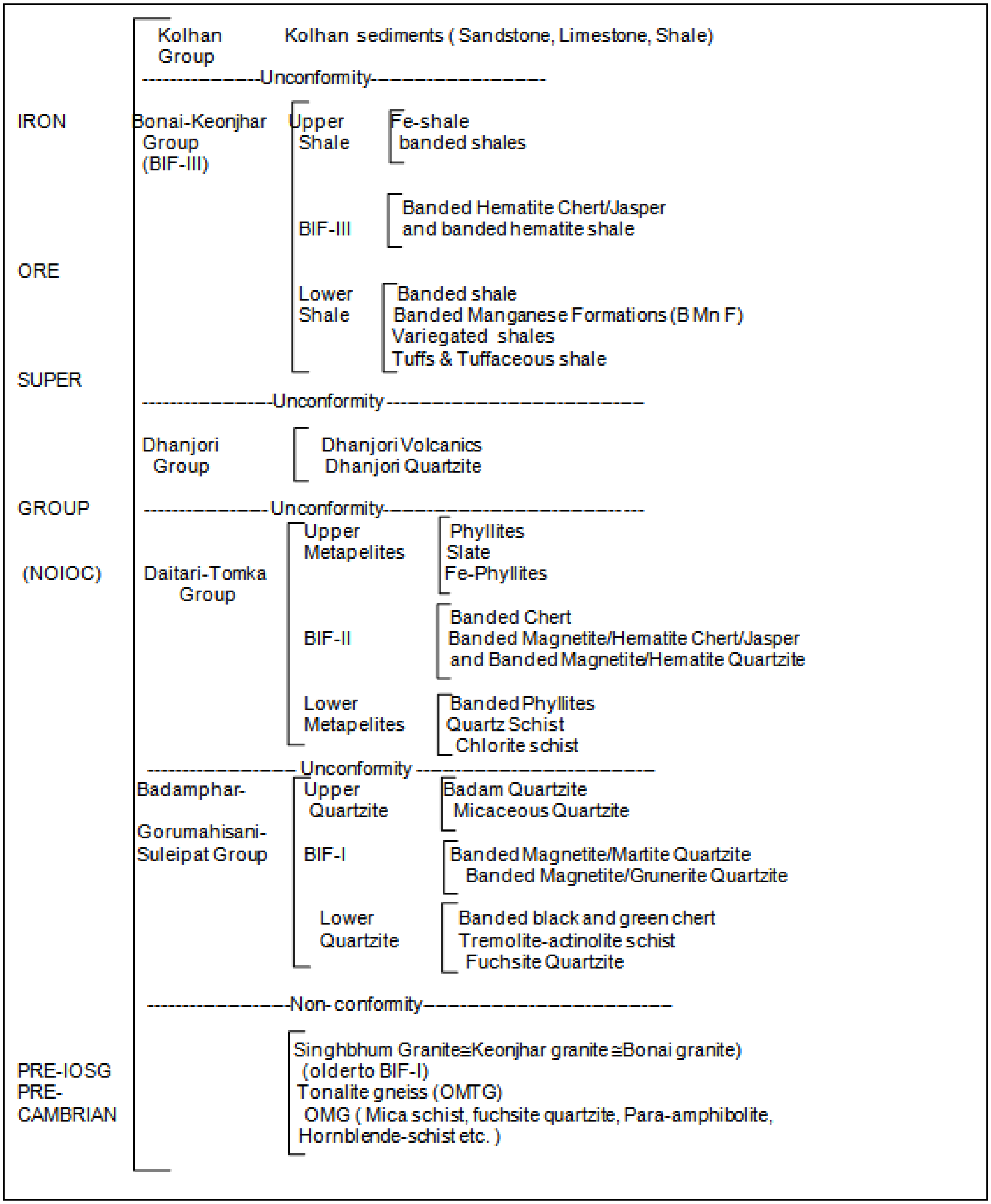


Fig 2.2: Stratigraphic Succession of Iron Ore Super Group of Odisha (Beura et al.2016).

2.1.1. Local Geology

The study area is occupied by the rock of Koira group Table (2.1). This belt is 60km long and 25 km wide extending from south of Malangtoli in Keonjhar district up to Chakra Dhrampurin West Singhbhum district (Jharkhand). The western syncline known as Koira syncline, due to steep dip and overturned nature of its limb form a deeper basin with thick sequence of younger shales in the core region. On the other hand, the eastern syncline known as Bamberi syncline is a shallower basin and exposes younger litho members within the core region as outliers. The Upper shale unit within the Koira syncline is more or less continuous. The general strike of the beddings in N100W- S100E direction with occasional swing to N300E-S300W, having 20° - 40° dip towards west in the area. The area under investigation lies within the Upper Shale Formation of the Koira group described by Murthy & Acharya (19975)

Table 2.1: Startigraphy of Koira Group in Sundergarh district, Odisha		
	Soil Laterite	
Koira Group	Upper Shale Formation	Shale's of different color like purple, yellow with inter beds of Iron ore
	Banded Iron Formation	Coarsely banded BHJ followed up by finely banded BHJ and iron ore in the eastern block.

Dholta Pahar Iron ore Block of M/S. Kashvi Power and Steel Pvt. Ltd is belonging to Singhbhum iron ore series and main rock type in the study area are Laterite, Hematite, and Shale. Geologically, the area is underlain by Pre – Cambrian crystalline rocks like Granite, Granitic Gneiss, Banded Hematite Jasper, Quartzite, Slate, Phyllite, and Mica Schist.

Laterite

Laterites are observed in the study area including ML area that has been the resulted from a process of residual weathering. Laterite has been developed mostly over the shale unit or low grade iron ores of the area. The shale rich in alumina has given rise to aluminous laterite and those rich in iron have developed ferruginous laterites. Ferruginous laterite occupies most of the high lands in the vicinity of iron ore of central ridge while aluminous laterite occurs in the extreme east of the area.

Shale

Western side study area has occupied with fine laminated rock having different shades of colors ranging from brownish to purple grey. Different colors of the Shale are largely dependent of minerals compositions. It is mostly composed of clayey micaceous minerals, with lenses of chert.

Iron Ore

Iron ore formation are economically important meta sedimentary rocks that occur most commonly in Precambrain sedimentary succession Based on surface exposures and sub-surface geology 4 (four) types of iron ore are recorded in the explored block.(Fig 2.1).These are Hard Laminated Ore (HLO), Soft Laminated Ore (SLO), blue dust (powdery ore), lateritic ore and float ores. . The general strike of the beddings in N100W- S100Edirection with occasional swing to N300E-S300W, having 20° - 40° dip towards west in the study area

Geomorphology & Soil Type

Geomorphology: The district has varied geomorphological features. The geomorphic units are (I) Plain (ii)Deep Buried Pediment (iii) Shallow buried pediment (iv) Intermontane valley (v) Inselberg, (vi) Mesa & Butte, (vii) Residual Hills, (viii) Intermontane Valleys, (ix) Structural hills. The soil characteristics of the district show wide variation depending upon their occurrence, physical and chemical properties. The soil of the district is broadly grouped into (I) Alfisols (II) Ultisols (CGWB Report).

I. Alfisoil and Red Soil

The study area is covered with red sandy soils and red loamy soils. These soils predominantly occupy high and medium land throughout the Sundargarh district. The characteristics feature of Red soil is porous and fragile in structure. These are usually deficient in nitrogen, phosphate, organic matter and lime. These soils are suitable for cultivation of paddy and other crops.

II. Ultisoils

The ultisols comprises mainly of lateritic soils and red and yellow soils. These soils are mildly acidic in nature and deficient in nitrogen, phosphorous and potassium and organic matters. Soils of the district are generally having average to good fertility status. All common types of crops can be grown in the district.

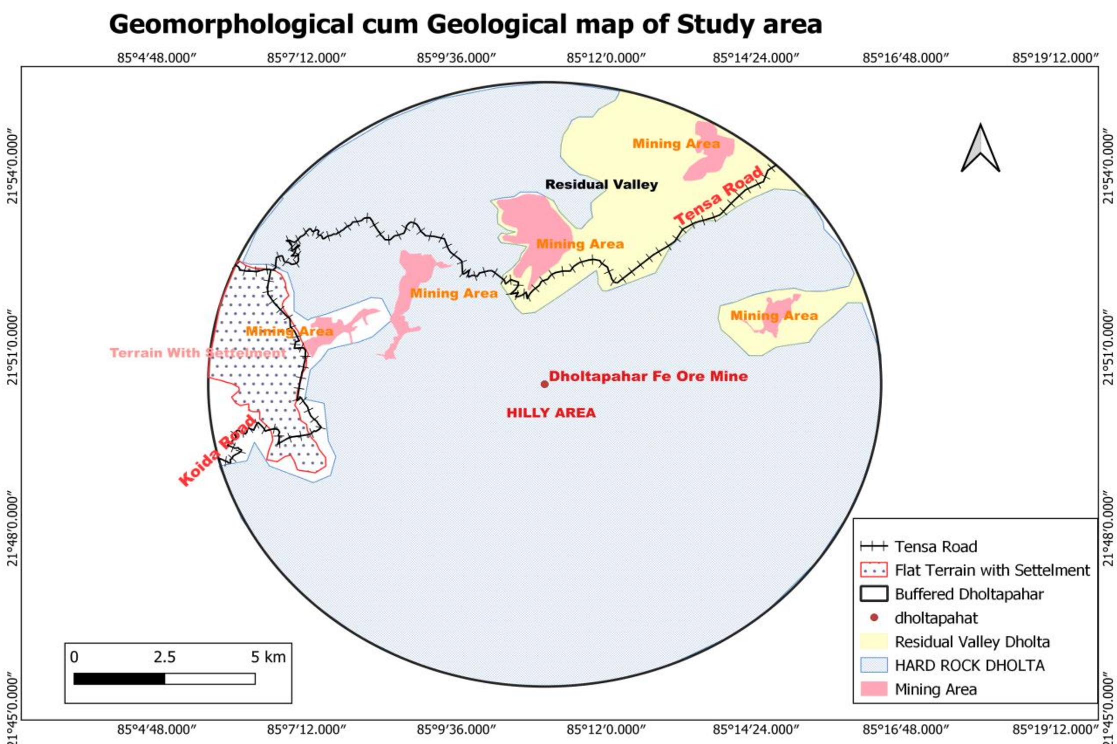


Fig 2.3: Geomorphological cum Geology map of Dholta Pahar Fe Mine

2.2. Climate and Rainfall pattern

The climate of the district is sub tropical climate characterized with hot and dry summer, cold winter and erratic in rainfall. The winter season extends from November to end of February, which is followed by summer season from March to the middle of June, and rainy season from middle of June to middle of October. During summer months the maximum temperature rises up to 43° C and May is the hottest month. December is the coldest month of the year when the average daily temperature drops down to 8° C. Relative humidity is around 60-70% throughout the year. The highest and lowest monthly mean relative humidity so far recorded is 97% (Dec) and 26% (April). The annual rainfall of last decade is given in Table (2.2).

Table 2.2 Decadal Rainfall in Sundergarh District (Source: WRIS online portal) 2011-2020						
Year	Actual Rainfall (mm)	Deviation (%)	Year	Actual Rainfall (mm)	Deviation (%)	Average Rainfall (mm)
2011	1788.35	20.87	2016	1098.51	-28.82	1415.126
2012	1435.18	1.39	2017	1323.91	-6.8	
2013	1537.77	7.97	2018	1396.59	-1.32	
2014	1335.09	-5.99	2019	1387.02	-2.02	
2015	1286.6	-9.9	2020	1562.24	9.4	

2.3 Ground water regime monitoring:

The study area comprises 10km radius zone in Dholta Pahar iron ore Block located in Koira Tehsil of Sundargarh district of Odisha. Detailed hydrogeological study of both core and buffer zone of mine area is carried out. The hydrogeological condition varied from place to place due to different litho unit of aquifer. The hydrogeological units of the study area are broadly categorized into two groups namely.

1. Consolidated formations.
2. Unconsolidated formations

1. Consolidated formations

The study area is occupied by the consolidated formations comprising of Precambrian metasediments of Gangpur series and Iron ore series and also granite gneiss, metasediments like amphibolite, epidiorite etc. Ground water is stored mainly in the secondary porosity resulting from weathering and fracturing of the rocks. Ground water occurs under confined to semi-confined condition in the deeper fractured zones. Water yielding capacity is mainly depend on the extent of fracture, depth, opening and size of fracture. Mica schist, quartzite and phyllite are the formation in the study area.

2. Unconsolidated Formation

Laterite and alluvium are the main constituents of unconsolidated formation in the study area. The laterite is belonging to sub recent to recent age having high porosity. It is the good aquifer for dug well in study area. The alluvium soils are also the potential aquifers due to their high degree of porosity and permeability but are only limited in their occurrence.

Table2.3: Well inventory data of Dug wells of Core and buffer zone of Dholta Pahar Fe ore Mine
(Lat & Long data are as per GPS reading, DO, EC, pH, and TDS measured on site using calibrated Hanna portable equipment during (April 2022).

Sr no.	Location	Latitude	Longitude	Elevation (m)	EC (mS)	pH	TDS(ppt)	Depth of the well (m)	Water Level(m)	DO (mg/l)
1	Dengura	21.869327	85.200782	608.26	60	6.5	30	49.5	28.3	6.8
2	Pond	21.868889	85.187991	619.85	20	5.9	10		0.5	1.38
3	Dholta Hand	21.870424	85.188821	620.56	35	6.7	15			4.6
4	Salkunda	21.819241	85.153618	449.78	340	6.7	170			2.59
5	Salkunda	21.818068	85.153606	431.39	260	6.7	140	55.3	22.9	6.08
6	Pond	21.876188	85.196579	572.02	650	7.3	360			4.73
7	Pit	21.878495	85.197651	653	20	6.3	10		0.5	4.24
Buffer Zone										
8	Tumsa Zero	21.873844	85.161773	723.31	70	6.9	40			4.25
9	Barsuan	21.870688	85.103978	366.28	560	6.9	290			2.42
10	Rainkela	21.868772	85.10608	370.59	300	7.1	160	69.69	27.27	3.51
11	Saskela	21.854939	85.111915	373.46	290	6.7	150			1.63
12	Panchayat Office Saskela	21.846799	85.116167	370.11	190	6.9	100			2.66
13	Salkunda	21.819241	85.153618	449.78	340	6.7	170			2.59
14	Salkunda	21.818068	85.153606	431.39	260	6.7	140	55.5	22.9	6.08

15	Comanado Steel Plant	21.918085	85.209714	573.27						5.94
16	Comanado Steel Plant	21.919268	85.208213	576.61	60	6.7	30		20.5	2.17
17	Radhe Krishna Mandir	21.895306	85.240408	588.94	70	6.6	30			2.47
18	Radhe Krishna Mandir	21.895102	85.241608	589.1	30	6.4	20	60.6	26.2	5.19
19	Koira, near bus stand	21.906956	85.248041	560.57	280	6.9	150			2.72
20	Koira, near Police Station	21.907018	85.239381	561.55	60	7.1	20	60.6	21.21	6.1
21	Koida Petrol Pump	21.909395	85.232136	573.13	120	6.8	60	10.9	6.4	5.13
22	Koida Chowk	21.913434	85.224078		60	6.5	25			5.5
23	Koira raod	21.905473	85.220677	552.92	70	6.1	40			3.6
24	Koira	21.909781	85.230875	558.29	120	6.8	60		18.5	5.16
25	Bhatuda	21.802585	85.144547	446.31	200	7.2	100			6.1
26	Bhatuda	21.802922	85.144842	449.3	160	7.3	80			6.5

2.3.1 Detailed study of core and buffer zone

As per the field investigation it has been observed that the main source of water is from cannel and groundwater. Groundwater is withdrawal from bore well as well as from hand pump (Fig-2.4). Most of dug well having water level from 3.7 to 7.5m in pre monsoon period. Total depth of dug well is from 9 to 12m. It has been observed that the bore wells are often from 16 to 30m in depth. Ground water is lying in weathered part of hard rock aquifer (2.5). Hard rock comprises Precambrian met sediments like Mica schist, quartzite, phyllite, conglomerate along with granite. The movement of the ground water in deeper rocks is controlled by the nature, size opening and continuity of joints & fracture present in them. Wells in hard rock generally yield 50 to 70 m3 /day of all the rock types. Schist, phyllite and their variants form very poor aquifers yielding 10 to 30 m3 /day for heavy drawdown. Well inventory of study area (Fig:2.5) in Pre Monsoon (April 2022) period showing ground water level varies within the range from 3.7 m to 36.3m bgl (Table 2.3)

Fig 2.4: Hand pump and bore well in core zone of Dholta Pahar block

2.3.1. Aquifer Characteristics

The study area both core and buffer zone having largely single aquifer of unconfined nature, developed on the weathered part of rocks of Koira group and laterites. The hills top area is devoid of any aquifer. Aquifers are developed only in the low lying area and valley parts of the study area.

The discharge varies from 10 to 70m3/day depending on lithology of aquifer. The transmissivity storability is mainly low and drawdown is moderately high to high. Open well having sustainable yield round the year. The area is categorized under safe zone according to the latest GWR estimation. Ambient quality of groundwater is fresh.

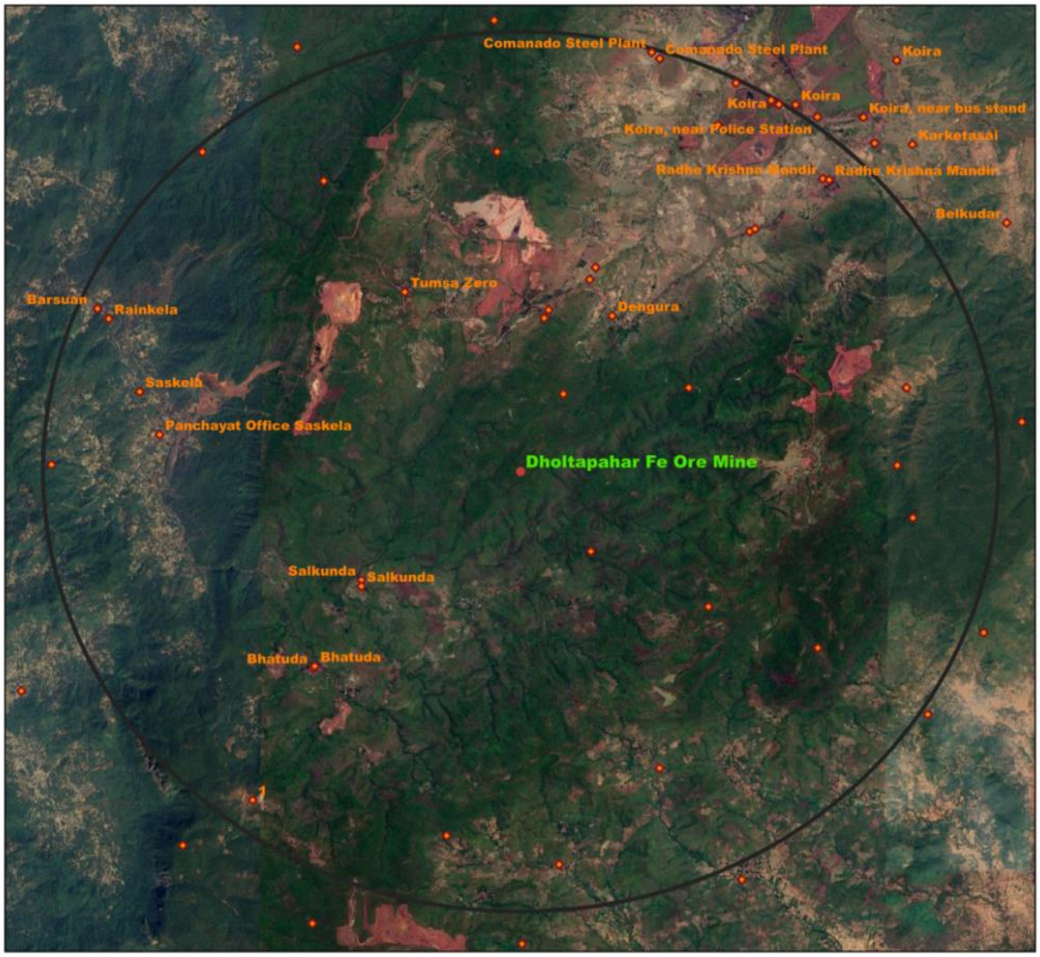


Fig2.5: Google image showing mine location and sample collection locations

DTW Map of Core and Buffer Zone of Dholtapahar Fe Ore Mine

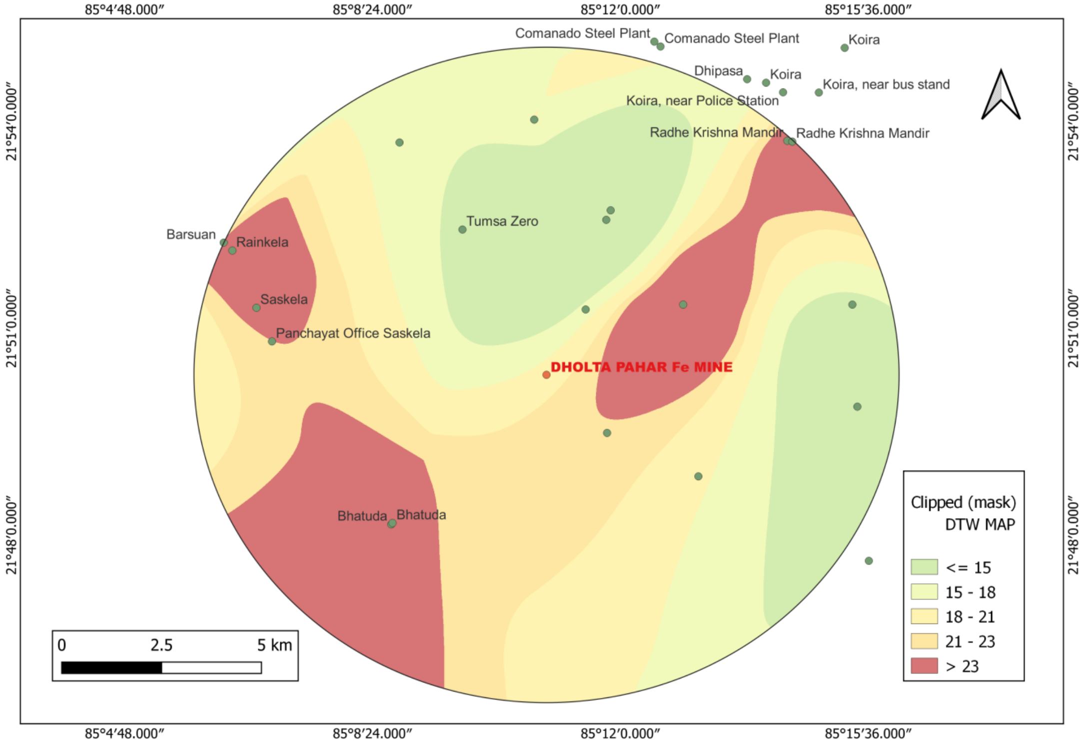


Fig 2.6: DTW map of core and buffer zone.

Groundwater Flow:

The groundwater contour map generated using the intense monitoring in core and buffer zone of mining is depicted in Fig 2.6.The map showing clear cut development of groundwater dived running through the mine area. The GW flow direction largely coincides with the surface water flow direction as shown in fig 2.7. Thus mine is on groundwater divide and any dewatering from mine will not effects significantly the flow direction of groundwater of the area.

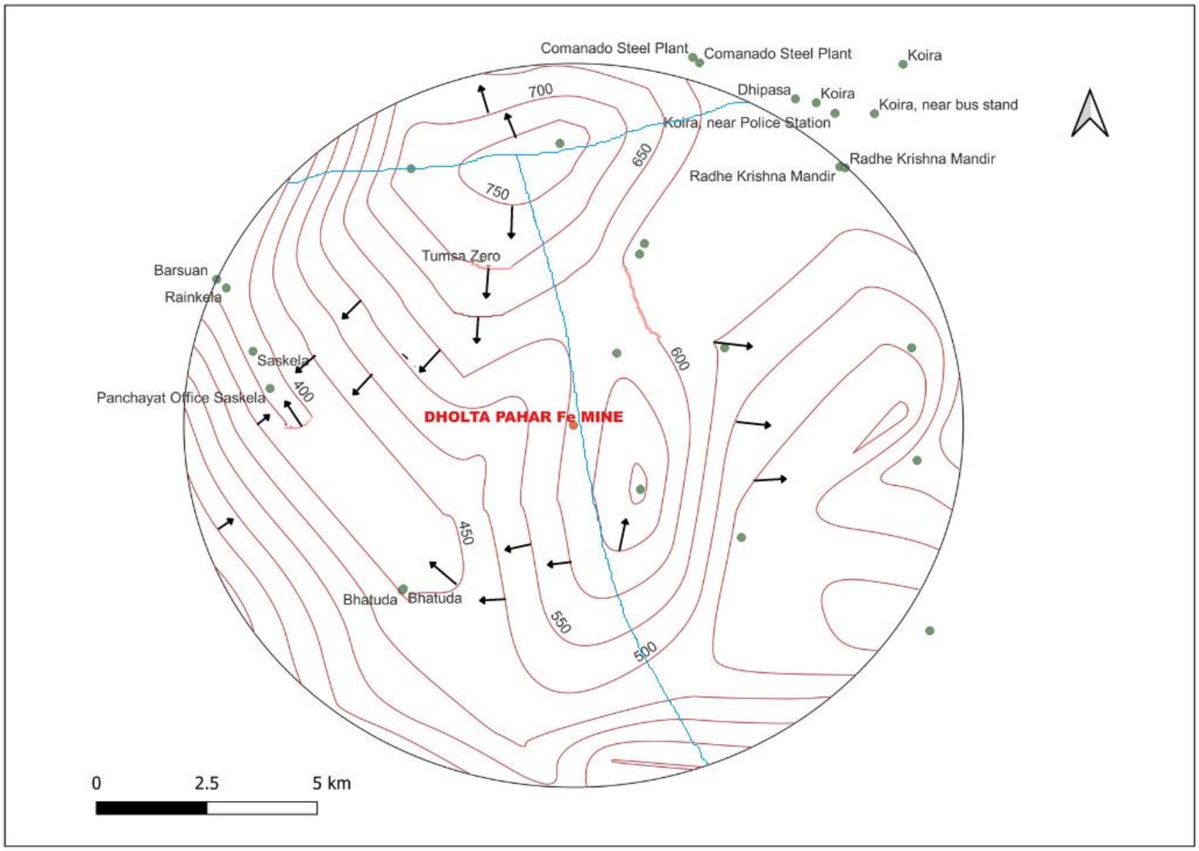


Fig 2.7: Groundwater contour map of Dholta pahar mine area

INDEX – Sky blue line shows groundwater divide, arrows indicate groundwater flow direction, values indicate groundwater elevation (m amsl), dots indicate data point used for generation of groundwater contour, buffer zone is marked by 10 km radius circle. Note the mine position is (Red dot).

2.4 Long term groundwater trend

The study area comprises 10km radius zone in Dholta Pahar block mine that largely fall under Koira tehsil, Sundergarh district, Odisha. In the core zone village the source of ground water such as bore well; hand pump and pond are used for domestic, irrigation and drinking whereout of 3 observation location of dug well, it has been observed that the water level (Pre monsoon 2022) varying from 3 to 7.5m bgl. Long term trend analysis of data obtained from WRIS shows no significant change-rise or fall as depicted in **Fig: 2.8**

Monthly Ground Water trends for Sundargarh from 01-Jan-2011 to 31-Jan-2021

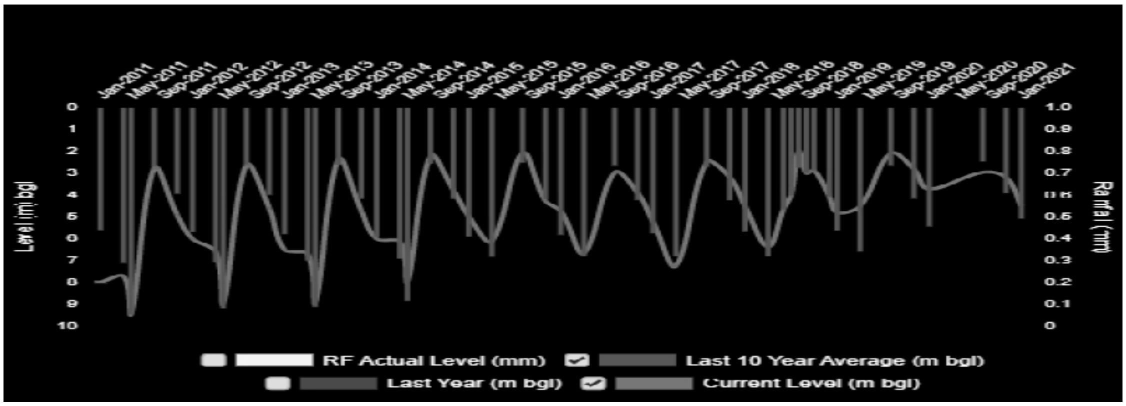


Fig 2.8: Long term well hydrograph of wells of Sundergarh district, Odisha (source: WRIS portal)

2.4.1Dynamic Groundwater Resource of study area:

The groundwater resource as estimated by CGWB (2020) is presented in the table 2.4 for Koira block of Sundargarh district Odisha and is in safe category.

Table: 2.4 Block wise Dynamic Groundwater Resources of Koira block, Sundergarh district, Odisha

	District	Block	Ground water Recharge (Ham)				Total Ground water Recharge (Hamm)	Total Natural Discharge (Ham)	Annual Extractable ground water resources (Ham)
			Monsoon Season		Non Monsoon Season				
			Recharge from Rainfall	Recharge from other sources	Recharge from Rainfall	Recharge from other sources			
1	Sundergarh	Koira	4777.33	139.58	572.73	172.14	5661.78	283.09	5378.69
	Annual Extractable Ground water Resources (Ham)	Annual Groundwater Draft (Ham)				Annual GW allocation for Domestic use as on 2025 (Ham)	Net Groundwater availability for future use (Ham)	Stage of Ground water Extraction (%)	Categorization (over exploited/ Critical/semi critical/ safe/ saline)
		Irrigation	Industrial	Domestic	Total Extraction				
2	5378.63	873.45	290.16	265.25	1428.8	304.71	3910.38	26.57	Safe

2.5 Groundwater Quality

Based on the above study, different ground water parameters were computed, which include pH, TDS, EC, DO, Temperature. Ground water in study area is potable with pH ranging 5.9 to 7.6 and total dissolved solid (TDS) ranging from 10 to 310 ppt and EC ranging from 20 to 600 µS. (Fig 2.9 and 2.10) Groundwater quality in the study area is fresh and all major and trace elements are found within the BIS 10500 permissible limit. Thus is suitable for all domestic, industrial and irrigational use. The general parameters of groundwater in study area as analyses are given in Table 2.5.The comparison of data reveal that the area mining (Project Area) is having less TDS).

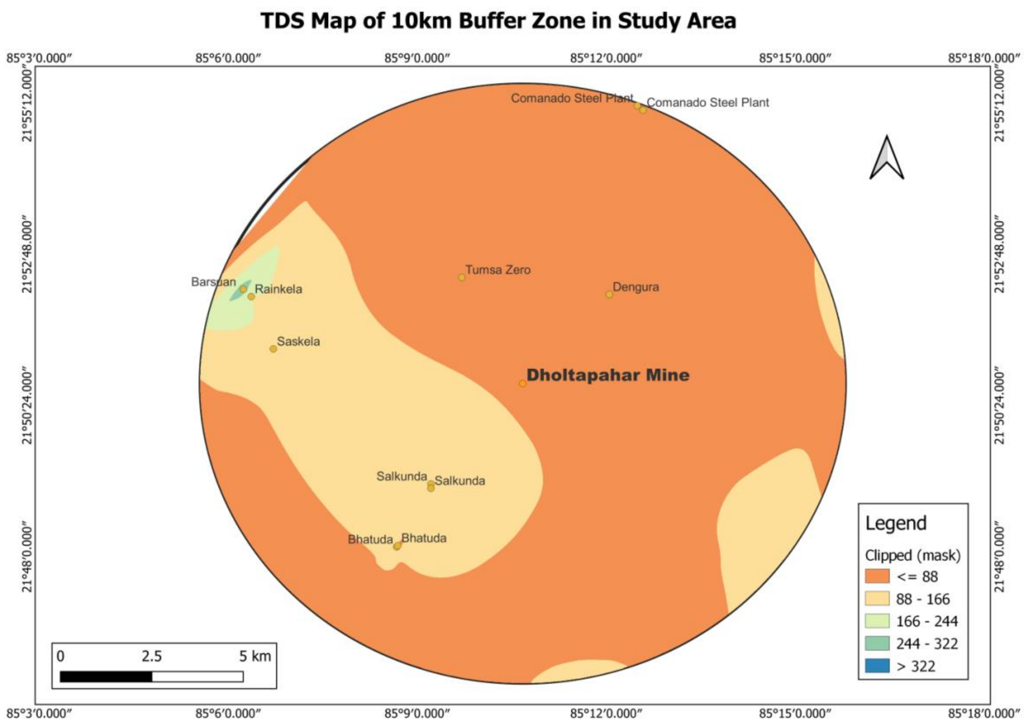


Fig 2.9: TDS map of Dholta Pahar block Fe ore mine

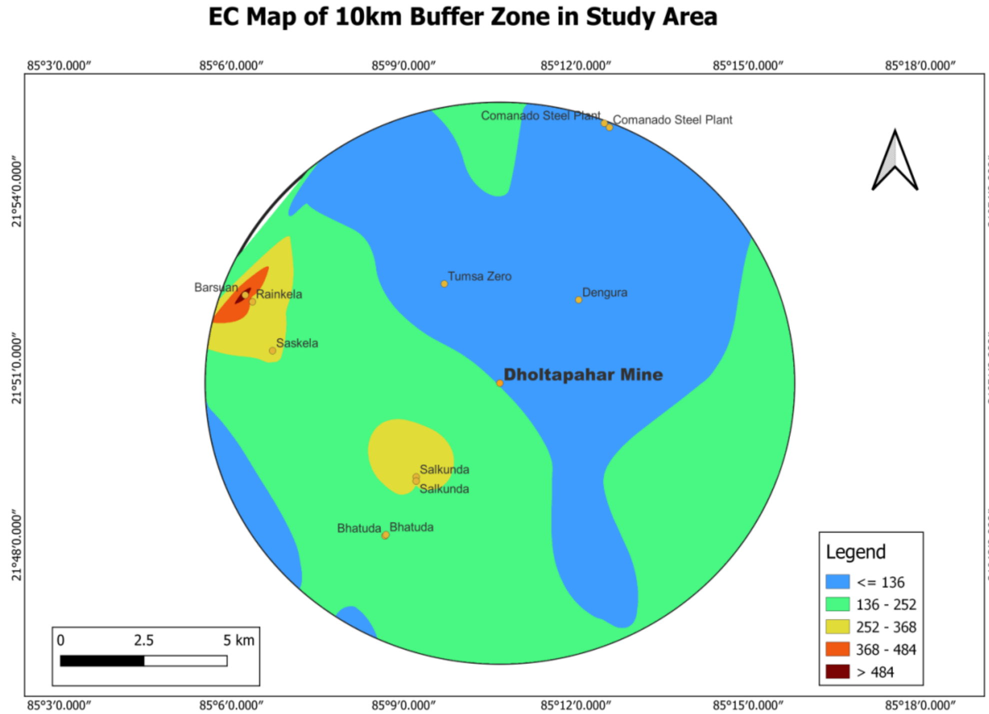


Fig 2.10: EC map of Dholta Pahar block Fe ore mine

Water Quality Data in Piper Trilinear Diagram: Different graphical methods can be adopted for representing geochemical variation which gives a better insight into the groundwater quality monitoring. One such efficient method of representation is plotting of Hill Piper Trilinear diagram in which data are plotted in two triangle fields and one diamond field. The diamond is then classified under various categories emphasizing their characteristics.

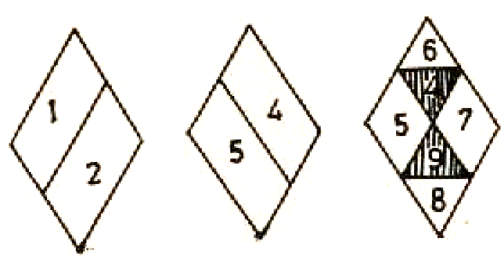


Fig2.11: Sub-divisions of the diamond field

On the basis of data collection from CGWB report (2020-2021). It has been observed that out of 63 samples are concentrated in Area 6 indicating that: Non-carbonate hardness exceeds 50% i.e., Ca + Mg - (SO_4 + Cl + NO_3). 50% samples are lies under area 4 representing strong acids (SO_4 + Cl + NO_3) exceed weak acids (CO_3 + HCO_3). Few samples can be noticed under Area 7: Non-carbonate alkali exceeds 50% i.e., Na + K- (SO_4 + Cl + NO_3).

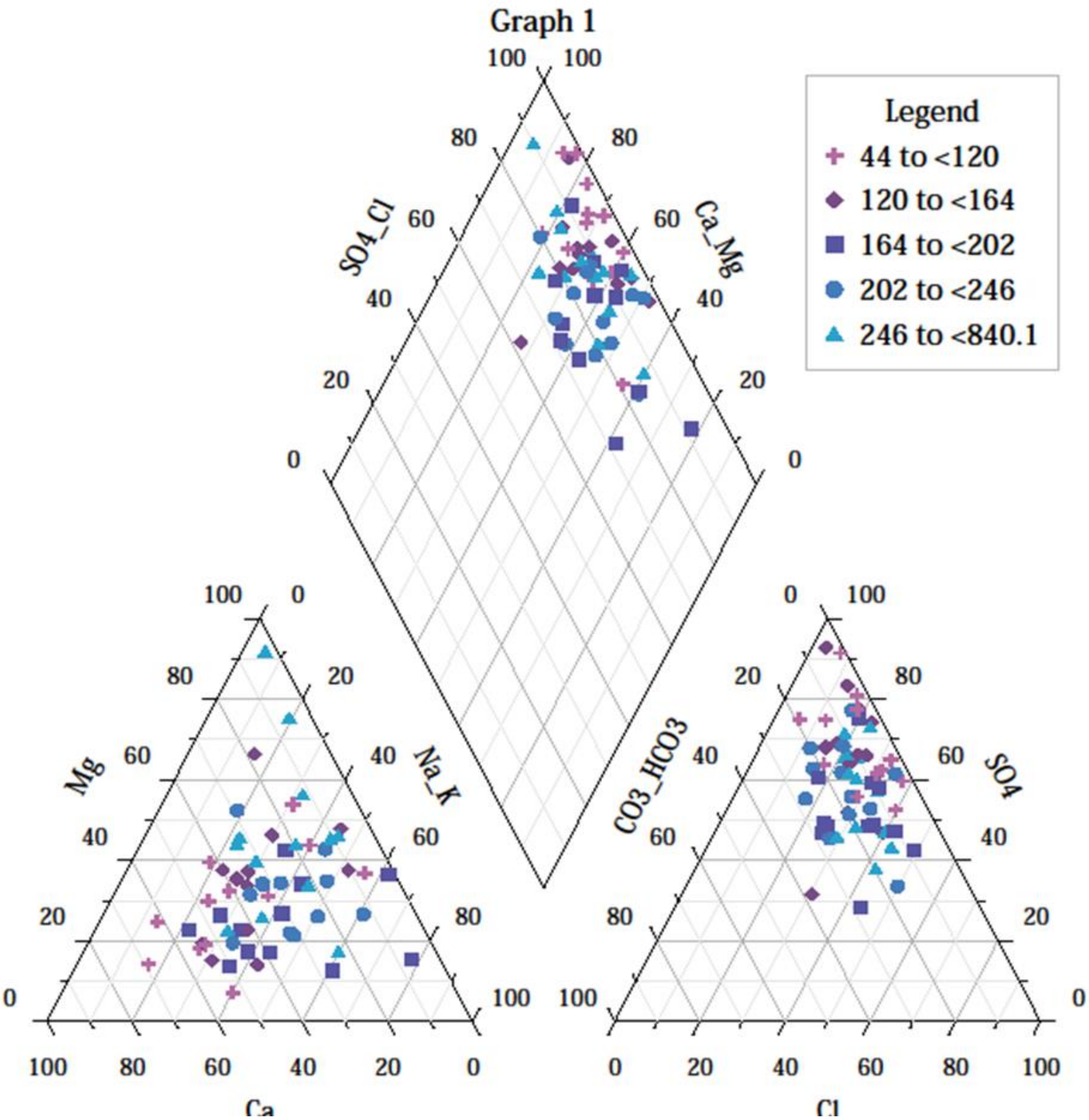


Fig2.12: **Water Quality Data in Piper Trilinear Diagram in study area**

USSL Diagram: The United States Salinity Laboratory (USSL) (1954) and Wilcox (1955) established standards for irrigation water quality classification. The Fig.7.5 is a simple scatter chart of sodium hazard (SAR) on the Y-axis versus salinity hazard (EC) on the X-axis. Using the SAR and the EC value of 41 water samples of Balaghat area determines the quality classification of the water.

Based on the EC, irrigation water can be classified into four categories; include:

I. Low-salinity water (C_1) can be used for irrigation with most crops on most soils with little likelihood that **soil salinity** will develop.

II. Medium-salinity water (C_2) can be used if a moderate amount of leaching occurs. Plants with moderate salt- tolerance can be grown in most cases without special practices for salinity control.

III. High-salinity water (C_3) cannot be used on soils, special management for salinity control may be required and plants with good salt tolerance should be selected.

IV. Very high salinity water (C_4) is not suitable for irrigation under ordinary conditions.

Sodium Adsorption Ratio: High sodium in irrigation water reduces the permeability of soil. The USSL diagram based on SAR divided to four categories included:

$$SAR = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$$

I. Low-sodium water (S_1) can be used for irrigation on almost all soils.

II. Medium-sodium water (S_2) will present an appreciable sodium hazard in certain fine-textured soils. This water may be used on coarse-textured or organic soils with good permeability.

III. High-sodium water (S_3) may produce harmful levels of exchangeable sodium in most soils and will require special soil management.

IV. Very high sodium water (S_4) is generally unsatisfactory for irrigation unless special action is taken, such as addition of gypsum to soil (Lyerly and Longenecker, 1957).

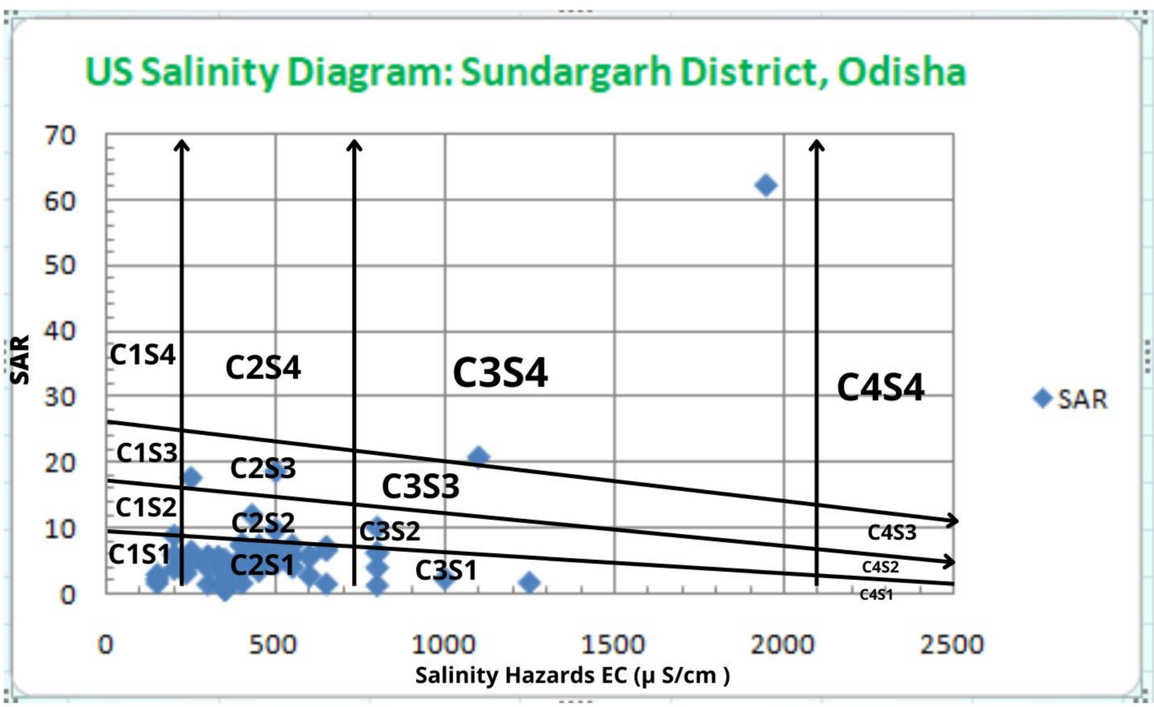


Fig 2.13: US Salinity diagram, Sundergarh district , Odisha

Data Analysis:

On the basis of data collection from CGWB report (2020-2021). It has been observed that out of 63 sample, most of the samples are concentrated under C2S1, C2S2 and C3S2 categories indicating low to medium sodium hazards with medium salinity. Out of these, few samples are scattered under C3S1 and C3S2 categories representing high salinity with low to medium sodium hazard. Few samples are scattered in C1S1 indicating low sodium hazards with low salinity.

3. Mining Plan

Government of Odisha has issued letter of Intent (copy enclosed as Annexure-III) under Rule 10(2) of Mineral Auction Rules 2015 to M/s Kashvi Power & Steel pvt Ltd for grant of Mining Lease for Dholta Pahar Block for iron ore over an area of 60.508Ha near Dengula village, Koira Tahasil of Sundargarh district of Odisha for a period of 50 years.

M/s Kashvi Power & Steel pvt Ltd is a part of Kashvi group and one of the growing company in Odisha. Kashvi Power & Steel Private Limited operates as a manufacturer of sponge iron, billet and ingots and exporter of minerals. Orissa based Kashvi group was founded by Mr. Debabrata Behera, a first generation entrepreneur. Mr Behera has more than two and half decades of experience in the business of iron ore trading and exporting, manufacturing of sponge iron, billet and ingots. Iron ore produced from the Dholta Pahar block will mostly be utilized in their sponge iron plant. However, as per the market demand, part of the iron ore may be sold to the consumers.

Table 3.1- Initial/subsequent Lease grant details

Grant	From	To	Lease deed execution date	Lease registration date
LOI issued vide no 8725/IV(B)SM-52/2021/SM,Bhubaneswar, dated 28.10.2021	Date of Execution of the Lease deed	50 Years from Date of Execution of the Lease deed	---	---

Table 3.2- Land Ownership Details

S.No.	Village	Taluka	Area (Ha)	Khasra No/ Compartment No.	Type of Land	Nature of Land
1	--	Koira	60.508	Forest Khata	Reserve Forest	Govt Land

Table 3.3- Location of Boundary Pillars –(add additional Row for subsequent pillars)

Pillar No.	Pillar Latitude *(dd:mm:ss.ss)*	Pillar Longitude *(dd:mm:ss.ss)*
1	N21°50'11.13855"	E85°10'43.73375"
2	N21°50'34.08851"	E85°10'43.53749"
3	N21°50'34.57854"	E85°11'14.26145"
4	N21°50'12.91054"	E85°11'14.63431"
5	N21°50'12.19012"	E85°10'58.24071"
6	N21°50'12.06361"	E85°10'57.81967"

Table: 3.4- Mining Plan/ Review of Mining Plan at Glance

1	Name of the lessee	M/s Kashvi Power & Steel Ltd.
2	IBM Registration no.	IBM/7815/2011
3	Address of lessee	Plot No 1234/P, Govinda Prasad, Bomikhal, Bhubaneswar

4	Name of Mine	Dholtapahar Iron Ore Block
5	Mine code	Not Obtained
6	Lease area in hects.	60.508
7	Forest area	60.508 Ha.
8	Name of Mineral	Iron Ore
9	Lease period from – to	LOI issued vide no 8725/IV(B) SM-52/2021/SM,Bhubaneswar, dated 28.10.2021 50years W.E.F date of execution of lease deed
10	Plan proposal period.	5year w.e.f date of execution of lease deed
11	Mineral Reserve(111,121&122) in tonnes	111-0
		121-0
		122- 23921613
		Total-23921613
12	Mineral Resource(211,221,222,331,332,333&334) in tonnes	211-0
		221-0
		222-0
		331-0
		332-23921613
		333-0
		334-0
		Total-23921613
13	Total (reserve resource) in tonne	23921613
14	Reserve estimation as on	Date-Date of execution of lease deed
15	Explored area in ha	G1 – 0
		G2- 60.508
		G3-0
		Explored and found Non-mineralized area – 20.008
		Un – explored area -Nil
		Total – 60.508
16	Exploration proposal Year wise No. of Bore Holes	1st year - 21nos
		2nd year – 21 nos
		3rd year – nil
		4th year – nil
		5th year - nil
17	Production proposal Rom in tonnes	1st year - 1999999
		2nd year – 1999999
		3rd year – 2000000
		4th year – 1999999
		5th year - 2000000
18	OB/Waste handling proposal CUM	1st year - 73250

		2nd year – 282550
		3rd year – 338600
		4th year – 234550
		5th year - 470700
19	Present EC permission in tonnes	Since it is a fresh lease, the lessee will obtain EC before Execution of the lease deed.
20	Present forest clearance area in ha	Since it is a fresh lease, the lessee will obtain FC before Execution of the lease deed.
21	Plantation Proposal in five years in numbers	1st year - 230
		2nd year – 230
		3rd year – 1126
		4th year – 230
		5th year - 230
		Total Plantation- 2046
22	Plantation Proposal in five years (ha)	1st year - 0.25
		2nd year – 0.25
		3rd year – 1.52
		4th year – 0.25
		5th year – 0.25
		Total Area- 2.52
23	Back filling proposal in hectares in five years(years wise)	Not Applicable
24	Check Dams numbers in five years	3nos
25	Garland drain in meters five years(years wise)	1st year - 320
		2nd year – 105
		3rd year – 0.0
		4th year – 0.0
		5th year – 0.0
26	Settling ponds (Numbers)(years wise)	1st year - 2
		2nd year – 1
		3rd year – 0
		4th year – 0
		5th year – 0
27	Total Area put to use in mining and allied activity at end of five years in ha	65.179
28	Bank Guarantee Amount Rs	Not Applicable
29	Validity pf BG up to	Not Applicable

3.1 Exploration Plan

Iron ore in the block occur as bedded stratiform deposit of regular habit with intercalations of shale and BIF, representing BHJ/BHQ/BHC. Since it is a stratiform type of regular habit, boreholes plans have been done at 200 m X 100 m grid spacing to fulfil the requirement of provisions of General Exploration of MEMC Rule-2015, accommodating the DIOP series holes drilled in 2006-08. The borehole locations are shown in the geological map of the Block. Dry core drilling was adopted by TC bits and as per driller's site report, virtually there was negligible loss in core recovery during core drilling. The core recovery has been recorded for all ore types are found to be 100%.A total of 19 vertical boreholes were drilled by rig KME-300 series& LTE-575 in the block, out of which 5 BHs were drilled during F.S 2006-08 and 14 BHs were drilled during 2017-18 for cumulative drilling meter age of 982.5 m. These boreholes are drilled at strike intervals of 200m and 100m spacing along dip direction. Depth of boreholes varies from 19.5m (BH-12) to 82.00m (BH-9).The Borehole BH-10, BH-11, BH-13 & BH-14 were shifted to 100m north of N200/ W400,74m north of N400/W400, 22m south of N500 and 50m north of S100 grid location respectively due to steep scarp sections and high gradient lines.

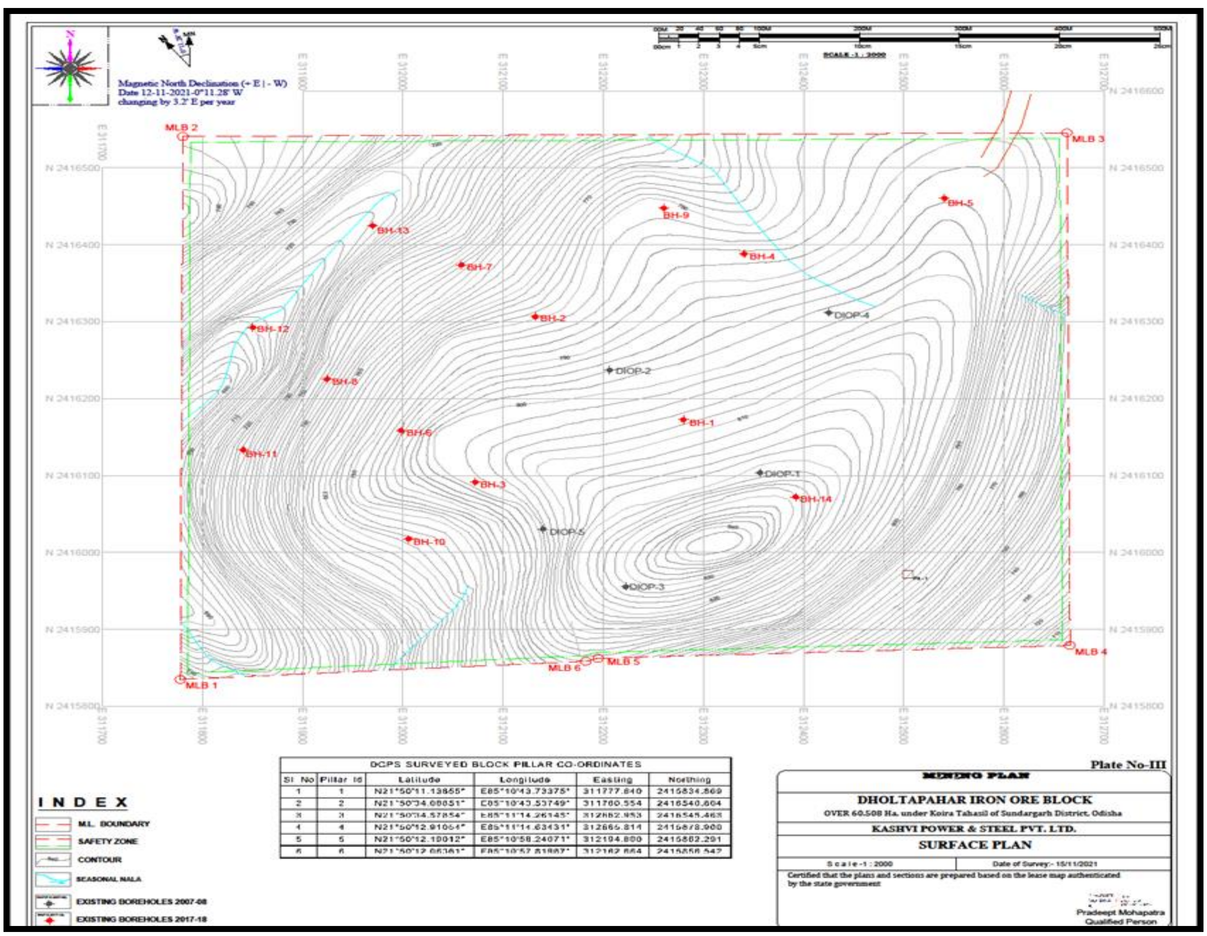


Fig. 3.1- Drill hole location

3.2.Mineralization details

The maximum thickness of ore bodies intersected at + 55% Fe cut off is 20.75 m in (BH-3) and minimum thickness is 0.6m in (BH-4) having average iron content of 61.863% Fe. The maximum thickness of low grade ore zone (45 < 55% Fe) intersected in the boreholes is 13.6m(DIOP-4) and minimum thickness of 0.7m (DIOP-1) having average iron content of 49.251%.Variegated shale and BHJ are found in the foot wall side, which limits the mineralization where as lateritised shale occurs as overburden. The ore types includes soft laminated types towards top and grades in to hard laminated while blue dust is localised in the bottom horizon. The ore bodies are often capped by laterite on surface. Though outcrops of soft laminated ore, and float ore are exposed on the surface but soft laminated ore and blue dust constitutes the bulk thickness of the ore zone as evidenced from drill cores.

3.2.1. Reserve / Resource

Table 3.5 Threshold value & Cut off Parameters

1	Threshold	45% Fe
2	Cut-off grade	55%Fe

Table 3.6 Mining Factors or Assumptions

Sl. no	Salient features	Description
1)	Method of Mining	Fully Mechanized (FM)
2)	Proposed production	2.0 Million Tones
3)	Type of ore	Lateritic Iron ore, Hard Laminated ore, Soft Laminated ore, Blue dust
4)	Proposed Means of raising	Drilling, Blasting, excavation, screening, crushing, loading etc.
5)	Proposed Bench height and width	Height- 10m Width – More than the height
6)	Proposed Stripping ratio (t/m3) (Ore: OB	1:0.28
7)	Over all slope	28^{0}-37.5^{0}
8)	Transportation ore to the stacking yard	Through dumper
9)	Nature of overburden/ interburden	Generally consists of BHJ, shale, and Laterites.
10	Drilling	110mm dia drill hole
11)	Blasting	Deep hole blasting using slurry/Emulsion, explosives & NONEL& Electric Detonator.

Table 3.6 Mineral Reserve

Classification	Code	Quantity			Grade	
		Forest	Non-Fores	Total	Forest	Non-Forest
A. Mineral Reserve		23921614	Nil	23921614	+45%Fe	Nil
1. Proved Mineral Reserve (A)	111 (In situ)	Nil	Nil	Nil	Nil	Nil
		Nil	Nil	Nil	Nil	Nil
	111(float)	Nil	Nil	Nil	Nil	Nil
		Nil	Nil	Nil	Nil	Nil
2. Probable Mineral Reserve (A)	121	Nil	Nil	Nil	Nil	Nil
3. Probable Mineral Reserve (A)	122 (In situ)	16448530	Nil	Nil	+55%Fe	Nil
		7182332	Nil	Nil	45-55%Fe	Nil
	122 (Float)	290752	Nil	Nil	+55%Fe	Nil
		--	Nil	Nil	Nil	Nil
B. Remaining Resources		Nil	Nil	Nil	Nil	Nil
1. Feasibility Mineral Resource (B)	211(In situ)	Nil	Nil	Nil	Nil	Nil
		Nil	Nil	Nil	Nil	Nil
	211(float)	Nil	Nil	Nil	Nil	Nil
		Nil	Nil	Nil	Nil	Nil
2. Prefeasibility Mineral Resource (B)	221	Nil	Nil	Nil	Nil	Nil
3. Prefeasibility Mineral Resource (B)	222	Nil	Nil	Nil	Nil	Nil
4. Measured Mineral Resource (B)	331	Nil	Nil	Nil	Nil	Nil
5. Indicated Mineral Resource (B)	332	Nil	Nil	Nil	Nil	Nil
6. Inferred Mineral Resource (B)	333	Nil	Nil	Nil	Nil	Nil
7. Reconnaissance Mineral Resource (B)	334	Nil	Nil	Nil	Nil	Nil
Total Mineral Resources (A+B)		23921614		23921614	+45%Fe	--

Table 3.7 Mineral Beneficiation / Processing

Sl. No.	Radicals	Wt %
1	Fe at +55 Cutoff	61.863%
2	Silica	2.892%
3	Alumina	3.133%

3.3. Mining Operations

During the plan period, it has been proposed to produce2.0 MTPA iron ore per annum. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc.

Strategy for Development:

It has been planned develop the areain a such a way by which both high grade and low grade iron ore production can be obtained for suitable blending purpose to make the material usable. The height and width of the proposed benches has been kept 10 and 15 meter respectively.

Haul Road:

The layout of roads for haulage of ore/ waste and access to different installation in the mine will be developed complying with the statutory regulations stipulated in the Metalli ferrous Mines Regulations, 1961. Overburden and Mineral reject will be transported to the respective site of dumping and stacking located in the lease area. Fifteen meter wide haul road will be developed in the lease area as per need at a gradient up to 1:16.

Site Services:

As far as day to day mine operation is concerned, the infrastructure such as site office, weigh bridge, rest shed, First-aid centre, blasting shed security house, magazine, guard house etc will be established before mining operation in the lease area.

Machineries to be deploye

The mine will be operated in a three shift basis. Process of excavation and loading of overburden/waste will be done by deploying hydraulic excavators and dumpers. Excavators of 0.9 - 2 m^3 capacities will be deployed for excavation & loading of ROM ore and dumpers of 25t capacity shall be deployed for transportation of ore and OB. Hard iron ore will be loosened through drilling & blasting. For the purpose, DTH drill of 115mm dia, compressor of 450cfm etc will be used during ensuing scheme period to achieve the targeted production. For maintenance of OB dumps dozers will be deployed. Loading & un-loading of sorted & sized ore is loaded by mechanized method.

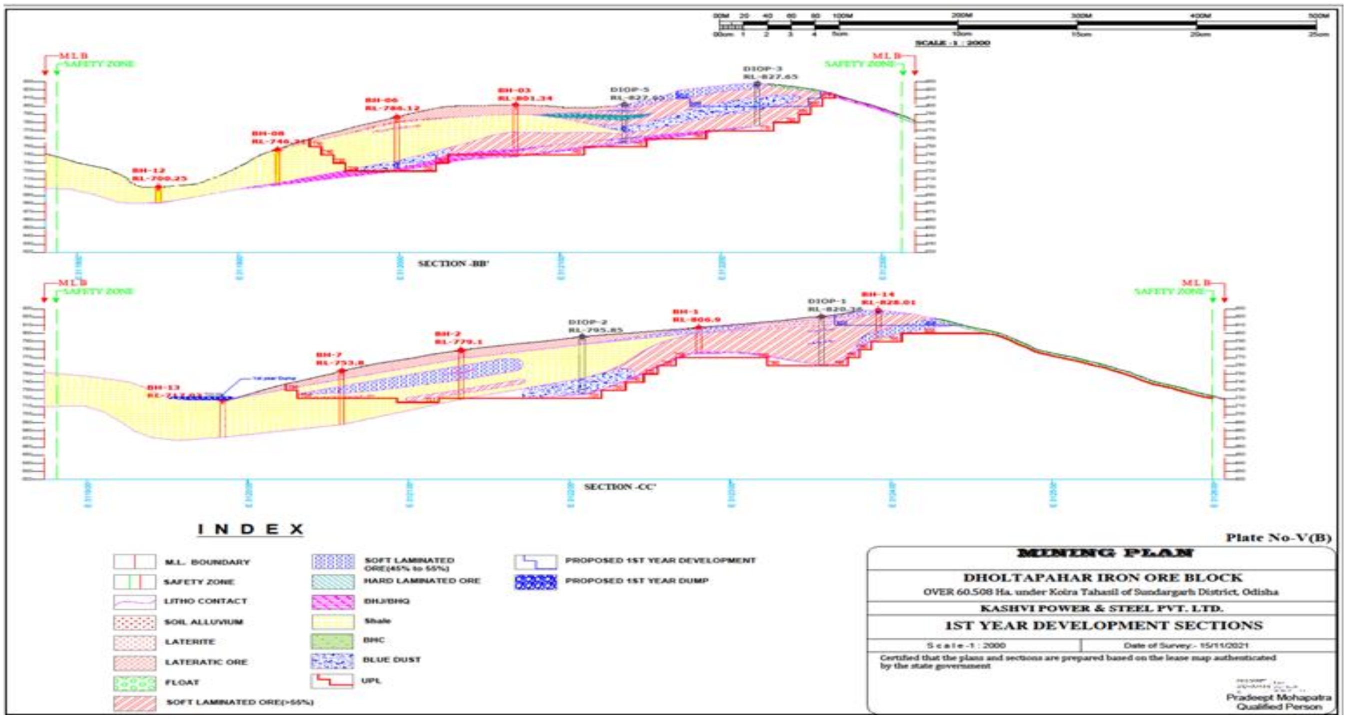
Transportation

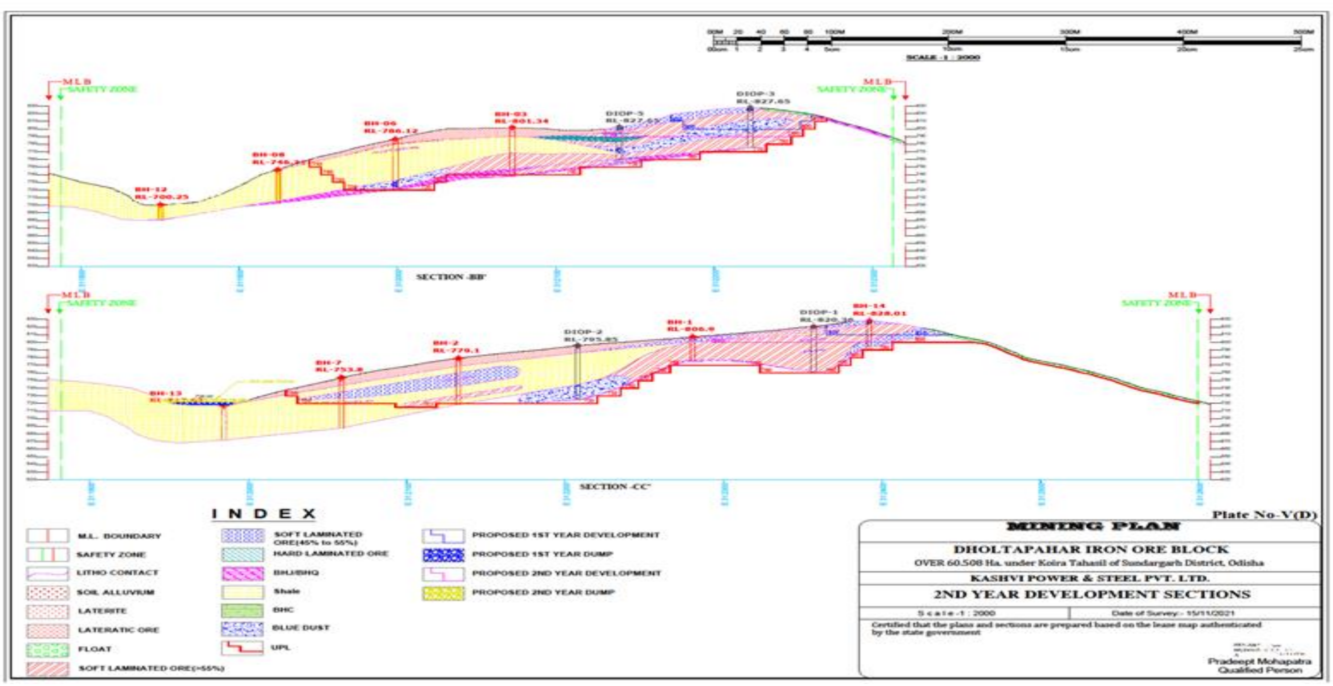
Ore will be transported from quarry site to screen and crushing site for processing by use of 25 ton dumpers and waste materials will be dispatched from quarry to dumping site by using same capacity dumpers. From the stock yard saleable material will be dispatch by using dumper of different capacities.

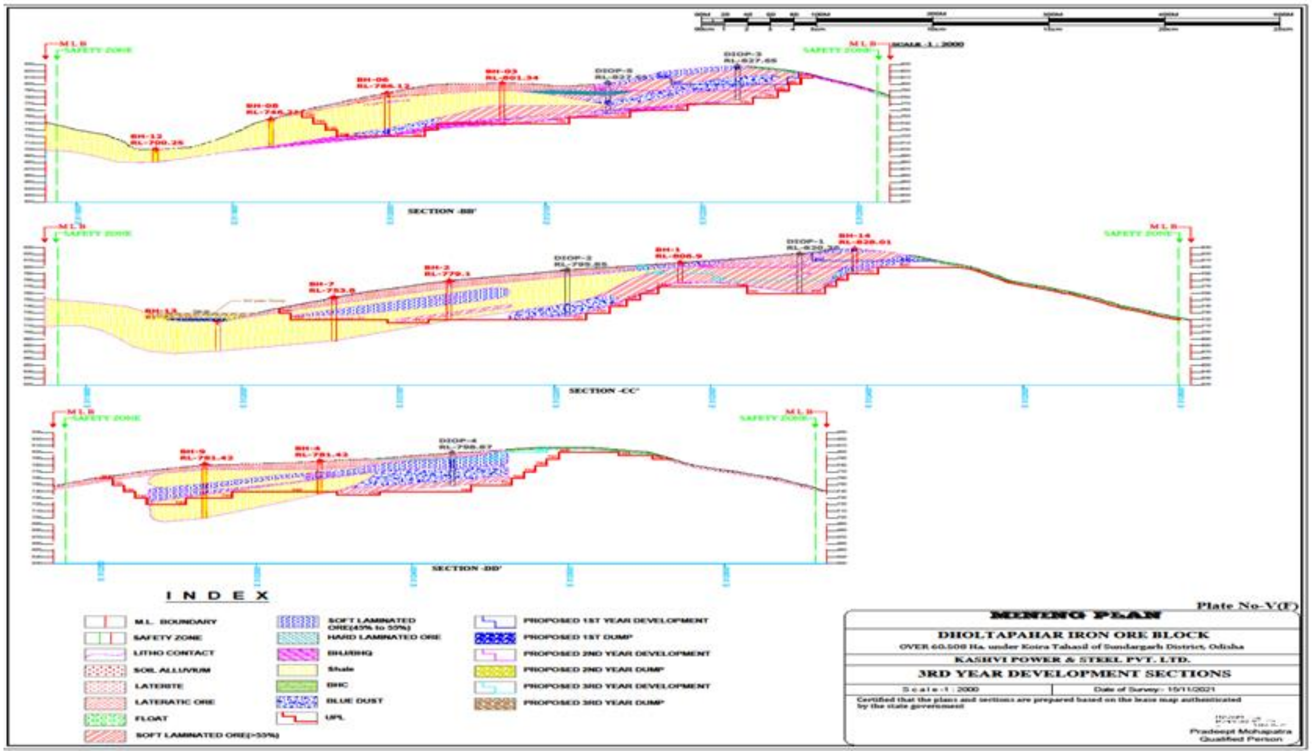
Table 3.8: Tentative Production Summary year wise

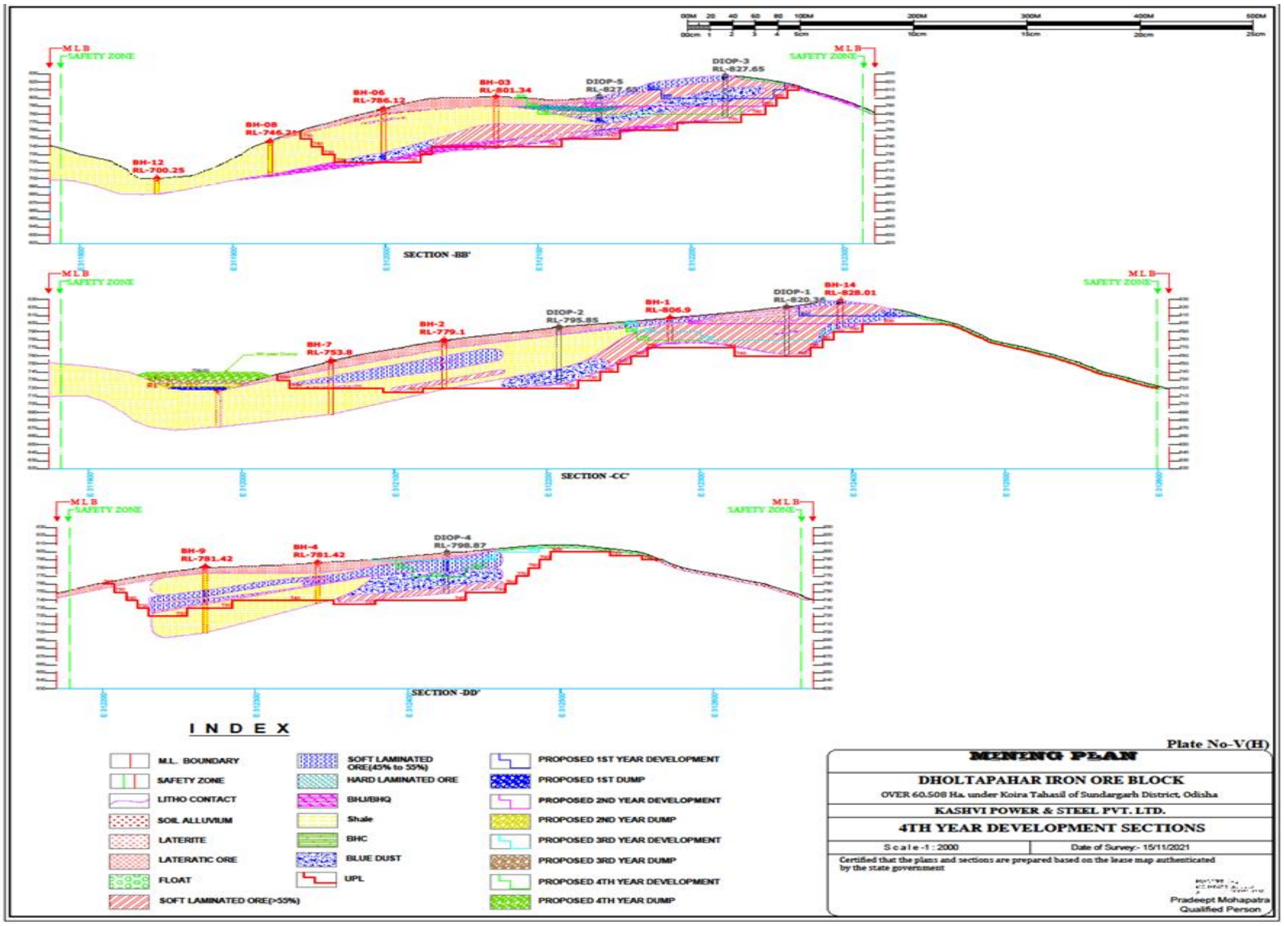
YEAR	PRODUCTION MAIN (in Tonne)	MINERAL REJECT (in Tonne)	ROM (in Tonne)	WASTE (in Tonne)
1ST	1525464	474535	1999999	146500
2ND	1448139	551860	1999999	565100
3RD	1539315	460685	2000000	677200
4TH	1479551	520447	1999998	469100
5TH	1629056	370944	2000000	941400
GRAND TOTAL	**7621525**	**2378471**	**9999996**	**2799300**

Fig 3.2: Year wise Development section

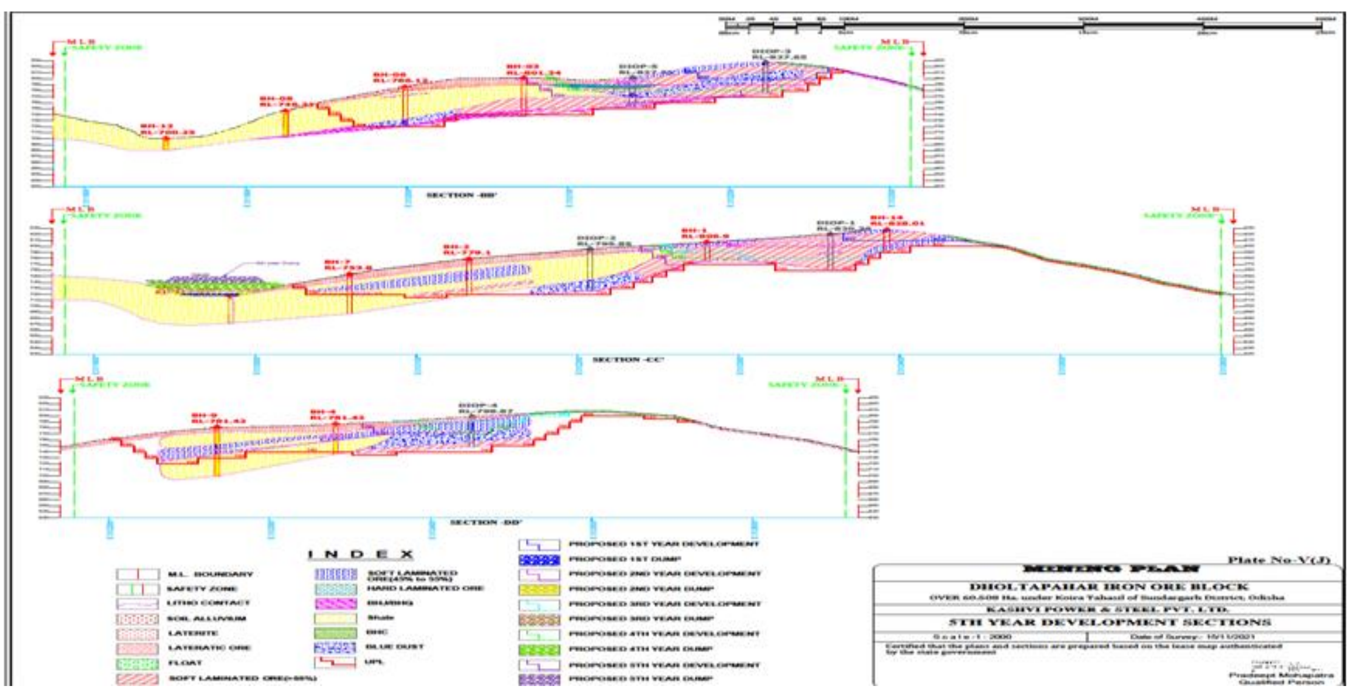




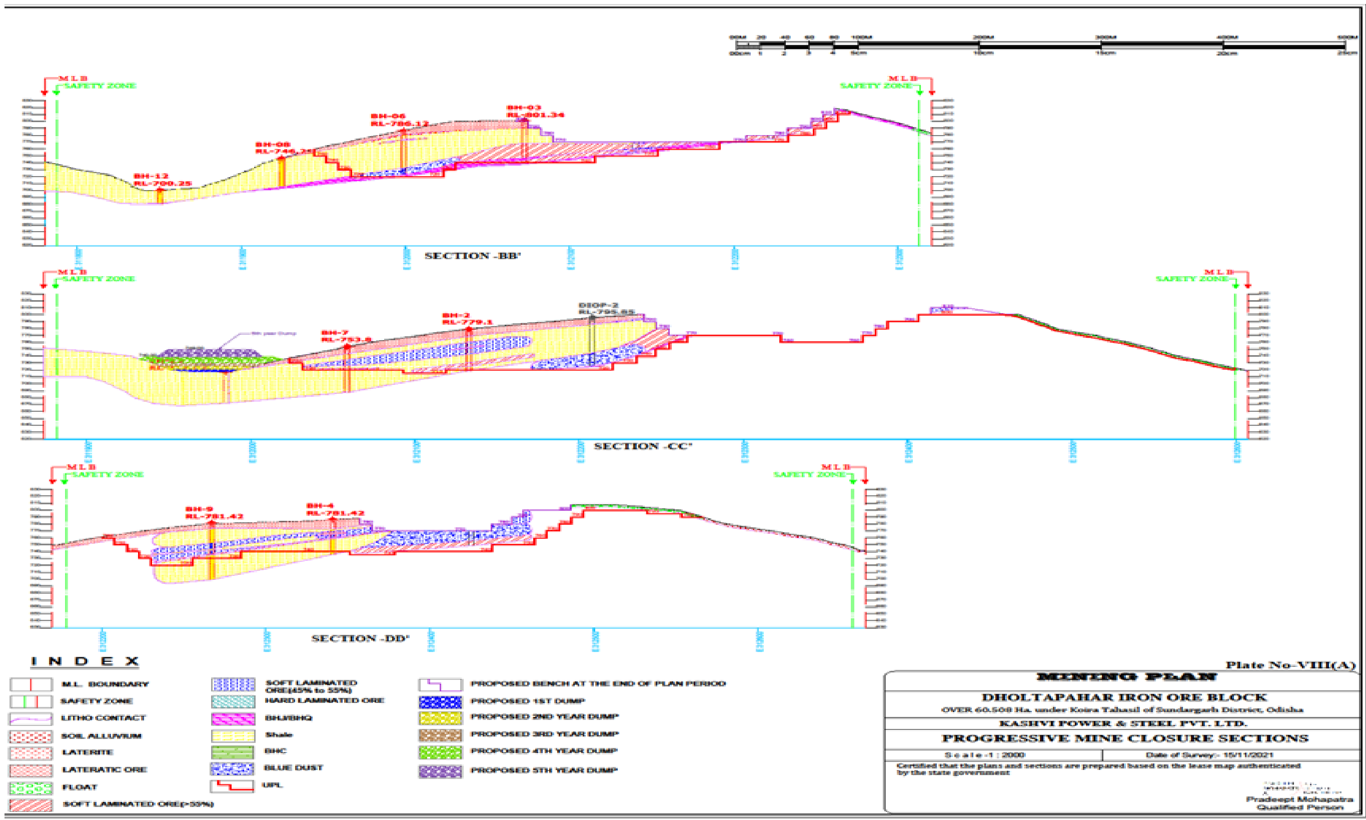




M L B
SAFETY ZONE
BH-12
RL-700.25
BH-08
BH-06
RL-786.12
BH-03
RL-801.34
DIOP-5
DIOP-3
RL-827.65
SECTION -BB'
BH-7
RL-753.8
BH-2
RL-779.1
DIOP-2
RL-795.85
BH-1
RL-806.9
DIOP-1
BH-14
RL-828.01
SECTION -CC'
BH-9
RL-781.42
BH-4
RL-781.42
DIOP-4
RL-798.87
SECTION -DD'
I N D E X
M.L. BOUNDARY
SAFETY ZONE
LITHO CONTACT
SOIL ALLUVIUM
LATERITE
LATERATIC ORE
FLOAT
SOFT LAMINATED ORE(>55%)
SOFT LAMINATED ORE(45% to 55%)
HARD LAMINATED ORE
BHJ/BHQ
Shale
BHC
BLUE DUST
UPL
PROPOSED 1ST YEAR DEVELOPMENT
PROPOSED 1ST DUMP
PROPOSED 2ND YEAR DEVELOPMENT
PROPOSED 2ND YEAR DUMP
PROPOSED 3RD YEAR DEVELOPMENT
PROPOSED 3RD YEAR DUMP
PROPOSED 4TH YEAR DEVELOPMENT
PROPOSED 4TH YEAR DUMP
Plate No-V(H)
MINING PLAN
DHOLTAPAHAR IRON ORE BLOCK
OVER 60.508 Ha. under Koira Tahasil of Sundargarh District, Odisha
KASHVI POWER & STEEL PVT. LTD.
4TH YEAR DEVELOPMENT SECTIONS
Scale-1 : 2000
Date of Survey:- 15/11/2021
Certified that the plans and sections are prepared based on the lease map authenticated by the state government
Pradeept Mohapatra
Qualified Person



SECTION -BB'
SECTION -CC'
SECTION -DD'
I N D E X
Plate No-V(J)
MINING PLAN
DHOLTAPAHAR IRON ORE BLOCK
KASHVI POWER & STEEL PVT. LTD.
5TH YEAR DEVELOPMENT SECTIONS
Pradeept Mohapatra
Qualified Person



3.9 Table: Total ROM and waste generation

Sl. No.	Year	Total Handling (t)	Waste Quantity (t)	ROM Quantity (t)	ROM Quantity Saleable Mineral (t)	ROM Quantity Mineral Reject (t)	Ore to OB Ratio (RoM Quantity / Waste Quantity)	Grade Range (%
1	1st	2146499	146500	1999999	1525175	453161	1:0.073	45% Fe to +65 % Fe
2	2nd	2565099	565100	1999999	1448139	551860	1:0.283	45% Fe to +65 % Fe
3	3rd	2677200	677200	2000000	1539315	460684	1:0.339	45% Fe to +65 % Fe
4	4th	2469099	469100	1999999	1479551	520447	1:0.235	45% Fe to +65 % Fe
5	5th	2941400	941400	2000000	1629056	370944	1:0.471	45% Fe to +65 % Fe
Total		**12799297**	**2799300**	**9999997**	**7621236**	**2357096**	**1:0.280**	45% Fe to +65 % Fe

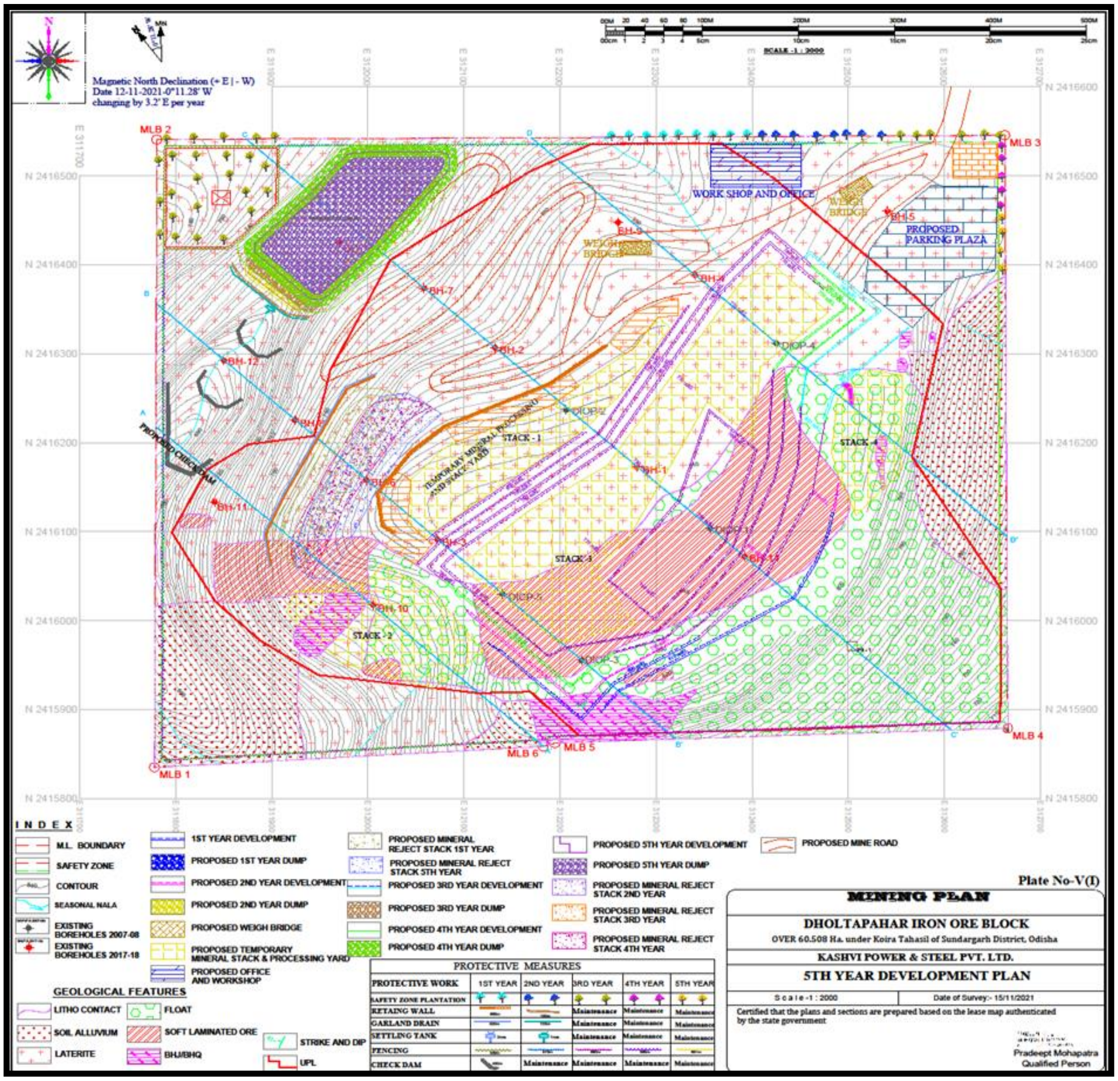


Fig 3.3: Five years development Plan

4. Proposed utilization of water for Mine Operation

Table 4.1: Proposal of Water Utilization in Dholta Pahar mine (Area= 60.508ha)					
Sl. No	Purpose	Ground Water (KLD)	RWH & Outside	Recycled STP &ETP (KLD)	Total from all source
1	Dust Suppression	59	30	9	98
2	Domestic Use	12	-	-	12
3	Plantation	8	8	5	21
4	ETP & Workshop, Wheel Washing System	18	2	4	24
	Total	**97**	40	**18**	**155**

As per the approved mine plan the Dholtapahar block mine proposed total requirement of water is 155 KLD. The required quantity will be drawn from ground water sources, RWH and recycled water. The entire water is utilize as per the Table 4.1

4.1 For Drinking – No mine discharge will be generating during mining activities. For Drinking and domestic use 12 KLD of water is required which obtained from groundwater sources.

4.2 Plantation – 21 KLD of water is required for plantation. It will obtain from 8KLD from groundwater, 8KLD from RWH and 5KLD from recycle water (ETP & STP).

4.3 Dust suppression, green belt development- as shown in table 4.1, 98KLD is required for this purpose. It is obtain from 59KLD groundwater, 30KLD from RWH and 9KLD from recycled water.

4.4 ETP & Workshop, Wheel Washing System- For ETP & Workshop and wheel washing system 18 KLD is obtain from groundwater, 2KLD from RWH and 4KLD from recycle water.

4.4 Runoff to stream- Small rills/gullies is generated during rainy season in lease area. RWH structures have been proposed on these rills/gullies.

4.5 Benefitted area- Nearby villagers

5. Comprehensive assessment of the impact on the ground water regime

Comprehensive assessment of the impact on the ground water regime in and around the project area highlighting the risks and proposed management strategies proposed to overcome any significant environmental issues.

M/s Kashvi Power & Steel pvt Ltd for grant of Mining Lease for Dholta Pahar Block for iron ore over an area of 60.508Ha near Dengula village, KoiraTahasil of Sundargarh district of Odisha for a period of 50 years. Iron ore produced from the block will mostly be utilized in the pellet plant. Total estimated mineable reserve within the area is 23921613 tonnes for iron ore. During the plan period, it has been proposed to produce 2.0 MTPA iron ore per annum. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc. There is no agriculture land in the core zone. However in buffer zone agriculture land will be preserved from siltation by retaining wall, check dams, garland drain and settling ponds. . The nearest surface water source is Teherai Nala which is flowing 500m away from the western side of the mining lease. Teherai Nala is the major 2nd order drainage system of the area. As per the field observation there are some mine pit surrounding the lease area which work as recharge tank in rainy season. The lease area experience heavy rainfall during rainy season so that it will minimizes the groundwater usage. Presently, in buffer zone during rainy season, the water is accumulated in the mine out area. The sump acts as a good rainwater accumulation structure and the collected rainwater is also seeps into the ground.

Fig 5.1: Existing mine pit within 2km of core zone

5.1. Impact on surface water sources:

DholtaPahar Iron ore mine is situated in the higher elevation as depicted in the fig 6.2: No perinial Nala/stream exists or generates from ML area of Dholta Pahar Fe mine. The ML area is not situated within any wetland zone and not part of any national park etc. Other existing small ponds/ water bodies within core and buffer zone has been investigated and the water quality is found normal.

5.1.1 Diversion

Existing channels [constructed dam/barrages/weir/canals/hydro-electric projects] No existing channel, constructed dam/barrages/weir/canals/hydro-electric projects etc need to be diverted due to the project. Thus 5.1.1 is not applicable.

5.1.2: Change

In land use [change in flood plain, lotic & lentic systems etc.]-No nala/stream/ river exist or generates from ML area of Dholtapahar mine. The ML area is not situated within any wetland zone thus change in land use in flood plain, lotic & lentic systems etc is not applicable.

5.2. Impact on groundwater sources–

The Dholta Pahar mine lease area is in Koira block of Sundergarh district, Odisha which is categorized under safe category (Stage of GW Extraction 33%) by the latest estimation carried out by CGWB (2020). The groundwater levels measured in core and buffer zone varies from (3.7-36.3m). The area is part of hard rock terrain with poor permeability rock and there is no aquifer system due to high elevation (824m). During the field study it has been found that a town name Tensa also has no aquifer. All the water requirements are fulfilled from supplied water foothill village name Barsua Based on the field observation it has been found that there is no weathered portion in around the lease area. At present there is no existing water body, the mining activity will be carried out in such a manner which won't create any threat of groundwater resources. The mine area experienced heavy rainfall hence by constriction of check dam, rooftop rain water harvesting structure, retaining wall and settling pond can enhance the water availability.

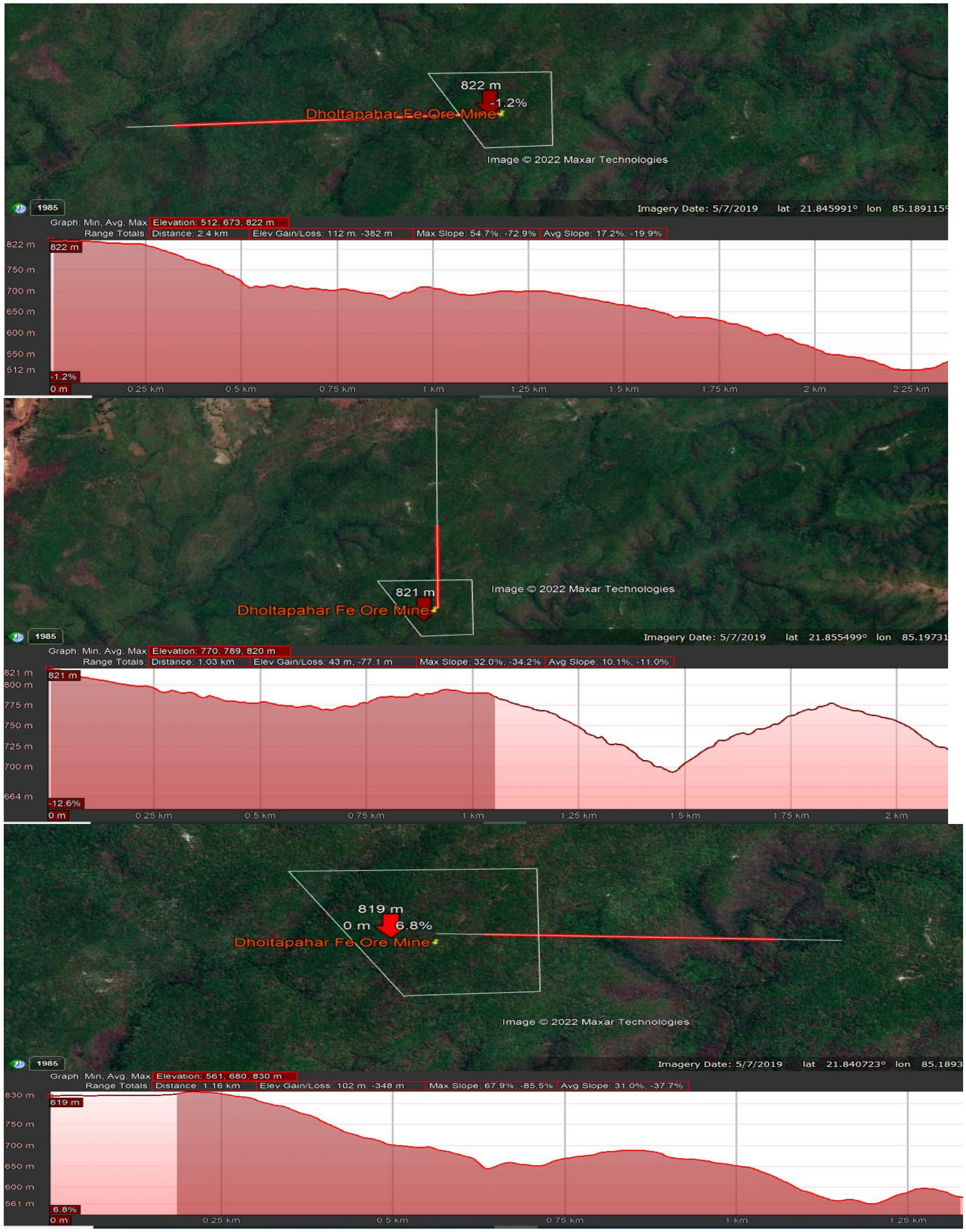


Fig 5.2: Google elevation profile of study area around Dholta Pahar Fe ore Mine from three directions

5.3. Socio-Economic Aspects:

5.3.1. Settlements and population dynamics around project area

The study area comes under rural. There exists about 31 villages in the study area and their details are given in Table 5.1 and 5.2

There is no impact of groundwater withdrawal by Dholtapahar Block Fe ore Mine on the study area, study can recommend NOC may be extended for next 5 yr with existing 97KLD extractions from groundwater system

Table 5.1 Crop production details of Sundergarh District Odisha in Kharif and Rabi Season				
	Kharif		Rabi	
Sl no.	Crops	Area (ha)	Crops	Area (ha)
1	Paddy	13250	Wheat	111
2	Maze	463	Cowpa	190
3	Ragi dry	205	Horsegram	774
4	Jower	124	Gram	298
5	Biri	1403	Mustard	395
6	Cowpa	146	Potato	109
7	Groundnut	296	Onion	195
8	Til	1286	Garlic	80
9	Zinger	156	Fieldpea	140
10	Other vegetables	1088	Other vegetables	1786

5.3.2. Dependency:

On sources of water [surface or sub-surface] the area by and large depends on rain-fed agriculture with supportive irrigation. It is seen that shifting of occupation among the local population is mostly towards mining and its related work. Mining leads to livelihood gain through creation of employment opportunities in the region. Loss of cultivable land and forest land due to mining activities which invites change in their native profession and may envisage involuntary migration of population to other region for livelihood. This working mining project has immensely benefitted this region in the field of potential employment, improved per capita income, improved social welfare, education, medical healthcare systems, communication, infrastructural build-up, etc. In the core zone no habitation exists. Hence, economic profile of population within core zone is not envisaged. In buffer zone, this project will help in direct employment opportunities for 259 persons and indirect employment for more than 250 persons through various service related activities connected with the project operations

Table 5.2 Population data of study area in part of Koida tehsil, Sundergarh district, Odisha						
Sl.no	Location	House	Male	Female	Total Population	Area (ha)
1	Baldihi	80	170	157	327	508
2	Ranisal	74	151	136	287	126
3	Padadhi	88	152	175	327	192
4	Patmunda	242	501	512	1013	384
5	Khajuridihi	85	179	186	365	797
6	Teheri	174	339	415	754	544
7	Sargigarh	176	355	383	738	363
8	Sanindipur	204	414	372	786	461
9	Kalmanga	323	634	656	1290	753
10	Ganua	376	820	797	1617	754
11	Rangalbeda	162	334	294	628	388
12	Kasira	270	581	699	1280	777
13	Badpatuli	108	217	239	456	346
14	Kadamdihi	105	249	265	514	697
15	Kirrakudar	81	186	168	354	203
16	Gaudiniposh	155	420	414	834	274
17	Badindipur	123	284	264	548	396
18	Dengula	173	438	498	936	3496
19	Saleipali	147	341	396	737	215
20	Basada	36	73	80	153	313
21	Dalita	18	33	36	69	424
22	Tegerei	174	339	415	754	544
23	Kula	149	379	374	753	332
24	Malda	147	297	267	564	577
25	Nuagaon	90	223	217	440	432
26	Patbeda	34	79	66	145	308
27	Railela	302	645	697	1342	683
28	Rengua	54	150	167	317	265
29	Sanputli	207	449	445	894	423
30	Taldihi	75	158	163	321	1104
31	Bandal	92	219	249	468	437

6. Proposed measures for disposal of wastewater by mine drawing saline water

The water in the surrounding of lease area is fresh and the TDS is ranges between 10 and 310 ppm in general so disposal of saline water not applicable.

7. Water Conservation

Measures to be adopted for water conservation which includes recycling, reuse, treatment, etc. This includes the water balance chart being adopted by the firm along with details of water conservation methods to be adopted. - Brief writes up along with capacity and flow chart of Sewage Treatment Plants / Effluent Treatment Plants / Combined Effluent Treatment Plants existing/ proposed within the project. - Details of water conservation measures to be adopted to reduce/ save the ground water. - Total water balance chart showing the usage of water for various processes in table 4.1

At present the lease area is required 155 KLD of water for mining operations. The entire water requirements are fulfilled by ground water, RWH and recycle water. The water is to be consumed by various mine operation such as dust suppression, domestic use, plantation, and ETP & workshop (Table 4.1). The area experiences high rainfall, the site will generate above volume of run offs during such rainy periods. The surface run off from the uncovered site would contain high concentration of suspended matter and eroded matter which will be checked through retaining wall, check dams and settling ponds.

Water conservations can be enhanced by including efficient measures of water use for mining and domestic consumption, effective reuse and recycles of water and treated water, adoption of appropriate rainwater harvesting methods. It is therefore following sub topics are incorporated in this chapter.
7.1 Water use and water balance
7.2 RWH

7.1 Water use and water balance:

Dholta Pahar iron ore mine is proposed a requirement of 155KLD of water. Water is to be used for dust suppression, domestic use, plantation, and ETP & workshop purposes shown in the (Table 4.1).

7.2. Rainwater Harvesting & Artificial recharge:

The total lease area of Dholta Pahar Iron ore mine is 60508 m² and its land use is discussed in chapter 1.4 and table 1.1. The area experiences high rainfall so that the mine has concentrated effort to conserve each drop of rainwater. The project area is having undulating hilly terrain and poor permeability. The depth of water level below ground level varies depending on the local topography, geology & hydrological conditions. The nearest surface water source is Teherai Nala which is flowing 500m away from the western side of the mining lease. Teherai Nala is the major 2nd order drainage system of the area. Mine pit structure also present all around the lease area where water gets collected from the uplands through drains. Garland drains & retaining walls will be constructed all around the dumps and plantation of native species will be carried out on the dump slopes to minimize erosion. A settling pond will be constructed to arrest silt and sediment flows from mining area during rain fall and the water so collected is being utilized for the mine area, roads, green belt development etc.

Table 7.1 Crop production details of Sundergarh District Odisha in Kharif and Rabi Season

	Kharif		Rabi	
Sl no.	**Crops**	**Area (ha)**	**Crops**	**Area (ha)**
1	Paddy	13250	Wheat	111
2	Maze	463	Cowpa	190
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8	Til	1286	Garlic	80
9	Zinger	156	Fieldpea	140
10	Other vegetables	1088	Other vegetables	1786

Fig 7.1: Existing rainwater harvesting pond and mine pit storage tank in buffer zone

Table 7.2: Pond and Water bodies in buffer zone									
Sl No.	Location	Latitude	Longitude	Elevation (m)	EC (mS)	pH	TDS(ppt)	DO (mg/l)	water body
1	Ranisal	21.884162	85.305325	596.84	650	7.1	320	4.7	Pond
2	Paatmunda	21.87555	85.308419	617.73	320	6.9	150	1.3	Pond
3	Khajuri dihi	21.863644	85.293346	664.9	300	7.2	139	4.52	Pond
4	KJSA Steel Plant	21.963844	85.317	577	650	7.5	360	3.28	Mine pit
5	Near Tensa Road	21.868889	85.187991	619.85	20	5.9	10	1.38	Open well
6	National Enterprise	21.84094	85.34045	867.2	190	7.2	80	3.1	Pond
7	Raikela Iron Mine	21.876188	85.196579	572.02	680	7.1	350	4.73	Pond
8	Raikela Iron mine	21.878495	85.197651	571.44	20	6.3	10	4.24	Open well
9	Comanado Steel Plant	21.918085	85.209714	573.27	450	6.8	240	5.94	Pond

7.3. Monitoring, Measurement and Capacity building

Monitoring and measurements of several parameters are part of water conservation strategy towards the motive of efficient management of water. The withdrawal of groundwater is regularly monitored and measured from the existing dug well. The water level is found at 3.7 to 36.3 m bgl in premonsoonal period, which varies from 2.5-5 m bgl in the monsoonal period. The Dholta pahar mine conducts regular capacity building of its maintenance staff that monitors and measures and keeping record of various data related to water use and water conservation. The workers have been trained for keeping record and onward submission of data as per the requirement. For monitoring of groundwater level in the area of Dholta pahar mine, as per the guideline of CGWA, a piezometer has to be constructed at the area. The installation of piezometer is proposed exclusively for monitoring of groundwater level deploying automatic water level recorder with telemetric arrangement of data transmission.

4. **Impact assessment of mining of Iron ore on Ground Water in and around Netrabandh Pahar, Sundergarh-**

   Click to view

Comprehensive Report on:

Groundwater Condition in both core and buffer zone of Netrabandha Pahar (West) Block Iron Ore Mine, Koira Block, Sundargarh District, Odisha.

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

M/s RAGA TRADECON PVT. LTD. (APPLICANT)
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Executive summary

M/S. Raga, Tradecon Pvt Lmt Bhubaneswaris located in Bhaliadihi Village, Koira Tehsil of Sundargarh District, Odisha. Bhaliadihi village is located in north east part of Sundergarh district. The study area falls under survey of India toposheet no F45N1N and F45N5N. Sanputli village is 1 km away from the study area. M/S. Raga, Tradecon Pvt Lmt operates as a manufacturer of sponge iron, billet and ingots and exporter of minerals. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc. During the plan period, it has been proposed to produce 1.0 MTPA iron ore per annum. The present study is made for obtaining NOC from CGWA for extraction of maximum 62 KLD of ground water during mining operation as per the approved mine plan. The present report is based on the Hydrogeological investigation made within core zone i.e 2km radius and buffer zone i.e 10km radius from mine lease, for assessment of impact of dewatering of groundwater by the mine and will be submitted to CGWA for obtaining NOC. The area is drained by IB and Brahmani River and its tributaries. The easterly flowing Sankh and westerly flowing Koel River join at Vedavyas near Rourkela to form the Brahmani River. The river, IB a tributary of Mahanadi controls the drainage of the western parts of the district. The drainage pattern of the area is dendritic. The study area is located in Bhaliadihi Village, Koira Tehsil of Sundargarh District, Odisha which falls under safe blocks as per the report on Dynamic Groundwater Resource of India, published by CGWB in 2019-20. The study area is having largely one geological formation name Singbhum-Keonjhar-Bonai group of iron ore of Precambrian age. These constitute hard rock's includes schist, tuffs, phyllite, basic rock, BHQ/BHJ have been classified as Iron Ore Series (IOS). Aquifers are developed only in the low lying area and valley parts of the study area. The total lease area of the proposed Netrabandha Pahar Fe ore block is 74.3700Ha (743700 m^2). Groundwater quality is fresh and potable in both core and buffer zone area and EC below 1900 ppm and TDS varies from 10 to 310 ppm in the study area. As per the approved mine plan 124.08 KLD is required for running the mining activity, no water discharge generating during mining activities. Rainwater is harvested within the ML area through construction of water conservation pond and Roof Top RWH structures. The annual conservation through RWH is about 18,576 m^3/yr. There is no impact on groundwater because of open cast mining. For the running of mine 124.08 KLD water is required, 62 KLD from ground water and 62.08 KLD will be arranged from RWH and recycle water. Thus, the study recommends NOC may be provided for next 5 yr with maximum 62KLD extractions from groundwater.

Acknowledgments and Certificate

Impact assessment and report preparation work as per the CGWA guideline was entrusted to MRCAWTM, Manav Rachna as accredited Groundwater Institution of CGWA by M/S. Raga, Trade con Pvt. Lmt. Odisha is thankfully acknowledged.

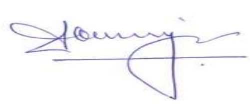
Impact assessment and report preparation work as per the CGWA guideline was entrusted to MRCAWTM, Manav Rachna as accredited Groundwater Institution of CGWA by M/S. Raga, Trade con Pvt. Lmt. Odisha is thankfully acknowledged.

Discussions with Mr. Pradeept Mohapatra, Director WCS, regarding the geology of lease area and plan our investigations according to scope of work is gratefully acknowledged. Help rendered by Shri Shubham, Geologist, Shri. Prabhat, M/S. Raga, Tradecon Pvt Lmt, Odisha in every stage of planning and Field verification, investigations in and around lease area and report preparation is thankfully acknowledged. He also provided all the available relevant data and records many of them are reproduced in this report and forms part of annexure section.

At lease area, during days of field investigation we have received warm welcome and all hospitality and requisite support from mine team. We thankfully acknowledge Mr. Pradeept Mohapatra, Director WCS and his team for their cooperation.

The report has been prepared by Ms Sheha Rai, Asstt Prof MRCAWTM and Sandeep Kumar Research Assistant, MRCAWTM under the supervision of Prof (Dr) Arunangshu Mukherjee, Director MRCAWTM. Ms Alifia Ibkar, RA MRCAWTM helped Mr Sandeep Kumar in the field work and data collection.

It is to certify that MRCAWTM have investigated the area of Netrabandha Pahar Fe ore block of Bhaliadihi Village, Koira Tehsil of Sundargarh District, Odisha. Based on actual data collected from field and literature survey done, has prepared the report as per the format of CGWA.



(Dr Arunangshu Mukherjee)
Director, MRCAWTM

MR Centre for Advance Water Technology & Management
Manav Rachna International Institute of Research & Studies
(Deemed to be University under section 3 of the UGC Act, 1956)
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CONTENTS

LIST OF TABLES

LIST OF FIGURES

Report on
Hydrogeological Investigation and Impact Assessment Report for Netrabandha Pahar (West) Block for Iron Ore Sundergarh District, Odisha

Introduction

The report is prepared as per the format prescribed by CGWA for impact assessment study, the Introductory chapter comprises the following subtitle for describing its

1.1 Objectives

1.2 Scope of the study

1.3 Project description-Plant, process, product and location

1.4 Land Use Land Cover and percentage of LULC categories

1.5 Topography and drainage

1.1 Objective

The Central Government had constituted the Central Ground Water Board as Authority vide notification number S.O. 38 (E), dated the 14th January,1997 to exercise powers under sub section (3) of section 3 of the Environment (Protection) act, 1986 (29 of 1986) for the purposes of regulation and control of Ground Water Management and Development. The Authority has been regulating ground water development and management by the way of issuing 'No Objection Certificates' for ground water extraction to industries or infrastructure projects or Mining Projects etc., and framed and issued guidelines in this connection from time to time. The entire process of grant of No Objection Certificate shall be online through a web based application system. The latest guideline issued by Gazette Notification no 2941 on 24th September 2020 supersedes all earlier guidelines issued by the Central Ground Water Authority (CGWA). As per the CGWA guideline the **M/S. Raga, Tradecon Pvt Lt Bhubaneswar** has to submit Impact assessment report along with undertaking for processing their application for regularization of groundwater abstraction for mining. There by **M/S. Raga, Tradecon Pvt Lmt Bhubaneswar** through **WCS Bhubaneswar** has engaged MRCAWTM, CGWA Accredited Groundwater Institution (Certificate No.-CGWA/RGI/025) vide work order dated 4th April 2022 to carry out the hydrogeological investigation along with impact assessment study incorporating socio-economic assessment study on groundwater regime due to withdrawal/ dewatering of groundwater by the proposed Netrabandha Pahar (West) Block Iron Ore mine (**Fig 1.1**) as per the prescribed format of CGWA.

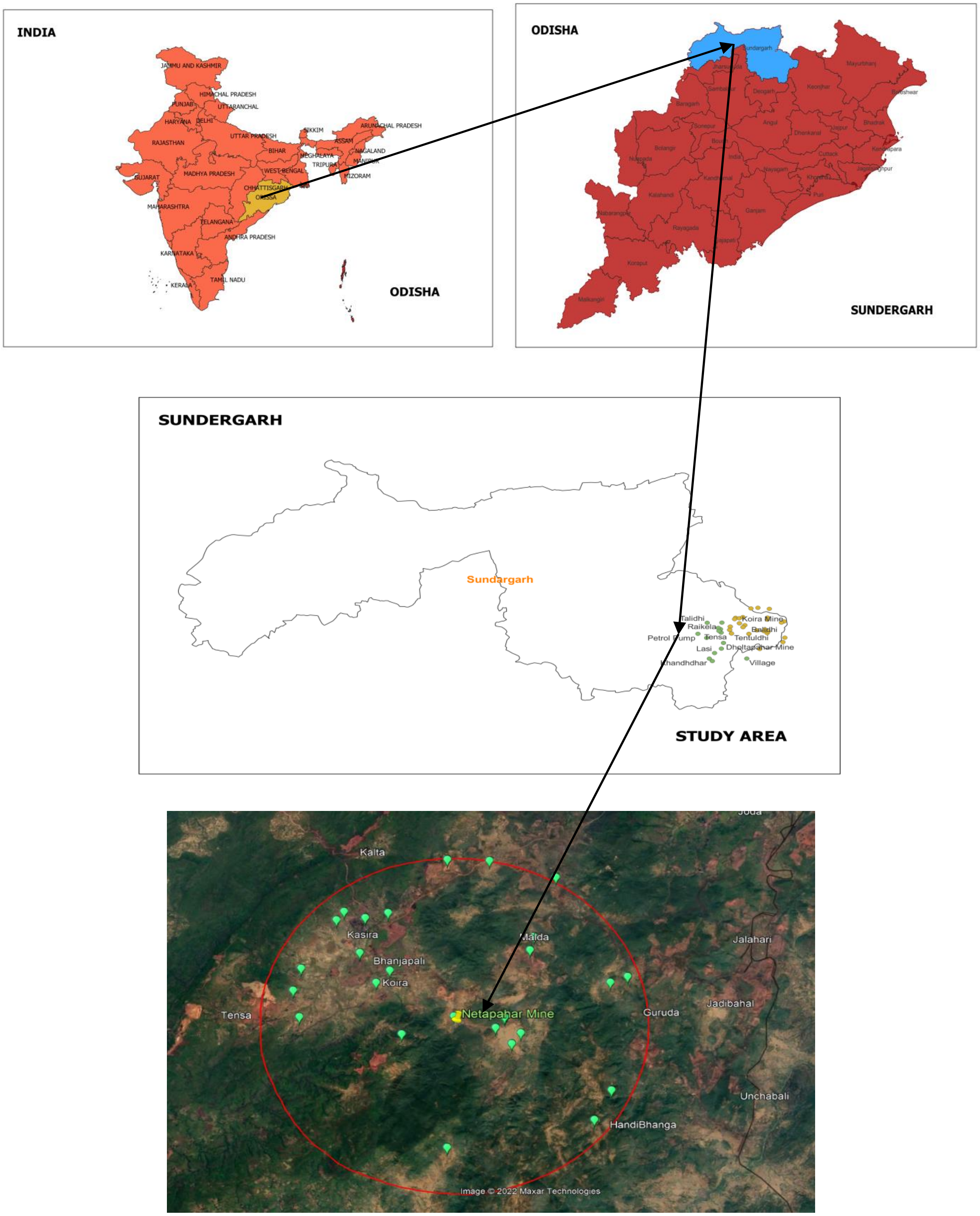


Fig 1.1: Location Map of Netrabandha Pahar Fe Ore Mine, Odisha

1.2. Scope of the study

The scope of study includes hydrological study around mine and providing certificated report along with providing guidance on techno-legal aspects and compliance for obtaining NOC from CGWA as per latest guidelines. Detailed hydro geological investigations within core and buffer zones (10km radius study area) of Netrabandha Pahar (West) Block for Iron Ore leased to M/S. Raga, Tradecon Pvt Lmt Bhubaneswar and assessment of impact of mining on groundwater regime in the study area which covers parts of Koira Tehsil of Sundergarh district, Odisha. As the mine is generating only 117.5 m3/day discharge thus groundwater modeling is not required along with impact assessment report for this case as per the CGWA guideline.

1.3. Project description

M/S. Raga, Tradecon Pvt Lmt. Bhubaneswar is a registered firm under Minerals (Development and Regulation) ACT, 1957 and The Mineral (Auction) Rules, 2015, Govt of Odisha. Netrabandha Pahar (West) iron ore Block located in Koira Tehsil of Sundargarh district of Odisha. The corporate identity Number of the company is U51420MH1995PTC162317. The total lease area of Netrabandha Pahar (West) Iron ore mine is 74.3700 ha. As part of the statutory clearance, the Mining Plan and Progressive Mine Closure Plan is prepared under Rule 16(1) of MCR, 2016 and Rule 23 of MCDR, 2017respectively for a period of 5 years from the date of opening of the mine for grant of Mining Lease in favor of M/s Raga TradeconPvt Ltd. The registered office is situated at State of Maharashtra(Mumbai) having is regd. office at 503, 5th floor, Greenland Apartment, Building no.3, JB Nagar, Andheri East, Mumbai- 400059, Maharashtra to carry on all or any of the business as manufacturers, buyers, sellers, suppliers, traders, exporters, minerals, metals etc. The company has planned to establish pellet plant in Sundergarh/Keonjhar district of Odisha with a period of two years. Total ore reserve estimation in the lease area is 17274072 tonnes. Estimated total production of ore during five year would be 3249000 tones. Therefore, remaining reserves will be 17274072MT-3249000MT=14024082MT. The production of Iron Ore @ 1000000MT per annum, life of the mine will be 14024082MT/1000000MT=14.02 years say 14 years. Therefore life of the mine will be 19 years which includes 5 year of plan period and 14 years of conceptual period.During the plan period, it has been proposed to produce 1.0 MTPA iron ore per annum. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc

Location

M/S. Raga, Tradecon Pvt Lmt Bhubaneswaris located in Bhaliadihi Village, Koira Tehsil of Sundargarh District, Odisha. Bhaliadihi village is located in north east part of Sundergarh district. The study area falls under survey of India toposheet no F45N1N and F45N5N. Sanputli village is 1 km away from the study area. Nearest railway station is Barsuan which is 23 km away from the lease area.The lease area of mine (Fig 1.2) is not located within 10km radius of

National Park /Wild Life Sanctuary / Protected area and don't falls under Coastal Regulation Zone (CRZ). Few shallow depth open cast pits mine are present in the study area.

Fig 1.2: Google image showing proposed area of Netrabandha Pahar (West) block iron ore mine pillar location.

1.4. Land use and Land cover (LULC) change in the study area

The total lease area of the proposed Netrabandha Pahar (West) block iron ore mine is 74.3700 ha (743700 m²). The mine area is situated in outer part of the Bhaliadihi village surrounded by hills and forest area. The land use of the mining area is given in Table no 1.1 the percentage has been represented through a pie diagram in. The nearest village is Jatapur Khappa located 0.8 km away from Netrabandha mine. Around 40 villages are located under 10km radius zone of the study area. (Annexure-1)

Comparison of LULC during 2017 and 2021 within the 10 kms radius of mine area show marginal changes in agriculture use, forest cover, built up area, as shown in figs and tables -1.1 & 1.2, however area under water body has increased from 4.683 ha to 41.484 ha due to accumulation of water into someabandon mine pitsand due to construction of water conservation structures in the area.

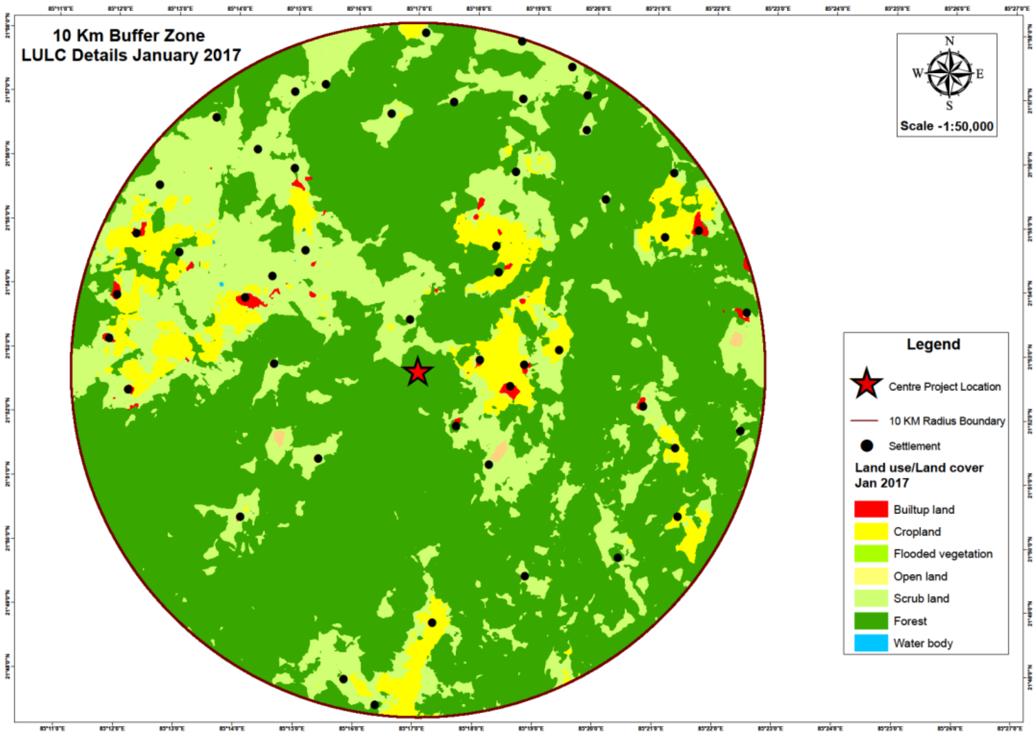


Fig: 1.3 Map showing LULC of Netrabandha Pahar (West) block Fe Ore Mine of 10km buffer zone (Jan 2017)

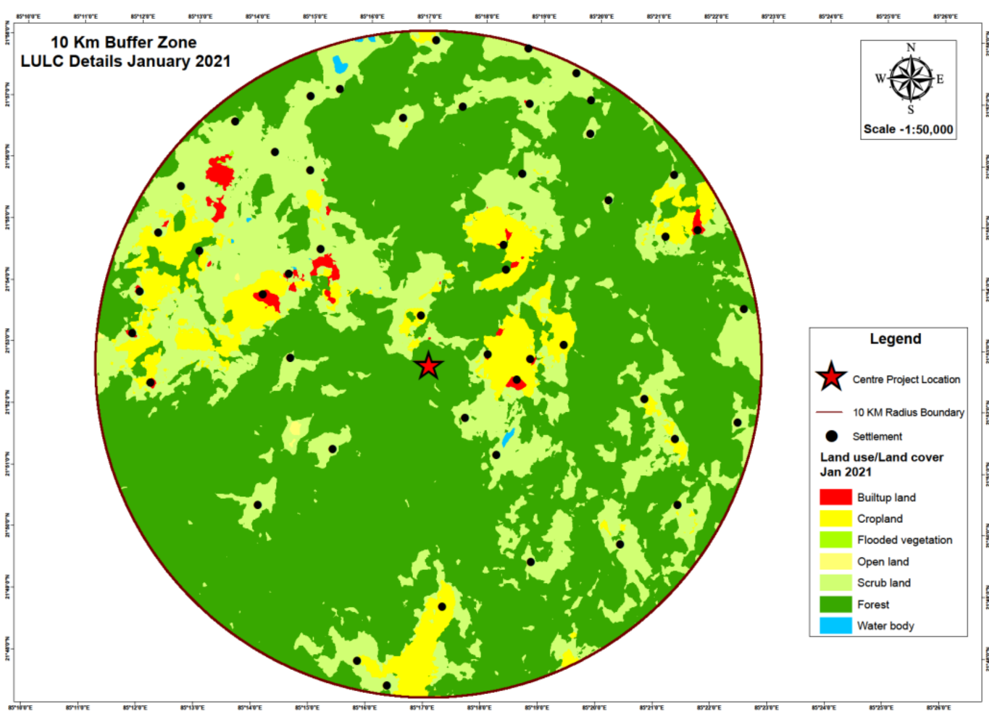
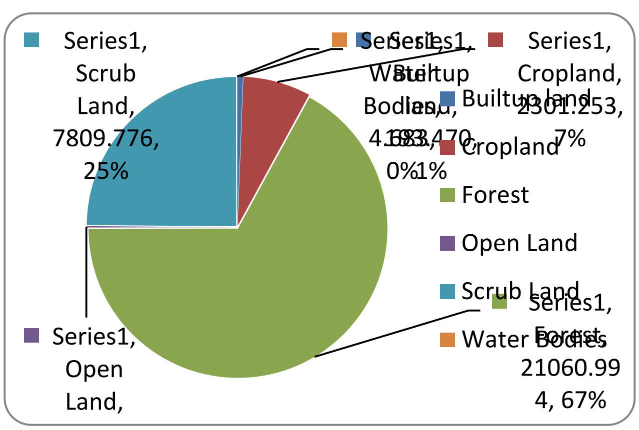


Fig 1.4: Map showing LULC of Netrabandha Pahar (West) Fe Ore Mine of 10km buffer zone (Jan 2021)

Table 1.1: LULC 2017 of study area **Table 1.2 LULC 2021 of study area**

Sl.No	LULC Type 2021	Area(Ha)
1	Built up land	272.881
2	Cropland	2350.058
3	Forest	20449.000
4	Open land	22.595
5	Scrubland	8272.331
6	Water Bodies	41.484
7	Flooded vegetation	7.195
Total Area(10 km Buffer Zone)		31415.545
	LULC Type 2017	**Area(Ha)**
1	Built up land	193.470
2	Cropland	2301.253
3	Forest	21060.994
4	Open Land	45.407
5	Scrub Land	7809.776
6	Water Bodies	4.683
Total Area(10 km Buffer Zone)		31415.582



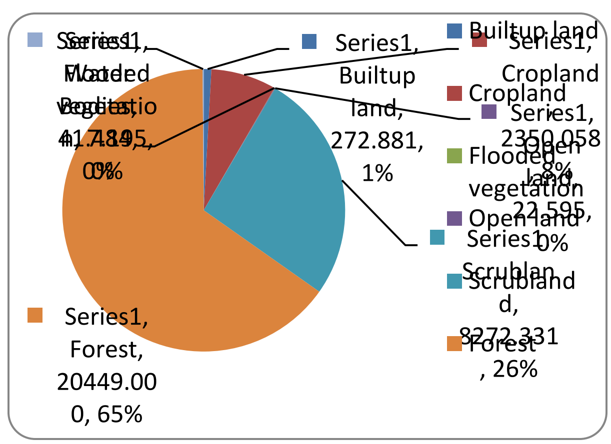


Table 1.3 LULC in core zone within the mine lease area				
Sl. No.	**Particular**	**Area put to use at Start of Year (ha) (A)***	**Additional Requirement (ha) (B)***	**Total (ha) (C = A + B)**
1	Area under Mining	0.00	4.012	4.012
2	Topsoil stacking	0.00	0.00	0.00
3	Overburden/Waste Dumping	0.00	1.375	1.375
4	Mineral Storage	0.00	7.087	7.087
5	Infrastructure (Workshop, Administrative Building,Magazine with safety zone, Parking Plaza and safety zone.)	0.00	4.592	4.592
6	Roads	0.00	4.339	4.339
7	Railways	0.00	0.00	0.00
8	Tailing Pond	0.00	0.00	0.00
9	Effluent Treatment Plant	0.00	0.00	0.00
10	Mineral Separation Plant	0.00	1.147	1.147
11	Township Area	0.00	0.00	0.00
12	Others to Specify(Check Dam)	0.00	0.00	0.00
Total		**0.000**	**22.552**	**22.552**

1.5. Topography and Drainage

Netrabandha Pahar (West) block is a part of Koira group of upper Shale formation. Study area having steep rising hills with intervening steep gorge and narrow valley. The geomorphic sub-units like the pediments, pediplains, buried pediments, valley fills, and lineaments are the predominant in the hard rock areas in study area. The highest elevation is 867.2m amsl and lowest elevation is 366.28m amsl.(Fig 1.3 & 1.4)

Study area is covered with different hills with intervening intermontane valleys, isolated hillocks and flat to gently undulating plains. The area is drained by IB and Brahmani River and its tributaries. The easterly flowing Sankh and westerly flowing Koel River join at Vedavyas near Rourkela to form the Brahmani River. The river, IB a tributary of Mahanadi controls the drainage of the western parts of the district. The drainage pattern of the area is dendritic. (Fig 1.5)

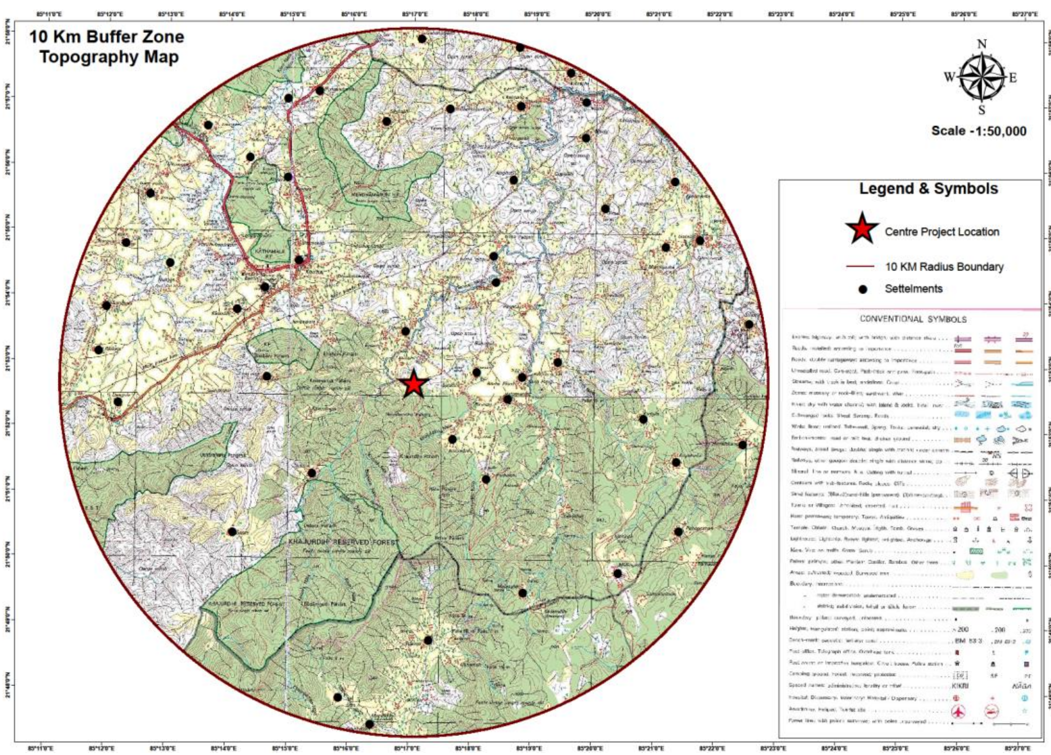


Fig 1.5: Topography Map of 10km buffer zone.

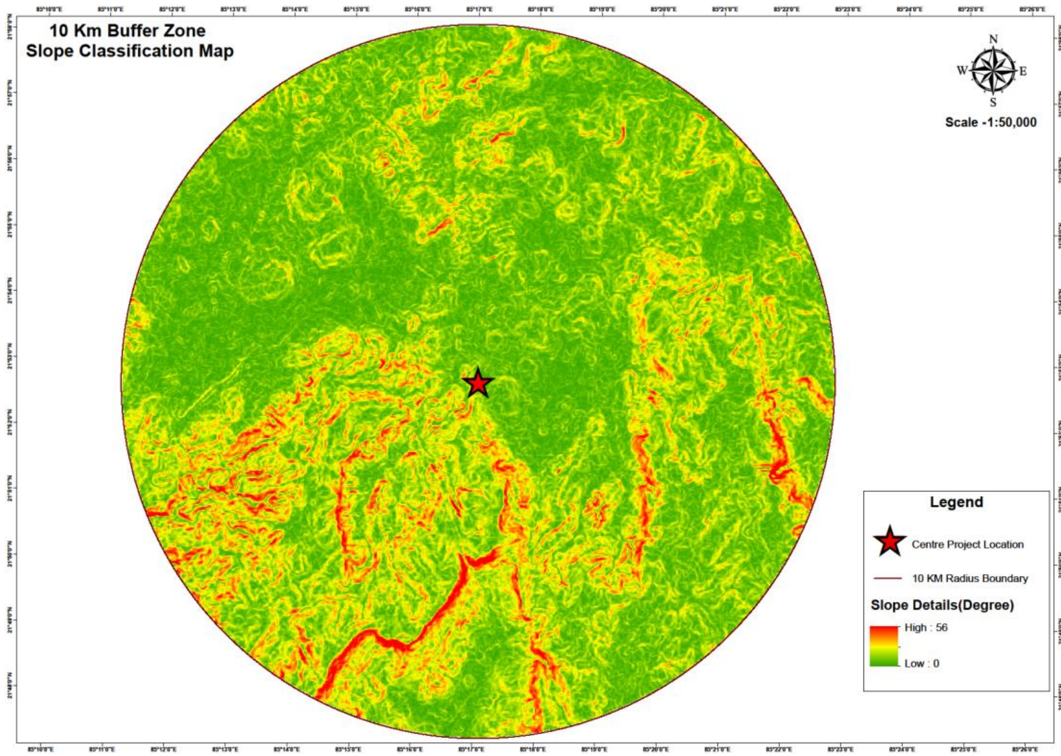


Fig 1.6: Slope map of Netrabandha Pahar (West) block Fe mine in 10km buffer zone.

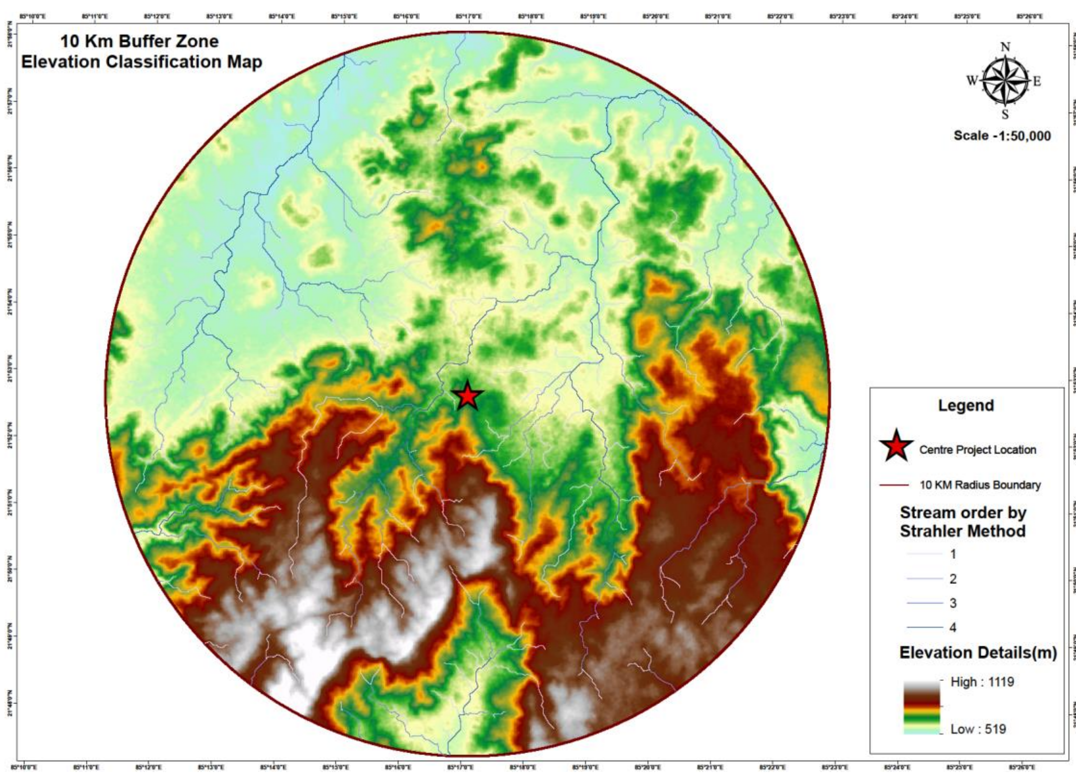


Fig 1.7: Drainage map and digital elevation map in 10km buffer zone

2. Groundwater Situations

Sundergarh district is North Western part of Odisha state. Sundargarh is recognized as an industrial district in the map of Odisha. Steel Plant, Fertilizer Plant, Cement factory, Ferro Vanadium Plant, Machine building factory, Glass and China clay factory and Spinning mills are some of the major industries of this District.Large part of the study area belongs to Bhaliadihi Village, Koira Tehsil of Sundargarh District, Odisha. Ground water is the main source of drinking as well as industrial and domestic purpose. However, the requirement of water in irrigation and agriculture is fulfilled mainly by river, canals as well as by rainwater. The rainwater also is the main source for recharge of groundwater of the area. The following major subtopics that are covered in this particular chapter are:

2.1Geology and Geomorphology
2.2 Climate and Rainfall pattern
2.3 Groundwater regime monitoring
2.4. Long term groundwater trend
2.5 Groundwater resources
2.6 Groundwater quality

2.1 Geology and Geomorphology

2.1.1. Regional Geology

Sundergarh district is rich in Iron ore, limestone, manganese, dolomite, and fire clay. Banded Iron Formation (BIF) and Iron ore deposit occupy three distinct provinces surrounding the North Odisha Iron Ore Craton (NOIOC). They are Bonai-Keonjhar belt in the western side of the Craton, Badampahar Gorumahisani- Suleipat belt in the eastern flank and Daitari-Tomka belt in the southern side of the Craton. All of these three belts having best preserved basin of Precambrian age that form Iron Ore Super Group (IOSG) of Odisha. Sundergarh district lies under Western flank by the Bonai –Keonjhar (BK) belt forming U shaped synclinoriumwhich is known as the Horseshoe belt. Iron Ore Super Group (IOSG) Odisha, rock assemblages is belonging to Singhbhum – North Odisha Iron Ore Craton. There are three or more Iron Ore Group existing in the IOSG such as Badampahar Group, Noamundi Group and Koira Group. These groups are separated by unconformity, different metamorphic grade, distinct sedimentary and igneous assemblages and ore types. (Fig 2.1)
The Mayurbhanj granite occurring along the eastern fringe of the Singhbhum granite was dated to be 3100Ma. The A type Mayurbhanj Granite Pluton (3.09Ga) occurring along the eastern margin of the Singhbhum – Odisha Craton, eastern India, represent the final phase of acid plutonism in this crustal block of Archaean age.

I. **BIF-1: Badampahar – Gorumahisani – Sulpet Belt**

BIF-1 comprising of iron formation of Badampahar Gorumahisani – Sulpet (BGS) Belt. The litho assemblage of this oldest Iron Ore Group consists of banded cherty quartzite, tremolite- actinolite schist and fuchsite quartzite. The Badam Quartzite is well exposed in the western side of BGS. Banded magnetite quartzite is the dominant litho unit in the BIF-1. The major mineral constituents are Magnetite, martite, hematite, specularite, goethite, grunerite, and quartz. The BIF-1 has suffered amphibolites facies of metamorphism.

II. **BIF – II: Daitari- Tomka Belt**

The BIF-II lying in the southern portion of the North Odisha Iron Ore Craton is confirmed to Daitari – Tomka belt. It is underlain and overlain by Badampahar quartzite and Dhanjori quartzite. The litho assemblage of this belt consists of banded magnetite/hematite quartzite, banded magnetite/hematite jasper, quartz sericite schist, phyllite, slate and banded chert. The rocks of BIF –II attain green schist facies of metamorphism.

III. **BIF – III: Bonai- Keonjhar Belt:**

BIF-III is a U- shaped pattern in the western flank of the NOIOC that rests over the Dhanjori Quartzite. The litho association of this area forms the youngest Iron Ore Group comprising of banded hematite jasper, banded hematite quartz/cherty, banded shale, banded manganese formation and ferruginous shale. The banded iron formation consist of predominantly iron oxide mineral such as hematite, martite, specularite, and magnetite. The litho assemblage of this youngest iron ore belt is unmetamorphosed and lack of intrusive. (Fig 2.2)

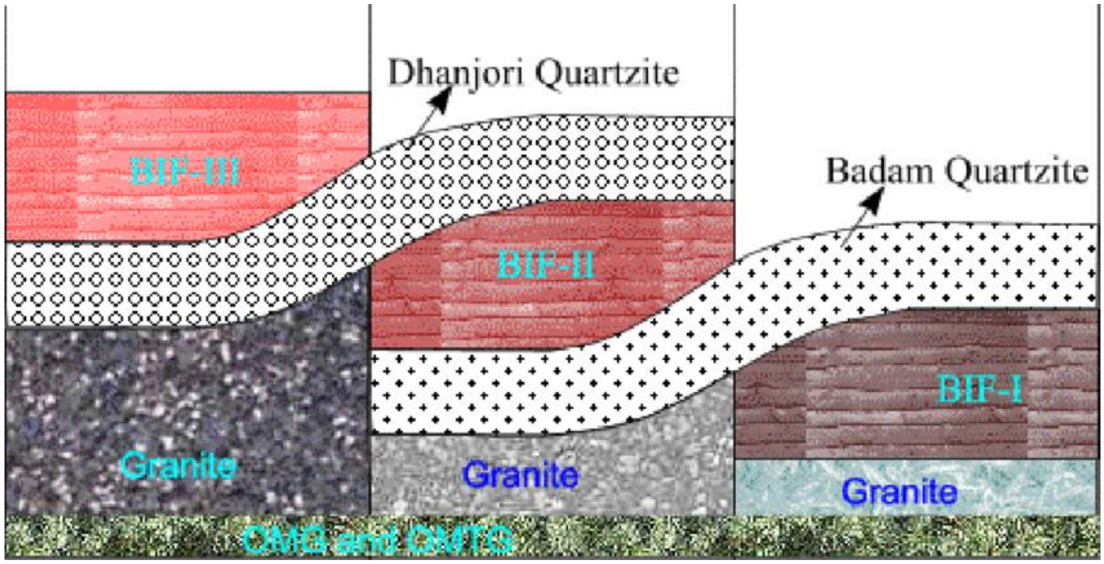


Fig 2.1: Schematic diagram of stratigraphic setting of three BIF of IOSG (Beura et al.2016

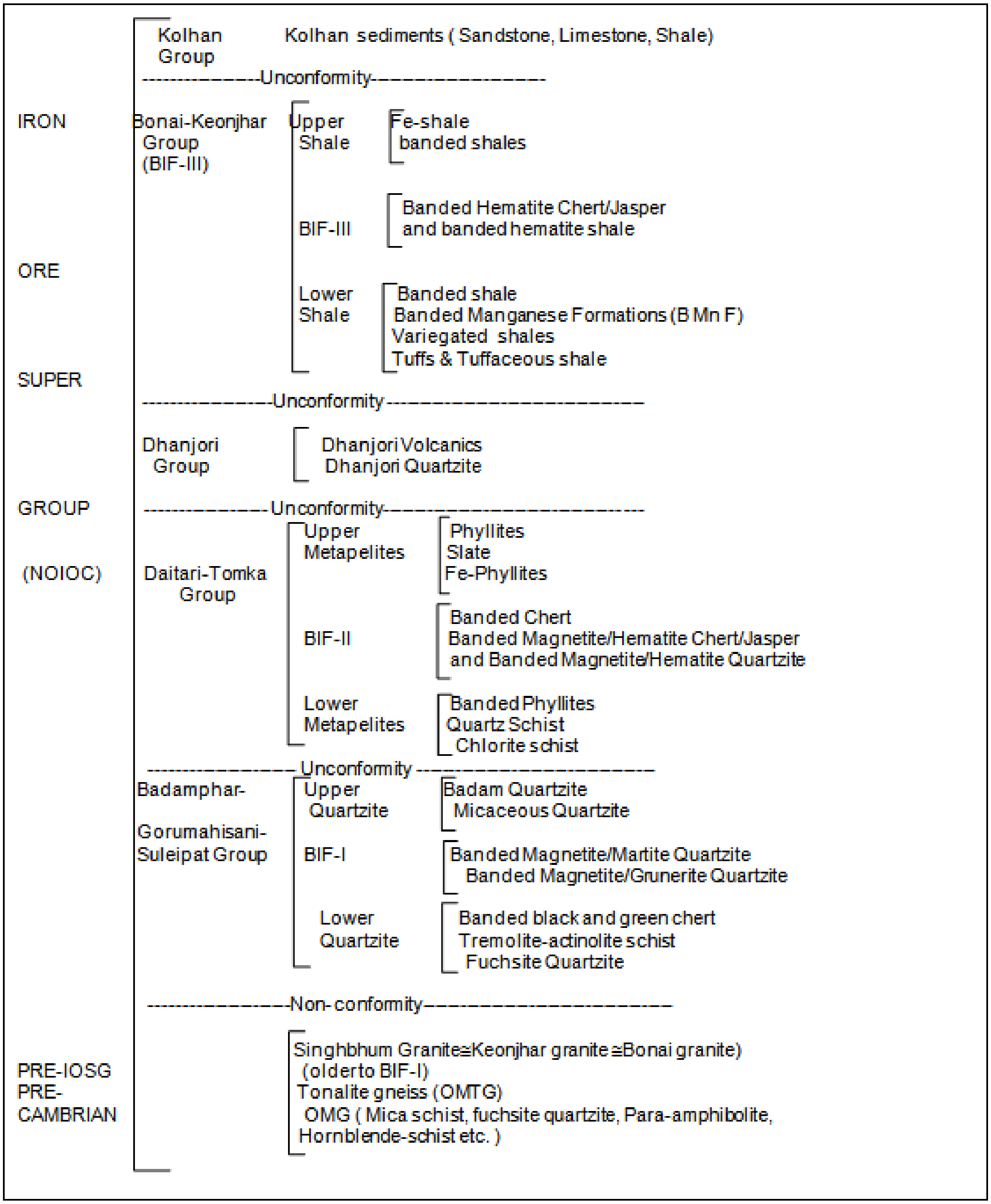


Fig 2.2: Stratigraphic Succession of Iron Ore Super Group of Odisha (Beura et al.2016).

2.1.1. Local Geology

The study area is occupied by the rocks of Koira Group (Table 2.1). This belt is 60 km long and 25 km wide extending from south of Malangtoli in Keonjhar district up to Chakradharpurin West Singhbhum district (Jharkhand).The western syncline known as Koira syncline, due to steep dip and overturned nature of its limb forms a deeper basin with thick sequence of younger shales in the core region. On the other hand, the eastern syncline known as Bamebari syncline is a shallower basin and exposes younger litho members within the core region as outliers. The Upper shale unit within the Koira syncline is more or less continuous. The general strike of beddingis in N100W–S100E direction with occasional swing to N300E-S300W, having 20° - 40° dip towards west in the area.The area under investigation lies within the Upper Shale Formation of the Koira Group as described by Murthy & Acharya (1975)

Table 2.1: Startigraphy of Koira Group in Sundergarh district, Odisha		
Soil Laterite		
Koira Group	Upper ShaleFormation	Shale's of different color like purple, yellow with inter beds of Iron ore
	Banded Iron Formation	Coarsely banded BHJ followed up by finely banded BHJ and iron ore in the eastern block.

Netrabandha Pahar Iron ore Block of M/s Raga Tradecon Pvt Ltd is belonging to Singhbhum iron ore series and main rock type in the study area are Laterite, Hematite, and Shale. Geologically, the area is underlain by Pre – Cambrian crystalline rocks like Granite, Granitic Gneiss, Banded Hematite Jasper, Quartzite, Slate, Phyllite, and Mica Schist.

Laterite

Laterites are observed in the study area including ML area that has been the resulted from a process of residual weathering. Laterite has been developed mostly over the shale unit or low grade iron ores of the area. The shale rich in alumina has given rise to aluminous laterite and those rich in iron have developed ferruginous laterites. Ferruginous laterite occupies most of the high lands in the vicinity of iron ore of central ridge while aluminous laterite occurs in the extremeeast of the area.

Shale

Western side study area has occupied with fine laminated rock having different shades of colors ranging from brownish to purple grey. Different colors of the Shale are largely dependent of minerals compositions.It is mostly composed of clayey micaceous minerals, with lenses of chert.

Iron Ore

Iron formations are economically important meta sedimentary rocks that occurs most commonly in Precambrian sedimentary succession. Based on surface exposures and sub-surface geology 4 (four) types of iron ore are recorded in the explored block(Fig 2.1). These are Hard Laminated Ore (HLO), SoftLaminated Ore (SLO), blue dust (powdery ore), lateritic ore and float ores. The general strike of iron ore is in N100W–S100E direction with occasional swing to N300E-S300W, having 20° - 40°dip towards west in the study area.

2.1.3 Geomorphology & Soil Type

Geomorphology: The district has varied geomorphological features. The geomorphic units are (I) Plain (ii) Deep Buried Pediment (iii)Shallow buried pediment (iv) Intermontane valley (v) Inselberg, (vi) Mesa & Butte, (vii) Residual Hills, (viii) Intermontane Valleys, (ix) Structural hills.The soil characteristics of the district show wide variation depending upon their occurrence, physical and chemical properties. The soil of the district is broadly grouped into (I) Alfisols (II)Ultisols(CGWB Report).

I. Alfisoil and Red Soil

The study area is covered with red sandy soils and red loamy soils. These soils predominantly occupy high and medium land throughout the Sundargarh district. The characteristics feature of Red soil is porous and fragile in structure. These are usually deficient in nitrogen, phosphate, organic matter and lime. These soils are suitable for cultivation of paddy and other crops.

II. Ultisoils

The ultisols comprises mainly of lateritic soils and red and yellow soils. These soils are mildly acidic in nature and deficient in nitrogen, phosphorous and potassium and organic matters. Soils of the district are generally having average to good fertility status. All common types of crops can be grown in the district.

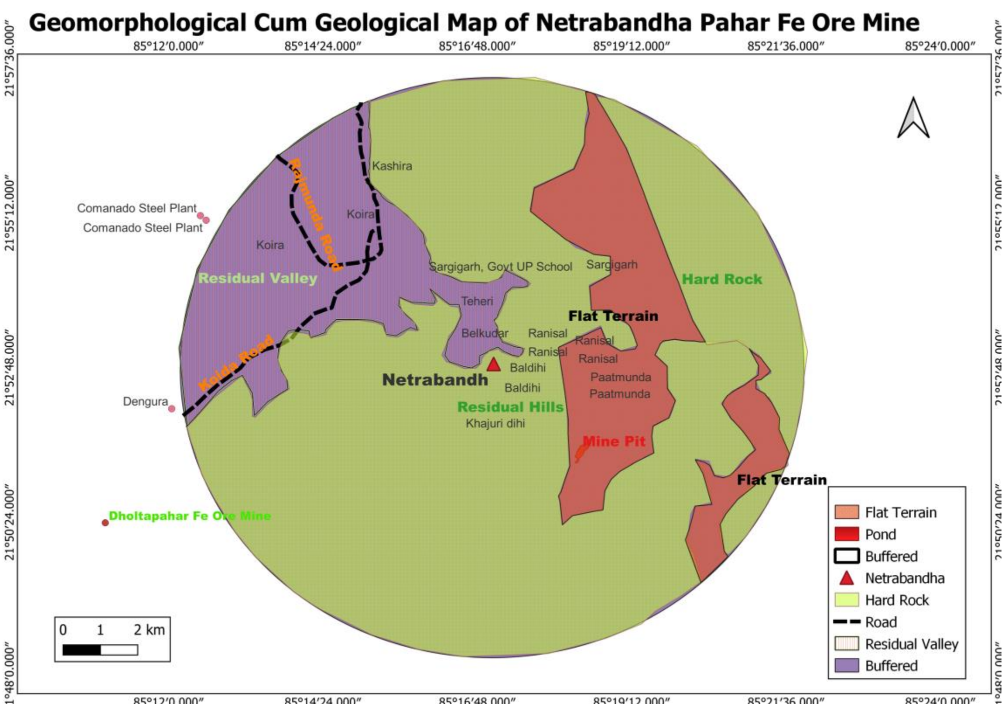


Fig 2.3: Geomorphological cum Geology map of Netrabandha Pahar (west) Fe Mine

2.2. Climate and Rainfall pattern

The climate of the district is sub tropical climate characterized with hot and dry summer, cold winter and erratic in rainfall.The winter season extends from November to end of February, which is followed by summer season from March to the middle of June, and rainy season from middle of June to middle of October. During summer months the maximum temperature rises up to 43° C and May is the hottest month. December is the coldest month of the year when the average daily temperature drops down to 8° C. Relative humidity is around 60-70% throughout the year. The highest and lowest monthly mean relative humidity so far recorded is 97% (Dec) and 26% (April). The annual rainfall of last decade is given in Table 2.2.

Table 2.2 Decadal Rainfall in Sundergarh District (Source: WRIS online portal) 2011-2020

Year	Actual Rainfall (mm)	Deviation (%)	Year	Actual Rainfall (mm)	Deviation (%)	Average Rainfall (mm)
2011	1788.35	20.87	2016	1098.51	-28.82	1415.126
2012	1435.18	1.39	2017	1323.91	-6.8	
2013	1537.77	7.97	2018	1396.59	-1.32	
2014	1335.09	-5.99	2019	1387.02	-2.02	
2015	1286.6	-9.9	2020	1562.24	9.4	

2.3. Groundwater regime monitoring:

The study area comprises 10km radius zone in Netrabandha Pahar (West) iron ore Block located in Koira Tehsil of Sundargarh district of Odisha.Detailed hydrogeological study of both core and buffer zone of mine area is carried out.The hydrogeological condition varied from place to place due to different litho unit of aquifer.The hydrogeological units of the study area are broadly categorized into twogroups namely.

1. Consolidated formations.
2. Unconsolidated formations

1. Consolidated formations

The study areais occupied by the consolidated formations comprising of Precambrian metasediments of Gangpur series and Iron ore series and also granite gneiss, metasediments like amphibolite, epidiorite etc. Ground water is stored mainly in the secondary porosity resulting from weathering and fracturing of the rocks. Ground water occurs under confined to semi-confined condition in the deeper fractured zones. Water yielding capacity is mainly depend on the extent of fracture, depth, opening and size of fracture. Mica schist, quartzite and phyllite are the formation in the study area.

Table2.3: Well inventory data of Dug wells of Core and buffer zone of NetrabandhaPahar (West) Mine (Lat & Long data are as per GPS reading, DO, EC, pH, and TDS measured on site using calibrated Hanna portable equipme during (April 2022).
CORE ZONE

Sr no	Location	Latitude	Longitude	Elevation (m)	EC (µmS)	pH	TDS (ppm)	Depth of the well (m)	Water Level(m)	Diameter(m)	DO (mg)
1	Baldihi	21.87667	85.297367	625.4	580	6.9	310	70.5	36.3		
2	Baldihi	21.87741	85.298323	639.37				10.5	3.7	2.2	
3	Baldihi	21.87799	85.298723	640.23	150	6.8	70				2.0
4	Khajuridihi	21.86364	85.293346	664.9							4.5
5	Teheri	21.8952	85.285082	623.02	70	6.4	40				6.1
6	Ranisal	21.88696	85.304426	629.56	280	6.7	140				2.4
7	Ranisal	21.88416	85.305325	596.84							4.
8	Ranisal	21.88596	85.304356	622.85	130	6.8	70	11.3	7.5	2.5	1.0
9	Ranisal	21.88695	85.304342	623.11	120	6.8	60	37.87	16.5		4.9
Buffer Zone											
10	Paatmunda	21.87555	85.308419	617.73							1.
11	Paatmunda	21.87508	85.308162	623.8	100	6.4	50				3.
12	Sargigarh	21.90469	85.30736	599.98	600	6.4	300	66.66	18.1		5.6
13	Sargigarh, Govt UP School	21.90428	85.305595	608.55	90	6.5	50				4.0
14	Sargigarh, Govt UP School	21.90414	85.305645	607.9	95	6.5	45				2.3
15	Sainindipur	21.91163	85.295871	615.81	50	6.3	20				4.9
16	Kalamang High School, Malda	21.95201	85.320045	567.21	450	7.2	220	72.72	30.3		3.
17	Guali Mine area	21.96384	85.317	577							3.2
18	Rengalbeda	21.95058	85.255734	562.95	40	7.6	20	69.69	30.3		6.0
19	Kashira	21.93019	85.251827	565.3	40	6.5	20				5.9
20	Koira	21.91776	85.2543	568.87	65	6.5	25				3.9
21	Koira, near bus stand	21.90696	85.248041	560.57	280	6.9	150				2.7
22	Koira, near Police Station	21.90702	85.239381	561.55	60	7.1	20	60.6	21.21		6.
23		21.9094	85.232136	573.13	120	6.8	60	10.9	6.4	2.1	5.1
24		21.91343	85.224078	559.84	60	6.5	25				5.
25		21.90547	85.220677	552.92	70	6.1	40				3.
26	Koira	21.90978	85.230875	558.29	120	6.8	60				5.1
27		21.90204	85.250144	568.47	280	7.2	150				2.3

28	Karketasai	21.9018	85.257257	581.28	85	6.9	40				2.4
29	Radhe Krishna Mandir	21.89531	85.240408	588.94	70	6.6	30				2.4
30	Radhe Krishna Mandir	21.8951	85.241608	589.1	30	6.4	20	60.6	26.2		5.1
31	Dengura	21.86933	85.200782	608.26	60	6.5	30				6.
32		21.88532	85.226671	605.57	60	7.2	30				6.0
33		21.88582	85.227661	604.12	75	6.9	35				3.
34	Paatmunda	21.8744	85.308941	608.23	90	6.5	50				6.0
35	Paturi	21.87887	85.314424	591.85	110	6.6	60				2.6
36	Ambilaam	21.88421	85.322733	592.69	80	6.7	40				3
37	Ambilaam	21.86698	85.347937	835.6	20	6.5	10				6.0
38		21.83836	85.336098	865.3	210	7.03	120				3.
39		21.84094	85.34045	867.2							3.
40	Koira	21.90933	85.235269	574.88	20	6.4	10				
41	Dhipasa	21.91018	85.230684	578.12	120	6.5	60				4.
42	Comanado Steel Plant	21.91809	85.209714	573.27							5.9
43	Comanado Steel Plant	21.91927	85.208213	576.61	60	6.7	30				2.1

2. Unconsolidated Formation

Laterite and alluvium are the main constituents of unconsolidated formation in the study area. The laterite is belonging to sub recent to recent age having high porosity. It is the good aquifer for dug well in study area. The alluvium soils are also the potential aquifers due to their high degree of porosity and permeability but are only limited in their occurrence.

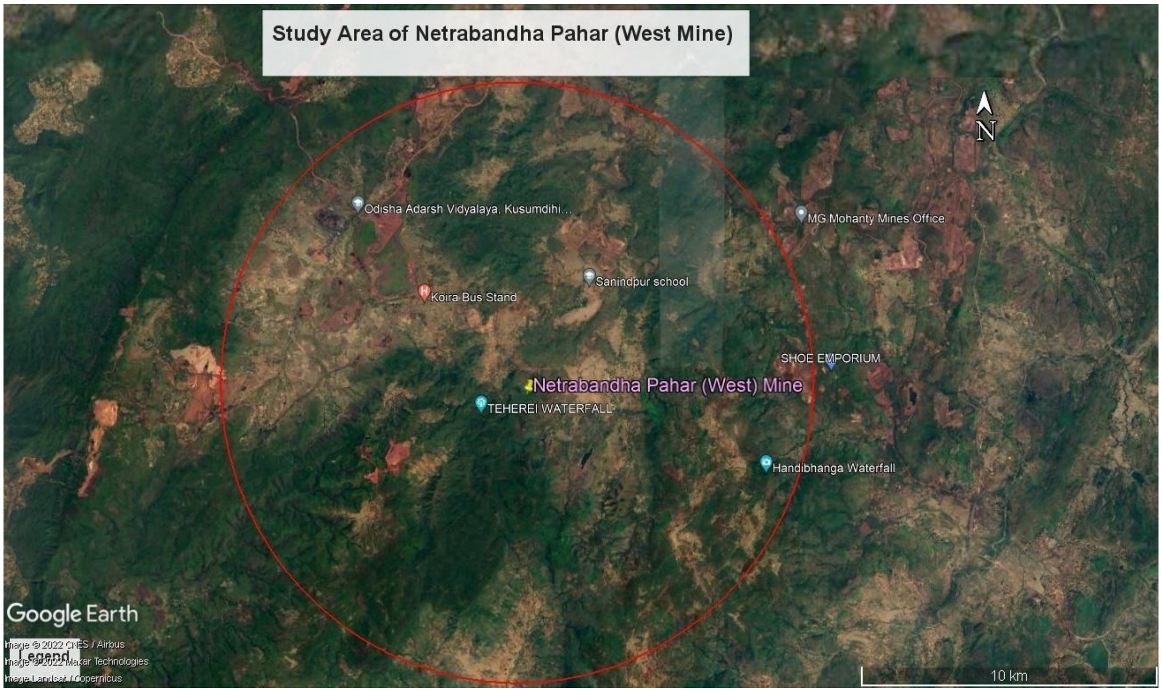
2.3.1 Detailed study of core and buffer zone

As per the field investigation it has been observed the main source of water is from cannel and groundwater. Groundwater is withdrawal from bore well as well as from hand pump (Fig- 2.3). Most of the dug well having water level from 3.7 to 7.5m in pre monsoon period. Total depth of dug well is from 9 to 12m. It has been observed that the borewells are often from 16 to 30m in depth. Ground water is lying in weathered part of hard rock aquifer(Table 2.3). Hard rock comprisesPrecambrian metasediments Like Mica schist, quartzite, phyllite, conglomerate along withgranite . The movement of the ground water in deeper rocks is controlled by the nature, size opening and continuity of joints & fracture present in them.Wells in hard rock generally yield 50 to 70 m3 /day of all the rock types. Schist, phyllite and their variants form very poor aquifers yielding 10 to 30 m3 /day for heavy drawdown. Well inventory of study area (Fig 2.4) in Pre Monsoon (April 2022) period showing groundwater level varies within the range from 3.7 m to 36.3m bgl (Table 2.3)

Fig 2.4: Hand pump and bore well in the core zone of Netrabandha Pahar (west) block

2.3.2 **Aquifer Characteristics**: The study area both core and buffer zone having largely single aquifer of unconfined nature, developed on the weathered part of rocks of Koira Group and laterites. The hill top areas are devoid of any aquifer. Aquifers are developed only in the low laying areas and valley parts of the study area.

The discharge varies from 10 to 70m3/day depending on lithology of aquifer. The transmissivity and storativity is mainly low and drawdown are moderately high to high. Open wells having sustainable yield round the year.The area is categorized under safe zone according to the latest GWR estimation. Ambient quality of groundwater is fresh.



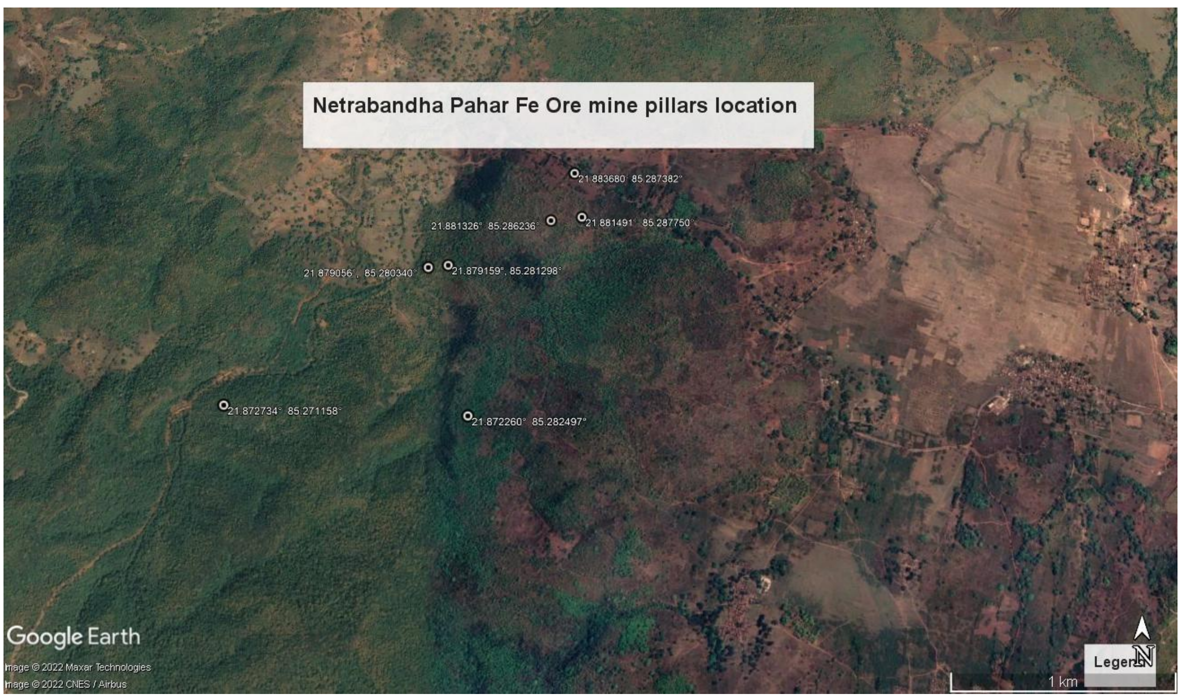


Fig 2.5: Map showing study area in the state Odisha. Pillar location of Netrabandha Pahar (West) at center and position of other villages on google image along with prominent roads. Inventory of wells of these villages are carried out under groundwater regime monitoring.

DTW Map of Core and Buffer Zone of Netranbandha Pahar Fe ore Mine

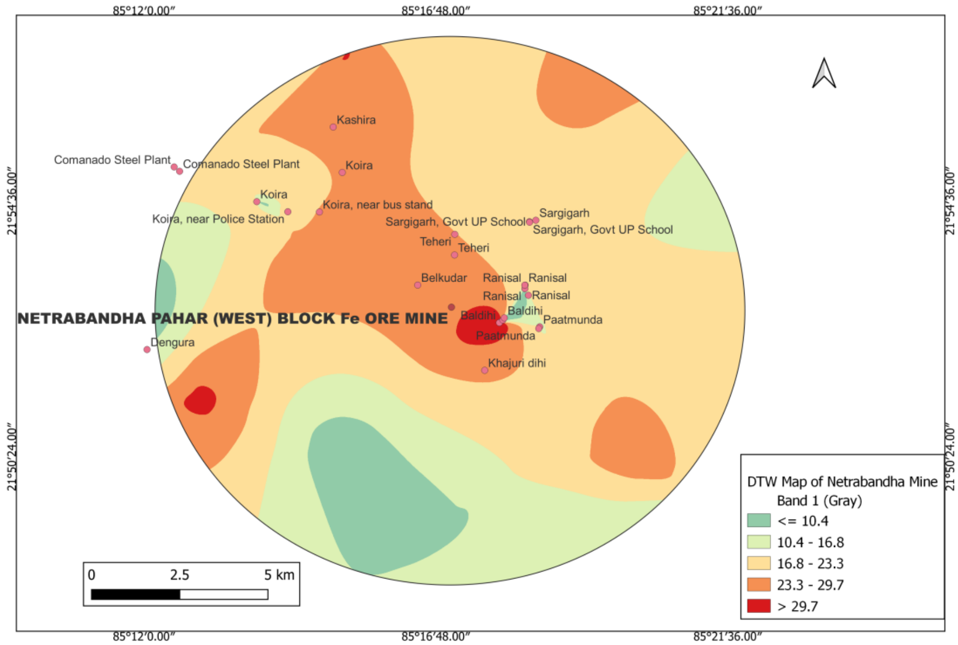


Fig 2.6: DTW map of core and buffer zone.

Groundwater Flow:

The groundwater contour map generated using the intense monitoring in core and buffer zone of mining is depicted in Fig 2.6.The map showing clear cut development of groundwater dived running through the mine area. The GW flow direction largely coincides with the surface water flow direction as shown in fig 1.5. Thus mine is on groundwater divide and any dewatering from mine will not effects significantly the flow direction of groundwater of the area.

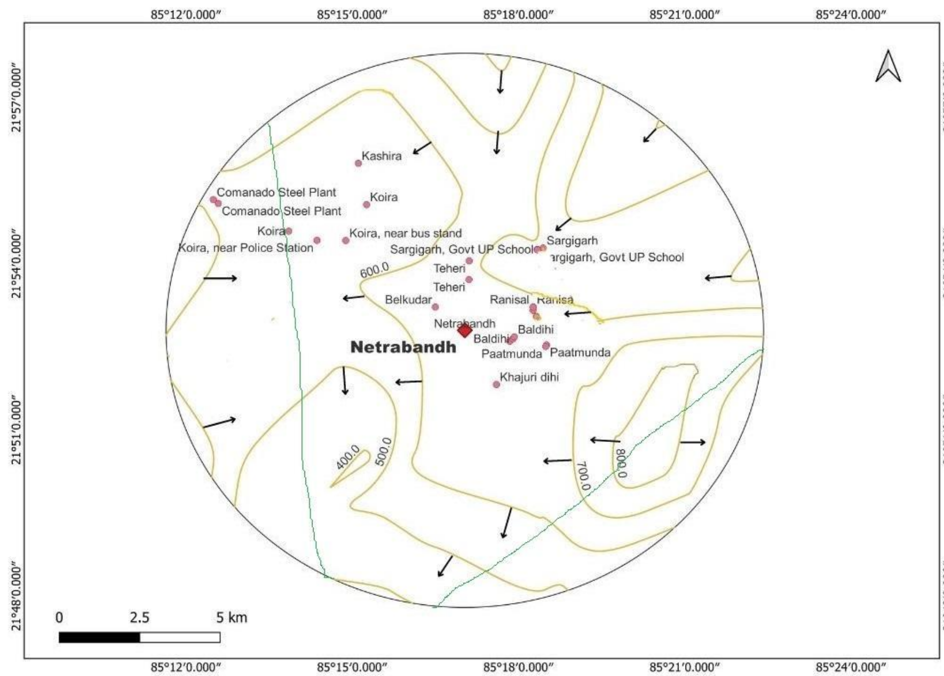


Fig 2.7: Groundwater contour map of Netrabandha Pahar (West bloc) Fe mine area

INDEX – Light Green line shows groundwater division, arrows indicate groundwater flow direction, values indicate groundwater elevation (m amsl), dots indicate data point used for generation of gw contour, buffer zone is marked by 10 km radius circle. Note the mine position is (Red dot).

2.4 Long term groundwater trend

The study area comprises 10km radius zone in Netrabandhapahar (West) block mine that largely fall under Koira tehsil, Sundergarh district, Odisha. In the core zone villages the source of ground water such as bore well; hand pump and pond are used for domestic, irrigation and drinkingwhereout of 3 observation location of dug well, it has been observed that the water level (Pre monsoon 2022) varying from 3 to 7.5m bgl. Long term trend analysis of data obtained from WRIS shows no significant change-rise or fall as depicted in **Fig: 2.5**

Monthly Ground Water trends for Sundargarh from 01-Jan-2011 to 31-Jan-2021

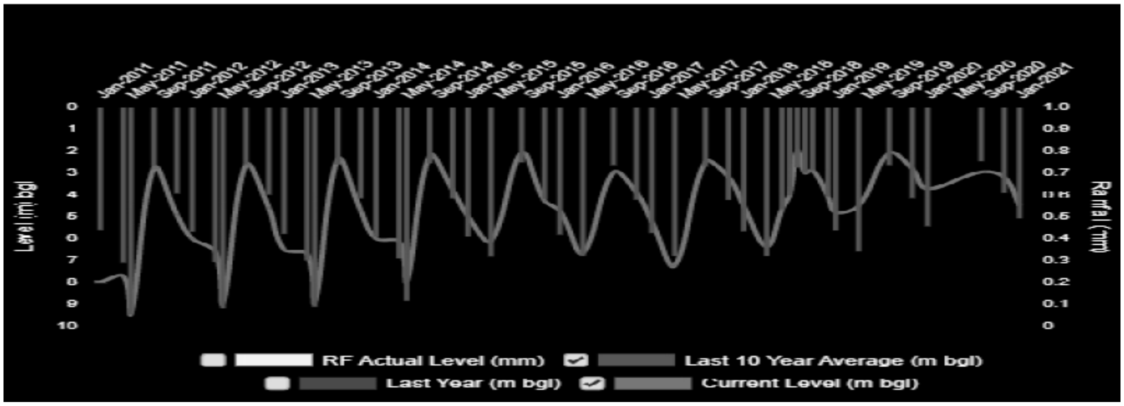


Fig 2.8: Long term well hydrograph of wells of Sundergarh district, Odisha (source: WRIS portal)

2.4.1Dynamic Groundwater Resource of study area:

The groundwater resource as estimated by CGWB (2020) is presented in the table 2.4for Koira block of Sundargarh district Odisha and is in safe category.

Table: 2.4 Block wise Dynamic Groundwater Resources ofKoira block,Sundergarh district, Odisha

	District	Block	Ground water Recharge (Ham)				Total Ground water Recharge (Hamm)	Total Natural Discharge (Ham)	Annual Extractable ground water resources (Ham)
			Monsoon Season		Non Monsoon Season				
			Recharge from Rainfall	Recharge from other sources	Recharge from Rainfall	Recharge from other sources			
1	Sundergarh	Koira	4777.33	139.58	572.73	172.14	5661.78	283.09	5378.69
	Annual Extractable Ground water Resources (Ham)	Annual Groundwater Draft (Ham)				Annual GW allocation for Domestic use as on 2025 (Ham)	Net Groundwater availability for future use (Ham)	Stage of Ground water Extraction (%)	Categorization (over exploited/ Critical/semi critical/ safe/ saline)
		Irrigation	Industrial	Domestic	Total Extraction				
2	5378.63	873.45	290.16	265.25	1428.8	304.71	3910.38	26.57	Safe

2.5 Groundwater Quality

Based on the above study, different ground water parameters were computed, which include pH, TDS, EC, DO, Temperature. Ground water in study area is potable with pH ranging 5.9 to 7.6 and total dissolved solid (TDS) ranging from 10 to 310 ppt and EC ranging from 20 to 600 µS. (Fig 2.9 and 2.10) Groundwater quality in the study area is fresh and all major and trace elements are found within the BIS 10500 permissible limit. Thus is suitable for all domestic, industrial and irrigational use. The general parameters of groundwater in study area as analyses are given in Table 2.5.The comparison of data reveal that the area mining (Project Area) is having less TDS).

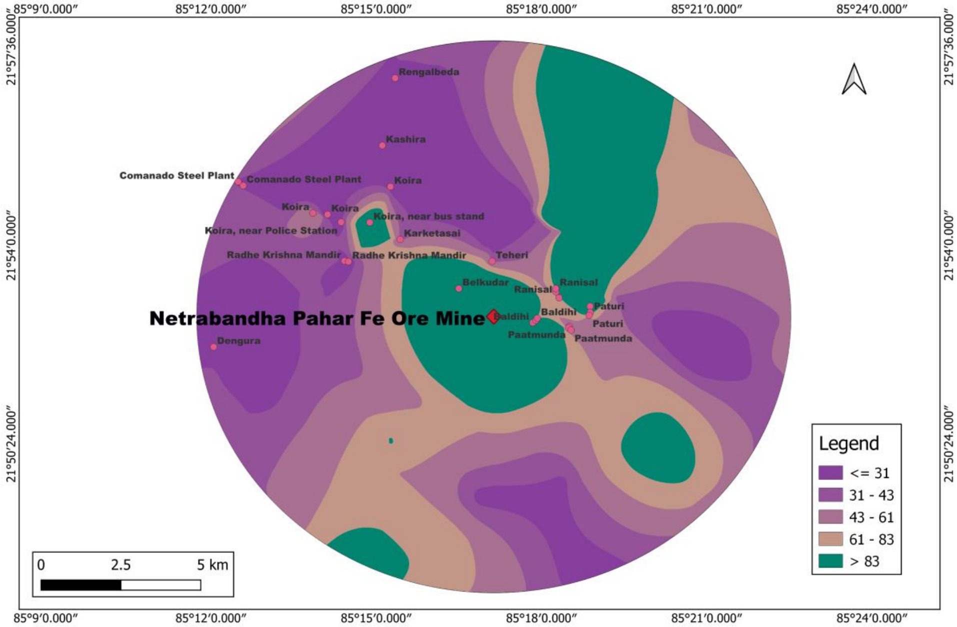


Fig 2.9: **TDS map of Netrabandha Pahar block Fe ore mine**

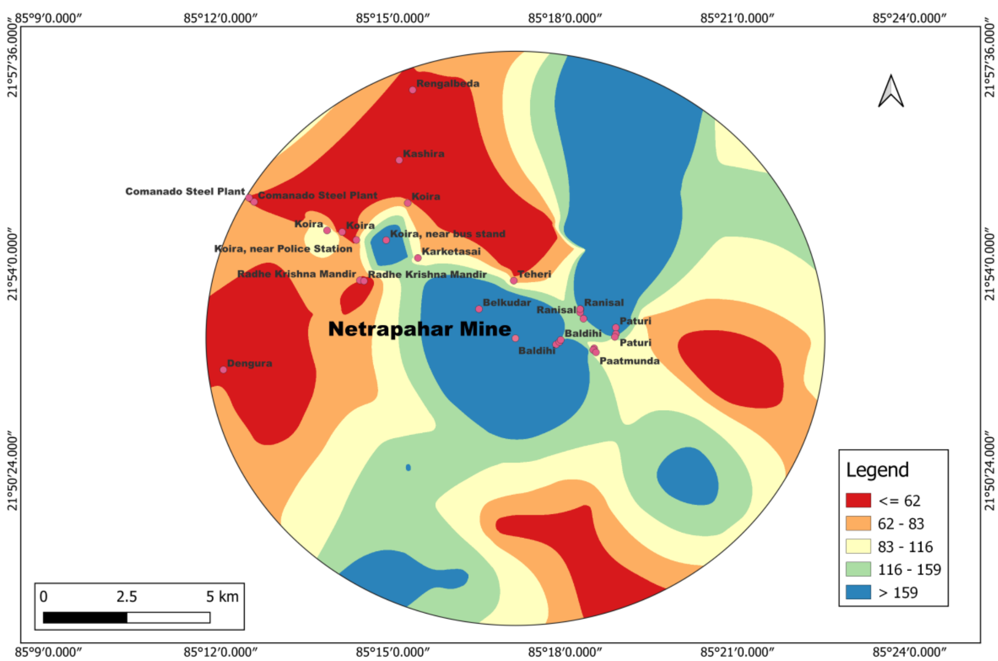


Fig 2.10: **EC map of Netrabandha Pahar (West) block Fe ore mine**

Water Quality Data in Piper Trilinear Diagram: Different graphical methods can be adopted for representing geochemical variation which gives a better insight into the groundwater quality monitoring. One such efficient method of representation is plotting of Hill Piper Trilinear diagram in which data are plotted in two triangle fields and one diamond field. The diamond is then classified under various categories emphasizing their characteristics.

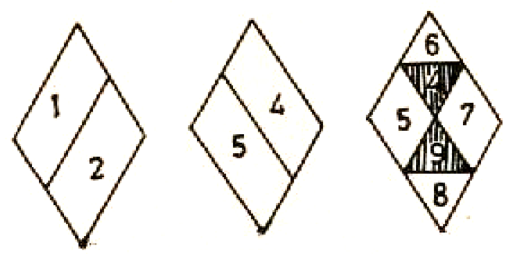


Fig2.11: Sub-divisions of the diamond field

On the basis of data collection from CGWB report (2020-2021). It has been observed that out of 63 samples are concentrated in Area 6 indicating that: Non-carbonate hardness exceeds 50% i.e., Ca + Mg - (SO4 + Cl + NO3). 50% samples are lies under area 4 representing strong acids (SO4 + Cl + NO3) exceed weak acids (CO3 + HCO3). Few samples can be noticed under Area 7: Non-carbonate alkali exceeds 50% i.e., Na + K- (SO4 + Cl + NO3).

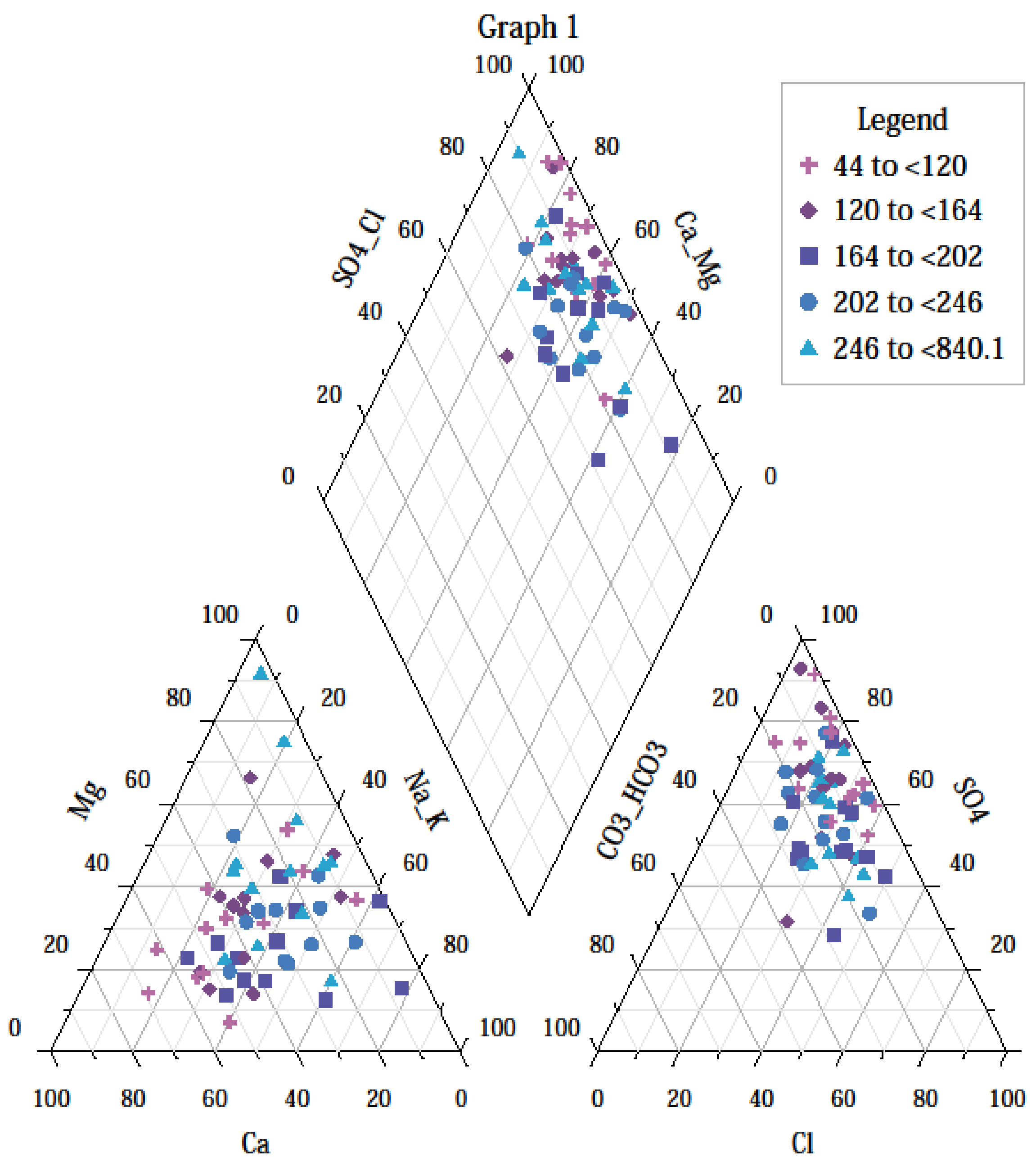


Fig 2.12: Water Quality Data in Piper Trilinear Diagram in study area

USSL Diagram: The United States Salinity Laboratory (USSL) (1954) and Wilcox (1955) established standards for irrigation water quality classification. The Fig.7.5 is a simple scatter chart of sodium hazard (SAR) on the Y-axis versus salinity hazard (EC) on the X-axis. Using the SAR and the EC value of 41 water samples of Balaghat area determines the quality classification of the water.

Based on the EC, irrigation water can be classified into four categories; include:

I. Low-salinity water (C_1) can be used for irrigation with most crops on most soils with little likelihood that **soil salinity** will develop.

II. Medium-salinity water (C_2) can be used if a moderate amount of leaching occurs. Plants with moderate salt- tolerance can be grown in most cases without special practices for salinity control.

III. High-salinity water (C_3) cannot be used on soils, special management for salinity control may be required and plants with good salt tolerance should be selected.

IV. Very high salinity water (C_4) is not suitable for irrigation under ordinary conditions.

Sodium Adsorption Ratio: High sodium in irrigation water reduces the permeability of soil.The USSL diagram based on SAR divided to four categories included:

$$SAR = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$$

I. Low-sodium water (S_1) can be used for irrigation on almost all soils.

II. Medium-sodium water (S_2) will present an appreciable sodium hazard in certain fine-textured soils. This water may be used on coarse-textured or organic soils with good permeability.

III. High-sodium water (S_3) may produce harmful levels of exchangeable sodium in most soils and will require special soil management.

IV. Very high sodium water (S_4) is generally unsatisfactory for irrigation unless special action is taken, such as addition of gypsum to soil (Lyerly and Longenecker, 1957).

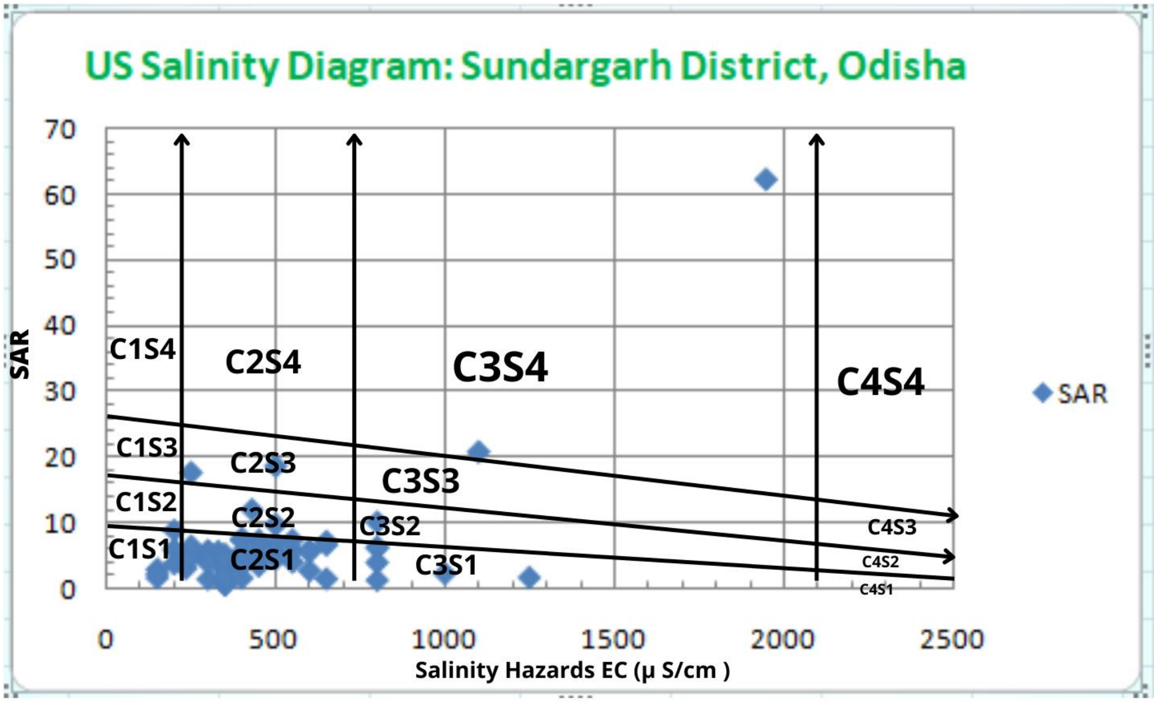


Fig 2.13: US Salinity diagram, Sundergarh district, Odisha

Data Analysis:

On the basis of data collection from CGWB report (2020-2021). It has been observed that out of 63 sample, most of the samples are concentrated under C2S1, C2S2 and C3S2 categories indicating low to medium sodium hazards with medium salinity. Out of these, few samples are scattered under C3S1 and C3S2 categories representing high salinity with low to medium sodium hazard. Few samples are scattered in C1S1 indicating low sodium hazards with low salinity.

3. Approved Mine Plan

Government of Odisha has issued letter of Intent (copy enclosed as Annexure-III) under Rule 10(2) of Mineral Auction Rules 2015 to M/s Raga Tradecon pvt Ltd for grant of Mining Lease for Netrabandha Pahar (West) Block for iron ore over an area of 74.3700Ha near Baliadihi village, Koira Tehsil of Sundergarh district of Odisha for a period of 50 years.

M/s Raga Tradecon Private Limited has planned to establish one beneficiation and pellet plant in Keonjhar/Sundargarh district of Odisha within a period of two year. Iron ore produced from the block will mostly be utilized in the pellet plant. The iron ore will also be utilized by conversion method in the sponge plant for which Raga tradecon pvt ltd has planned to make an arrangement sponge plant. However, as per the market demand, part of the iron ore may be sold to the consumers

Table 3.1- Initial/subsequent Lease grant details

Grant	From	To	Lease deed execution date	Lease registration date
LOI issued vide no 8722/IV(B)SM-53/2021/SM, Bhubaneswar, dated 28.10.2021	Date of Execution of the Lease deed	50 years W.E.F date of execution of lease deed	----	-----

Table 3.2- Land Ownership Details

S.No.	Village	Taluka	Area (Ha)	Khasra No/ Compartment No.	Type of Land	Nature of Land
1	--	Koira	74.370	Forest Khata	Reserve Forest	Govt Land

Table 3.3- Location of Boundary Pillars

Pillar No.	Pillar Latitude *(dd:mm:ss.ss)*	Pillar Longitude *(dd:mm:ss.ss)*
1	21°52’ 58.66927” N	85°16’46.84900” E
2	21°52’ 44.60249” N	85°16’ 49.22482” E
3	21°52’ 44.97118” N	85°16’ 52.67427” E
4	21°52’ 20.13448” N	85°16’ 56.99025” E
5	21° 52’ 21.842” N	85° 17’ 16.168” E
6	21° 52’ 52.774” N	85° 17’ 10.449” E
7	21°52’53.367” N	85°17’ 15.901” E
8	21°53’01.24710”N	85°17’14.57591” E

Table: 3.4- Mining Plan/ Review of Mining Plan at Glance

1	Name of the lessee	M/S Raga Tradecon Pvt. Ltd.
2	IBM Registration no.	Not obtained.
3	Address of lessee	1st floor, Shyam Residency,Flat No 101, Bhubaneswar-751006
4	Name of Mine	Netrabandha Pahar (West) block for iron ore
5	Mine code	Not Obtained
6	Lease area in hects.	74.370
7	Forest area	52.056Ha.
8	Name of Mineral	Iron Ore
9	Lease period from – to	LOI issued vide no 8722/IV(B)SM-53/2021/SM, Bhubaneswar, dated 28.10.2021 50years W.E.F date of execution of lease deed
10	Plan proposal period.	5year w.e.f date of execution of lease deed
11	Mineral Reserve(111,121&122) in tonnes	111-0
		121-0
		122- 17274072.2
		Total-17274072.2
12	Mineral Resource(211,221,222,331,332,333&334) in tonnes	211-0
		221-0
		222-753821
		331-0
		332-18027893.0
		333-0
		334-0
		Total-18781714
13	Total (reserve resource) in tonne	18781714
14	Reserve estimation as on	Date-Date of execution of lease deed
15	Explored area in ha	G1 – 0
		G2-74.370
		G3-0

		Explored and found Non-mineralized area – 42.41
		Un – explored area -Nil
		Total – 74.370
16	Exploration proposal Year wise No. of Bore Holes	1st year - nil
		2nd year – 25nos
		3rd year – 24 nos
		4th year – nil
		5th year - nil
17	Production proposal Rom in tonnes	1st year - 399990
		2nd year – 450000
		3rd year – 600000
		4th year – 800000
		5th year - 1000000
18	OB/Waste handling proposal CUM	1st year - 65518
		2nd year – 41982
		3rd year – 66408
		4th year – 315008
		5th year –319543
19	Present EC permission in tonnes	Since it is a fresh lease, the lessee will obtain EC before Execution of the lease deed.
20	Present forest clearance area in ha	Since it is a fresh lease, the lessee will obtain FC before Execution of the lease deed.
21	Plantation Proposal in five years in numbers	1st year - 230
		2nd year – 230
		3rd year – 230
		4th year – 200
		5th year –200
		Total Plantation-1060
22	Plantation Proposal in five years (ha)	1st year - 0.25
		2nd year – 0.25
		3rd year – 0.25
		4th year – 0.20
		5th year – 0.20
		Total Area- 1.15
23	Back filling proposal in hectares in five years(years wise)	Not Applicable
24	Check Dams numbers in five years	Nil
25	Garland drain in meters five years(years wise)	1st year - 258
		2nd year – 0.0
		3rd year – 0.0
		4th year – 0.0
		5th year – 0.0
26	Settling ponds (Numbers)(years wise)	1st year - 1
		2nd year – 0

		3rd year – 0
		4th year – 0
		5th year – 0
27	Total Area put to use in mining and allied activity at end of five years in ha	29.143
28	Bank Guarantee Amount Rs	Not Applicable
29	Validity pf BG up to	Not Applicable

3.1. Exploration Plan

Iron ore in the Netrabandha Pahar west block occur as isolated bodies associated with buff coloured variegated shale and ferruginous shale. The ore bodies are capped by ferruginous laterite on surface. Though the ore types show out crops of hard ore, lateritic ore and float ore on the surface but soft laminated and powdery ore constitutes the thickness of the ore zone as evidenced from drill cores. As per the field visit float ore thickness varies from 0.50m to 5m. However, average thickness of float ore is around 2m.

The details of the drilling and ore horizons intersected in different boreholes, depth of bore holes drilled. The maximum over burden thickness of 24m is found in BH 10 while it is minimum in BH-7 i.e. 5.300 m. Basing on the observations of the litho log and assay log of the BH 2, 3, 5, 6, 8, 9, 13, 14 and BH 1 where only 3 m of low grade iron was intercepted beyond 24.20 m and surface exposures of ore bodies on mineralized zone area has been demarcated in the geological map. Out of the 15 BHs, only 6 BHs intercepted workable iron ore horizons.

3.2. Mineralization details

Depth of boreholes varies from 23m (BH 14) to 69m (BH 5) and cumulative thickness of ore bodies intersected at +55% Fe cut off is 106.3 m having average iron content of 61.093% Fe. The thickness of low grade ore zone (45 - 55% Fe) intersected in the bore holes varies from 1 to 10 m (BH15) having average iron content of49.367%with a cumulative thickness of 59.7 m. Buff & white colored shale are found in the foot wall side, where as laterite ferruginous shale and a thin rim of floats occurs with an average thickness of 2m. The ore is mainly soft laminated type. Hard laminated ore occurs in only BH 7 at a depth level of 20 m from surface while Blue dust is encountered only in BH 12 for a thickness of 28.40 m below 22 m thick SLO. Ferruginous shale occurring as partings within the ore zone shows gradual decrease of iron content towards bottom. Iron ore in the Netrabandha Pahar west block occurs isolated bodies associated with buff colored variegated shale and ferruginous shale.

3.2.1. Reserve / Resource

Table 3.5 Threshold value & Cut off Parameters

1	Threshold	45% Fe
2	Cut-off grade	55%Fe

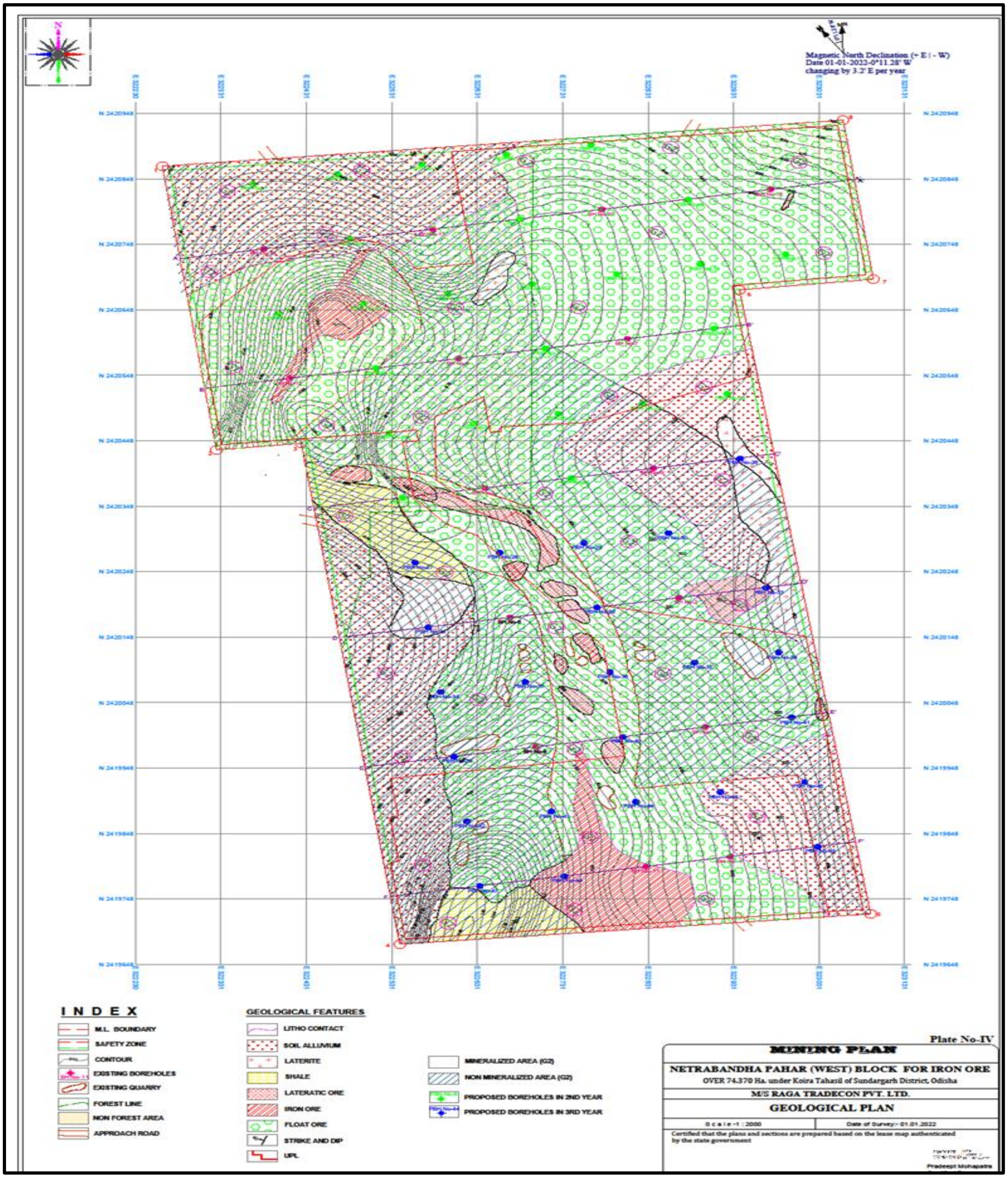


Fig3.1: Bore location in lease area of Netrabandha Pahar Fe ore mine

Table: 3.6 Mining Factors or Assumptions

S.n	Salient features	Description
1)	Method of Mining	Fully Mechanized (FM)
2)	Proposed production	1.0 Million Tones during 5th year
3)	Type of ore	Lateritic Iron ore, Hard Laminated ore, Soft Laminated ore, Blue dust
4)	Proposed Means of raising	Drilling, Blasting, excavation, screening, crushing, loading etc.
5)	Proposed Bench height and width	Height- 10m Width – 15m or More than the height
6)	Proposed Stripping ratio (t/m3) (Ore: Ol	1:0.28
7)	Over all slope	28^0-37.5^0
8)	Transportation ore to the stacking yard	Through dumper
9)	Nature of overburden/ interburden	Generally consists of BHJ, shale, and Laterites.
10	Proposed Drilling	110mm dia drill hole
11)	Proposed Blasting	Deep hole blasting using slurry/Emulsion, explosives &NONEL & Electric Detonator.

Table 3.7: Mineral Reserve

Classification	Code	Quantity			Grade	
		Forest	Non-Forest	Total	Forest	Non-Forest
A. Mineral Reserve		14563715.751	2710356.48	17274072.23	+45%Fe	+45 %Fe
1. Proved Mineral Reserve (A)	111	Nil	Nil	Nil	Nil	Nil
		Nil	Nil	Nil	Nil	Nil
2. Probable Mineral Reserve (A)	121	Nil	Nil	Nil	Nil	Nil
3. Probable Mineral Reserve (A)	122	12650160.234	2641128.80	15291289.034	+55%Fe	+55 %Fe
		1913555.516	69227.68	1982783.196	45-55%Fe	45-55%Fe
B. Remaining Resources		324525.6	429295.4	753821	+45%Fe	+45 %Fe
1. Feasibility Mineral Resource (B)	211	Nil	Nil	Nil	Nil	Nil
		Nil	Nil	Nil	Nil	Nil
2. Prefeasibility Mineral Resource (B)	221	Nil	Nil	Nil	Nil	Nil
3. Prefeasibility Mineral Resource (B)	222	283309.12	298443.08	581752.2	+55%Fe	+55 %Fe
		41216.48	130852.32	172068.8	45-55%Fe	45-55%Fe
4. Measured Mineral Resource (B)	331	Nil	Nil	Nil	Nil	Nil
5. Indicated Mineral	332	Nil	Nil	Nil	Nil	Nil

Resource (B)						
6. Inferred Mineral Resource (B)	333	Nil	Nil	Nil	Nil	Nil
7. Reconnaissance Mineral Resource (B)	334	Nil	Nil	Nil	Nil	Nil
Total Mineral Resources (A+B)		14888241.4	3139652	18027893.0	+45%Fe	+45 %Fe

Table 3.8 Mineral Beneficiation / Processing

Sl. No.	Radicals	Wt %
1	Fe	56.32%
2	Silica	4.3%
3	Alumina	8.4%

3.3. Mining Operations

During the plan period, it has been proposed to produce 1.0 MTPA iron ore eper annum. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc.

Strategy for Development:

The quarry-1 has been proposed in the non-forest land and quarry-2 in forest land. It is pertinent to be mentioned here that, even after obtaining the final forest clearance, tree felling and working permission will take more time and during that period we will commence and operate in the quarry-1 which is situated in the non-forest land.

Haul Road:

The layout of roads for haulage of ore/ waste and access to different installation in the mine will be developed complying with the statutory regulations stipulated in the metalliferrous Mines Regulations, 1961. Overburden and Mineral reject will be transported to the respective site of dumping and stacking located in the lease area. Fifteen meter wide haul road will be developed in the lease area as per need at a gradient up to 1:16.

Site Services:

As far as day to day mine operation is concerned, the infrastructure such as site office, weigh bridge, rest shed, First-aid centre, blasting shed security house, magazine, guard house etcwill be established before mining operation in the lease area.

Machineries to be deployed.

The mine will be operated in a three shift basis. Process of excavation and loading of overburden/waste will be done by deploying hydraulic excavators and dumpers. Excavators of 0.9 – 2.5m^3 capacities will be deployed for excavation & loading of ROM ore and dumpers of 25t capacity shall be deployed for transportation of ore and OB. Hard iron ore will be loosened through drilling & blasting. For the purpose, DTH drill of 115mm dia, compressor of 450cfm etc will be used during ensuing scheme period to achieve the targeted production. For maintenance of OB dumps dozers will be deployed. Loading & un-loading of sorted & sized ore is loaded by mechanized method.

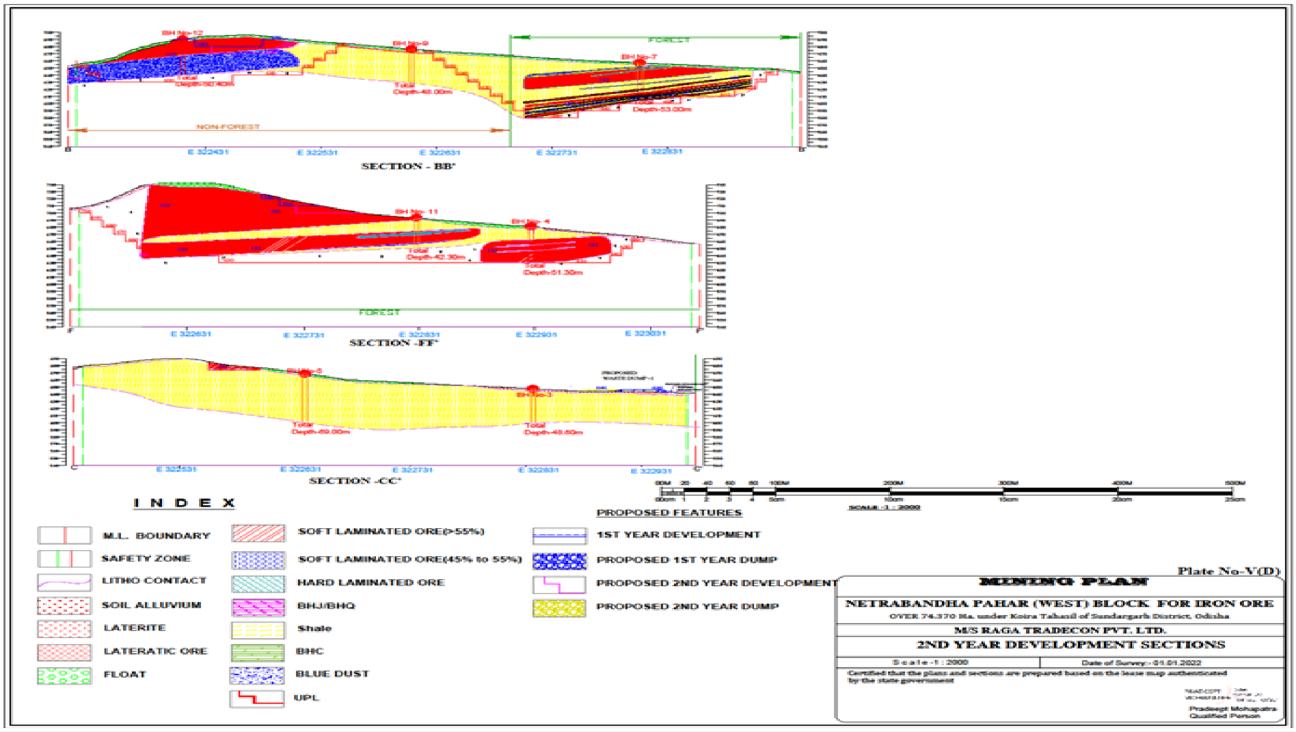
Transportation

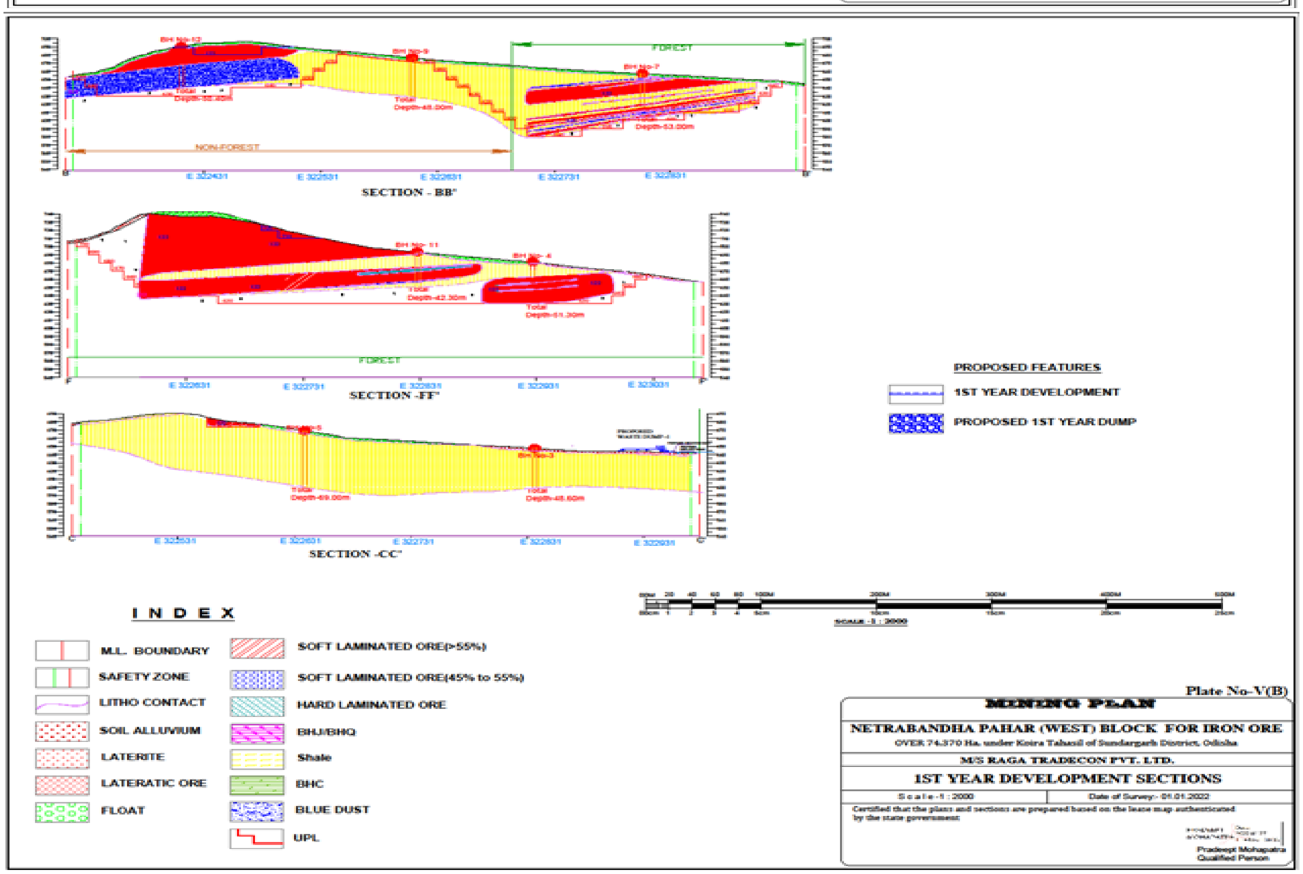
Ore will be transported from quarry site to screen and crushing site for processing by use of 25 ton dumpers and waste materials will be dispatched from quarry to dumping site by using same capacity dumpers. From the stock yard saleable material will be dispatch by using dumper of different capacities.

Table 3.9: Tentative Production Summary year wise

YEAR	PRODUCTION MAIN (in Tonne)	MINERAL REJECT (in Tonne)	ROM (in Tonne)	WASTE (in Tonne)
1ST	399990	0	399990	131036.6
2ND	450000	0	450000	83964.28
3RD	600000	0	600000	132815
4TH	800000	0	800000	503297.5
5TH	1000000	0	1000000	198255.5
Grand Total	**3249990**	**0**	**3249990**	**1049369**

Fig 3.2: Year wise Development section


SECTION - BB'
NON-FOREST
FOREST
SECTION -FF'
SECTION -CC'
INDEX
M.L. BOUNDARY
SAFETY ZONE
LITHO CONTACT
SOIL ALLUVIUM
LATERITE
LATERATIC ORE
FLOAT
SOFT LAMINATED ORE(>55%)
SOFT LAMINATED ORE(45% to 55%)
HARD LAMINATED ORE
BHJ/BHQ
Shale
BHC
BLUE DUST
UPL
PROPOSED FEATURES
1ST YEAR DEVELOPMENT
PROPOSED 1ST YEAR DUMP
PROPOSED 2ND YEAR DEVELOPMENT
PROPOSED 2ND YEAR DUMP
Plate No-V(D)
MINING PLAN
NETRABANDHA PAHAR (WEST) BLOCK FOR IRON ORE
OVER 74.370 Ha. under Koira Tahasil of Sundargarh District, Odisha
M/S RAGA TRADECON PVT. LTD.
2ND YEAR DEVELOPMENT SECTIONS
Scale-1 : 2000
Date of Survey:- 01.01.2022
Certified that the plans and sections are prepared based on the lease map authenticated by the state government
Pradeept Mohapatra
Qualified Person


SECTION - BB'
NON-FOREST
FOREST
SECTION -FF'
SECTION -CC'
PROPOSED FEATURES
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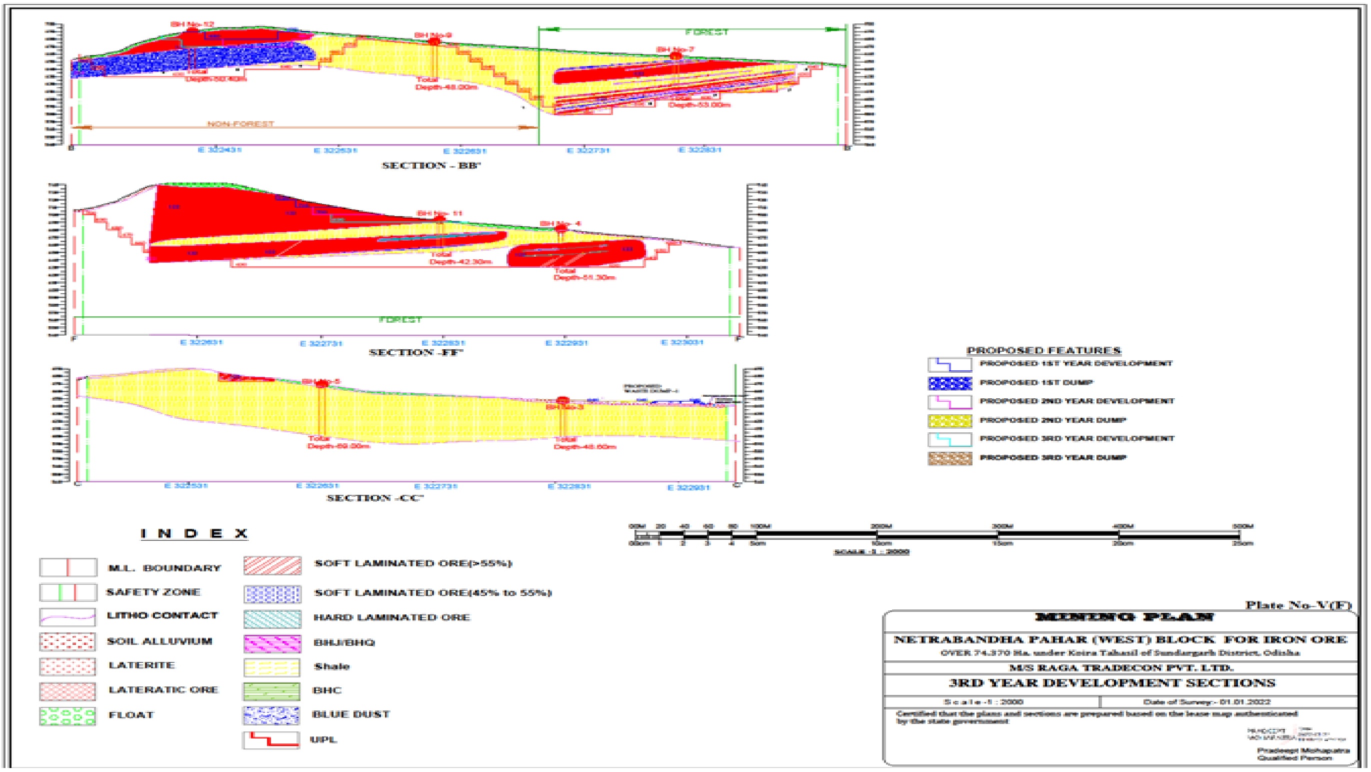
SECTION - BB'
SECTION -FF'
SECTION -CC'
PROPOSED FEATURES
PROPOSED 1ST YEAR DEVELOPMENT
PROPOSED 1ST DUMP
PROPOSED 2ND YEAR DEVELOPMENT
PROPOSED 2ND YEAR DUMP
PROPOSED 3RD YEAR DEVELOPMENT
PROPOSED 3RD YEAR DUMP
I N D E X
M.L. BOUNDARY
SAFETY ZONE
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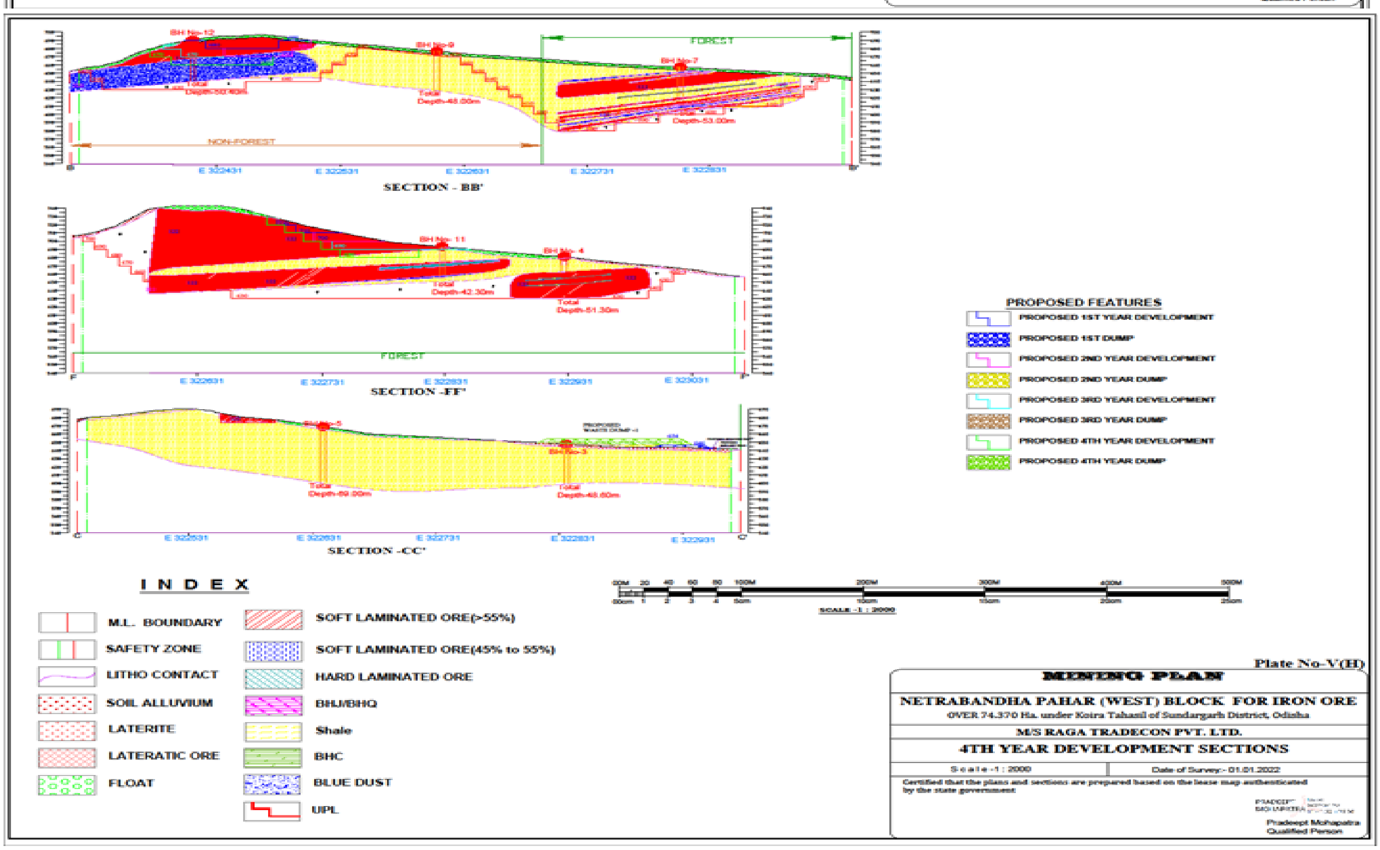
BHJ/BHQ
Shale
BHC
BLUE DUST
UPL
SCALE -1 : 2000
Plate No-V(F)
MINING PLAN
NETRABANDHA PAHAR (WEST) BLOCK FOR IRON ORE
M/S RAGA TRADECON PVT. LTD.
3RD YEAR DEVELOPMENT SECTIONS
Pradeept Mohapatra
Qualified Person


SECTION - BB'
SECTION -FF'
SECTION -CC'
PROPOSED FEATURES
PROPOSED 1ST YEAR DEVELOPMENT
PROPOSED 1ST DUMP
PROPOSED 2ND YEAR DEVELOPMENT
PROPOSED 2ND YEAR DUMP
PROPOSED 3RD YEAR DEVELOPMENT
PROPOSED 3RD YEAR DUMP
PROPOSED 4TH YEAR DEVELOPMENT
PROPOSED 4TH YEAR DUMP
I N D E X
M.L. BOUNDARY
SAFETY ZONE
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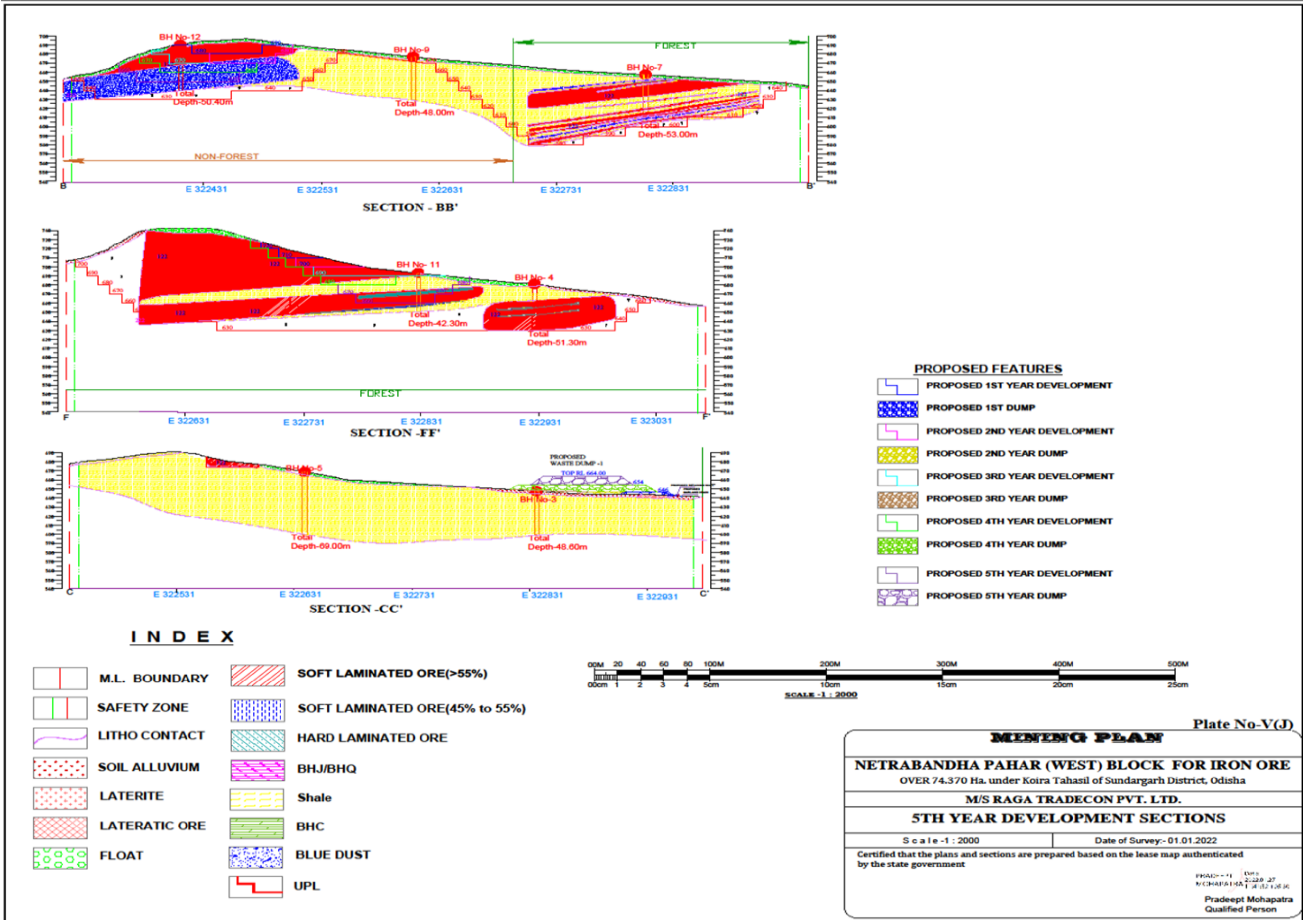
BHC
BLUE DUST
UPL
SCALE -1 : 2000
Plate No-V(H)
MINING PLAN
NETRABANDHA PAHAR (WEST) BLOCK FOR IRON ORE
M/S RAGA TRADECON PVT. LTD.
4TH YEAR DEVELOPMENT SECTIONS
Pradeept Mohapatra
Qualified Person



3.10 Table: Total ROM and waste generation

Sl. No.	Year	Total Handling (t)	Waste Quantity (t)	ROM Quantity (t)	ROM Quantity Saleable Mineral (t)	ROM Quantity Mineral Reject (t)	Ore to OB Ratio (RoM Quantity / Waste Quantity)	Grade Range (%
1	1st	531027	131036.6	399990	399990	0	1:0.327	45% Fe to +65 % Fe
2	2nd	533964	83964.28	450000	450000	0	1:0.186	45% Fe to +65 % Fe
3	3rd	732815	132815	600000	600000	0	1:0.221	45% Fe to +65 % Fe
4	4th	1303298	503297.5	800000	800000	0	1:0.629	45% Fe to +65 % Fe
5	5th	1198256	198255.5	1000000	1000000	0	1:0.198	45% Fe to +65 % Fe
Total		**4299360**	**1049369**	**3249990**	**3249990**	**0**		

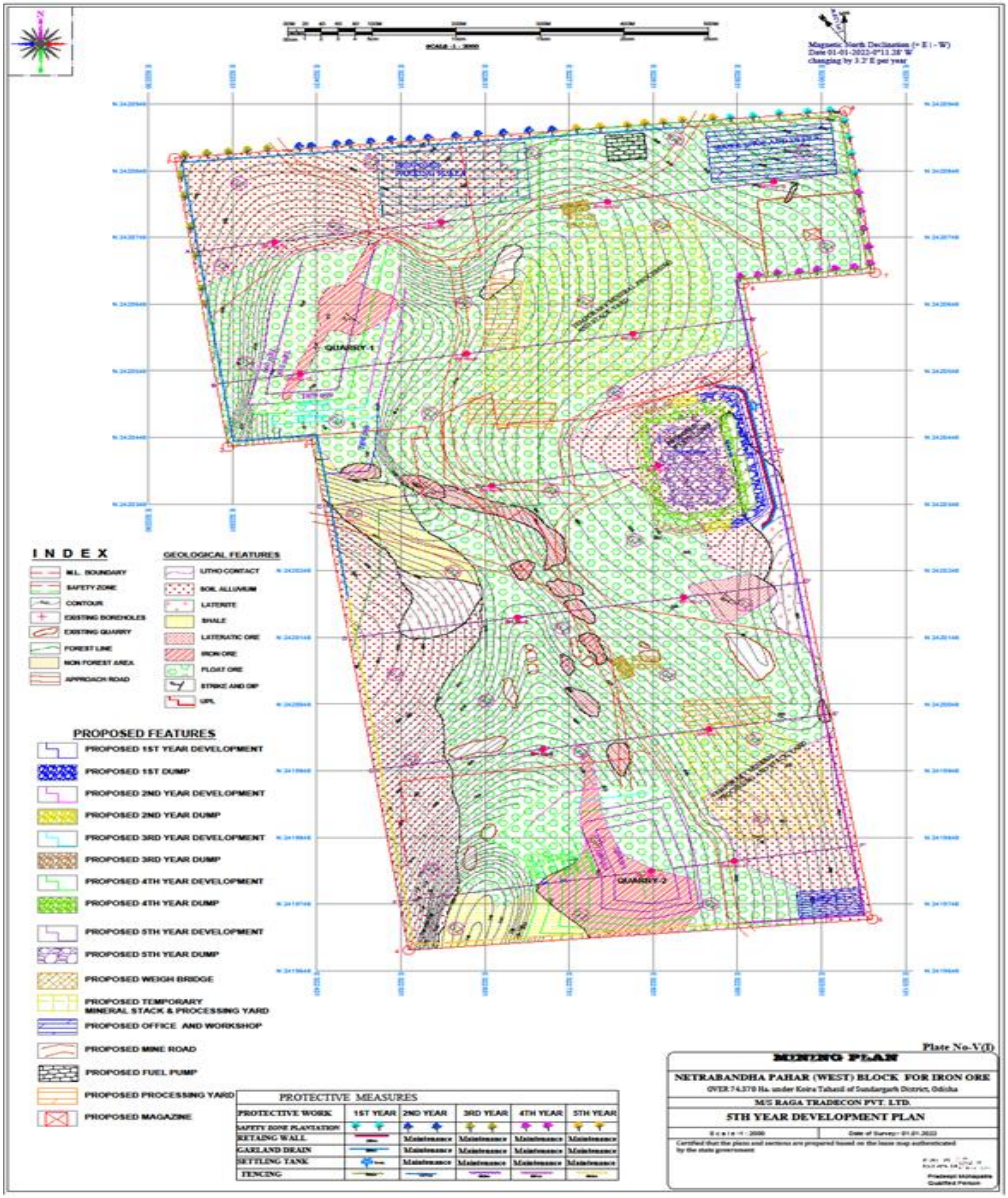


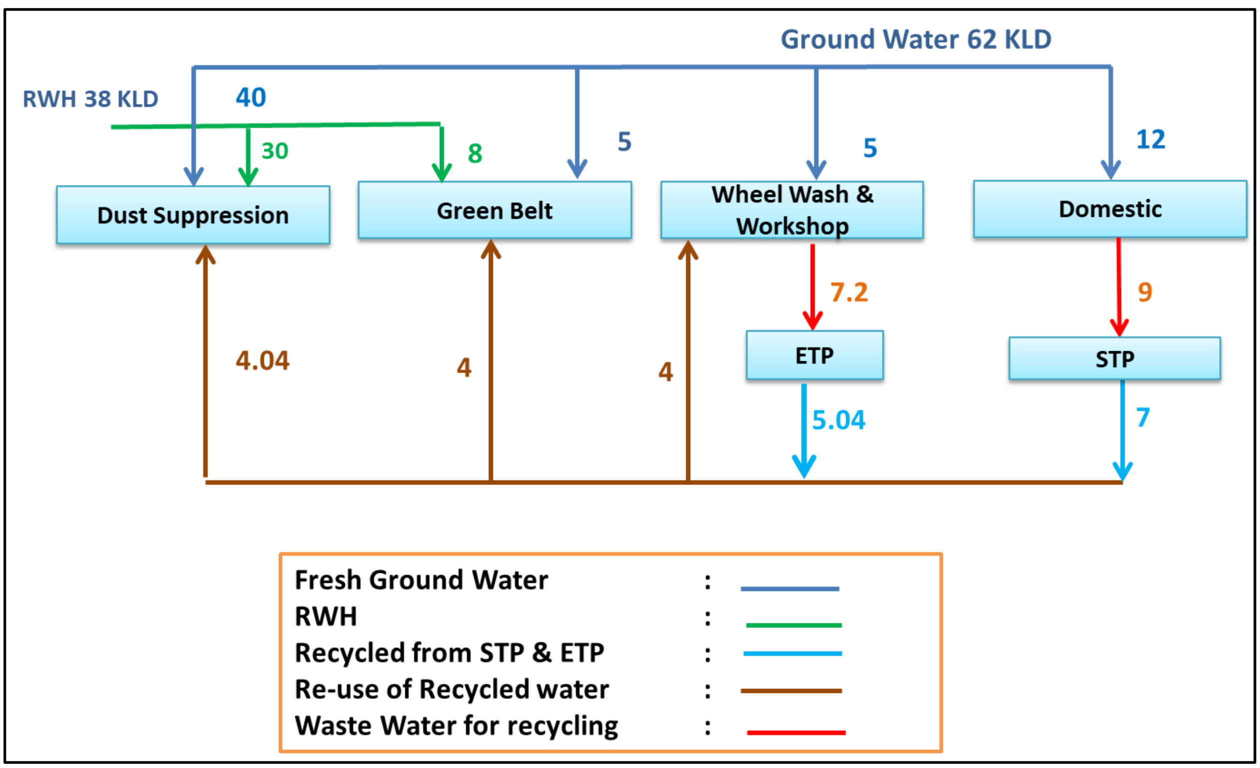
Fig 3.3: Five years development Plan

4. Proposed utilization of water for Mine operation

As per the approved mine plan the Netrabandha Pahar (West) block mine proposed 124.08 KLD of water. The required quantity will be drawn from ground water sources, RWH and recycled water. The entire water is utilize as per the Table 4.1

Table 4.1: Annual requirement of water from all sources & Reduction of GW consumption

Components	From Ground Water in KLD	Recycle water Generation from ETP	From RWH in KLD	From STP in KLD	Total Usage in KLD	Days	Annual Water Consumption from all sources in cum	Annual GW Consumption in cum	Reduction of GW consumption in cum	Reduction of GW consumption in KLD
Dust Supression	40	0	30	4.04	74.04	240	17769.6	9600	8169.6	34.04
Green Belt	5	0	8	4	17	240	4080	1200	2880	12
Industrial	5	5.04	0	4	14.04	300	4212	1500	2712	9.04
Domestic	12	7	0	0	19	300	5700	3600	2100	0
Total	**62**	**12.04**	**38**	**12.04**	**124.08**	-	**0**	**15900**	**15861.6**	**55.08**



4.1 For Drinking & Domestic – Drinking water of 12 KLD is proposed to be obtained from ground water and domestic requirement of 5KLD from STP & ETP.

4.2 Plantation – 17 KLD of water recycled from ETP is proposed to be used for maintaining green belt.

4.5Dust suppression - as shown in table4.1, 74.04 KLD is required for dust suppression is obtaining partly from surface water, groundwater and recycled water.

4.4 Industrial: For running the mining industry 14.04 KLD water is required, which obtaining from surface water, groundwater and recycled water.

4.3 Recharge- Roof Top rain water harvesting is proposed

4.4 Runoff to stream- No discharge is released to any stream from the Netrabandha Pahar (West) block mine

4.5 Benefitted area- Nearby villagers

Comprehensive assessment of the impact on the ground water regime

Comprehensive assessment of the impact on the ground water regime in and around the project area highlighting the risks and proposed management strategies proposed to overcome any significant environmental issues.

M/s Raga Tradeconpvt Ltd for grant of Mining Lease for Netrabandha Pahar (West) Block for iron ore over an area of 74.3700Ha near Baliadihi village, Koira Tehsil of Sundargarh district of Odisha for a period of 50 years. The company has planned to establish one beneficiation and pellet plant in Keonjhar/Sundargarh district of Odisha within a period of two year. Iron ore produced from the block will mostly be utilized in the pellet plant. Total estimated mineable reserve within the area is 17274072tonnes for iron ore. Estimated total production of ore during five year would be 3249000tones. During the plan period, it has been proposed to produce 1.0 MTPA iron oreper annum. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc. There is no agriculture land in the core zone. However in buffer zone agriculture land will be preserved from siltation by retaining wall, check dams, garland drain and settling ponds.. The nearest surface water source is TeheraiNala which is flowing 500m away from the western side of the mining lease. TeheraiNala is the major 2nd order drainage system of the area. As per the field observation there are some mine pit surrounding the lease area which work as recharge tank in rainy season. The lease area experience heavy rainfall during rainy season so that it will minimizes the groundwater usage. Presently, during rainy season, the water collected in the mine area is drained to the sump floor of each quarry. The sump acts as a good rainwater recharge structure and the collected rainwater normally seeps into the ground.

Fig 5.1: Pond and Hand pump in core zone of lease area

5.1. Impact on surface water sources:

Netrabandha Pahar (West) block Iron ore mine is situated in the higher elevation as depicted in the fig 6.2: No Nala/stream exist or generates from ML area of Netrabandha mine. The ML area is not situated within any wetland zone and not part of any national park etc. Other existing small ponds/ water bodies within core and buffer zone has been investigated and the water quality is found normal.

5.1.1: Diversion

Existing channels [constructed dam/barrages/weir/canals/hydro-electric projects] No existing channel, constructed dam/barrages/weir/canals/hydro-electric projects etc need to be diverted due to the project. Thus 6.1.1 is not applicable.

5.1.2: Change

in land use [change in flood plain, lotic & lentic systems etc.]-No nala/stream/ river exist or generates from ML area of Netrapahar Fe ore mine. The ML area is not situated within any wetland zone thus change in land use in flood plain, lotic & lentic systems etc is not applicable.

5.2. Impact on groundwater sources–

The Netrabandha mine lease area is in Koira block of Sundergarh district, Odisha which is categorized under safe category (Stage of GW Extraction 33%) by the latest estimation carried out by CGWB (2020). The groundwater levels measured in core and buffer zone varies from (3.7-36.3m). The area is part of hard rock terrain with poor permeability rock and there is no aquifer system due to high elevation (717 m). Based on the field observation it has been found that there is no weathered portion in around the lease area.At present there is no existing water body, the mining activity will be carried out in such a manner which won’t create any threat of groundwater resources. The mine area experienced heavy rainfall hence by constriction of check dam, rooftop rain water harvesting structure, retaining wall and settling pond can enhance the water availability.

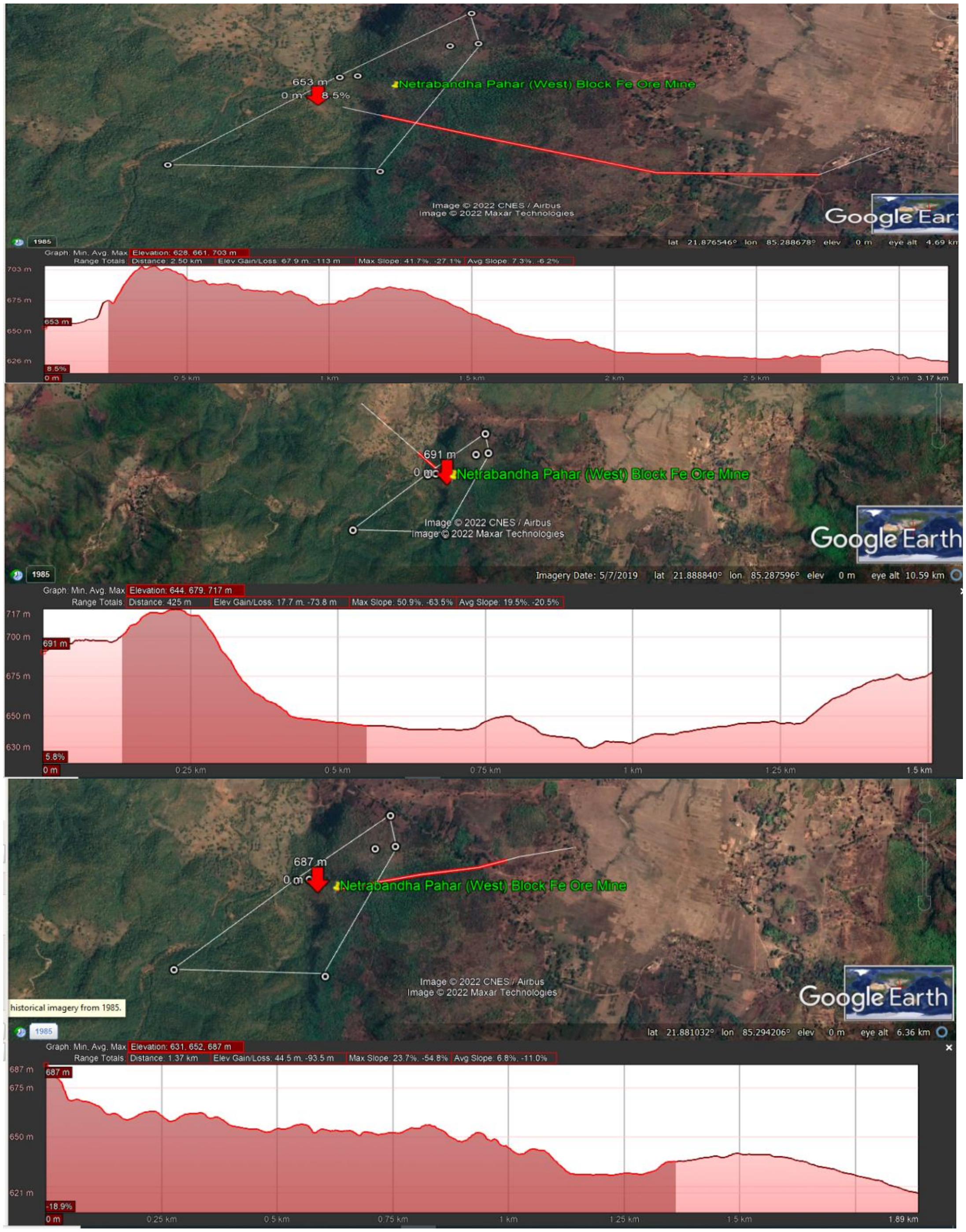


Fig 5.2: Google elevation profile of study area around Netrabandha Pahar Fe ore Mine from three directions

5.3. Socio-Economic Aspects:

5.3.1. Settlements and population dynamics around project area

The study area comes under rural. There exists about 31 villages in the study area and their details are given in Table 5.1 and 5.2

There is no impact on groundwater condition because of mining activity in Netrabandha Pahar (West) Block.

Table 5.1 Crop production details of Sundergarh District Odisha in Kharif and Rabi Season

	Kharif		**Rabi**	
Sl no.	**Crops**	**Area (ha)**	**Crops**	**Area (ha)**
1	Paddy	13250	Wheat	111
2	Maze	463	Cowpa	190
3	Ragi dry	205	Horsegram	774
4	Jower	124	Gram	298
5	Biri	1403	Mustard	395
6	Cowpa	146	Potato	109
7	Groundnut	296	Onion	195
8	Til	1286	Garlic	80
9	Zinger	156	Fieldpea	140
10	Other vegetables	1088	Other vegetables	1786

5.3.2. **Dependency** on sources of water [surface or sub-surface] the area by and large depends on rain-fed agriculture with supportive irrigation. It is seen that shifting of occupation among the local population is mostly towards mining and its related work. Mining leads to livelihood gain through creation of employment opportunities in the region. Loss of cultivable land and forest land due to mining activities which invites change in their native profession and may envisage involuntary migration of population to other region for livelihood.This working mining project has immensely benefitted this region in the field of potential employment, improved per capita income, improved social welfare, education, medical healthcare systems, communication, infrastructural build-up, etc. In the core zone no habitation exists. Hence, economic profile of population within core zone is not envisaged. In buffer zone, this project will help in direct employment opportunities for 259 persons and indirect employment for more than 250 persons through various service related activities connected with the project operations

Table 5.2: Population data of study area in part of Koida tehsil, Sundergarh district, Odisha						
Sl.no	Location	House	Male	Female	Total Population	Area (ha)
1	Baldihi	80	170	157	327	508
2	Ranisal	74	151	136	287	126
3	Padadhi	88	152	175	327	192
4	Patmunda	242	501	512	1013	384
5	Khajuridihi	85	179	186	365	797
6	Teheri	174	339	415	754	544
7	Sargigarh	176	355	383	738	363
8	Sanindipur	204	414	372	786	461
9	Kalmanga	323	634	656	1290	753
10	Ganua	376	820	797	1617	754
11	Rangalbeda	162	334	294	628	388
12	Kasira	270	581	699	1280	777
13	Badpatuli	108	217	239	456	346
14	Kadamdihi	105	249	265	514	697
15	Kirrakudar	81	186	168	354	203
16	Gaudiniposh	155	420	414	834	274
17	Badindipur	123	284	264	548	396
18	Dengula	173	438	498	936	3496
19	Saleipali	147	341	396	737	215
20	Basada	36	73	80	153	313
21	Dalita	18	33	36	69	424
22	Tegerei	174	339	415	754	544
23	Kula	149	379	374	753	332
24	Malda	147	297	267	564	577
25	Nuagaon	90	223	217	440	432
26	Patbeda	34	79	66	145	308
27	Railela	302	645	697	1342	683
28	Rengua	54	150	167	317	265
29	Sanputli	207	449	445	894	423
30	Taldihi	75	158	163	321	1104
31	Bandal	92	219	249	468	437

6. Proposed measures for disposal of wastewater by mine drawing saline water

The water in the surrounding of lease area is fresh and the TDS is ranges between 10 and 310 ppm in general so disposal of saline water not applicable.

7. Water Conservation

Measures to be adopted for water conservation which includes recycling, reuse, treatment, etc. This includes the water balance chart being adopted by the firm along with details of water conservation methods to be adopted. - Brief writes up along with capacity and flow chart of Sewage Treatment Plants / Effluent Treatment Plants / Combined Effluent Treatment Plants existing/ proposed within the project. - Details of water conservation measures to be adopted to reduce/ save the ground water. - Total water balance chart showing the usage of water for various processes in Table no 4.1

At present the lease area is required 124.04 KLD of water for mining operations. The entire water requirements are fulfilled by RWH, recycle water from STP & ETP and ground water. The water is to be consumed by various mine operation such as dust suppression, domestic use, plantation, and workshop (Table 4.1).The area experiences high rainfall, the site will generate above volume of run offs during such rainy periods. The surface run off from the uncovered site would contain high concentration of suspended matter and eroded matter which will be checked through two ponds, Roof top RWH and settling ponds.

Water conservations can be enhanced by including efficient measures of water use for mining and domestic consumption, effective reuse and recycles of water and treated water, adoption of appropriate rainwater harvesting and artificial recharge methods. It is therefore following sub topics are incorporated in this chapter.
7.1 Water use and water balance
7.2 RWH and Artificial Recharge

7.1 Water use and water balance:

Netrabandha Pahar (West) block iron ore mine is proposed of 124.04 KLD water. Water is to be used for dust suppression, domestic use, plantation, and workshop purposes shown in the(Table 4.1).

7.2. Rainwater Harvesting & Artificial recharge:

The total lease area of Netrabandha Pahar (West) Iron ore mine is 743700 m²and its land use is discussed in chapter 1.4 and table 1.1. The area experiences high rainfall so that the mine has concentrated effort to conserve each drop of rainwater. The project area is having undulating hilly terrain and poor permeability. The depth of water level below ground level varies depending on the local topography, geology & hydrological conditions. The nearest surface water source is TeheraiNala which is flowing 500m away from the western side of the mining lease. TeheraiNala is the major 2nd order drainage system of the area. Mine pit structure also present all around the lease area where water gets collected from the uplands through drains.Garland drains & retaining walls will be constructed all around the dumps and plantation of native species will be carried out on the dump slopes to minimize erosion. A settling pond will be constructed to arrest silt and sediment flows from mining area during rain fall and the water so collected is being utilized for the mine area, roads, green belt development etc.

Table 7.1 Crop production details of Sundergarh District Odisha in Kharif and Rabi Season

	Kharif		Rabi	
Sl no.	**Crops**	**Area (ha)**	**Crops**	**Area (ha)**
1	Paddy	13250	Wheat	111
2	Maze	463	Cowpa	190
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7	Groundnut	296	Onion	195
8	Til	1286	Garlic	80
9	Zinger	156	Fieldpea	140
10	Other vegetables	1088	Other vegetables	1786

Fig 7.1: Existing rainwater harvesting pond and mine pit storage tank in study area

Table 7.2: Pond and Water bodies in study area									
Sl No.	**Location**	**Latitude**	**Longitude**	**Elevation (m)**	**EC (mS)**	**pH**	**TDS(ppt)**	**DO (mg/l)**	**water body**
1	Ranisal	21.884162	85.305325	596.84	650	7.1	320	4.7	Pond
2	Paatmunda	21.87555	85.308419	617.73	320	6.9	150	1.3	Pond
3	Khajuridihi	21.863644	85.293346	664.9	300	7.2	139	4.52	Pond
4	KJSA Steel Plant	21.963844	85.317	577	650	7.5	360	3.28	Mine pit
5	Near Tensa Road	21.868889	85.187991	619.85	20	5.9	10	1.38	Open well
6	National Enterprise	21.84094	85.34045	867.2	190	7.2	80	3.1	Pond
7	Raikela Iron Mine	21.876188	85.196579	572.02	680	7.1	350	4.73	Pond
8	Raikela Iron mine	21.878495	85.197651	571.44	20	6.3	10	4.24	Open well
9	Comanado Steel Plant	21.918085	85.209714	573.27	450	6.8	240	5.94	Pond

7.3. Monitoring, Measurement and Capacity building

Monitoring and measurements of several parameters are part of water conservation strategy towards the motive of efficient management of water. The withdrawal of groundwater is regularly monitored and measured from the existing dug well. The water level is found at 3.7 to 36.3 m bgl in pre monsoonal period, which varies from 2.5-5 m bgl in the monsoonal period. The Netrabandha Pahar mine conducts regular capacity building of its maintenance staff that monitors and measures and keeping record of various data related to water use and water conservation. The workers have been trained for keeping record and onward submission of data as per the requirement. For monitoring of groundwater level in the area of Netrabandha Pahar mine, as per the guideline of CGWA, a piezometer has to be constructed at the area. The installation of piezometer is proposed exclusively for monitoring of groundwater level deploying automatic water level recorder with telemetric arrangement of data transmission.

Proposed Roof top rainwater harvesting structure

A roof top rainwater harvesting is proposed using standard deign as given below for mine lease area and associated building at the mine core zone by drilling of 30m deep 6’’ dia bore well (Fig 7.2)

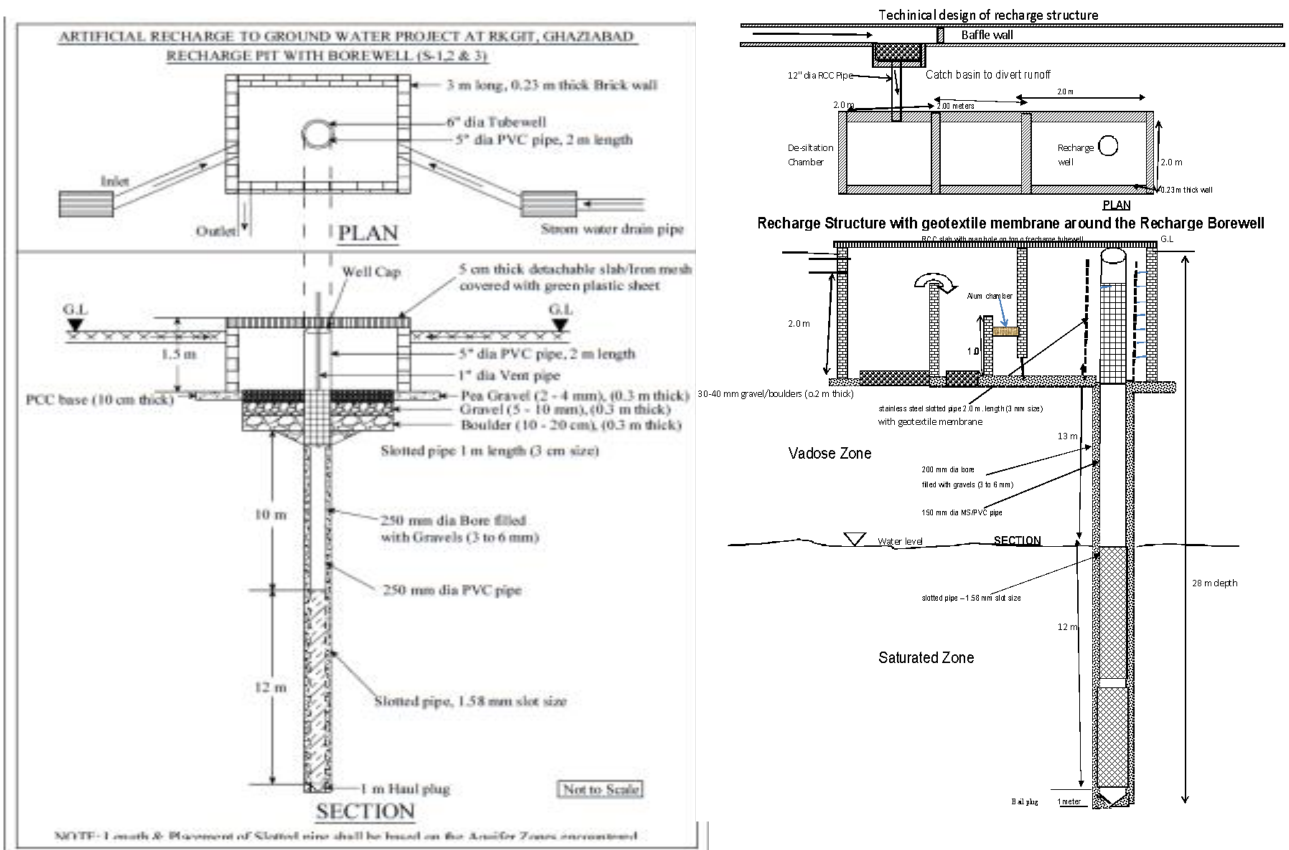

Fig 7.2 Design of proposed rooftop rain water harvesting structure

8. Any other details pertaining to the project: NA

5. **Study for Rainwater harvesting around Iron ore mine of Dholta Pahar, Sundergarh, Odissa-**

Click to view

Comprehensive Report on:

Proposed RWH Structure in core zone of Dholta Pahar Block Iron Ore Mine, Koira Block, Sundargarh District, Odisha.

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

M/S KASHVI POWER AND STEEL PVT LTD
PLOT NO 1234/P, GOVINDA PRASAD, BOMIKHAL, BHUBANESWAR- 751006
E-MAIL ID: groupkashvi@gmail.com

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By MRCAWTM – May 2022

Executive summary

M/s Kashvi Power & Steel pvt Ltd is located in Dengula Village, Koira Tehsil of Sundargarh District, Odisha. Dengula village is located in north east part of Sundergarh district. The study area falls under survey of India toposheet no F45N1N and F45N5N. Kashvi Power & Steel Private Limited operates as a manufacturer of sponge iron, billet and ingots and exporter of minerals. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc. During the plan period, it has been proposed to produce 2.0 MTPA iron ore per annum. The present study is made for obtaining NOC from CGWA for extraction of maximum 97KLD of groundwater during mining operation as per the approved mine plan. The present report is based on the Hydrogeological investigation made within core zone and its 10km radius buffer zone for assessment of impact of dewatering of groundwater by the mine and will be submitted to CGWA for obtaining renewal of NOC. The area is drained by IB and Brahmani River and its tributaries. The easterly flowing Sankh and westerly flowing Koel River join at Vedavyas near Rourkela to form the Brahmani River. The river, IB a tributary of Mahanadi controls the drainage of the western parts of the district. The drainage pattern of the area is dendritic. The study area is located in Dengula Village, Koira Tehsil of Sundargarh District, Odisha whichfalls under safe blocks as per the report on Dynamic Groundwater Resource of India, published by CGWB in 2019-20. The study area is having largely one geological formation name Singbhum-Keonjhar-Bonai group of iron ore of Precambrian age. These constitute hard rock's includes schist, tuffs, phyllite, basic rock, BHQ/BHJ have been classified as Iron Ore Series (IOS). Aquifers are developed only in the low lying area and valley parts of the study area. The total lease area of the proposed Dholtapahar Fe ore block is 60.508 ha (605080 m²). Groundwater quality is fresh and potable in both core and buffer zone area and EC remains below 1900 ppm and TDS varies from 10 to 310 ppm in the study area. As per the approved mine plan the dewatering of groundwater maximum 97KLD as the mine is generating no water discharge and only 97 KLD will be extracted from ground water for mine use. Rainwater is harvested within the ML area through construction of water conservation pond and earth bunds. The annual conservation through RWH is about 26825m³/anm. There is no impact on groundwater because of open cast mining. For the running of mine 155KLD water is required, 97KLD from ground water and 58KLD of water from RWH and recycle water from STP & ETP. Thus, the study recommends NOC may be provided for next 5 yr with maximum 97 KLD extractions from groundwater.

Acknowledgments and Certificate

Impact assessment and report preparation work as per the CGWA guideline was entrusted to MRCAWTM, Manav Rachna as accredited Groundwater Institution of CGWA by M/S. Kashvi Power and Steel Pvt. Lmt, Odisha is thankfully acknowledged.

Discussions with Mr. Pradeept Mohapatra, Director WCS, regarding the geology of lease area and plan our investigations according to scope of work is gratefully acknowledged. Help rendered by Mr. Shubham, Geologist, M/S. Kashvi Power and Steel Pvt. Lmt, Odisha in every stage of planning and Field verification, investigations in and around lease area and report preparation is thankfully acknowledged. He also provided all the available relevant data and records many of them are reproduced in this report and forms part of annexure section.

At lease area, during days of field investigation we have received warm welcome and all hospitality and requisite support from mine team. We thankfully acknowledge Mr. Pradeept Mohapatra, Director WCS and his team for their cooperation.

The report has been prepared by Ms Sheha Rai, Asstt Prof MRCAWTM and Sandeep Kumar Research Assistant, MRCAWTM under the supervision of Prof (Dr) Arunangshu Mukherjee, Director MRCAWTM. Ms Alifia Ibkar, RA MRCAWTM helped Mr Sandeep Kumar in the field work and data collection.

It is to certify that MRCAWTM have investigated the area of Dholtapahar Fe ore block of Dengula Village, Koira Tehsil of Sundargarh District, Odisha. Based on actual data collected from field and literature survey done, has prepared the report as per the format of CGWA.

(Dr Arunangshu Mukherjee)
Director, MRCAWTM

MR Centre for Advance Water Technology & Management
Manav Rachna International Institute of Research & Studies
(Deemed to be University under section 3 of the UGC Act, 1956)
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CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0. Introduction

1.1. Project description

M/S. Kashvi Power and Steel Pvt. Lmt, Bhubaneswar is a registered firm under Minerals (Development and Regulation) ACT, 1957 and The Mineral (Auction) Rules, 2015, Govt of Odisha. Dholtapahar Fe Ore Block located in Koira Tehsil of Sundargarh district of Odisha. The IBM company number is IBM/7815/2011. The total lease area of Dholtapahar Fe ore block is 60.508 ha. As part of the statutory clearance, the Mining Plan and Progressive Mine Closure Plan is prepared under Rule 16(1) of MCR, 2016 and Rule 23 of MCDR, 2017 respectively for a period of 5 years from the date of opening of the mine for grant of Mining Lease in favor of M/S. Kashvi Power and Steel Pvt. Lmt. The registered office is situated at State of Maharashtra (Mumbai) having is registered office at 503, 5th floor, Greenland Apartment, Building no.3, JB Nagar, Andheri East, Mumbai- 400059, Maharashtra to carry on all or any of the business as manufacturers, buyers, sellers, suppliers, traders, exporters, minerals, metals etc. M/s Kashvi Power & Steel Pvt Ltd is a part of Kashvi group and one of the growing companies in Odisha. Kashvi Power & Steel Private Limited operates as a manufacturer of sponge iron, billet and ingots and exporter of minerals. Iron ore produced from the Dholta Pahar block will mostly be utilized in their sponge iron plant. However, as per the market demand, part of the iron ore may be sold to the consumers. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc. During the plan period, it has been proposed to produce 2.0 MTPA iron ore per annum.

1.2. Location

M/s Kashvi Power & Steel pvt Ltd is located in Dengula Village, Koira Tehsil of Sundargarh District, Odisha. Dengula village is located in north east part of Sundergarh district. The study area falls under survey of India toposheet no F45N1N and F45N5N. Taldihi village is 1.5 km away from the study area. Nearest railway station is Barsuan which is 23 km away from the lease area. The lease area of mine is not located within 10km radius of National Park /Wild Life Sanctuary / Protected area and don’t falls under Coastal Regulation Zone (CRZ). Many shallow depth open cast pits mine are present in the study area.

Fig 1.1: Google Image showing Dholta pahar mine Pillars location

1.3. Topography and Drainage

Dholtapahar block is a part of Koira group of upper Shale formation. Study area having steep rising hills with intervening steep gorge and narrow valley. The geomorphic sub-units like the pediments, pediplains, buried pediments, valley fills, and lineaments are the predominant in the hard rock areas in study area. The highest elevation is 825m MSL and lowest elevation is 550m MSL

Study area is covered with different hills with intervening intermontane valleys, isolated hillocks and flat to gently undulating plains. The area is drained by IB and Brahmani River and its tributaries. The easterly flowing Sankh and westerly flowing Koel River join at Vedavyas near Rourkela to form the Brahmani River. The river, IB a tributary of Mahanadi controls the drainage of the western parts of the district. The drainage pattern of the area is dendritic.

1.4. Groundwater Situations

Sundergarh district is North Western part of Odisha state. Sundergarh is recognized as an industrial district in the map of Odisha. Steel Plant, Fertilizer plant and Cement factory.

Ferro Vanadium Plant. Machine building factory, Glass and China clay factory and Spinning mills are some of the major industry of this district. Large part of the study area belongs to Dengula Village, Koira Tehsil of Sundargarh District, Odisha. Ground water is the main source of drinking as well as industrial and domestic purpose. However, the requirement of water in irrigation and agriculture is fulfilled mainly by river, canals, as well as by rainwater. The rainwater also is the main source for recharge of groundwater of the area.

1.5. Climate and Rainfall pattern

The climate of the district is sub tropical climate characterized with hot and dry summer, cold winter and erratic in rainfall. The winter season extends from November to end of February, which is followed by summer season from March to the middle of June, and rainy season from middle of June to middle of October. During summer months the maximum temperature rises up to 43° C and May is the hottest month. December is the coldest month of the year when the average daily temperature drops down to 8° C. Relative humidity is around 60-70% throughout the year. The highest and lowest monthly mean relative humidity so far recorded is 97% (Dec) and 26% (April). The annual rainfall of last decade is given in Table (1.1).

Table 1.1 Decadal Rainfall in Sundergarh District (Source: WRIS online portal) 2011-2020

Year	Actual Rainfall (mm)	Deviation (%)	Year	Actual Rainfall (mm)	Deviation (%)	Average Rainfall (mm)
2011	1788.35	20.87	2016	1098.51	-28.82	1415.126
2012	1435.18	1.39	2017	1323.91	-6.8	
2013	1537.77	7.97	2018	1396.59	-1.32	
2014	1335.09	-5.99	2019	1387.02	-2.02	
2015	1286.6	-9.9	2020	1562.24	9.4	

1.6. Ground water regime monitoring:

The lease area of 60.508 ha is completely hard rock zone and located at higher elevation, no evidence of groundwater has been reported during the exploratory drilling. Hence, in process of mining there is no possibility of cutting groundwater or any ground water discharge will find during the mining activity.

The study area comprises 10km radius zone in Dholta Pahar iron ore Block located in Koira Tehsil of Sundargarh district of Odisha. Detailed hydrogeological study of both core and buffer zone of mine area is carried out. The hydrogeological condition varied from place to place due to different litho unit of aquifer. The hydrogeological units of the study area are broadly categorized into two groups namely.

1) Consolidated formations.
2) Unconsolidated formations

1). Consolidated formations

The study area is occupied by the consolidated formations comprising of Precambrian metasediments of Gangpur series and Iron ore series and also granite gneiss, metasediments like amphibolite, epidiorite etc. Ground water is stored mainly in the secondary porosity resulting from weathering and fracturing of the rocks. Ground water occurs under confined to semi-confined condition in the deeper fractured zones. Water yielding capacity is mainly depend on the extent of fracture, depth, opening and size of fracture. Mica schist, quartzite and phyllite are the formation in the study area.

2). Unconsolidated Formation

Laterite and alluvium are the main constituents of unconsolidated formation in the study area. The laterite is belonging to sub recent to recent age having high porosity. It is the good aquifer for dug well in study area. The alluvium soils are also the potential aquifers due to their high degree of porosity and permeability but are only limited in their occurrence.

2. Water Conservation

Measures to be adopted for water conservation which includes recycling, reuse, treatment, etc. This includes the water balance chart being adopted by the firm along with details of water conservation methods to be adopted. - Brief writes up along with capacity and flow chart of Sewage Treatment Plants / Effluent Treatment Plants / Combined Effluent Treatment Plants existing/ proposed within the project. - Details of water conservation measures to be adopted to reduce/ save the ground water. - Total water balance chart showing the usage of water for various processes.

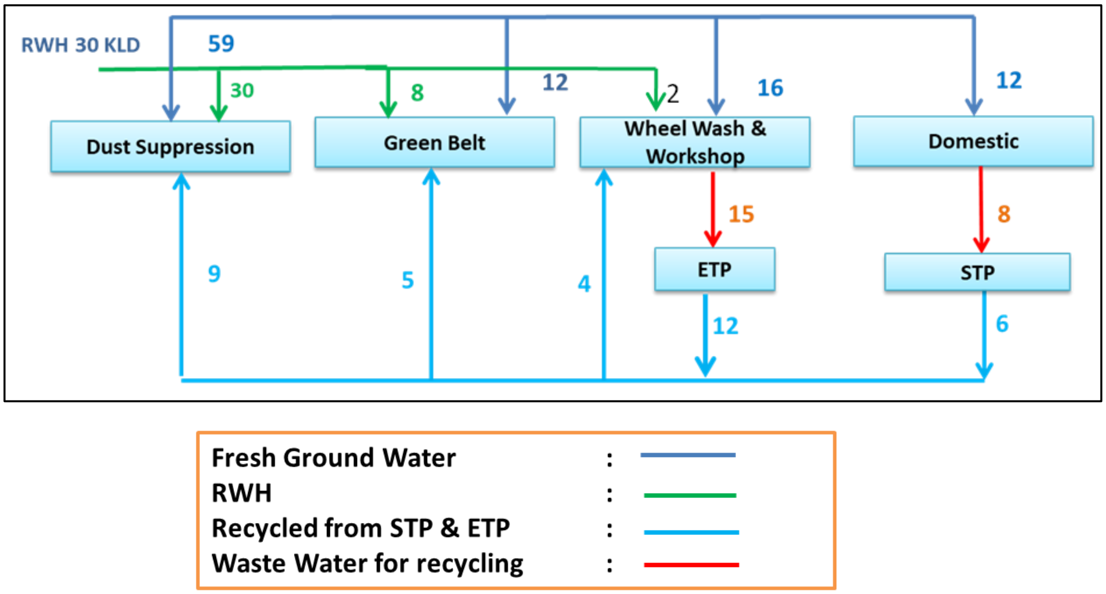
At present the lease area is required 155KLD water for mining operations. The 97KLD of water requirements are fulfilled by ground water, rest by RWH and recycle water. The water is to be consumed by various mine operation such as dust suppression, domestic use, plantation, and ETP & workshop (Table 2.1). The area experiences high rainfall, the site will generate above volume of run offs during such rainy periods. The surface run off from the uncovered site would contain high concentration of suspended matter and eroded matter which will be checked through retaining wall, check dams and settling ponds.

Water conservations can be enhanced by including efficient measures of water use for mining and domestic consumption, effective reuse and recycles of water and treated water, adoption of appropriate rainwater harvesting. It is therefore following sub topics are incorporated in this chapter.
2.1 Water use and water balance
2.2 RWH

2.1. Water use and water balance:

Dholta Pahar iron ore mine is proposed of 155KLD water. Water is to be used for dust suppression, domestic use, plantation, and ETP & workshop purposes shown in the (Table 2.1)

Table 2.1: Proposal of Water Utilization in Dholta Pahar mine (Area= 60.508ha)					
Sl. No	**Purpose**	**Ground Water (KLD)**	**RWH & Outside**	**Recycled STP &ETP (KLD)**	**Total from all source**
1	Dust Suppression	59	30	9	98
2	Domestic Use	12	-	-	12
3	Plantation	8	8	5	21
4	ETP & Workshop, Wheel Washing System	18	2	4	24
	Total	**97**	40	**18**	**155**



2.2. Rainwater Harvesting

The total lease area of Dholta Pahar Iron ore mine is 60508 m². The area experiences high rainfall so that the mine has concentrated effort to conserve each drop of rainwater. The project area is having undulating hilly terrain and poor permeability. The depth of water level below ground level varies depending on the local topography, geology & hydrological conditions. The nearest surface water source is Teherai Nala which is flowing 500m away from the western side of the mining lease. Mine pit structure also present all around the lease area where water gets collected from the uplands through drains. Garland drains & retaining walls will be constructed all around the dumps and plantation of native species will be carried out on the dump slopes to minimize erosion. A settling pond will be constructed to arrest silt and sediment flows from mining area during rain fall and the water so collected is being utilized for the mine area, roads, green belt development etc.

Following two type of rainwater harvesting structure is proposed in lease area

1. Earth bunds
2. Ponds

1. **Erath bunds**

   Earthen bunds are essentially an external catchment, long slope technique of water harvesting. Typically a U-shaped structure of earthen bunds which farmers build on their cultivated lands to harvest runoff from adjacent upslope catchments, this technique usually collects rainwater and, sometimes, floodwaters.

2. **Pond**

   A pond is a body of freshwater smaller than a lake. Ponds are naturally formed by a depression in the ground filling and retaining water. Streams or spring water is usually fed into these bodies. It is different from a river or a stream because it does not have moving water and it differs from a lake because it has a small area and is no more than around 1.8m deep. Some ponds are formed naturally, filled either by an underwater spring, or by rainwater.

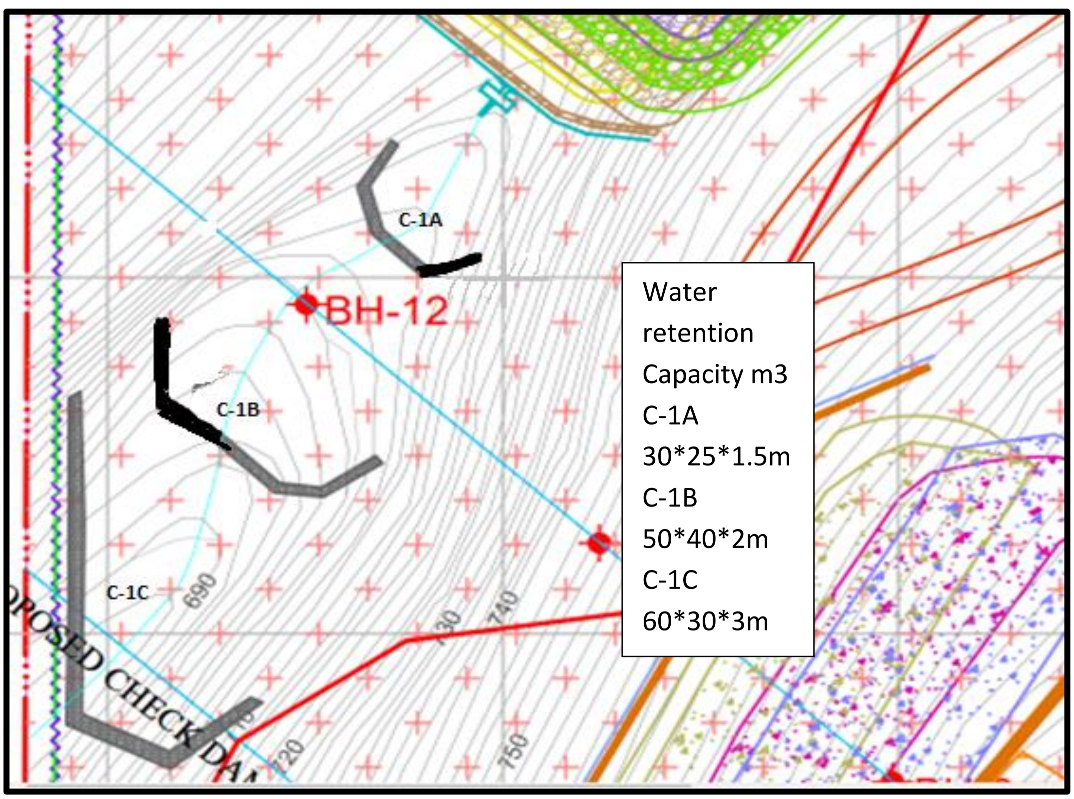


Fig 2.1: Proposed Earth bund structure N-W direction in lease area

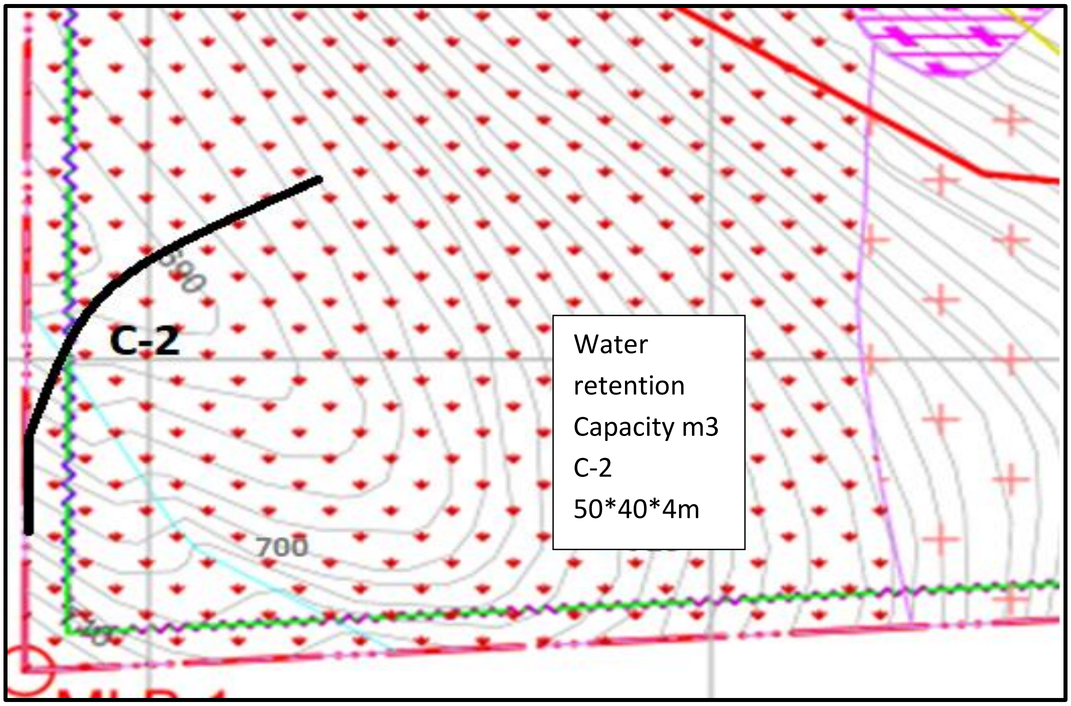


Fig 2.2: Proposed Earth bund structure in S-W direction in lease area

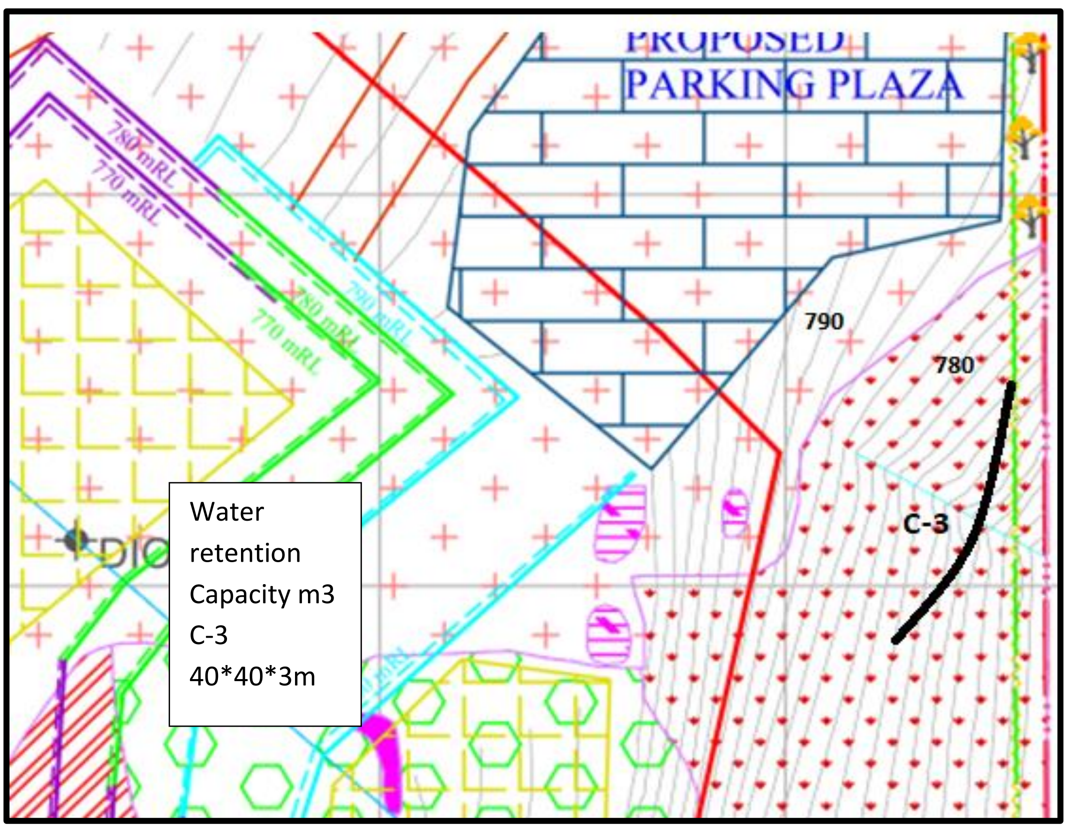


Fig 2.3: Proposed Earth bund structure in N-E direction in lease area

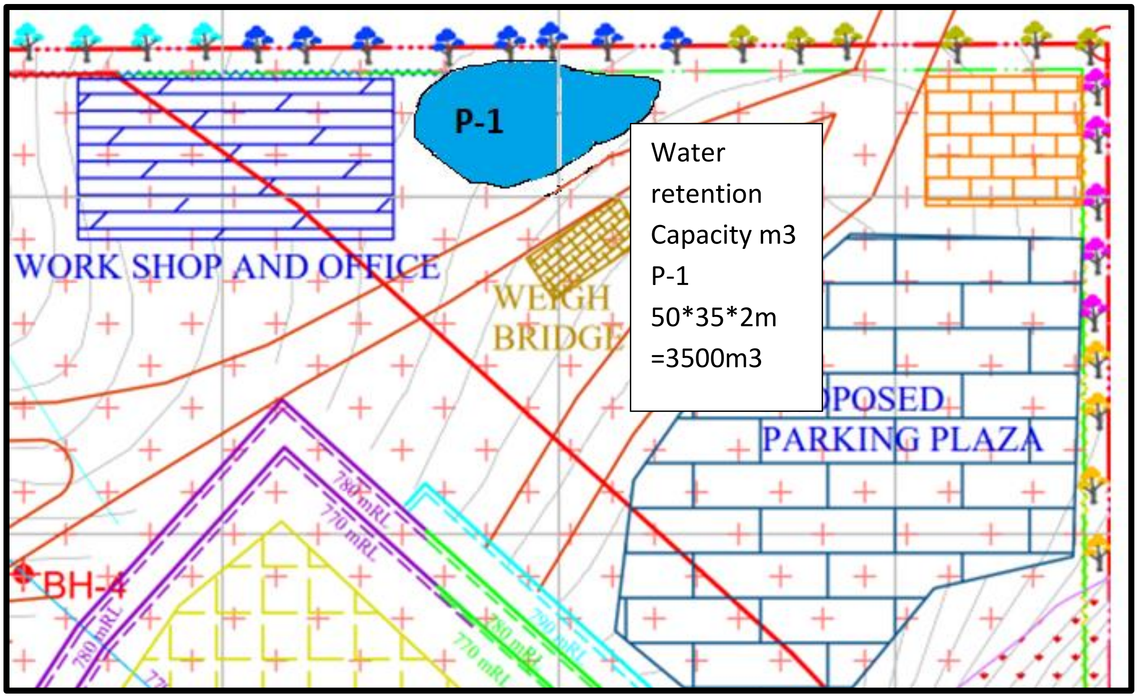


Fig 2.4: Proposed Earth pond structure in N direction in lease area

Table 2.2- Proposed Rainwater Harvesting Structures within ML area of Dholtapahar Iron Ore Mine

Sno	Locations Index	Lat	Log	Type of Structure	Proposed Dimensions		
					Bund Length in m	Bund Max hight in m	Capacity in m3
1	C-1A	21.841544	85.179932	Earthen Bund	60	3	1125
3	C-1B	21.840184	85.179465	Earthen Bund	100	4	4000
4	C-1C	21.839546	85.17899	Earthen Bund	150	6	5400
5	C-2	21.837018	85.179022	Earthen Bund	110	8	8000
6	C-3	21.840721	85.187198	Earthen Bund	75	6	4800
7	P-1	21.842596	85.185239	Pond	50*35	2	3500
						TOTAL	**26825**

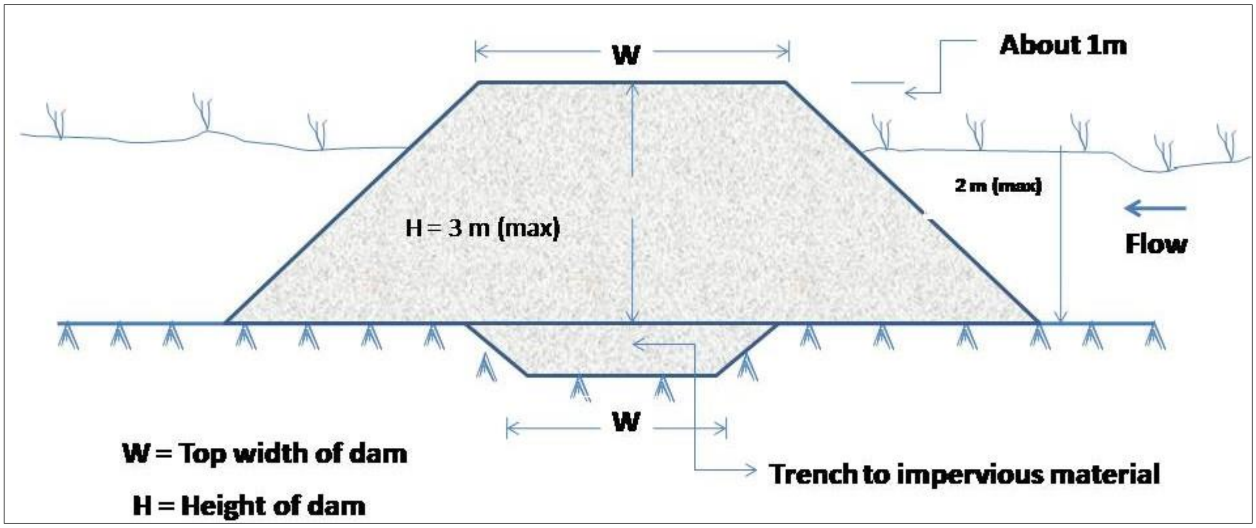


Fig 2.5: Proposed earth bund structure in lease area

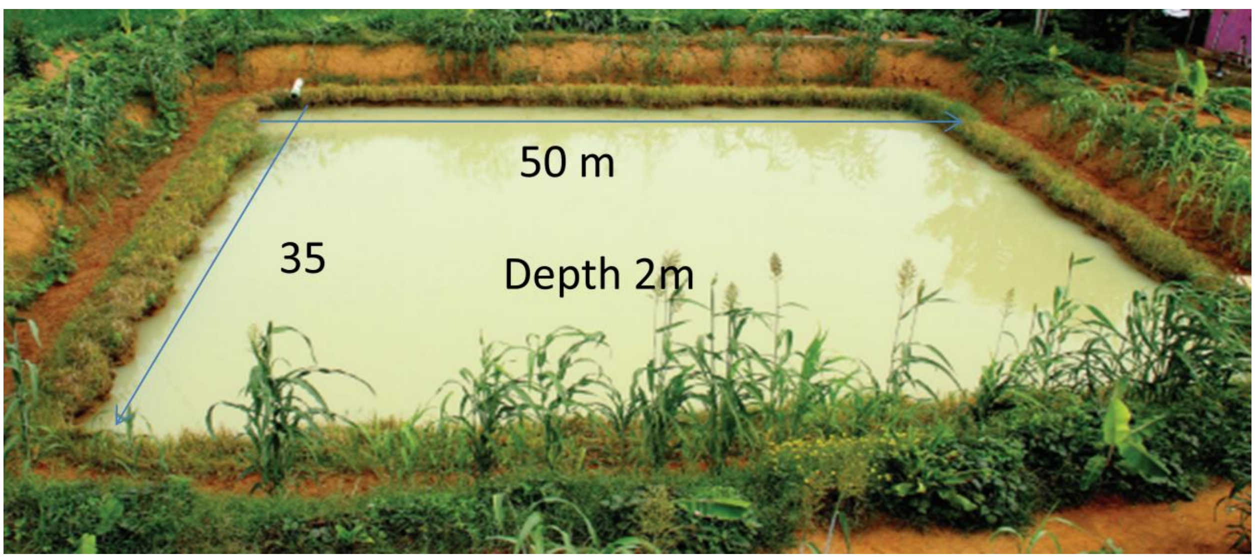


Fig 2.6 Proposed pond structure in the lease area

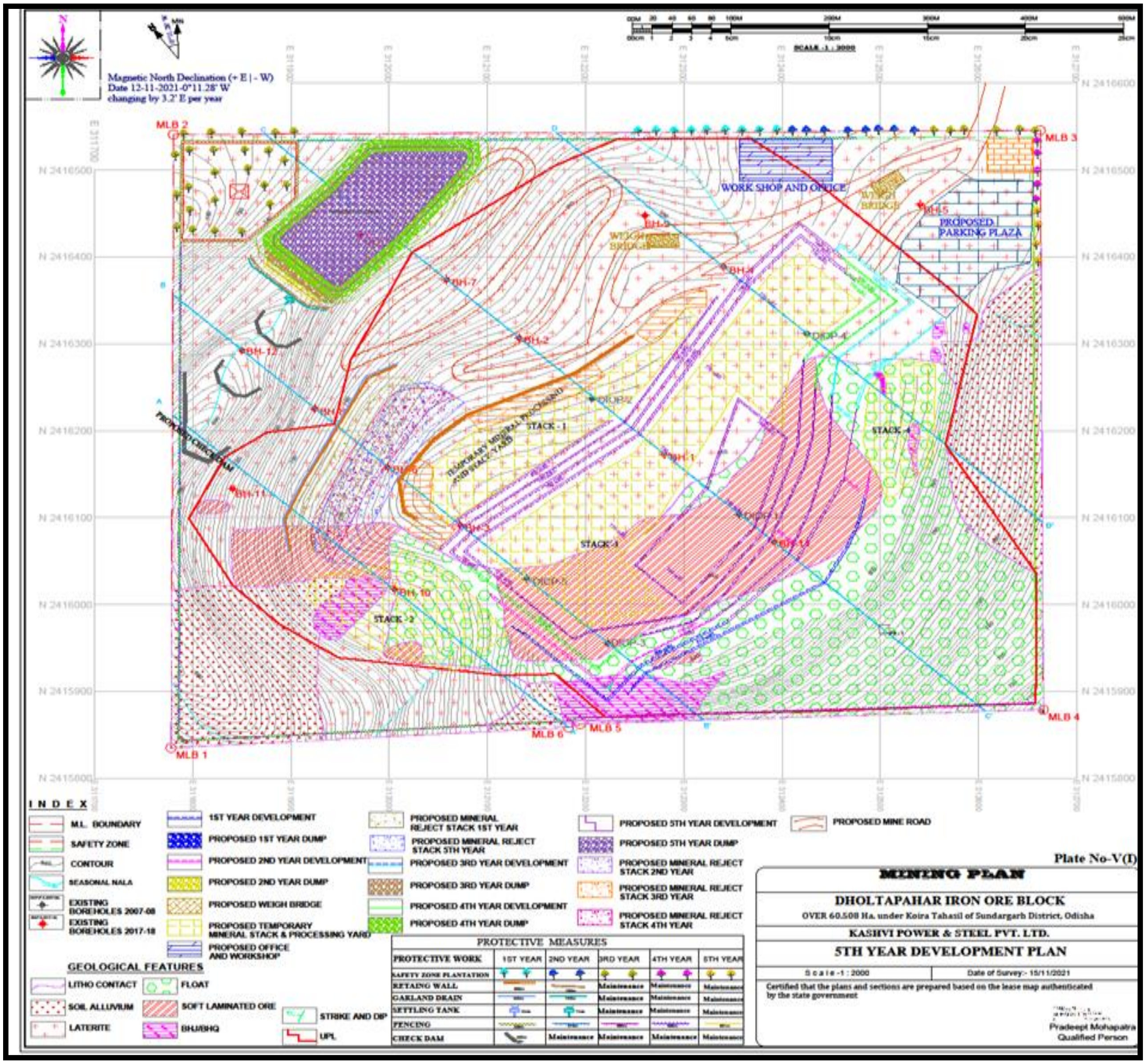


Fig 2.7: Approved mine plan of lease area

Fig 2.8: Existing rainwater harvesting pond and mine pit storage tank in Buffer Zone.

4.1. Monitoring, Measurement and Capacity building

Monitoring and measurements of several parameters are part of water conservation strategy towards the motive of efficient management of water. The withdrawal of groundwater is regularly monitored and measured from the existing dug well. The water level is found at 3.7 to 36.3 m bgl in pre monsoonal period, which varies from 2.5-5 m bgl in the monsoonal period. The Dholta pahar mine conducts regular capacity building of its maintenance staff that monitors and measures and keeping record of various data related to water use and water conservation. The workers have been trained for keeping record and onward submission of data as per the requirement. For monitoring of groundwater level in the area of Dholta Pahar mine, as per the guideline of CGWA, a piezometer has to be constructed at the area. The installation of piezometer is proposed exclusively for monitoring of groundwater level deploying automatic water level recorder with telemetric arrangement of data transmission.

Comprehensive Report on:

Proposed RWH Structure in core zone of Netrabandha Pahar Block Iron Ore Mine, Koira Block, Sundargarh District, Odisha.

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept
2020]

M/S KASHVI POWER AND STEEL PVT LTD
PLOT NO 1234/P, GOVINDA PRASAD, BOMIKHAL, BHUBANESWAR- 751006
E-MAIL ID: groupkashvi@gmail.com

6. **Study for Rainwater harvesting around Iron ore mine of Netrabandh Pahar, Sundergarh, Odissa-**

Click to view

Comprehensive Report on:

Proposed RWH Structure in Core Zone of Netrabandha Pahar Block Iron Ore Mine, Koira Block, Sundargarh District, Odisha.

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

M/S KASHVI POWER AND STEEL PVT LTD

PLOT NO 1234/P, GOVINDA PRASAD, BOMIKHAL, BHUBANESWAR- 751006

E-MAIL ID: groupkashvi@gmail.com

By MRCAWTM – May 2022

Executive summary

M/S. Raga, Tradecon Pvt Lmt Bhubaneswaris located in Bhaliadihi Village, Koira Tehsil of Sundargarh District, Odisha. Bhaliadihi village is located in north east part of Sundergarh district. The study area falls under survey of India toposheet no F45N1N and F45N5N. Sanputli village is 1 km away from the study area. M/S. Raga, Tradecon Pvt Lmt operates as a manufacturer of sponge iron, billet and ingots and exporter of minerals. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc. During the plan period, it has been proposed to produce 1.0 MTPA iron ore per annum. The present study is made for obtaining NOC from CGWA for extraction of maximum 124.08 KLD ground water required during mining operation as per the approved mine plan. The present report is based on the Hydrogeological investigation made within core zone and its 10km radius of buffer zone for assessment of impact of dewatering of groundwater by the mine and will be submitted to CGWA for obtaining of NOC. The area is drained by IB and Brahmani River and its tributaries. The easterly flowing Sankh and westerly flowing Koel River join at Vedavyas near Rourkela to form the Brahmani River. The river, IB a tributary of Mahanadi controls the drainage of the western parts of the district. The drainage pattern of the area is dendritic. The study area is located in Bhaliadihi Village, Koira Tehsil of Sundargarh District, Odisha which falls under safe blocks as per the report on Dynamic Groundwater Resource of India, published by CGWB in 2019-20. The study area is having largely one geological formation name Singbhum-Keonjhar-Bonai group of iron ore of Precambrian age. These constitute hard rock's includes schist, tuffs, phyllite, basic rock, BHQ/BHJ have been classified as Iron Ore Series (IOS). Aquifers are developed only in the low lying area and valley parts of the study area. The total lease area of the proposed Netrabandha Pahar Fe ore block is 74.3700Ha (743700 m²). Groundwater quality is fresh and potable in both core and buffer zone area and EC remains below 1900 ppm and TDS varies from 10 to 310 ppm in the study area. As per the approved mine plan the mining activities restricted above the water table hence no water discharge has been generated during mining activities. The total water requirement is 124.08 KLD out of this 62 KLD will be extracted from ground water for mine use. Rainwater is harvested within the ML area through construction of water conservation pond and Roof Top RWH. The annual conservation through RWH is about 18576 m³/yr. There is no long term impact on groundwater because of open cast mining. Rest 62.08 KLD water will be arrange from RWH & recycle of waste water through ETP & STP. Thus, the study recommends NOC may be provided for next 5 yr with maximum 62 KLD extractions from groundwater.

Acknowledgments and Certificate

Impact assessment and report preparation work as per the CGWA guideline was entrusted to MRCAWTM, Manav Rachna as accredited Groundwater Institution of CGWA by M/S. Raga, Trade con Pvt. Lmt. Odisha is thankfully acknowledged.

Impact assessment and report preparation work as per the CGWA guideline was entrusted to MRCAWTM, Manav Rachna as accredited Groundwater Institution of CGWA by M/S. Raga, Trade con Pvt. Lmt. Odisha is thankfully acknowledged.

Discussions with Mr. Pradeept Mohapatra, Director WCS, regarding the geology of lease area and plan our investigations according to scope of work is gratefully acknowledged. Help rendered by Shri Shubham, Geologist, Shri. Prabhat, M/S. Raga, Tradecon Pvt Lmt, Odisha in every stage of planning and Field verification, investigations in and around lease area and report preparation is thankfully acknowledged. He also provided all the available relevant data and records many of them are reproduced in this report and forms part of annexure section.

At lease area, during days of field investigation we have received warm welcome and all hospitality and requisite support from mine team. We thankfully acknowledge Mr. Pradeept Mohapatra, Director WCS and his team for their cooperation.

The report has been prepared by Ms Sheha Rai, Asstt Prof MRCAWTM and Sandeep Kumar Research Assistant, MRCAWTM under the supervision of Prof (Dr) Arunangshu Mukherjee, Director MRCAWTM. Ms Alifia Ibkar, RA MRCAWTM helped Mr Sandeep Kumar in the field work and data collection.

It is to certify that MRCAWTM have investigated the area of Netrabandha Pahar Fe ore block of Bhaliadihi Village, Koira Tehsil of Sundargarh District, Odisha. Based on actual data collected from field and literature survey done, has prepared the report as per the format of CGWA.

(Dr Arunangshu Mukherjee)
Director, MRCAWTM

MR Centre for Advance Water Technology & Management
Manav Rachna International Institute of Research & Studies
(Deemed to be University under section 3 of the UGC Act, 1956)
Sector-43, Delhi – Surajkund Road, Aravali Hills, Faridabad - 121004

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.1. Project description

M/S. Raga, Tradecon Pvt Lmt. Bhubaneswar is a registered firm under Minerals (Development and Regulation) ACT, 1957 and The Mineral (Auction) Rules, 2015, Govt of Odisha. Netrabandha Pahar (West) iron ore Block located in Koira Tehsil of Sundargarh district of Odisha. The corporate identity Number of the company is U51420MH1995PTC162317. The total lease area of Netrabandha Pahar (West) Iron ore mine is 74.3700 ha. As part of the statutory clearance, the Mining Plan and Progressive Mine Closure Plan is prepared under Rule 16(1) of MCR, 2016 and Rule 23 of MCDR, 2017respectively for a period of 5 years from the date of opening of the mine for grant of Mining Lease in favor of M/s Raga Tradecon Pvt Ltd. The registered office is situated at State of Maharashtra(Mumbai) having is regd. office at 503, 5th floor, Greenland Apartment, Building no.3, JB Nagar, Andheri East, Mumbai- 400059, Maharashtra to carry on all or any of the business as manufacturers, buyers, sellers, suppliers, traders, exporters, minerals, metals etc. The company has planned to establish pellet plant in Sundergarh/Keonjhar district of Odisha with a period of two years. Total ore reserve estimation in the lease area is 17274072 tonnes. Estimated total production of ore during five year would be 3249000 tones. Therefore, remaining reserves will be 17274072MT-3249000MT=14024082MT. The production of Iron Ore @ 1000000MT per annum, life of the mine will be 14024082MT/1000000MT=14.02 years. Therefore total life of the mine will be 19 years which includes 5 year of plan period and 14 years of conceptual period. During the plan period, it has been proposed to produce 1.0 MTPA iron ore per annum. The mine will be developed by opencast mining method with mechanized means deploying machinery like wagon drill machine, rock breaker, hydraulic / diesel operated shovel, dumper/tipper etc.

Location

M/S. Raga, Tradecon Pvt Lmt Bhubaneswaris located in Bhaliadihi Village, Koira Tehsil of Sundargarh District, Odisha. Bhaliadihi village is located in north east part of Sundergarh district. The study area falls under survey of India toposheet no F45N1N and F45N5N. Sanputli village is 1 km away from the study area. Nearest railway station is Barsuan which is 23 km away from the lease area. The lease area of mine is not located within 10km radius of National Park /Wild Life Sanctuary / Protected area and don’t falls under Coastal Regulation Zone (CRZ). Few shallow depth open cast pits mine are present in the study area.

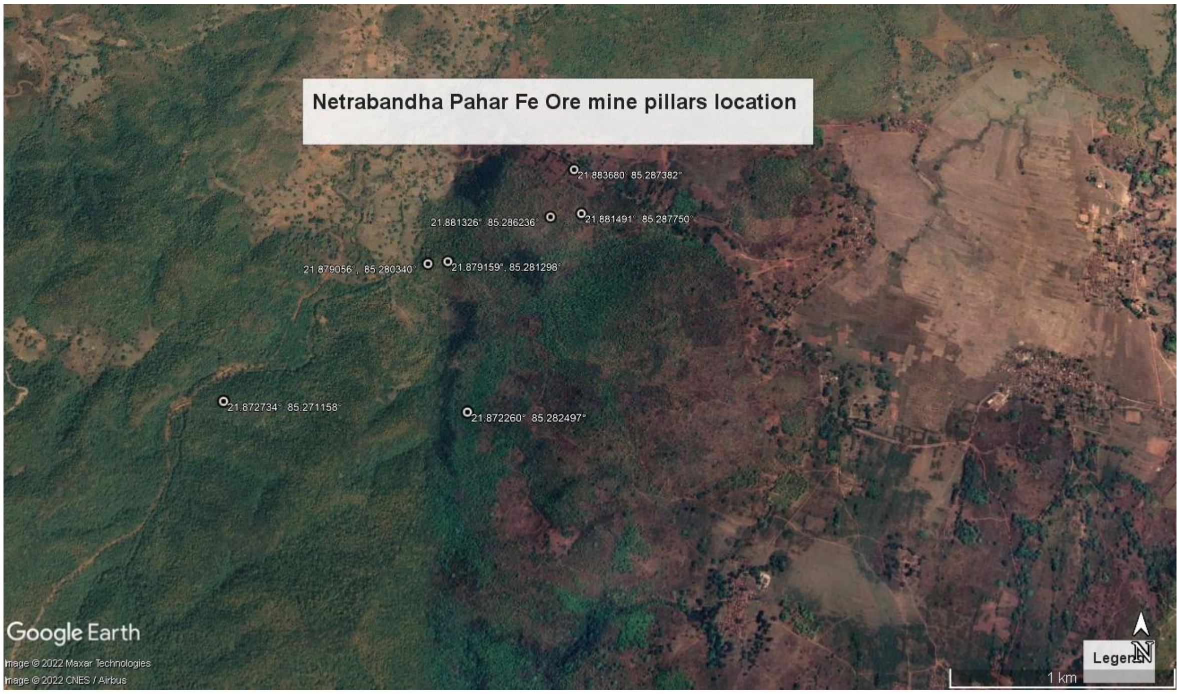


Fig 1.1: Google image showing proposed area of Netrabandha Pahar (West) block iron ore mine

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1.2. Topography and Drainage

Netrabandha Pahar (West) block is a part of Koira group of upper Shale formation. Study area having steep rising hills with intervening steep gorge and narrow valley. The geomorphic sub-units like the pediments, pediplains, buried pediments, valley fills, and lineaments are the predominant in the hard rock areas in study area. The highest elevation is 867.2m amsl and lowest elevation is 366.28m amsl.

Study area is covered with different hills with intervening intermontane valleys, isolated hillocks and flat to gently undulating plains. The area is drained by IB and Brahmani River and its tributaries. The easterly flowing Sankh and westerly flowing Koel River join at Vedavyas near Rourkela to form the Brahmani River. The river, IB a tributary of Mahanadi controls the drainage of the western parts of the district. The drainage pattern of the area is dendritic.

1.3. Groundwater Situations

Sundergarh district is North Western part of Odisha state. Sundergarh is recognized as an industrial district in the map of Odisha. Steel Plant, Fertilizer plant and Cement factory. Ferro Vanadium Plant. Machine building factory, Glass and China clay factory and Spinning mills are some of the major industry of this district. Large part of the study area belongs to Bhaliadihi Village, Koira Tehsil of Sundargarh District, Odisha. Ground water is the main source of drinking as well as industrial and domestic purpose. However, the requirement of water in irrigation and agriculture is fulfilled mainly by river, canals, as well as by rainwater. The rainwater also is the main source for recharge of groundwater of the area.

1.4. Climate and Rainfall pattern

The climate of the district is sub tropical climate characterized with hot and dry summer, cold winter and erratic in rainfall. The winter season extends from November to end of February, which is followed by summer season from March to the middle of June, and rainy season from middle of June to middle of October. During summer months the maximum temperature rises up to 43° C and May is the hottest month. December is the coldest month of the year when the average daily temperature drops down to 8° C. Relative humidity is around 60-70% throughout the year. The highest and lowest monthly mean relative humidity so far recorded is 97% (Dec) and 26% (April). The annual rainfall of last decade is given in Table (1.1).

Table 1.1 Decadal Rainfall in Sundergarh District (Source: WRIS online portal) 2011-2020

Year	Actual Rainfall (mm)	Deviation (%)	Year	Actual Rainfall (mm)	Deviation (%)	Average Rainfall (mm)
2011	1788.35	20.87	2016	1098.51	-28.82	1415.126
2012	1435.18	1.39	2017	1323.91	-6.8	
2013	1537.77	7.97	2018	1396.59	-1.32	
2014	1335.09	-5.99	2019	1387.02	-2.02	
2015	1286.6	-9.9	2020	1562.24	9.4	

1.5. Groundwater regime monitoring:

The study area comprises 10km radius zone in Netrabandha Pahar (West) iron ore Block located in Koira Tehsil of Sundargarh district of Odisha.Detailed hydrogeological study of both core and buffer zone of mine area is carried out.The hydrogeological condition varied from place to place due to different litho unit of aquifer.The hydrogeological units of the study area are broadly categorized into twogroups namely.

1. Consolidated formations.
2. Unconsolidated formations

1) Consolidated formations

The study areais occupied by the consolidated formations comprising of Precambrian metasediments of Gangpur series and Iron ore series and also granite gneiss, metasediments like amphibolite, epidiorite etc. Ground water is stored mainly in the secondary porosity resulting from weathering and fracturing of the rocks. Ground water occurs under confined to semi-confined condition in the deeper fractured zones. Water yielding capacity is mainly depend on the extent of fracture, depth, opening and size of fracture. Mica schist, quartzite and phyllite are the formation in the study area.

2) Unconsolidated Formation

Laterite and alluvium are the main constituents of unconsolidated formation in the study area. The laterite is belonging to sub recent to recent age having high porosity. It is the good aquifer for dug well in study area. The alluvium soils are also the potential aquifers due to their high degree of porosity and permeability but are only limited in their occurrence.

2. Water Conservation

Measures to be adopted for water conservation which includes recycling, reuse, treatment, etc. This includes the water balance chart being adopted by the firm along with details of water conservation methods to be adopted. - Brief writes up along with capacity and flow chart of Sewage Treatment Plants / Effluent Treatment Plants / Combined Effluent Treatment Plants existing/ proposed within the project. - Details of water conservation measures to be adopted to reduce/ save the ground water. - Total water balance chart showing the usage of water for various processes.

At present the lease area is required 117.5 KLD for mining operations. The entire water requirements are fulfilled by ground water as well as surface/ recycle/ RWH water. The water is to be consumed by various mine operation such as dust suppression, domestic use, plantation, and ETP & workshop. The area experiences high rainfall, the site will generate above volume of run offs during such rainy periods. The surface run off from the uncovered site would contain high concentration of suspended matter and eroded matter which will be checked through retaining wall, earth bunds and settling ponds.

Water conservations can be enhanced by including efficient measures of water use for mining and domestic consumption, effective reuse and recycles of water and treated water, adoption of appropriate rainwater harvesting and artificial recharge methods. It is therefore following sub topics are incorporated in this chapter.

2.1 Water use and water balance

2.2. RWH and Artificial Recharge

2.1. Water use and water balance:

Netrabandha Pahar (West) block iron ore mine is proposed of 117.5KLD water. Water is to be used for dust suppression, domestic use, plantation, and ETP & workshop purposes shown in the (Table 2.1).

Table 2.1: Proposal of Water Utilization in Netrabandha Pahar (West) block mine (Area= 74.3700ha)

Sl. No	Purpose	Surface water /RWH (KLD)	Ground Water Ab(KLD)	Recycled STP &ETP (KLD)	Total water needed from all source(KLD)
1	Dust Suppression	9.8	89.5	2.7	102
2	Domestic Use	-	4.5		4.5
3	Plantation	-	-	4.8	4.8
4	ETP & Workshop, Wheel-Washing System	6.2			6.2
Total		**16.0**	**94.0**	**7.5**	**117.5**

2.2. Rainwater Harvesting

The total lease area of Netrabandha Pahar (West) Iron ore mine is 743700 m². The area experiences high rainfall so that the mine has concentrated effort to conserve each drop of rainwater. The project area is having undulating hilly terrain and poor permeability. The depth of water level below ground level varies depending on the local topography, geology & hydrological conditions. The nearest surface water source is Teherai Nala which is flowing 500m away from the western side of the mining lease. Teherai Nala is the major 2nd order drainage system of the area. Mine pit structure also present all around the lease area where water gets collected from the uplands through drains. Garland drains & retaining walls will be constructed all around the dumps and plantation of native species will be carried out on the dump slopes to minimize erosion. A settling pond will be constructed to arrest silt and sediment flows from mining area during rain fall and the water so collected is being utilized for the mine area, roads, green belt development etc.

Following two type of rainwater harvesting structure is proposed in lease area

1. Roof top RWH
2. Ponds

1. Roof top rainwater harvesting structure

Rooftop Rain Water Harvesting is the technique through which rain water is captured from the roof catchments and stored in reservoirs. Harvested rain water can be stored in sub-surface ground water reservoir by adopting artificial recharge techniques to meet the household needs through storage in tanks. The Main Objective of rooftop rain water harvesting is to make water available for future use. Capturing and storing rain water for use is particularly important in dry land, hilly, urban and coastal areas.BH-13 will be used and completely developed as a roof top RWH structure to collect all roof water and directed transferred to underground. Total 1326m3 will be captured by roof top RWH structure. The propose location of RT RWH has been shown in Fig 2.2. Total capacity of the roof top RWH has shown in table no 2.2

A roof top rainwater harvesting is proposed using standard deign as given below for mine lease area and associated building at the mine core zone (Fig 2.1)

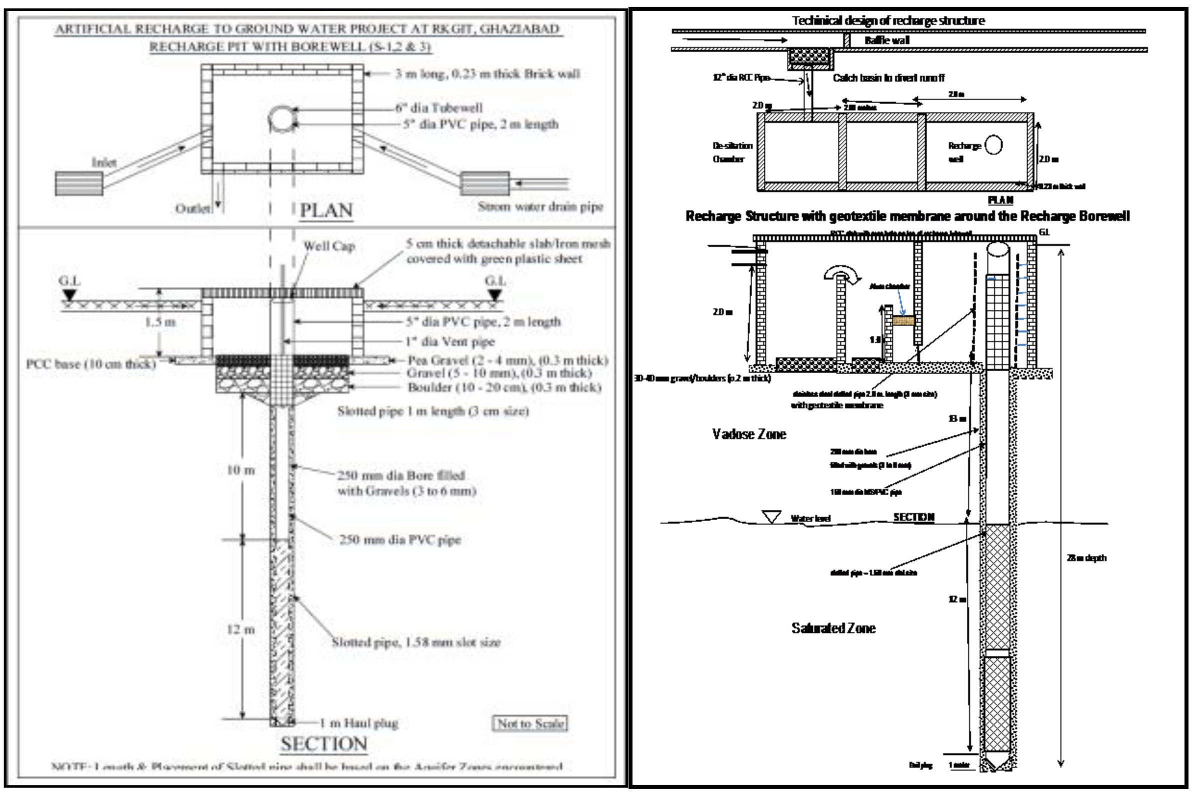
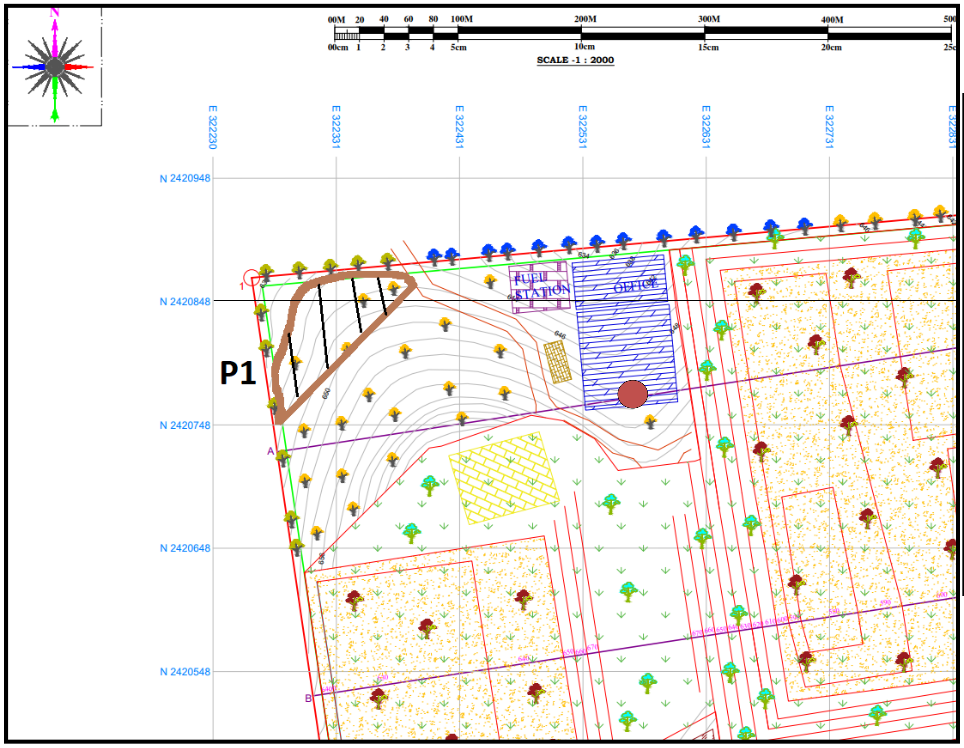


Fig 2.1: Standard Design of rooftop rain water harvesting structure

2. **Pond**

A pond is a body of freshwater smaller than a lake. Two Ponds has been proposed in lease to collect rainwater and seasonal flow. The dimension of P1 is 140*30*2m3 has been proposed in N- W corner of the lease area to collect available rain water flow. Pond P2 has been proposed in western side of the lease area with dimension of 200*50*2m3. The location of proposed P1 & P2 has been shown in Fig 2.2 and Fig 2.3. Total capacity of the pond has shown in table no 2.2. Pond design and pond slope design has shown in Fig 2.4 &2.5.



Water retention Capacity m3
P-1
140*30*2m
=8400m3

BH-13
50*25*0.75
*1.45=
1326m3

Fig 2.2: Proposed location of Pond (P1) and roof top RWH structure in lease area

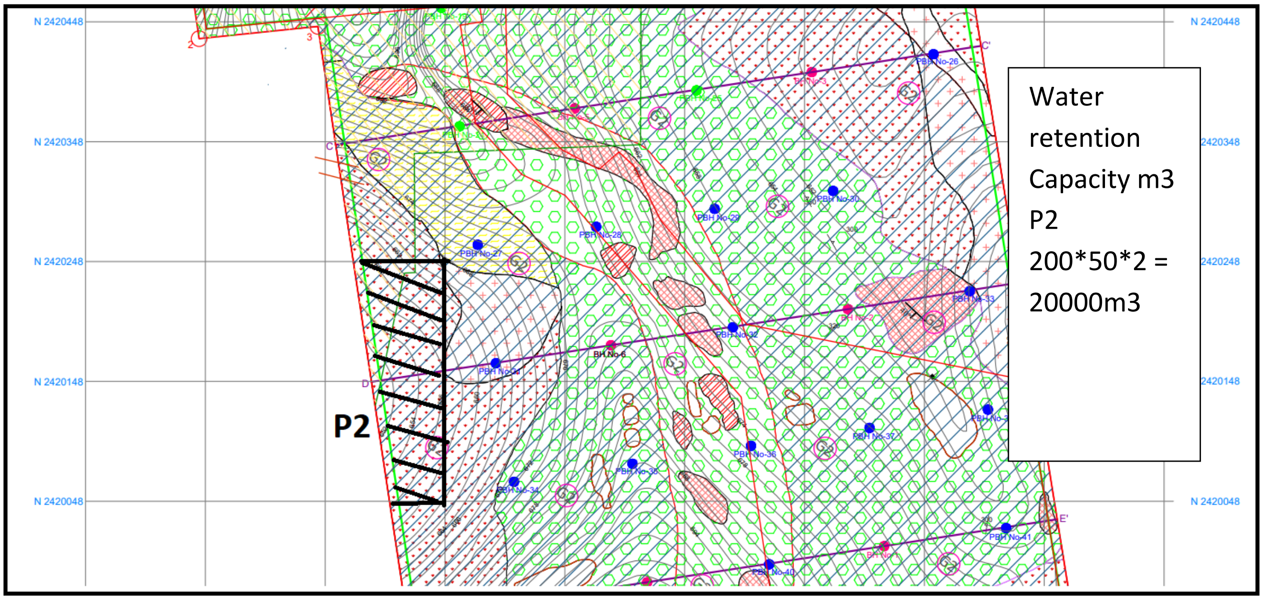


Fig 2.3: Proposed location of Pond (P2) in lease area

Table 2.2- Proposed Rainwater Harvesting Structures within ML area of Netrabandha Pahar Iron Ore Mine

S/n	Locations Index	Lat	Log	Type of Structure	Proposed Dimensions		
					Bund Length in m	Bund Max height in m	Capacity in m3
1	P-1	21.882795	85.280346	Pond	140*30	2	8400
2	P-2	21.87649	85.282057	Pond	200*50	2	20000
3	BH-13	21.882815	85.282281	Roof top RWH	50*25*0.75*1.45		1326
						TOTAL	**29726**

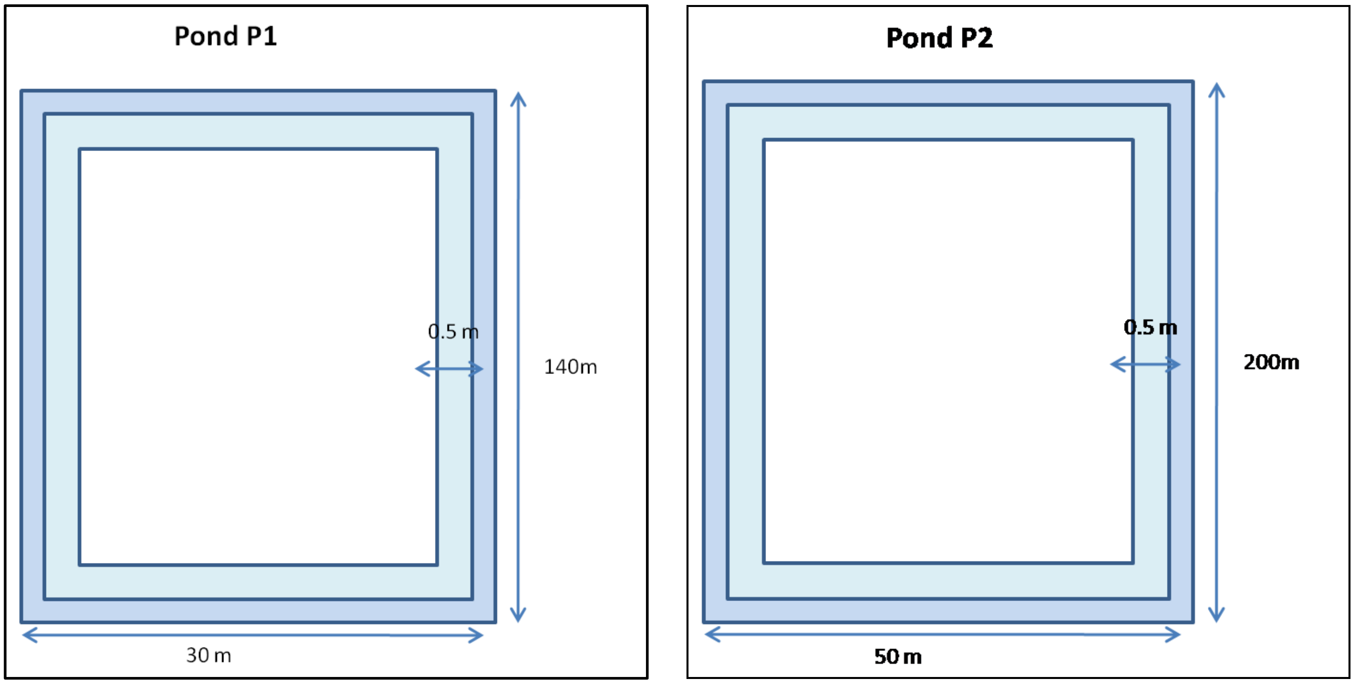


Fig 2.4 Proposed Pond Designs of P1 and P2 in the Lease Area

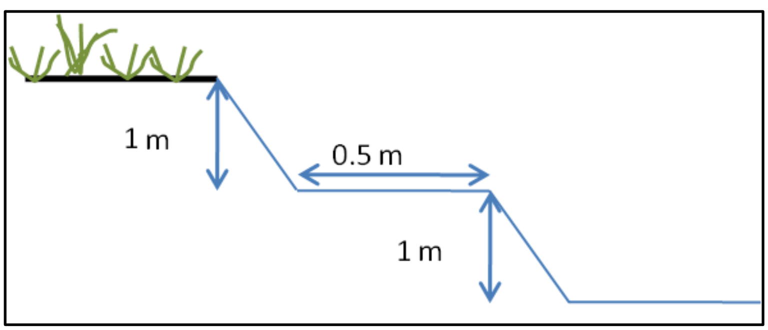


Fig 2.5 **Proposed Pond Slope Design**

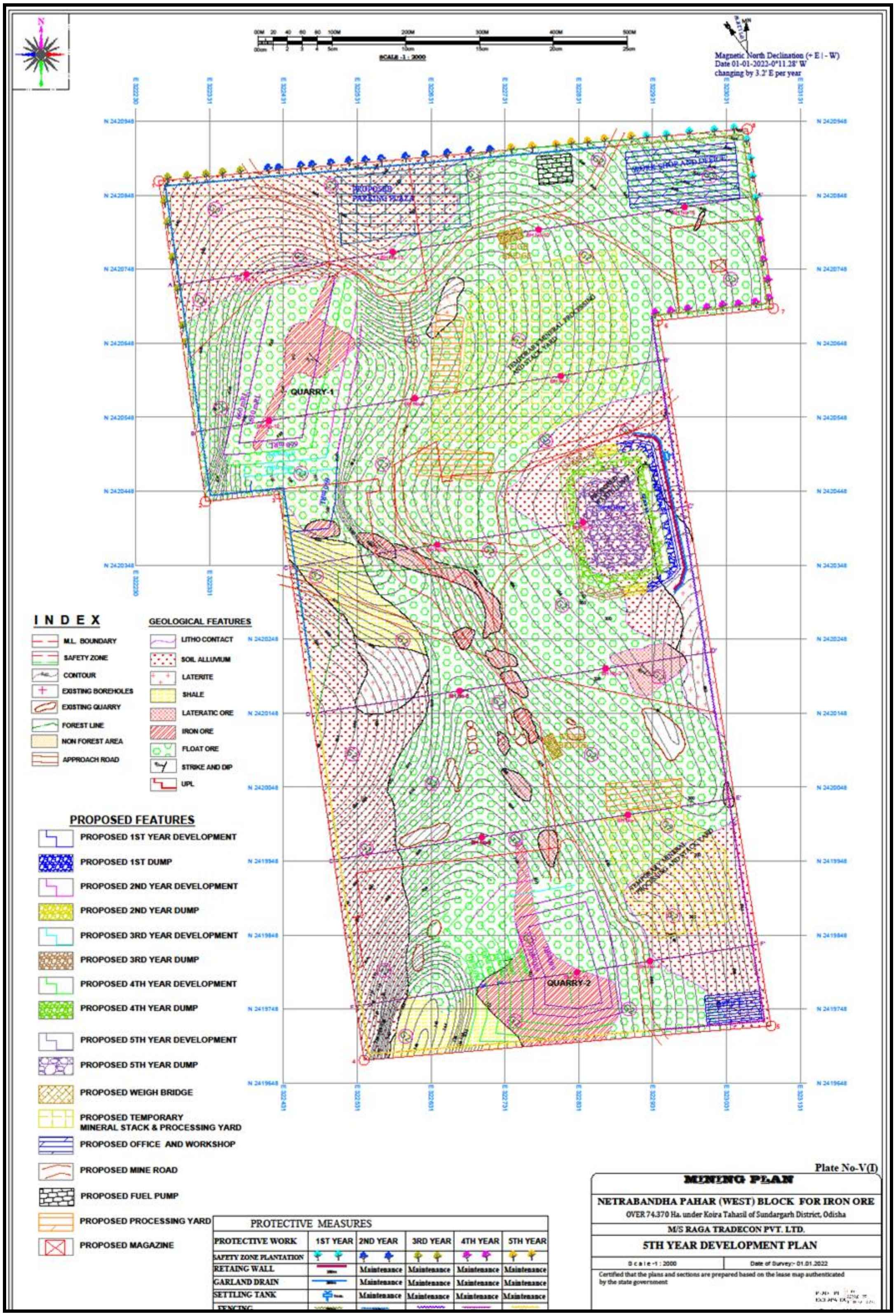


Fig 2.6: Approved mine plan of lease area

Fig 2.7: Existing water harvesting structure in Buffer Zone

2.3. Monitoring, Measurement and Capacity building

Monitoring and measurements of several parameters are part of water conservation strategy towards the motive of efficient management of water. The withdrawal of groundwater is regularly monitored and measured from the existing dug well. The water level is found at 3.7 to 36.3 m bgl in pre monsoonal period, which varies from 2.5-5 m bgl in the monsoonal period. The Netrabandha Pahar mine conducts regular capacity building of its maintenance staff that monitors and measures and keeping record of various data related to water use and water conservation. The workers have been trained for keeping record and onward submission of data as per the requirement. For monitoring of groundwater level in the area of Netrabandha Pahar mine, as per the guideline of CGWA, a piezometer has to be constructed at the area. The installation of piezometer is proposed exclusively for monitoring of groundwater level deploying automatic water level recorder with telemetric arrangement of data transmission.

7. **Impact assessment of underground mining of Manganese on Ground Water in and around Miragpur, MP-**

Click to view

Comprehensive Report on:

Groundwater Condition in both core and buffer zone of Miragpur Manganese Mine, Khairlangi Block, Balaghat District, Madhya Pradesh

Sneha Rai

Comprehensive Report on:

Groundwater Condition in both core and buffer zone of Miragpur Manganese Mine, Khairlangi Block, Balaghat District, Madhya Pradesh

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

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By MRCAWTM - March 2022

Executive summary

An Underground Mine of Manganese Ore of M/s D P Rai is located at coordinate 21°37'56.9"N 79°49'56.2"E of village Miragpur, Balaghat district Madhya Predesh adjacent to the State Maharastra boarder. The mine was established in March 2006. The mine was previously developed as an open cast mine for ore extraction since April 2016. It is proposed to extend and expand the existing o/c workings in the strike direction to the east and west both and the Pit will be further deepened. The present study is made for obtaining and NOC from CGWA for extraction of maximum 68KLD groundwater during mining operation as per the approved mine plan. The mine discharge will remain below 100 KLD during all future expansion of mining operation during next 5 -10 years. The present report is based on the hydrogeological investigation made within core zone and its 10km radius buffer zone for assessment of impact of dewatering of groundwater by the mine and will be submitted to CGWA for obtaining renewal of NOC.

The study area falls under Wanganga river subbasin of Godavari basin and comprises of parts of Khairlangi Block of MP and Bhandara block of Maharastra both falls under safe blocks as per the report on Dynamic Groundwater Resource of India, published by CGWB in 2019-20. The study area is having largely one geological formation, Mansar Group of rocks of Proterozoic quartzite mica schist in the area. These are constituting hard rock aquifer of phreatic nature. The Thickness of aquifer is about 12-17m.The 24.288 ha mine lease area is located near water divide and having radiating flow direction, but no river/ stream generates from this area. The av annual groundwater level in the core zone remain 6m bgl in comparison to 5m level of buffer zone. Groundwater quality is fresh and potable in both core and buffer zone area and TDS remains below 1900 ppm varies from 150 to 1900 ppm in the study area.

As per the approved mine plan the dewatering of groundwater maximum 68KLD was obtained but the quantum of water generates as mine discharge remain largely below this limit around 8KLD in general. The water generated during mining processes containing heavy silt load. The entire water is reused in maintaining the green belt/horticulture and dust suppression within the ML area and for mining operation. Rainwater is harvested within the ML area through construction of water conservation pond. Roof top Rainwater harvesting structure is proposed as per building bylaw. The annual conservation through RWH&AR is about 0.14ham at present and will increase due to construction of rooftop RWH structure.

There is limited long term impact of groundwater dewatering by Miragpur mine on the study area, Thus the study recommend NOC may be provided for next 5 yr with maximum 68 KLD extraction from groundwater system as mine discharge.

Acknowledgments and Certificate

Impact assessment and report preparation work as per the CGWA guideline was entrusted to MRCAWTM, Manav Rachna as accredited Groundwater Institution of CGWA by M/s D P Rai Nagpur is thankfully acknowledged.

Discussions with Mr. Abhishek Rai, Chairman cum Managing Director, regarding the history of mine establishment and its process of miningof Mn ore has helped us in understanding the process well and plan ourinvestigations according to scope of work is gratefully acknowledged. Help rendered by Shri Sudhakar Chande, Manager & Mr. Himanshu, Geologist in every stage of planning and execution, investigations in and around plant area and report preparation is thankfully acknowledged. He also provided all the available relevant data and records many of them are reproduced in this report and forms part of annexure section.

At mine level, during days of field investigation we have received warm welcome and all hospitality and requisite support from mine team. We thankfully acknowledge Shri Sudhakar Chande Mines Manager and his team for their cooperation.

The report has been prepared by Ms Sheha Rai, Asstt Prof MRCAWTM and Sandeep Kumar RA MRCAWTM under the supervision of Prof (Dr) Arunangshu Mukherjee, Director MRCAWTM. Ms Alifia Ibkar, RAMRCAWTM helped Mr Sandeep Kumar in the field work and data collection.

It is to certify that MRCAWTM have investigated the area of Pandharwani Mine Khairlangi Balagahat and based on actual data collected from field and literature survey done, has prepared the report as per the format of CGWA.

(Dr Arunangshu Mukherjee)

Director, MRCAWTM

MR Centre for Advance Water Technology & Management

Manav Rachna International Institute of Research & Studies

(Deemed to be University under section 3 of the UGC Act, 1956)

Sector-43, Delhi – Surajkund Road, Aravali Hills, Faridabad - 121004

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Comprehensive Report onGroundwater Condition in both core and buffer zone of Pendharwani Manganese Mine, Khairlangi Block, Balaghat District, Madhya Pradesh

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

Format for Impact Assessment Report as per the CGWA Norms

SNo	Point of Report	Reply Enclosed
[1.]	Brief about the proposed project giving location details, coordinates, google/ toposheet maps, etc. demarcating the project area	**Yes** [Chapter-1]
1.1	*Land Use Land Cover of the surrounding area, Percentage of LULC categories*	**Yes**
1.2	*Topography and drainage.*	**Yes**
1.3	Details of wetlands [Highlight protected wetlands / Ramsar sites / NLCP lakes/ other important wetlands in terms of dependencies of local communities if any]	**Not Applicable**
[2]	Ground water situation in and around the project area including water level and quality data and maps along with quality issues, if any. In case of mines, ground water conditions in both core and buffer zone should be described.	**Yes** [Chapter-2]
2.1	Brief geology of the area	**Yes**
2.2	Hydrogeology of the area	**Yes**
	2.2.1 Aquifer description [type, depth, storativity, permeability and porosity]	**Yes**
	2.2.2 Ground water flow and aquifer interaction [flow direction, Ground water – surface water connectivity]	**Yes**
	2.2.3 Ground water level trend analysis [pre – monsoon and post – monsoon] for 10 years	**Yes**
	2.2.4 Hydrograph of the water level for 10 years	**Yes**
	2.2.5 Predicted water level declines for affected aquifers [Ground water modeling]	**Not Required** as per norms

	2.2.6 Ground water quality [pre - monsoon and post – monsoon]	**Yes**
	2.2.7 Water quality of nearby water bodies	**Yes**
[3.]	Details of the tubewells/ borewells proposed to be constructed. This includes the aquifer parameters, drilling depth, diameter, tentative lithological log, details of pump to be lowered, H.P. of pump, tentative discharge of tubewells/ borewells, etc. Locations to be marked on thesite plan/ map.	**Yes [**Chapter-2,3]
[4.]	Details of Geophysical studies carried out in and around the project area. Ground water resources computation of the block in which the project falls	**Yes [**Chapter-4]
	4.1 Results of Geophysical analysis [vertical electrical sounding (VES), horizontal profiling and imaging, transient electromagnetism method (TEM)] etc	**Yes**
[5.]	Approved Mine plan in case	**Yes** (Chapter-5)
	5.1 Year wise mine plan including excavation depth, area and mine seepage.	**Yes**
[6.]	Proposed usage of pumped water in case of infrastructure dewatering projects.	**Yes** (Chapter-6)
6.1	*For drinking, irrigation etc.*	**Yes**
6.2	*Recharge*	**Yes**
6.3	*Runoff to stream*	**Yes**
6.4	*Benefitted area*	**Yes**

SNo	Point of Report	Reply Enclosed
6.5	Dust suppression, Green belt development etc	**Yes**
[7.]	Comprehensive assessment of the impact on the ground water regime in and around the project area highlighting the risks and proposed management strategies proposed to overcome any significant environmental issues.	**Yes [**Chapter-4]
7.1	Impact on surface water sources	**Yes (** Chapter – 7**)**
7.2	*Impact on groundwater sources*	**Yes**
	7.2.1. A description of the impacts on environmental values that have occurred, or	**Yes**

	are likely to occur, because of any past ground water abstraction.	
	7.2.2 An assessment of the likely impacts on environment that will occur, or are likely to occur, because of the ground water abstraction for a five years period starting on the consultation day for the report; and over the projected life of the resource project area, affected area and radius of influence in case of dewatering	**Yes**
7.3	*Socio-Economic Aspects:*	**Yes**
	7.3.1 Settlements and population dynamics around project area	**Yes**
	7.3.2 Dependency on sources of water [surface or sub-surface]	**Yes**
	7.3.3 Ground water uses [e.g. irrigation (irrigation method, number of watering) water supply etc.]	**Yes**
	7.3.4 Improvement / decline in agricultural yield in last 5 years and likely impact after NOC	**Yes**
	7.3.5 Impact of proposed / existing project on local communities [based on local interactions (interactions must be with stakeholders like fishermen community,farmers etc.]	**Yes**
[8.]	Proposed measures for disposal of waste water by industries drawing saline water.	**Not Applicable**
[9.]	Measures to be adopted for water conservation which includes recycling, reuse, treatment, etc. This includes the water balance chart being adopted by the firm along with details of water conservation methods to be adopted.	**Yes [**Chapter-3]
	Brief write up along with capacity and flow chart of Sewage Treatment Plants / Effluent Treatment Plants / Combined Effluent Treatment Plants existing/ proposed within the project.	**Yes**
	Details of water conservation measures to be adopted to reduce/ save the groundwater.	**Yes**
	- Total water balance chart showing the usage of water for various processes.	**Yes**
[10.]	Any other details pertaining to the project.	Annexure (s)

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Report on:
Hydrogeological Investigation and Impact Assessment Report for Miragpur Manganese Ore Mine Balaghat District, MP

Introduction

The report is prepared as per the format prescribed by CGWA for impact assessment study, the Introductory chapter comprises the following subtitle for describing its

1.1 Objectives
1.2 Scope of the study
1.3 Project description-Plant, process, product and location
1.4 Land Use Land Cover and percentage of LULC categories
1.5 Topography and drainage.

1.1 Objective

The Central Government had constituted the Central Ground Water Board as Authority vide notification number S.O. 38 (E), dated the 14th January,1997 to exercise powers under sub section (3) of section 3 of the Environment (Protection) act, 1986 (29 of 1986) for the purposes of regulation and control of Ground Water Management and Development. The Authority has been regulating ground water development and management by way of issuing 'No Objection Certificates' for ground water extraction to industries or infrastructure projects or Mining Projects etc., and framed and issued guidelines in this connection from time to time. The entire process of grant of No Objection Certificate shall be online through a web based application system. The latest guideline issued by Gazette Notification no 2941 on 24th September 2020 supersedes all earlier guidelines issued by the Central Ground Water Authority (CGWA). CGWA vide email dated 21st Nov 2020 and 13th Jan 2021 instructed the M/s D.P. Rai, Nagpur, Maharashtra to submit Impact assessment report along with undertaking for processing their application for regularization of groundwater abstraction for mining. There by M/s D.P. Rai, Nagpur, Maharashtra engaged Dr Arunangshu Mukherjee, CGWA Accredited Groundwater Professional vide email dated 30th Dec 2021 to carry out the hydro geological investigation along with impact assessment study incorporating socio-economic assessment study on groundwater regime due to withdrawal/ dewatering groundwater by **Miragpur Manganese Ore Mine, Balaghat** M/s D.P. Rai, Nagpur, Maharashtra as per the prescribed format of CGWA.

1.2 Scope of Study

The scope of study includes hydrological study around mine and providing certificated report along with providing guidance on techno-legal aspects and compliance for obtaining NOC for CGWA as per latest guidelines. Detailed hydrogeological investigations within core and buffer zones (10km radius study area) of **Miragpur Manganese Ore Mine, Balaghat** leased to M/s D.P. Rai, Nagpur, Maharashtra and assessment of impact of mining on groundwater regime in the study area which covers parts of Khairlanji block/tehsil, Balaghat district of Madhya Pradesh and some villages of Bhandara district, Maharashtra. As the mine is generating only 8m³/day discharge thus groundwater modeling is not required along with impact assessment report for this case as per the CGWA guideline.

1.3 Project description

M/s D.P. Rai, Nagpur, is a partnership firm registered under Indian Partnership Act, 1932. Miragpur Manganese ore mine is engaged in the mining activities since decades. Miragpur mine having an area of 24.288 ha & 4.339 ha. Presently mining is through underground method. Existing open pit size-4180 m² as on 1-04-2016- This is the Main Pit which was proposed to be extended along strike towards the western lease boundary and depth extension proposed up 330 MRL. The surface elevation at 24.288 ha & 4.339 ha mine lease area varies between 345 and 342 m amsl. The firm is well equipped with tools qualified personnel and required plans. Miragpur Mine is an underground mine for proposal of production of Mn ore of 1300 tons/Yr. Mn ore band, running from (N200W to S200E) direction with an average thickness of ore is 8 (Eight) meters. Dip of the ore body is approx. 250 towards (SW).

Location

Miragpur Manganese Ore Mine is located in Miragpur village, Tehsil Khairlanji, District Balaghat, Madhya Pradesh. Miragpur village is situated in the south west portion in Balaghat district, Madhya Pradesh. The study area falls under survey of India toposheet no F44N14. Miragpur mine is situated 50km from Balaghat Town and 25 km from Khairlanji tehsil headquarters and 130 km from Nagpur railway station. Mining lease area is surrounded by the agriculture land and small hillocks of weathered soil. Many shallow depths abounded open cast mines pits are present within the study area. The opening of Miragpur underground mine is located at coordinate 21°37'56.9"N 79°49'56.2"E (**Fig1.1**).The lease area of underground mine is not located within 10km radius of National Park /Wild Life Sanctuary / Protected area and don't falls under Coastal Regulation Zone (CRZ).

1.4 Land use and Land cover (LULC) change in the study area:

The total area of the Miragpur mine is 24.288 Ha (242800 m²) & 4.339 ha. The mine is situated in outer part of the Miragpur village surrounded by hills and forest area. The land use of the mining area is given in **Table no 1.1** and the percentage has been represented through a pie diagram in **Fig 1.2**. The nearest village is Jatapur Khappa located 0.8 km Comparison of LULC during 2015 and 2021 within the 10 kms radius of mine area show marginal changes in agriculture use, forest cover, built up area, as shown in figs and tables -1.2 & 1.3, however area under water body has increased from 60 ha to 124 ha due to accumulation of water into some abandon mine pit sand due to construction of water conservation structures in the area.

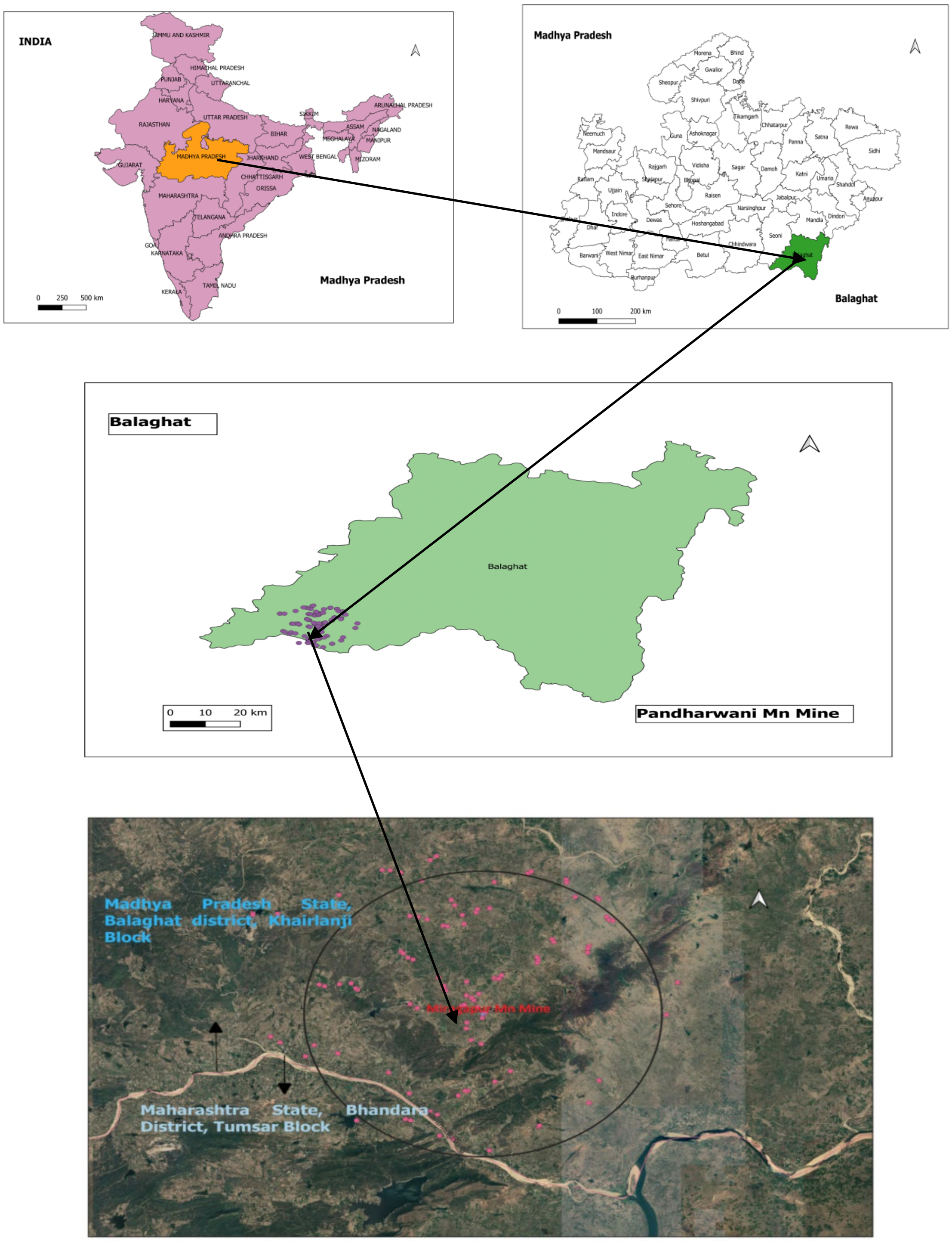


Fig 1.1: Location map of Miragpur Mn Mine, Balaghat district, Madhya Pradesh

Fig 1.2: Google image showing Miragpur Mn Mine

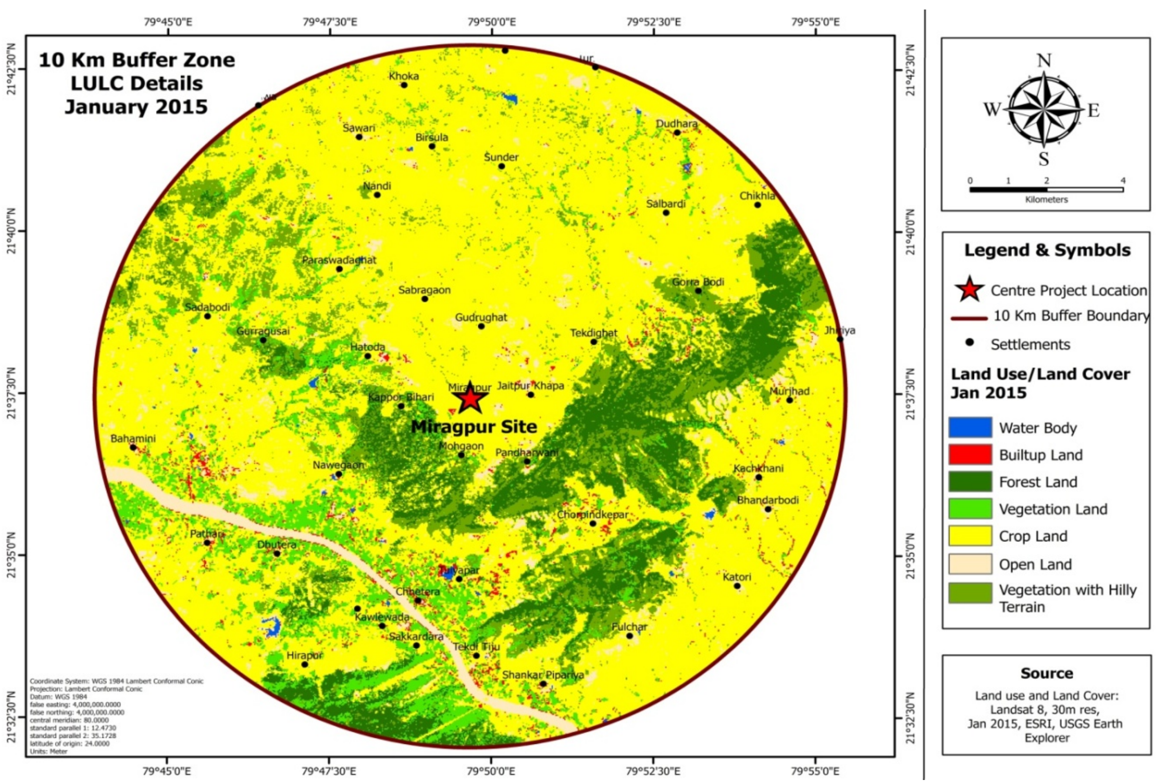


Fig 1.3: Map showing LULC of Miragpur Mn Mine of 10km buffer zone (Jan 2015

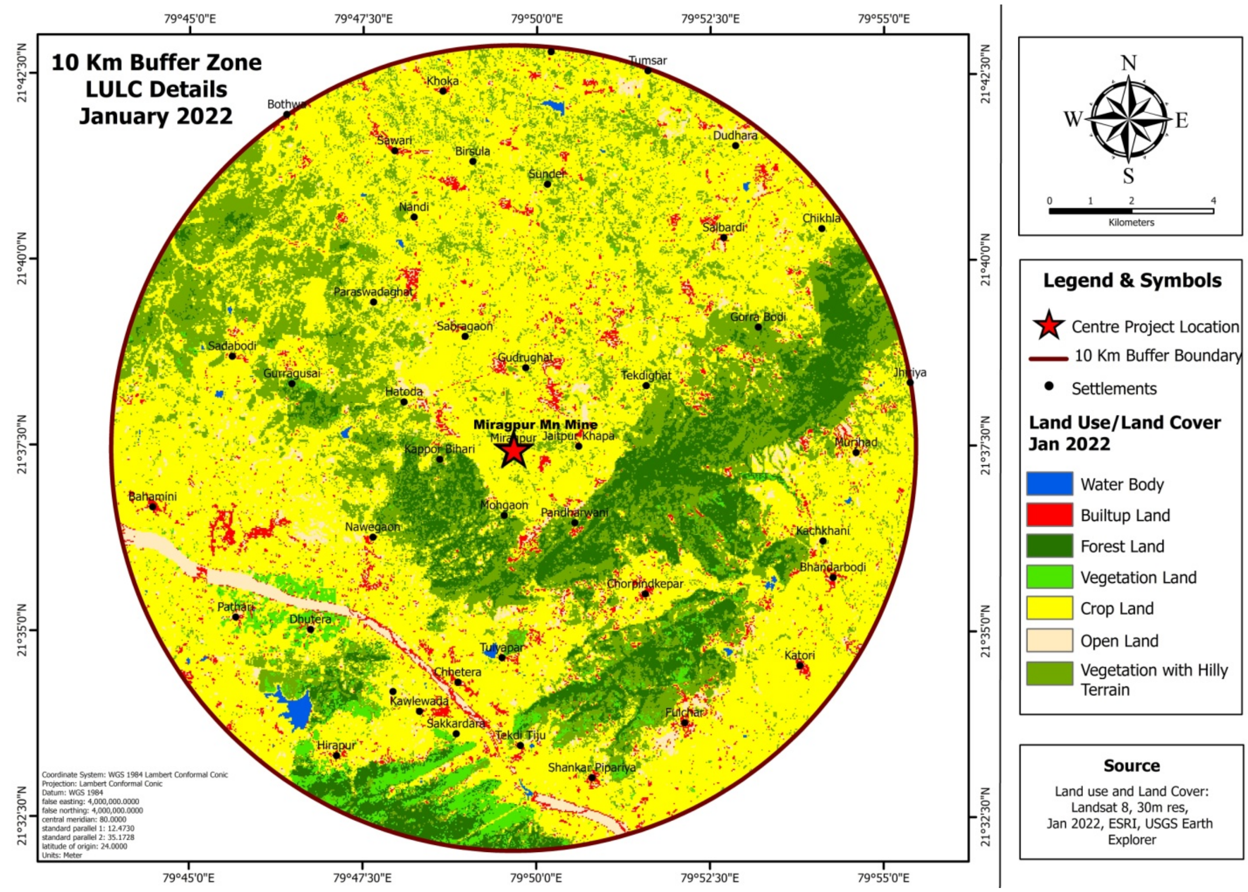


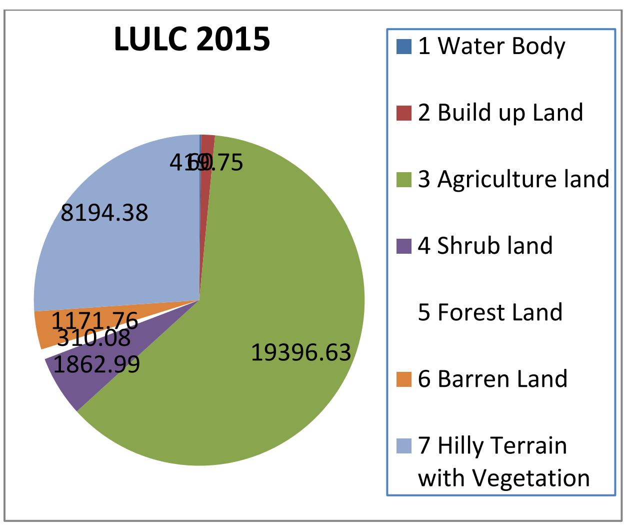
Fig 1.4: Map showing LULC of Miragpur Mn Mine of 10km buffer zone (Jan 2022

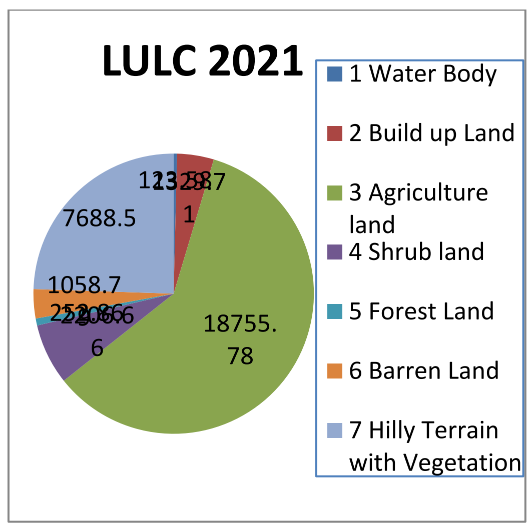
Table 1.1 LULC 2015 of Study Area

Sr.no	LULC Type	Area (Ha)
1	Water Body	123.58
2	Build up Land	1329.71
3	Agriculture land	18755.78
4	Shrub land	2206.66
5	Forest Land	252.86
6	Barren Land	1058.79
7	Hilly Terrain with Vegetation	7688.5
Total Area (10km Buffer zone)		**31415.88**

Table 1.2 LULC 2021 of Study Area

Sr.no	LULC Type	Area (Ha)
1	Water Body	60
2	Build up Land	419.75
3	Agriculture land	19396.63
4	Shrub land	1862.99
5	Forest Land	310.08
6	Barren Land	1171.76
7	Hilly Terrain with Vegetation	8194.38
Total Area (10km Buffer zone		**31415.59**





1.5 Topography and Drainage: The Miragpur mine belongs to Mansar Formation of Sausar Series. The Terrain is almost flat having some exposed rocks. The highest elevation is 466m amsl and lowest elevation is 267m amsl. The digital elevation model presented in Fig 1.5. The gradient of the study area has been measured by remote sensing data using elevation map in Fig 1.6. The western part and southern half of study area having southerly slope whereas the central (including mine area) and northeastern part having northeasterly slope. The area south of Bawanthadi River is having northerly slope.

Drainage: There is no water body and Nallah in the lease area. At a distance of 8km NW direction a seasonal river called Bawanthadi flows in E-W direction. Bawanthadi is a tributary of river Wainganga of Godavari basin. Wainganga river entering Balaghat district from its Northwestern part from the Seoni district, creates the boundary between Sehoni and Balghat district and flowing south through the lowlands, it enter the Bhandara district. The Rajiv Sagar (Bawanthadi) interstate irrigation project, between the states of Madhya Pradesh and Maharashtra, envisages construction of a dam across river Bawanthadi. It has been constructed near village Kudwa in Katangi Tehsil of Balaghat district, M.P. and village Sitekasa of Tumsar Tehsil of Bhandara district, Maharashtra.

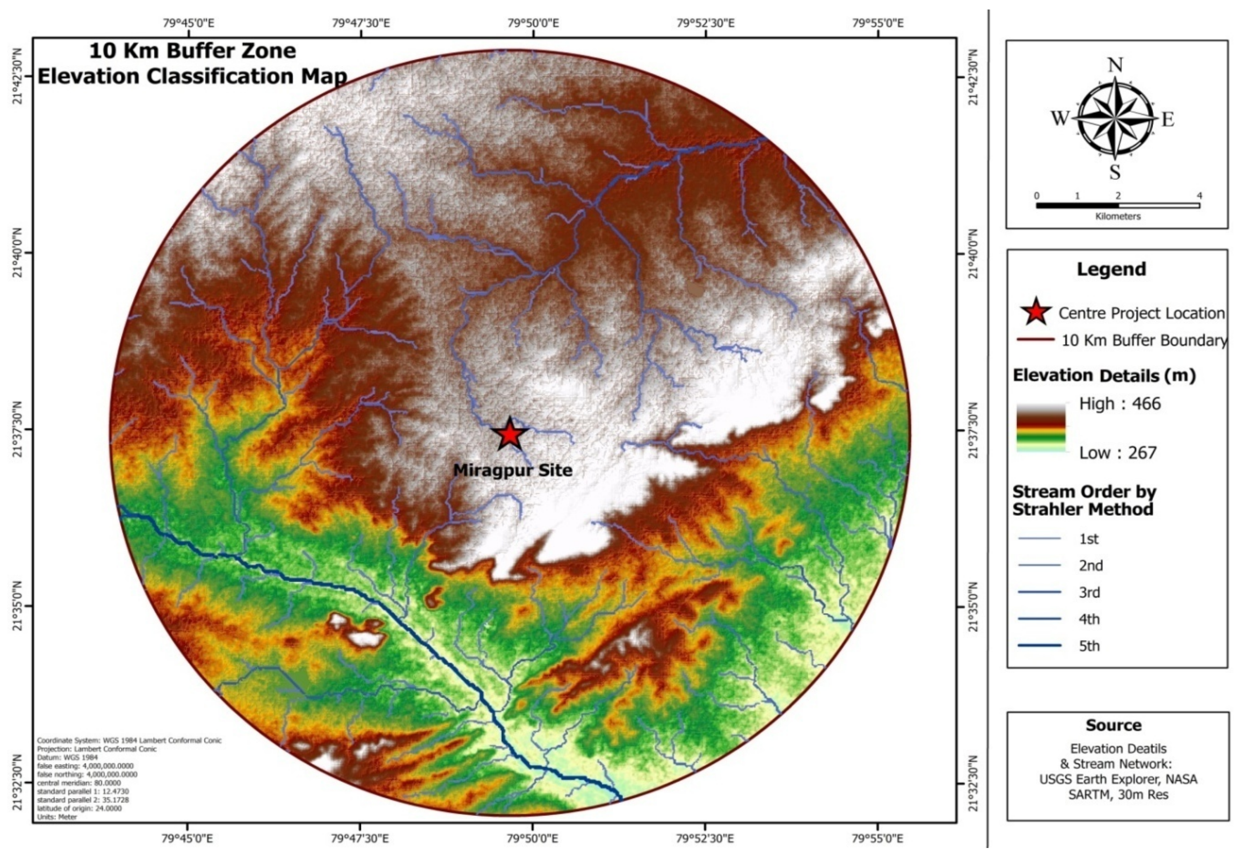


Fig 1.5: Digital elevation map in 10km buffer zone.

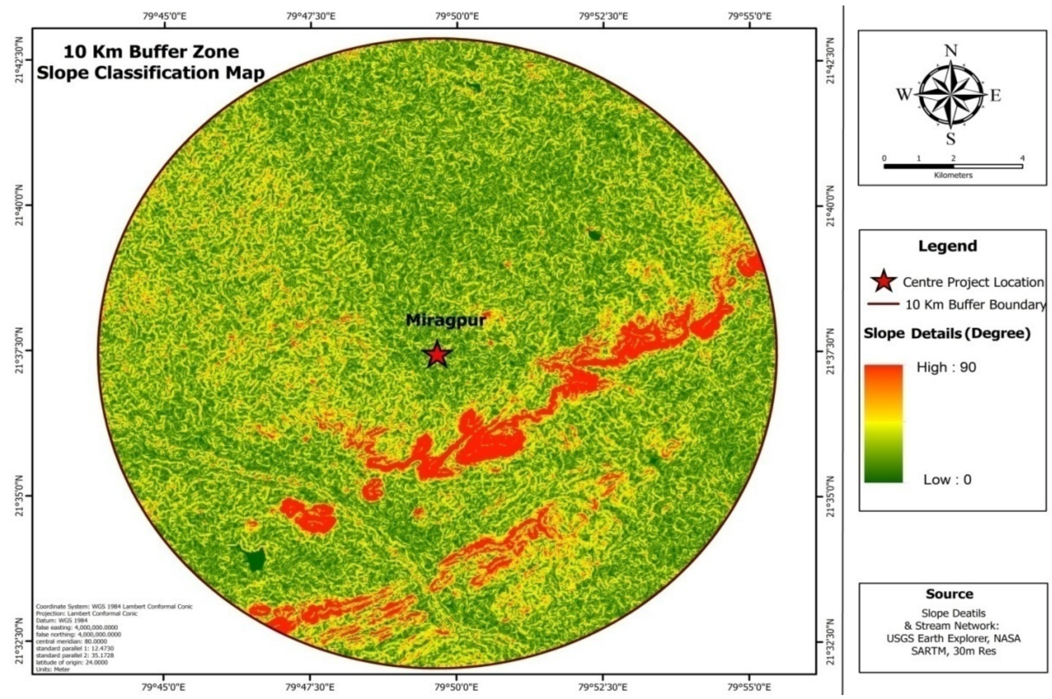


Fig 1.6: Slope map of Miragpur Mn mine in 10km buffer zone

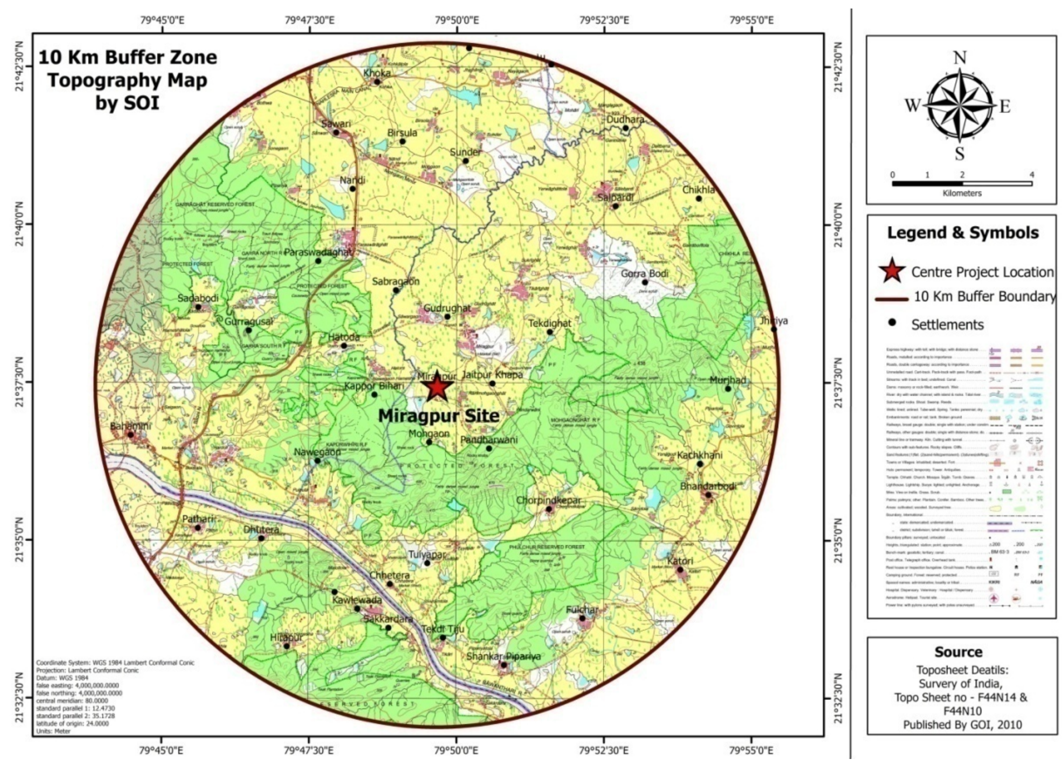


Fig 1.7: Topography Map map in 10km buffer zone.

2. Groundwater Situations

Large part of the study area belongs to Khairlanji block which is located in Southwestern part of Balaghat District Madhya Pradesh. Ground water is the main source of drinking as well as domestic purpose. However, the requirement of water in irrigation and agriculture is fulfilled mainly by river as well as rainwater. The rainwater also is the main source for recharge of groundwater of the area. The following major subtopics that are covered in this particular chapter are:

2.1 Geology and Geomorphology
2.2. Climate and Rainfall pattern
2.3 Groundwater regime monitoring
2.4 Long term groundwater trend
2.5 Groundwater resources
2.6 Groundwater quality

2.1. Geology and Geomorphology

Manganese deposit of Madhya Pradesh – Maharashtra belongs to Sausar Group of rocks, displayed in accurate shape band which runs over 200 km. from Ukwa in M.P. to Kachidhana via Tumsar-Bhandara& Nagpur dist. of Maharashtra. Mansar Formation of Sausar Group is folded and re-folded and thrusted by many cycles of deformations. Sausar sequence is rested over rocks of Gneissic complex with unconformity. Dolomites, Limestone, Mica Schist, quartzite, Biotite Granulite are the rock types associated with this series. Mica Schist, quartz mica schist along with Manganese have been made exposed in mine area by previous opencast activities. Mica Schist is coarse to fine grain rock with fish skin luster.

Geological Formation in the Study area

- **Alluvium soil:** On the basis of field study it has been observed that the lateritic soil is found with brown to red color. The average thickness of the soil is cover is 3m in study area.
- **Mica Schist with Quartzite:** It has been observed that the formation in the study area is trend in ENE-WSW and the trend of Manganese ore body is NNW-SSW. Mica Schist is coarse to fine grained with fish skin luster. Mica Schist is crenulated, filled with needles of stretched vitreous quartz. Quartz associated with schist is thick vitreous but crushed at places due to deformation.
- **Manganese ore with Gondite**: Manganese ore in Miragpur mine belong to Mansar Formation. Manganese ore is dark steel grey with Braunite as principal mineral associated with other oxide and silicate. Thetrendof the manganese ore deposit is mostly NNE-SSW and the angle of dip is varying from about 75° to 80°.

The manganese deposit of the Balaghat district, M.P., founds as NNE-SSW to ENE-WSW trending conformable bands in the form of lenses of varying sizes, enclosed within the metasedimentary sequence of Sausar Group of rocks of Precambrian age (Banerjee, et. al. 2007). The Madhya Pradesh-Maharashtra manganese belt is the largest manganese ore deposits of India which are intensely deformed and metamorphosed varies from green schist facies to upper amphibolite facies with gradual increase in the grade of metamorphism from East to West The regionally metamorphosed syngenetic sedimentary bodies of manganese ores in the Sausar Group of Balaghat district, Madhya Pradesh exhibit a definite trend in the formation and transformation of manganese oxide phases with progressive metamorphism. A regional trend is clearly noticeable from the paragenesis of Ore minerals in the manganese ore bodies from different metamorphic zones. Braunite forms at a very low temperature, appearing in the chlorite zone of regional metamorphism, and it continues in stable form right up to the sillimanite zone. Bixbyite as a high temperature mineral appears first in biotite zone and also appears in the sillimanite and almandine zone in the Balaghat

Stratigraphic succession of Sausar group (Bandyopadhyay, et. al., 1995)

FORMATION	LITHOLOGY
Bichua Formation	Dolomite, Marble, Calc silicate gneiss schist.
Junewani Formation	Metapelite (Mica Schist), Quartzite, granulite, biotite-Gneiss (Reworked basement).
Charboli Formation	Quartzite, feldspathic Schists, Gneisses, Autoclastic Quartz, Conglomerate.
Mansar Formation	Metapelite (mica-schists and gneisses), graphitic Schists, Phyllite quartzite, major manganese deposits and gondite.
Lohangi Formation	Calc-Silicate Schists and gneisses, marble, Manganese deposits.
Sitasaongi Formation	Quartz mica Schists, Feldspathic Schists, mica gneiss, Quartzite, Conglomerate.
Tirodi Gneiss	Biotite gneiss, Amphibolite, Calc-Silicate Gneiss (Tirodi Gneiss), Granulites, Mica Feldspathic Schists.
---Unconformity---	
Older Metamorphics	Charnockite, Orthogneisses and Granite Biotite Gneisses, hornblende Gneisses, Amphibolites and calcgranulites

Geomorphology: Morphologically the area having Alluvial plains, intermonnate valleys, denudational hills and peneplains. Natural levees can be seen in the bank of Bawanthadi River. Strems are showing dendritic pattern, drainage density is modarate.

2.2 Climate and Rainfall:

The mining area is situated in Khairlanji block of Balaghat district, but the study area covers the southwestern part of Balaghat district and northern part Tumsar block of Bhandara district in Maharashtra State, India. The nearest Meteorological station is at Satona (Hydromet Division, IMD), which is located around 60 kms from the study area. Therefore, the data collected from IMD Satna and from the state data of Madhya Pradesh and Maharashtra have been considered to discuss the climate and rainfall of the study area (Table **2.1 to 2.4**)

Winds

The wind velocity is higher during the pre-monsoon period as compared to post monsoon period. The maximum wind velocity 7.7 km/hr observed during the month of June and minimum 3.9 km/hr during the month of December.

Temperature

The Climate of the district is sub- tropical or moderate characterized by a hot summer and general dryness except during the southwest monsoon season. The cold season usually begins from the month of December and continues to February. December is the coldest month with mean minimum temperature of around 8◦C The winter is followed by the summer season which starts from March and continues to the middle of June having mean daily maximum temperature of 43◦C in the month of May. The period from the middle of June to September is the southwest monsoon which is followed by the post monsoon or transition period in the months of October and November.

Humidity

The relative humidity is maximum during the southwest monsoon which ranges between 70-75%, it is comparatively drier in the rest of the year. The driest part of the year is the summer season, when relative humidity is less 34%. May is the driest month of the year.

Rainfall

Rain fall is the major source of the water of the area is discussed. The area is characterized by semi-arid type of climate, which is mainly having moderate dryness except during the monsoonal months. The normal annual rainfall of Balaghat district is 1471.6 mm. Balaghat district receives maximum rainfall during southwest monsoon period i.e. June to September and a very little rainfall during north-east monsoon (October to December). in the wake of thunderstorms and western disturbances. Thus, surplus water for ground water recharge is available only during the southwest monsoon period.

Table 2.1 Decadal Rainfall in Balaghat District (Source: WRIS online portal) 2011-2020						
Year	Actual Rainfall (mm)	Deviation (%)	Year	Actual Rainfall (mm)	Deviation (%)	Average Rainfall (mm)
2011	1131.59	-1.69	2016	1055.89	-8.27	1151.14
2012	1067.65	-7.25	2017	908.02	-21.11	
2013	1481.32	28.68	2018	1036.58	-9.95	
2014	1154.34	0.27	2019	1263.39	9.75	
2015	1018.4	-11.53	2020	1394.22	21.11	

Table 2.2 District wise average Annual Rainfall of and Departure(%) from Normal rainfall					
District	Normal rainfall (mm) 1980-2010	Average rainfall (mm) 2011-2020	Actual rainfall (mm) 2021	Departure (%) in 2021 from Normal Rainfall	Departure (%) in 2021 from Average Rainfall
Balaghat	1471.6	1151.14	1062.69	-27.7	-7.03

Table 2.3-Monthly rainfall of 5 years in mm

Year	January		February		March		April		May		June		July		August		September		October	Nov	Dec	
	Rain fall	% Dep.	Rainfall	% Dep.	Rainfall	% Dep.	Rain fall	% Dep.	Rainfall	% Dep.	Rainfall	% Dep.	Rainfall	% Dep.	Rainfall	% Dep.	Rainfall	% Dep.	Rainfall			
2013	18.4	-37	5.8	-71	37.4	220	6.4	36	2.6	-52	124.1	0	800.6	155	276.3	-16	195.1	7	4.9			
2014	0		0	-100	34.2	192	24.2	415	25	363	53.8	-57	378.7	20	209.6	-36	50.2	-72	3.6			
2015	0		71	253	21.6	85	0.6	-67	1	-81	145.1	17	146.9	-53	176.4	-46	172.9	-5	0			
2016	0.9	-97	8.5	-58	0.3	-97	3	-36	7.7	43	205.5	65	206.9	-34	212.5	-35	101.1	-44	4.1			
2017	12.9	-59	0		1.4	-88	3.8	-19	14.5	169	25.8	-79	207.6	-34	192.5	-42	152	-16	220.4			
Ave.	6.44		17.06		18.98		7.6		10.2		110.9		348.14		213.46		139.26		46.6	12.6	1.76	932.9

Table 2.4 Average Monthly Meteorological Data of study area (source: IMD)

Month	Temperature (° C)		Rel. Humidity (%)		Vapour Pressure (hpa)		Mean Wind Speed (Km/hr)	Average Rainfall (mm) (2012-16)	Cloud Amount (oktas)	
	Min.	Max.	Morning	Evening	Morning	Evening			Morning	Evening
January	4	29.2	60	48	10.15	10.1	4	6.44	1.2	1.3
February	6.6	33.1	51	37	10.95	10.8	5.6	17.06	1	1
March	11.4	38.6	41	27	11.36	10.5	5.8	18.98	1.1	1.2
April	16.9	42.6	34	22	12.9	12.7	7.5	7.6	1.2	1.5
May	22.3	45	45	26	18.6	14.9	7.6	10.16	1.3	1.4

June	23.1	41.8	59	49	25.7	24.5	8.1	110.86	4	4.6
July	22.8	37	79	71	28.9	29.8	7.9	348.14	5.8	5.8
August	22.4	33.5	80	72	29.7	28.9	7.1	213.46	5.7	5.9
September	21.6	33.8	79	71	27.9	27.8	6.9	139.26	4.3	5
October	14.1	33.7	67	60	21.8	22.3	4.5	46.6	2.3	2.4
November	8	31.8	56	51	16.3	14.1	3.3	12.6	1.3	0.9
December	5	29.5	59	45	10.8	10.5	3.8	1.76	1	1

2.3 Groundwater regime monitoring

The study area comprises 10km radius zone in Miragpur Manganese mine that fall largely under Khairlanji block, Balaghat district, Madhya Pradesh and partlyin Tumsar Tehsil of Bhandara district, Maharashtra. Detailed hydrogeological study of both core zone and buffer zone of mine area is carried out. The study area having single aquifer formed in hard rock comprises Quartz Mica Schist.Total groundwater extraction from the Miragpur mine is 8KLD is through pump. Dug well are used for drinking and domestic purpose.

2.2.1 Detailed study of core and buffer zone

Major source of the water in the study area is south-west monsoon and very small contribution from north- east monsoon during winter. As per the field study it has been observed that in the study area groundwater is withdrawal from dug well and hand pump. Most of dug wells in study area having depth 4 to 8 m ground water. It varies during summer between 5m to 10m and 2.5m to 6.0m in winter. It has been observed that the borewells are often 20 to 40m in depth. Ground water is lying in weathered part of hard rock aquifer. Hard rock's comprise in the study area is Sausar sequence rested over rocks of Gneissic complex with unconformity. Dolomites, Limestone, Mica Schist, quartzite, Biotite Granulite are the rock types associated with this series. The movement of the ground water in deeper rocks is controlled by the nature, size opening and continuity of joints & fracture present in them. Wells in hard rock generally yield 50 to 70 m3 /day of all the rock types. Schist, phyllite and their variants form very poor aquifers yielding 10 to 30 m3 /day for heavy drawdown. Well inventory of study area in Pre Monsoon (Feb 2022) period showing water level varies within the range from 1.4 m to 8m bgl

(Table 2.5).

Table2.5: Well inventory data of Dug wells of Core and buffer zone of Pandharwani Mine

(Lat & Long data are as per GPS reading, DO, EC, pH, and TDS measured on site using calibrated Hanna portable equipment during Feb 2022).

S. N.	Village	Latitude	Longitude	Elevation (m amsl)	Water Level (m)	Diameter (m)	Depth (m)	DO (mg/l)	EC (µS)	pH	TDS (ppm)
Core Zone of Mine											
1	Sukdighat	21.64861	79.848755	342.09	7	2.7	8.5	4.53	1560	7.2	650
2	Sukdighat	21.64824	79.851071	353.48					2550	7.3	1230
3	Sukdighat	21.65027	79.852384	346.06	6.7	2.5	8.75		1990	7.8	1050
4	Pandharwani Mine lease	21.62827	79.844225	344.4	5	3	9.25	3.8	300	7.4	150
5	Ranimohgaon	21.61919	79.834619	329.81	6	2	8.25	4.03	1050	7.5	510
6	Gudhrughat	21.64652	79.834762	340.56	4.2	1.5	8.50	5.3	580	7.9	280
7	Sabargaon	21.64262	79.823377	342.44	6.5	2	9.0	2.6	3800	6.8	1900
8	Paraswadaghat	21.65951	79.807917	338.8	7	2.5	9.9	7.2	1005	7.3	520
Buffer Zone of Mine											
9	Birsula	21.6943	79.827105	351.11	4.5	2	8.0		1080	7.7	560
10	Sitakhor	21.71768	79.816533	341.65	5	2	8.60		540	7.4	260
11	Katedara	21.71186	79.792357	342.87	4	1.5	7.55		880	7.5	440
12	Tirodi	21.68626	79.739922	332.9	4.5	2	8.0		720	7.1	310
13	Bamani	21.61442	79.736391	306.33	3.5	2	7.0		820	7.1	444
14	Bonkatta	21.60287	79.753879	286.6	6	1.4	8.25		910	7.1	440
15	Garragussai	21.64557	79.776808	301.68	4.3	2.1	7.85		1111	6.7	560
16	Garragussai	21.64505	79.770978	306.13	5.1	2	6.8		1720	7.2	900
17	Sadabodi	21.6439	79.763553	309.29	4.4	1.5	8.25		1360	7.4	680
18	Garragussai	21.64269	79.779196	307.21					710	8	190
19	Churiya Par	21.57994	79.830656	296.62	4.5	1.5	8.55		1050	7.5	490
20	Kawlewada (Near Bawanthadhi river)	21.56613	79.804115	283.19	6	1.5	8.8		830	7.3	360
21	Katori	21.5756	79.896254	279.11	4.2	1.5	7.90		1870	7.4	940
22	Gorra Bodhi	21.66599	79.895665	331.16	4.8	2	9.0	4.2	680	7.4	320
23	Chikhla	21.66357	79.895535	333.95	6	2.8	8.5	2.05	1220	7.5	620
24	Chikhla	21.68264	79.906358	332.58	8	2	9.5	3.61	1910	6.9	960

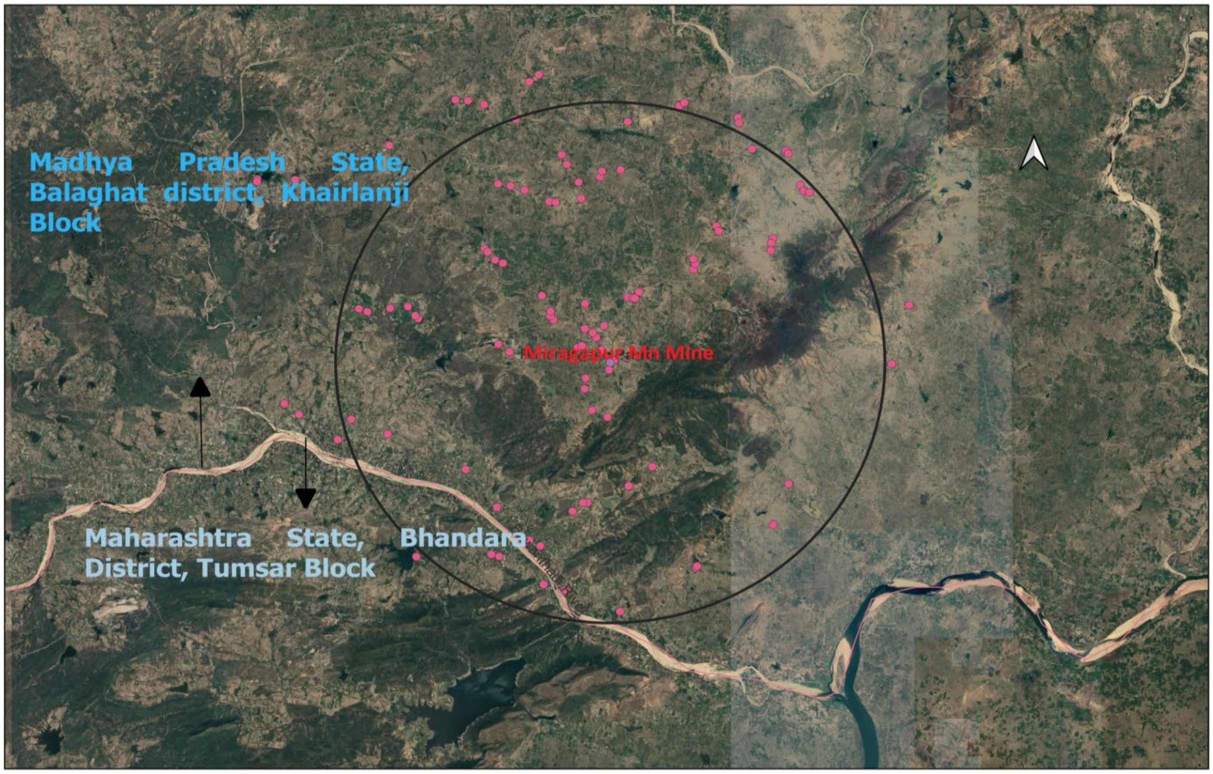


Fig 2.1: Map showing study area divided by state boundary of Madhya Pradesh and Maharashtra. Note the location of Miragpur Mn Mine at center and position of other villages on google image along with prominent roads. Inventory of wells of these villages are carried out under groundwater regime monitoring.

Fig2.2: Key map showing Tube well, Dug well and Borewell locations within the mine of Miragpur Mn Mine on google image and photo graph of measuring groundwater parameter.

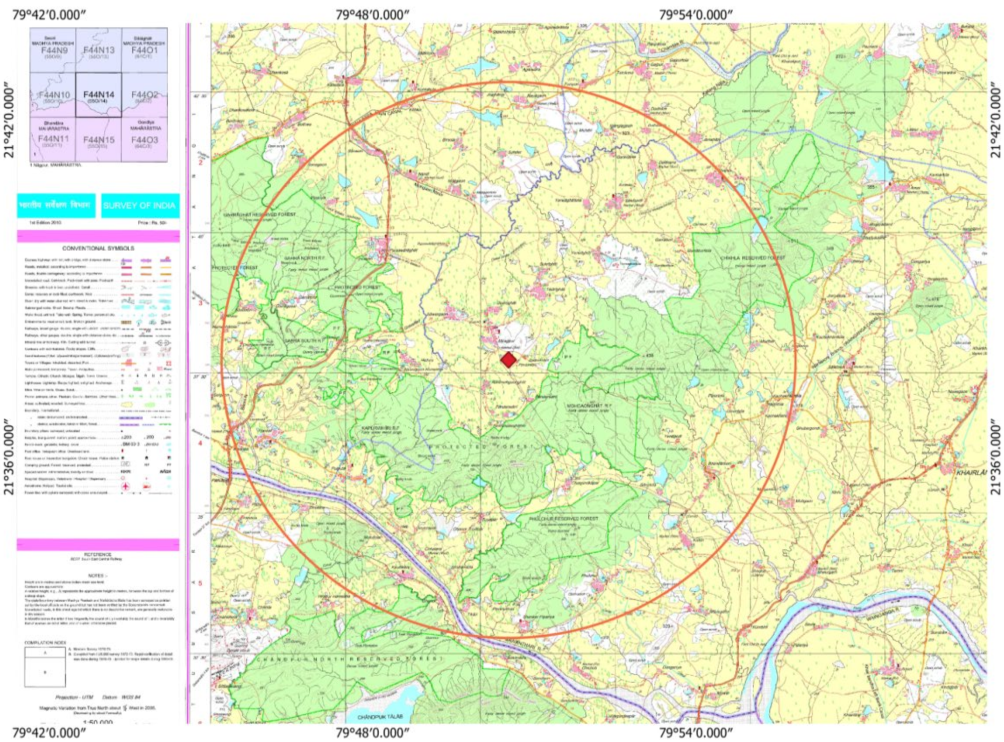


Fig 2.3: Topography of study area. Note the position of project area within the study area.

Water level in 10km buffer zone in Study area

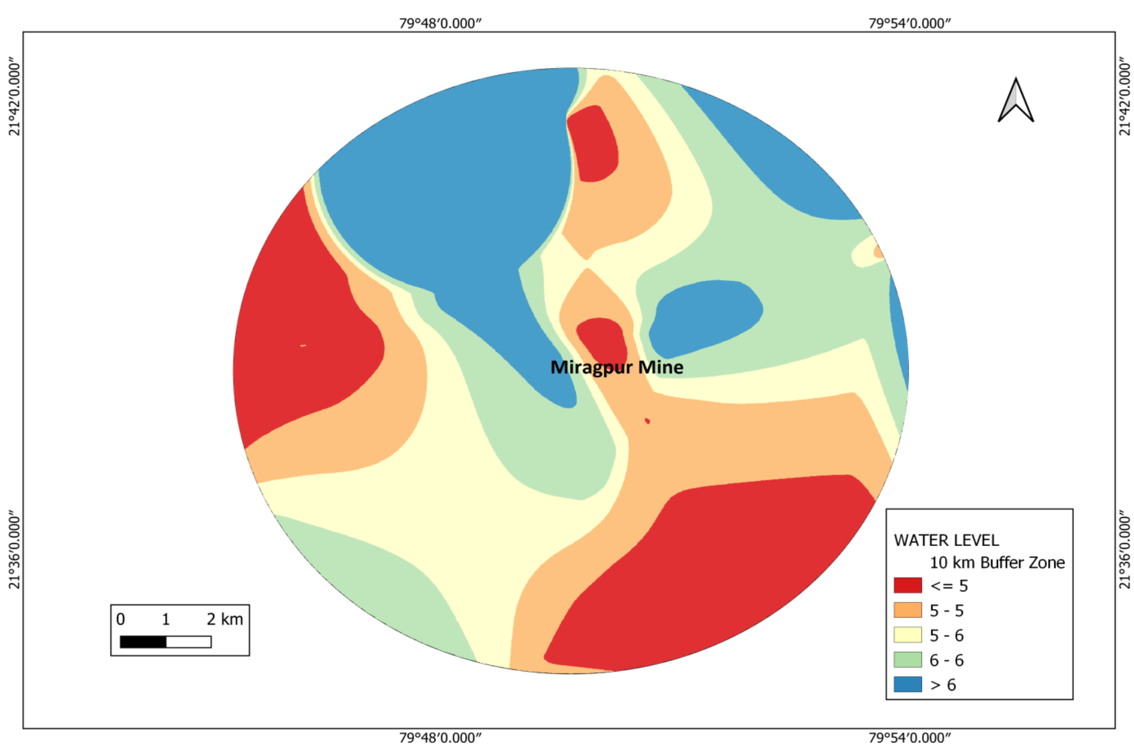


Fig: 2.4 DTW map of core and Buffer zone of Miragpur Mn Mine

Groundwater Flow: The groundwater contour map generated using the intense monitoring in core and buffer zone of mining is depicted in **Fig 2.5.**The map showing clear cut development of groundwater dived running through the mine area. The GW flow direction largely coincides with the surface water flow direction as shown in fig 1.5. Thus mine is on groundwater divide and any dewatering from mine will not effects significantly the flow direction of groundwater of the area.

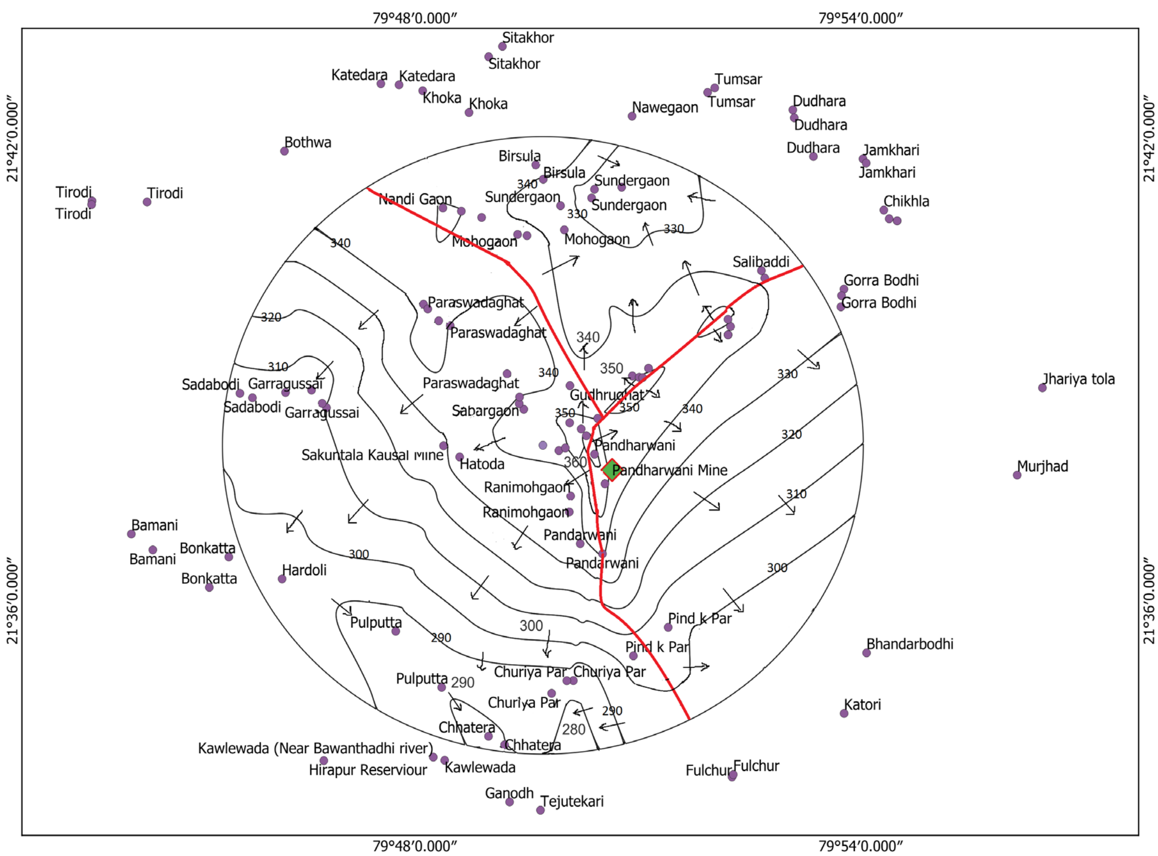
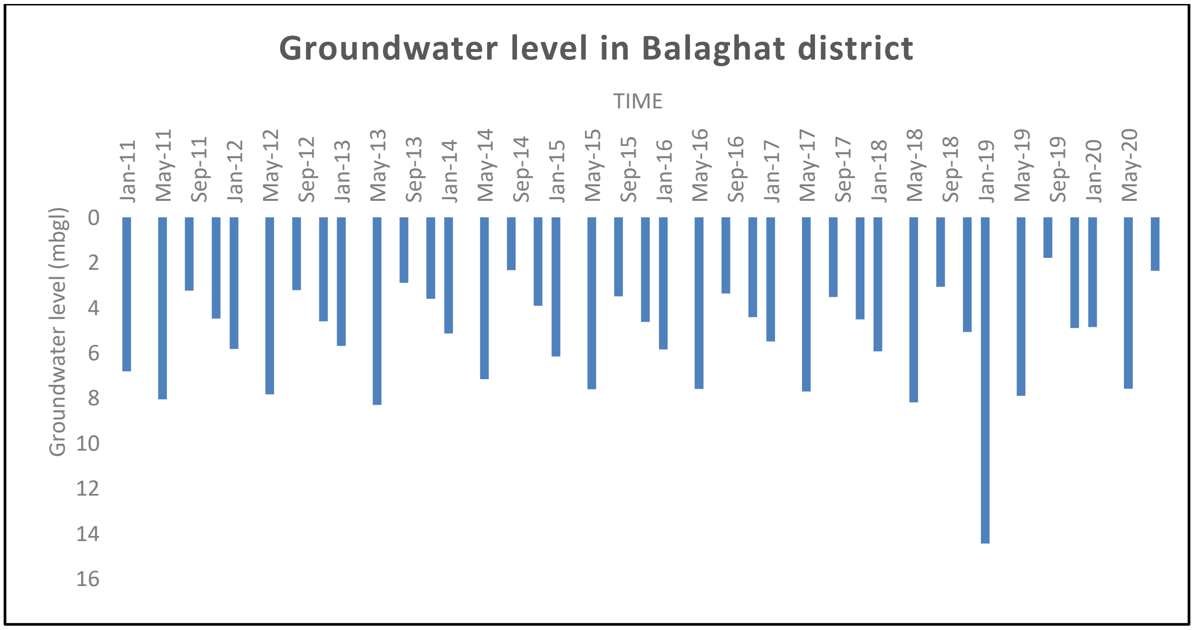


Fig 2.5 Groundwater contour map of Miragpur mine area.

INDEX-Red line shows groundwater divide, arrows indicating groundwater flow direction, values indicate groundwater elevation (m amsl), dots indicate data point used for generation of GW contour, buffer zone is marked by 10km radius circle. Note the mine position (green box) situated near GW divide.

2.4. Long term groundwater trend

The study area comprises 10km radius zone in Miragpur Manganese mine that largely fall under Khairlanji block, Balaghat district, Madhya Pradesh and partly to Tumsar Tehsil of Bhandara district, Maharashtra. The source of ground water such as dug well; hand pump and pond are used for domestic, irrigation and drinking in the core zone villages. Out of 23 observation location of dug well, it has been observed that the water level (Pre monsoon 2022) of more than 10 villages around the buffer zone and core zone area is varying from 4 to 8m bgl. Long term trend analysis of data obtained from CGWB shows no significant change-rise or fall as depicted in **Fig 2.6 and 2.7.**



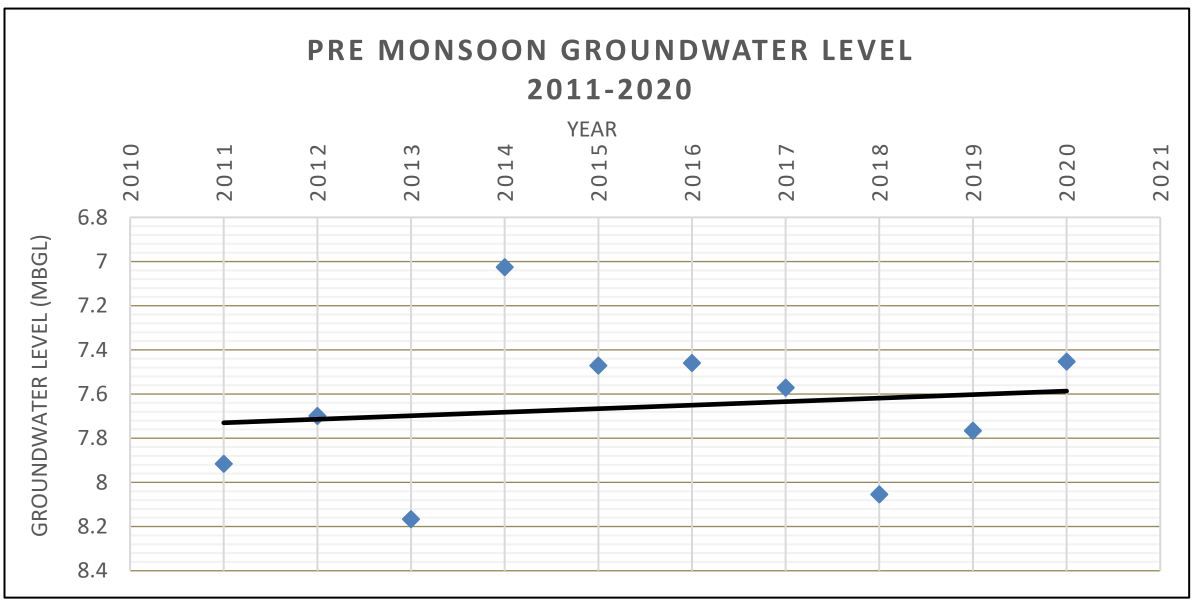


Fig 2.6: Long term well hydrograph of wells of Balaghat district, Madhya Pradesh (source: WRIS online portal)

2.3.1 Dynamic Groundwater Resource of study area: The groundwater resource as estimated by CGWB (2020) is presented in the table 2.6 for two blocks of MP and Maharashtra and are in safe category.

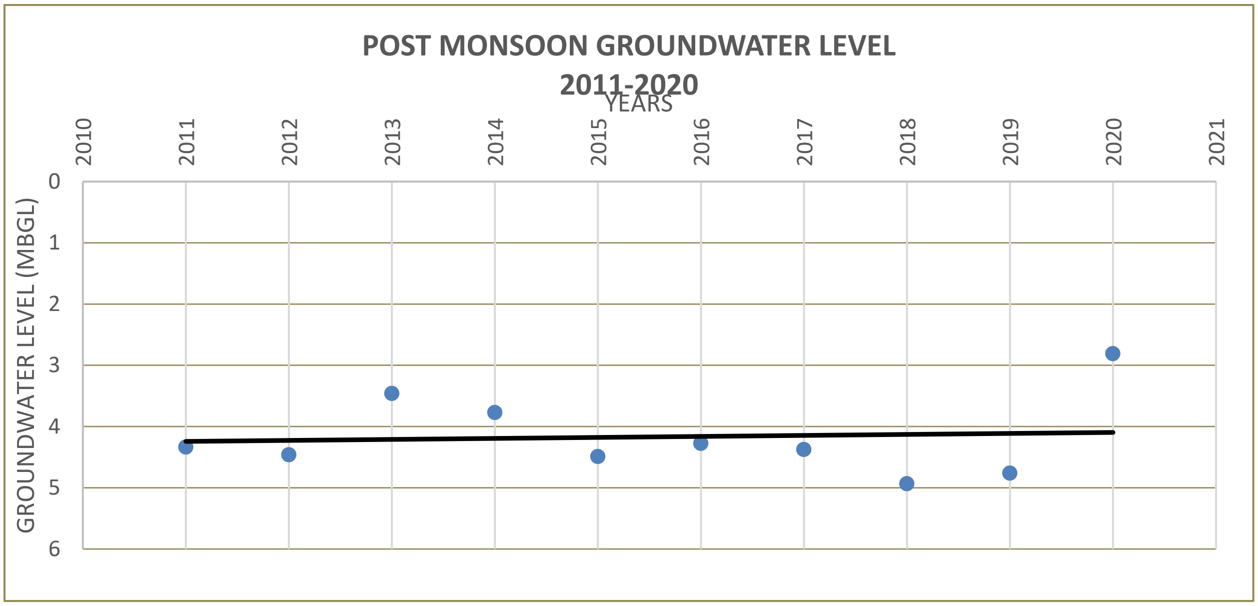


Fig 2.7: Long term pre monsoon groundwater level tend in Balagaht district showing slightly increasing trend

Table: 2.6 Block wise dynamic groundwater resources of Kharlangi, MP and Tumsar, Mahara

Sr no	State	District	Assessment Unit Name	Assessment Unit Type	Recharge from Rainfall-MON	Recharge from Other Sources-MON	Recharge from Rainfall -NM	Recharge from Other Sources-NM	Total Annual Ground Water Recharge (Ham)
1	Madhya Pradesh	Balaghat	Kharlangi	Block	5218	314	534.26	318	6384.26
2	Maharashtra	Bhandara	Tumsar	Block	4666.057	1079.197	95.083	2387.81	8228.14

Assessment Unit Name	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)	Irrigation Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semi critical/ Safe)
Kharlangi	430.0	5954.26	1643	1987	388.00	33.371	Safe
Tumsar	411.4	7816.74	3123.72	3744.41	680.53	47.903	Safe

2.5 Groundwater Quality

Based on the above study, different ground water parameters were computed, which include pH, TDS, EC, DO, Temperature. Ground water in study area is potable with pH ranging 6.4 to 8.5 and total dissolved solid (TDS) ranging from 120 to 1900 ppt and EC ranging from 300 to 3800 µS. (**Fig 2.8 and 2.9)**

Groundwater quality in the study area is fresh and all major and trace elements are found within the BIS 10500 permissible limit.Thus is suitable for all domestic, industrial and irrigational use.The general parameters of groundwater in study area as analyses are given inTable 2.5.The comparison of data reveals that the area mining (Project Area) is having less TDS).

2.4.1. Groundwater quality of Mining area

Groundwater quality has been analyzed by collecting groundwater samples of existing tube well in study area. The groundwater test result through NABL accredited Lab show low in TDS in the range of 402 mg/l and all other parameters well within permissible range as shown in table 2.5.

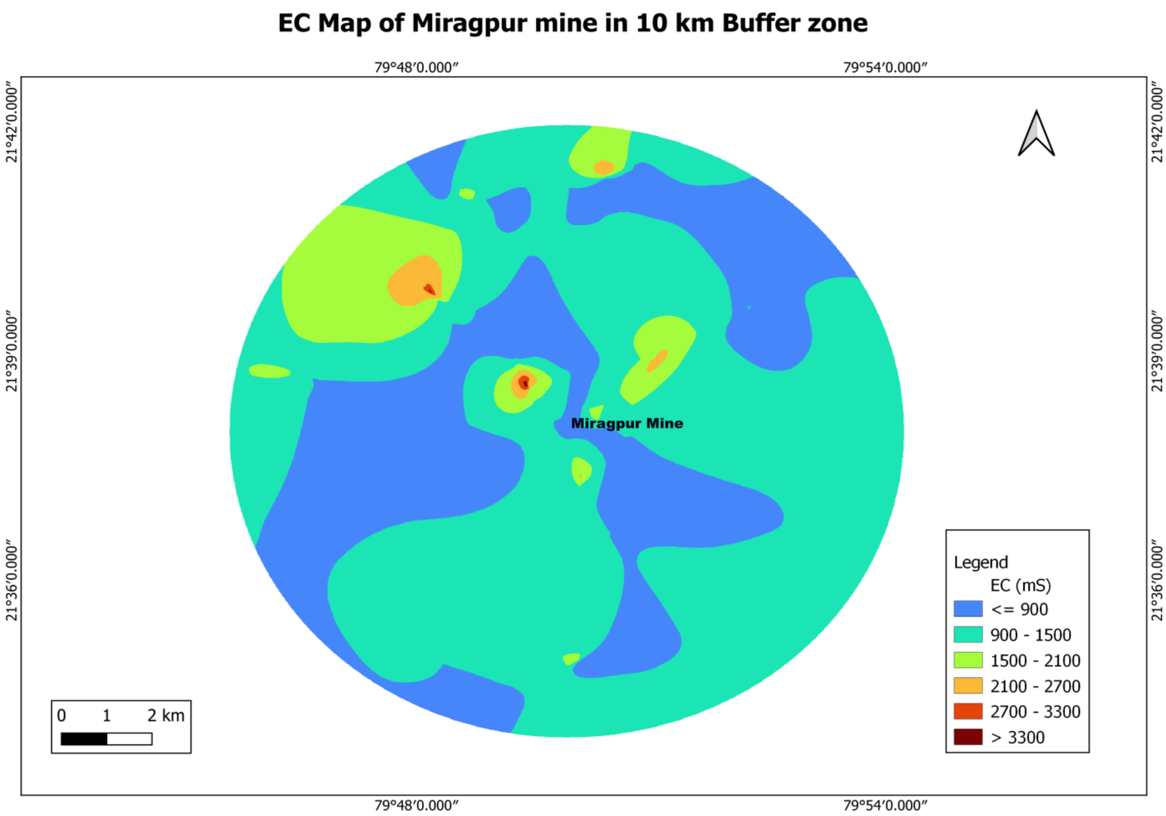


Fig: 2.8 EC map of study area

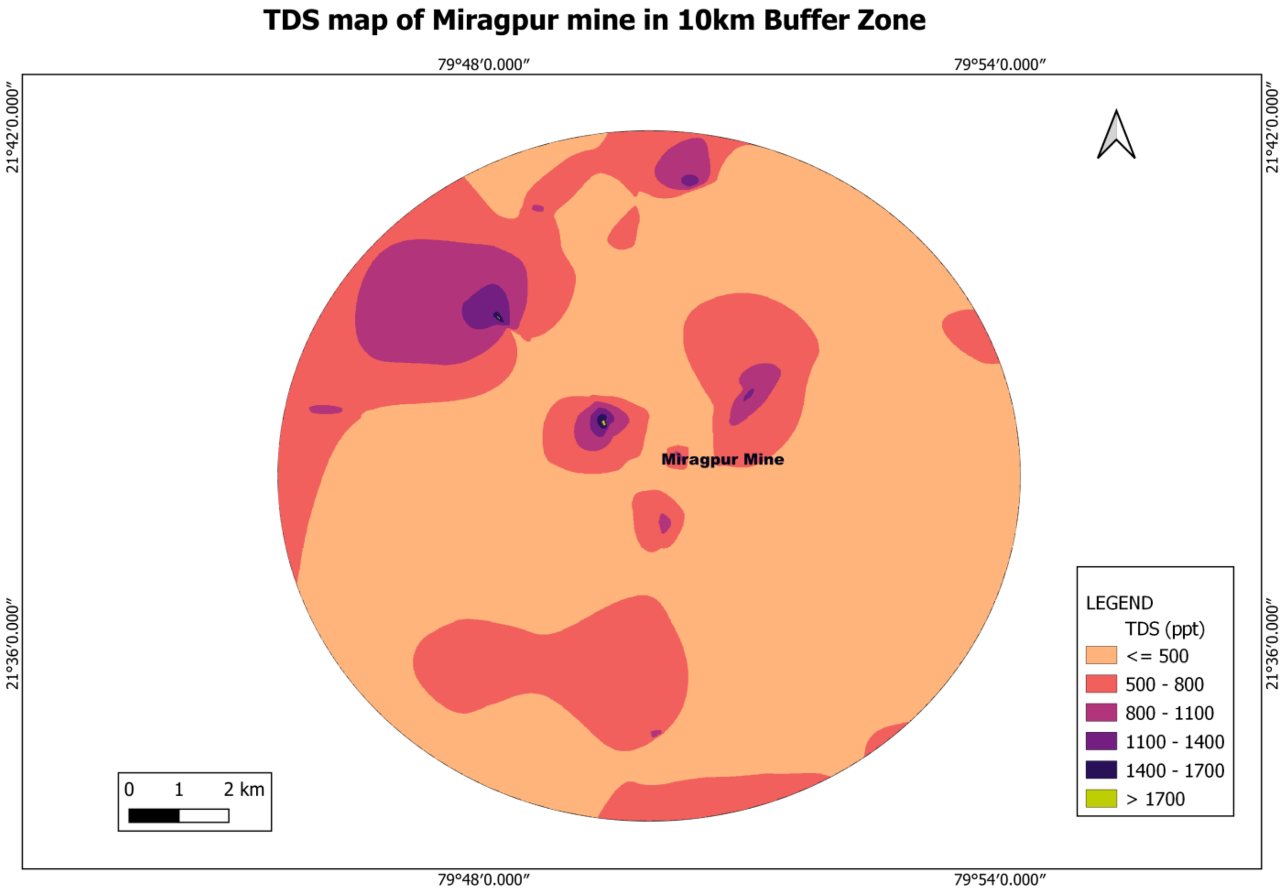


Fig 2.9: TDS map of study area

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Cert No.: TC-6872

TEST REPORT

Name & Address of the Customer To, **M/s D.P. RAI** **"NANHAKA" 10, EAST HIGH COURT ROAD, RAMDASPERTH , NAGPUR (MS)**	**ULR No: TC687218000000109P** Despatch No: 2073 Issue Date : 13/07/2021 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 25/06/2021
Method of test : APHA 23rd edition	**Date of Receipt**	: 01/07/2021
Packing :- Plastic bottle	**Period of testing**	:
Sample Condition at receipt: packed	**Method of sampling**	: BIS/3025
Sample Particulars: Ground Water	**Sample tested as received**	: OK
Sample collected by: CES Representative	**Page no.**	
No. of Sample - 18	**Serial No. of Sample**	109/7

Sr. No	Test Parameters	Unit	Method No.	Pandarwani Mine (109/7)
1	pH	-	4500 H+B	7.52
2	Conductivity	µmhos/cm	2510 B	986.10
3	Turbidity	NTU	2130 B	4.20
4	Total Solid	mg/lit	2540 B	487.00
5	Total Dissolved Solid	mg/lit	2540 C	402.00
6	Total suspended solid	mg/lit	2540 D	85.00
7	Total Alkalinity	mg/lit	2320 B	126.00
8	Total Hardness as $CaCO_3$	mg/lit	2340 C	428.00
9	Ca Hardness as $CaCO_3$	mg/lit	3500 B	212.00
10	Mg Hardness as $CaCO_3$	mg/lit	3500 B	216.00
11	*Calcium as Ca	mg/lit	3500 B	84.96
12	*Magnesium as Mg	mg/lit	3500 B	52.48
13	Sulphates as SO_4	mg/lit	4500- SO_4 E	94.58
14	Chlorides as Cl	mg/lit	4500-Cl^- B	131.96
15	Iron as Fe	mg/lit	3500- Fe B	<0.05
16	Nitrate as NO_3	mg/lit	4500-NO_3 B	19.58
17	Nitrite as NO_2 -N	mg/lit	4500- NO_2 B	<0.10
18	Phosphate as P	mg/lit	4500-PD	<0.10
19	Fluoride as F	mg/lit	4500- F D	<0.10
20	Copper as Cu	mg/lit	3500-Cu B	<0.10
21	Chromium as Cr^{6+}	mg/lit	3500-Cr^+ B	<0.10
22	*Coliform	MPN/100ml	IS:15185	<2.00
23	Manganese as Mn	mg/lit	3500- Mn B	<0.20

For Creative Enviro Services

Authorised Signatory

42, Doorsanchar Nagar, Near Savoy Complex, E-8 Extension, Gulmohar, Bhopal-462 039 (M.P.)
Telephone : 0755-4299319, Fax : 0755-4243510, Mobile : 9425009319
Email: creativelab.bpl@gmail.com, creative.bpl@gmail.com, Websearch : www.creativeenviroservices.com

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Cert No.: TC-6872

TEST REPORT

Name & Address of the Customer To, **M/s D.P. RAI** **"NANHAKA" 10, EAST HIGH COURT ROAD, RAMDASPERTH , NAGPUR (MS)**	**ULR No: TC687218000000109P** 2073 **Despatch No:** **Issue Date :** 13/07/2021 **Client Ref:** Nil **Date :** Nil		
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Method of test : APHA 23rd edition	**Date of Receipt**	: 01/07/2021	
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Sample Condition at receipt: packed	**Method of sampling**	: BIS/3025	
Sample Particulars: Ground Water	**Sample tested as received**	: OK	
Sample collected by: CES Representative	**Page no.**		
No. of Sample - 18	**Serial No. of Sample**	109/7	

Sr. No	Test Parameters	Unit	Method No.	Pandarwani Mine (109/7)
24	Zinc as Zn	mg/lit	3111-Zn B	<0.05
25	Total Chromium	mg/lit	3500-Cr+ B	<0.05
26	Cadmium as Cd	mg/lit	3111-Cd B	<0.05
27	Lead as Pb	mg/lit	3111-Pb B	<0.05
28	Mercury as Hg	mg/lit	3112- Hg B	<0.01
29	Nickel as Ni	mg/lit	3111-Ni B	<0.05
30	Arsenic as As	mg/lit	3114-As B	<0.05
31	Sodium Na	mg/lit	3500- Na B	34.67
32	Potassium K	mg/lit	3500- K B	4.53
33	Boron as B	mg/lit	4500-B B	<0.1
34	Selenium as Se	mg/lit	3114-Se B	<0.05
35	COD	mg/lit	5220 B	<4.00
36	BOD (3 day 27degree)	mg/lit	IS 3025, P- 44	<2.00

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Table 2.7: Analytical results of groundwater samples collected in Pandharwani mine

Water Quality Data in Piper Trilinear Diagram: Different graphical methods can be adopted for representing geochemical variation which gives a better insight into the groundwater quality monitoring. One such efficient method of representation is plotting of Hill Piper Trilinear diagram in which data are plotted in two triangle fields and one diamond field. The diamond is then classified under various categories emphasizing their characteristics. (**Fig 2.10 and 2.11**)

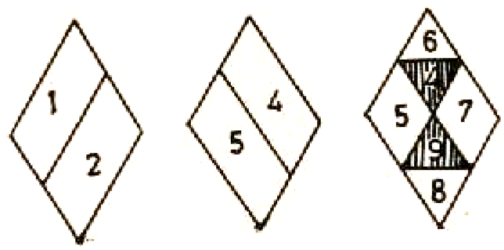


Fig 2.10: Sub-divisions of the diamond field

On the basis of data collection from CGWB report (2019-2020). It has been observed that out of 41 samples are concentrated in Area 6 indicating that: Non-carbonate hardness exceeds 50% i.e., Ca + Mg - (SO4 + Cl + NO3). Few samples come under Area 4 representing strong acids (SO4 + Cl + NO3) exceed weak acids (CO3 + HCO3). Only 2 samples can be noticed under Area 7: Non-carbonate alkali exceeds 50% i.e., Na + K-(SO4 + Cl + NO3).

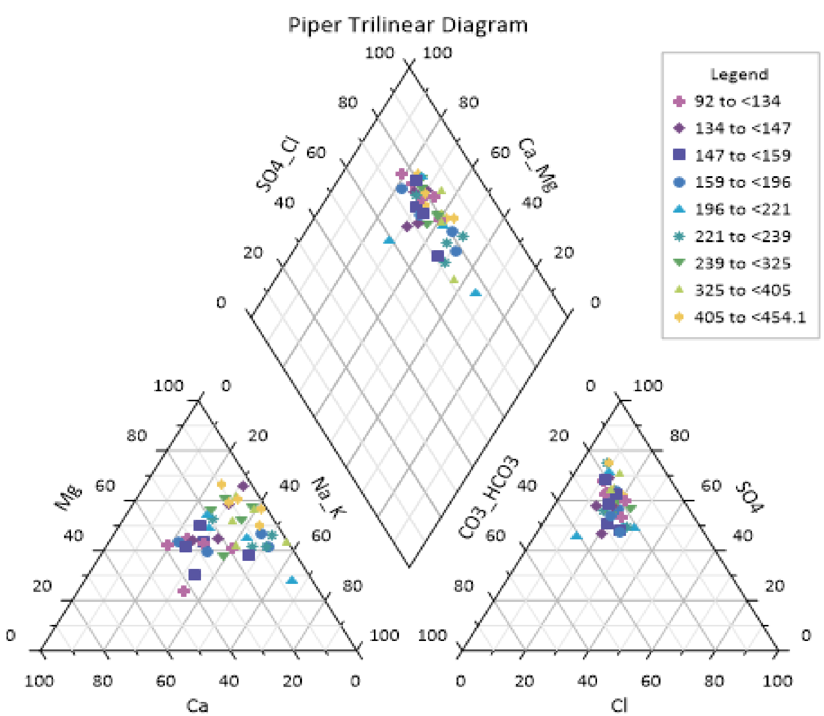


Fig: 2.11 Distribution of water samples in Piper Trilinear Diagram

USSL Diagram: The United States Salinity Laboratory (USSL) (1954) and Wilcox (1955) established standards for irrigation water quality classification. The Fig.7.5 is a simple scatter chart of sodium hazard (SAR) on the Y-axis versus salinity hazard (EC) on the X-axis.Using the SAR and the EC value of 41 water samples of Balaghat area determines the quality classification of the water.

Based on the EC, irrigation water can be classified into four categories; include:

I. Low-salinity water (C_1) can be used for irrigation with most crops on most soils with little likelihood that **soil salinity** will develop.

II. Medium-salinity water (C_2) can be used if a moderate amount of leaching occurs. Plants with moderate salt- tolerance can be grown in most cases without special practices for salinity control.

III. High-salinity water (C_3) cannot be used on soils, special management for salinity control may be required and plants with good salt tolerance should be selected.

IV. Very high salinity water (C_4) is not suitable for irrigation under ordinary conditions.

Sodium Adsorption Ratio: High sodium in irrigation water reduces the permeability of soil.The USSL diagram based on SAR divided to four categories included:

$$SAR = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$$

I. Low-sodium water (S_1) can be used for irrigation on almost all soils.

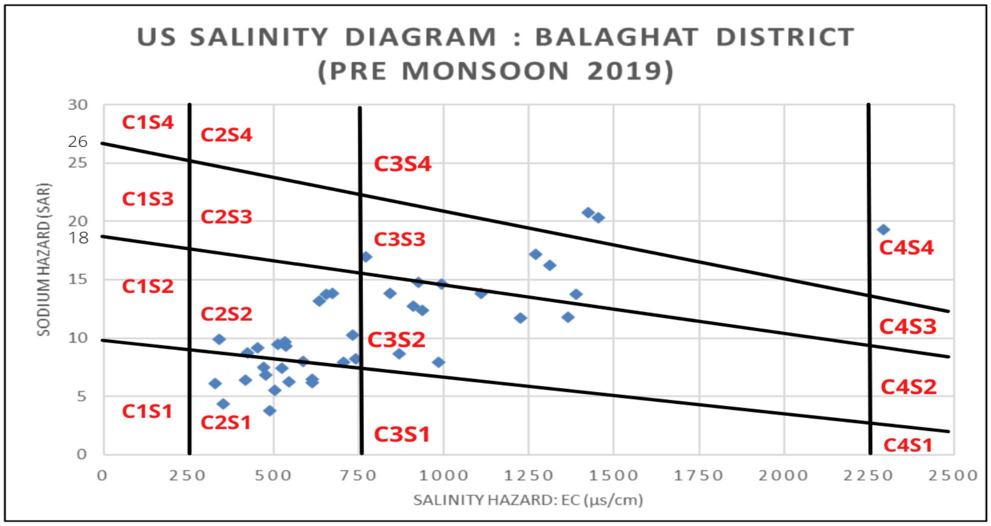
II. Medium-sodium water (S_2) will present an appreciable sodium hazard in certain fine-textured soils. This water may be used on coarse-textured or organic soils with good permeability.

III. High-sodium water (S_3) may produce harmful levels of exchangeable sodium in most soils and will require special soil management.

IV. Very high sodium water (S_4) is generally unsatisfactory for irrigation unless special action is taken, such as addition of gypsum to soil (Lyerly and Longenecker, 1957).

Data Analysis:

On the basis of samples collected from the study area, it can be observed that out of 41 samples of Pre and Post Monsoon 2019, most of the samples are concentrated under C2S1, C2S2 and C3S2categories indicating low to medium sodium hazards with medium to high salinity. Out of these, few samples are scattered under C3S3 and C3S4 categories representing high salinity with high sodium hazard and high salinity with very high sodium hazard respectively **(Fig 2.12).**



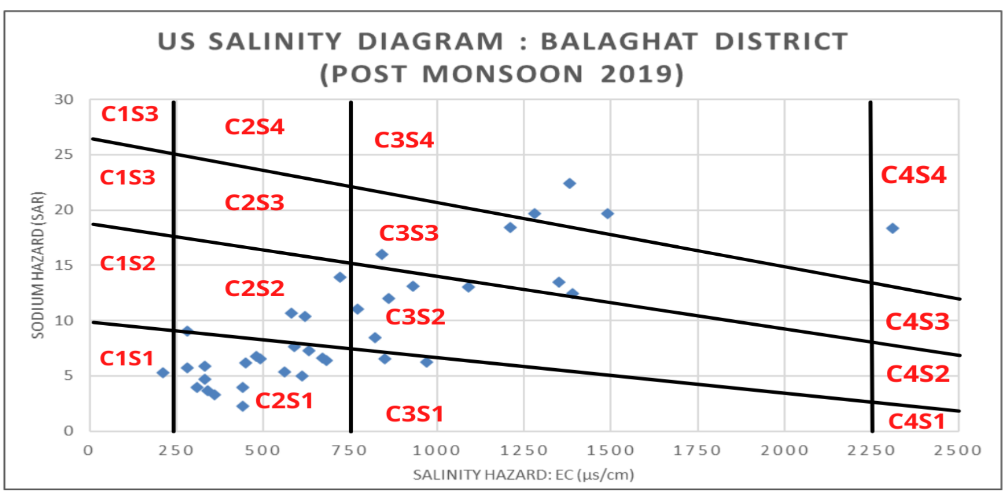


Fig: 2.12 US Salinity diagram of Pre Monsoon 2019 and Post Monsoon 2019, Balaghat

3. Details of bore well proposed to be constructed

3.1. Proposed Piezometer with Automatic water Recorder

A piezometer with automatic water level recorder has been proposed with using standard design near to mine office within the lease area. The coordinate of the proposed point is 21.632513, 79.832085. The Automatic water level recorder has been proposed in exiting piezometer well for the purpose of continuous monitoring of water fluctuation and continuous data acquisition.

Fig 3.1: Proposed Piezometer with automatic water recorder

4. Geophysical Survey of Study area

Surface geophysical investigation involving resistivity survey was taken up in the area covering nearly 1.5 line km area. Five VES (vertical Electrical sounding) was conducted to know the subsurface geohydrological condition in the core zone. The data so obtained is interpreted for use in combination with lithologs obtained during exploratory drilling carried out for ore.

4.1 Geophysical Studies in an around the Mine area

Geophysical/Vertical Electrical Sounding is a technique to delineate the weathered, fractured zone and hydro geological suitability. VES technique is effective to delineate the hard terrain. Geophysical / VES investigation has been carried out at five locations in an around the mine area. Schluberger electrode configuration in the study area has been conducted to delineate the distribution of subsurface rocks.The usual practice in the field is to apply an electrical direct current (DC) between two electrodes implanted in the ground and to measure the difference of potential between two additional electrodes that do not carry current. Total five numbers of VES (VES 1 to VES 5) have been carried out at site for detection of ground water in alluvium zone of subsurface and different type of rocks. All the data sheets are given below with tabulated interpretation & recommendations.

RESISTIVITY SURVEY

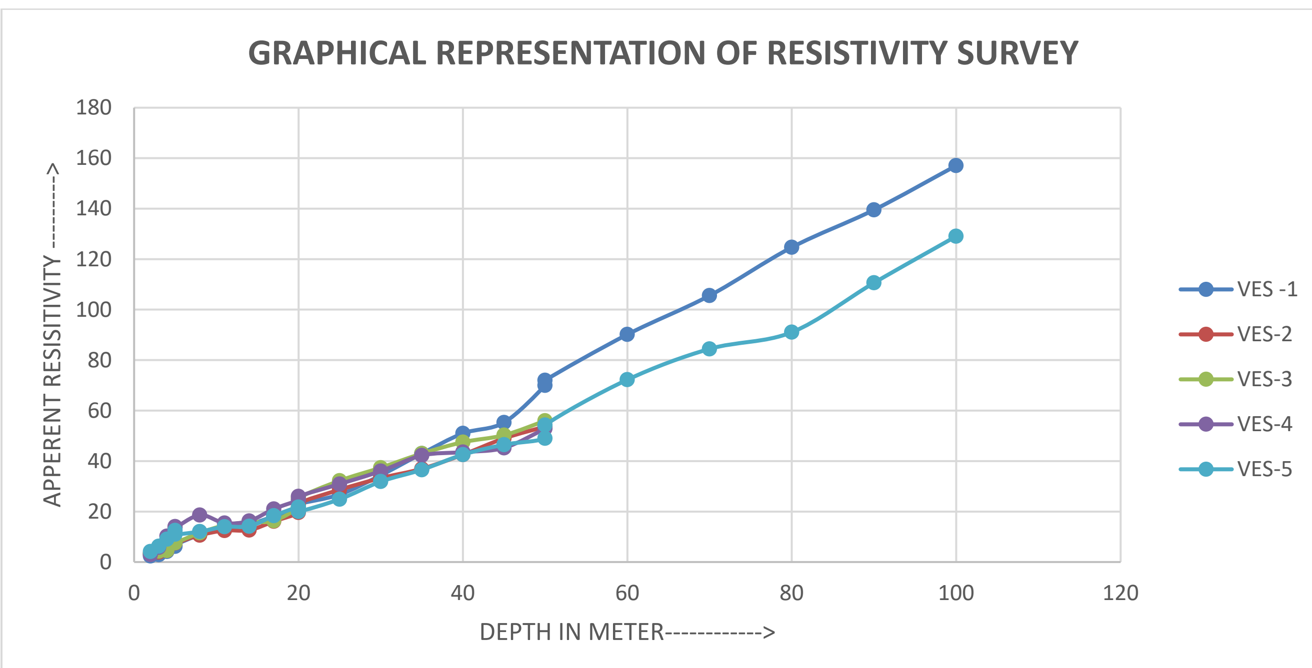
GROUND WATER INVESTIGATION

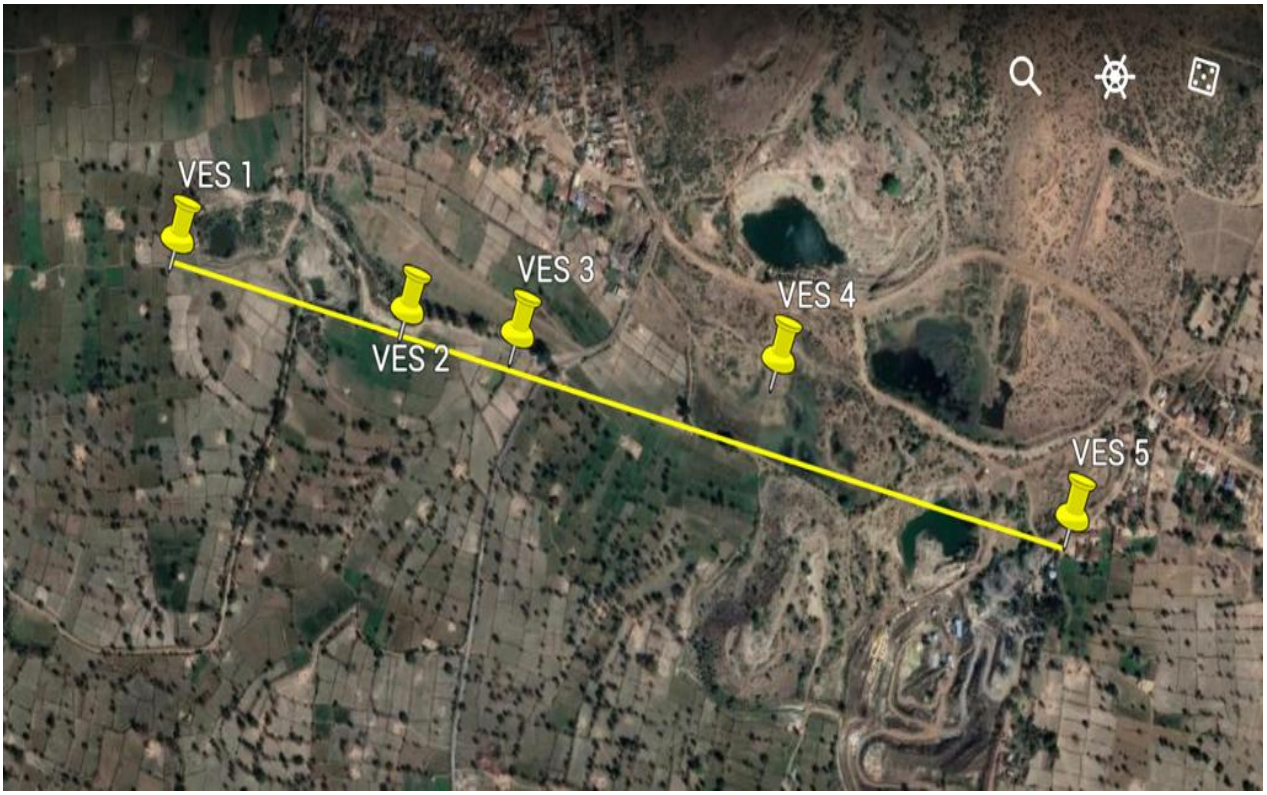
DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

- FROM VES-1 TO VES-5

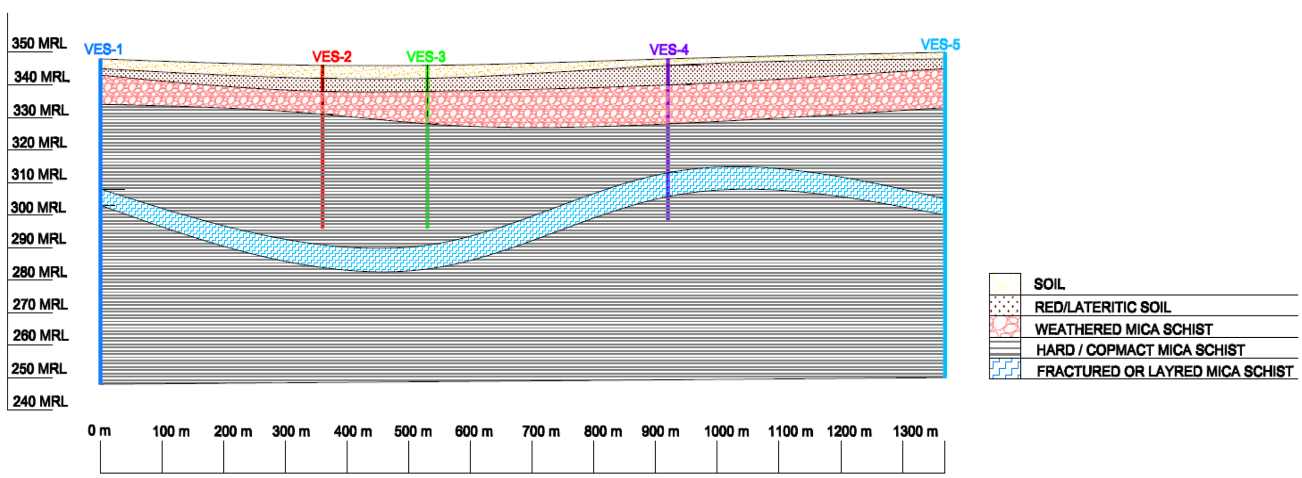
S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	VES-1 APPARENT RESISTIVITY (OHM -Mtr)	VES-2 APPARENT RESISTIVITY (OHM -Mtr)	VES-3 APPARENT RESISTIVITY (OHM -Mtr)	VES-4 APPARENT RESISTIVITY (OHM -Mtr)	VES-5 APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	2.42	3.47	3.14	2.98	4.17
2.	3	1	2.91	3.93	4.28	5.84	6.24
3.	4	1	4.17	4.52	4.52	10.27	9.02
4.	5	1	6.21	7.83	8.21	14.05	12.55
5.	5	2	6.85	7.51	7.58	13.55	11.01
6.	8	2	10.83	10.64	11.59	18.61	12.06
7.	11	2	13.68	12.49	14.51	15.43	13.96
8.	14	2	14.92	12.66	15.83	16.28	14.17
9.	17	2	18.13	16.11	16.34	21.04	18.35

10.	20	2	21.46	19.59	21.77	24.57	21.77
11.	20	5	22.97	23.20	25.32	26.03	20.02
12.	25	5	26.76	28.65	32.23	30.91	24.88
13.	30	5	34.36	33.26	37.38	36.01	31.88
14.	35	5	42.97	36.94	42.97	42.22	36.56
15.	40	5	50.96	42.55	47.50	43.54	42.55
16.	45	5	55.29	49.00	50.26	45.23	46.49
17.	50	5	69.97	53.65	55.98	52.87	48.98
18.	50	10	72.00				54.28
19.	60	10	90.16				72.24
20.	70	10	105.55				84.44
21.	80	10	124.68				91.04
22.	90	10	139.52				110.61
23.	100	10	157.05				129.06





GRAPHICAL REPRESENTATION OF REISTIVITY SURVEY



VES -1

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

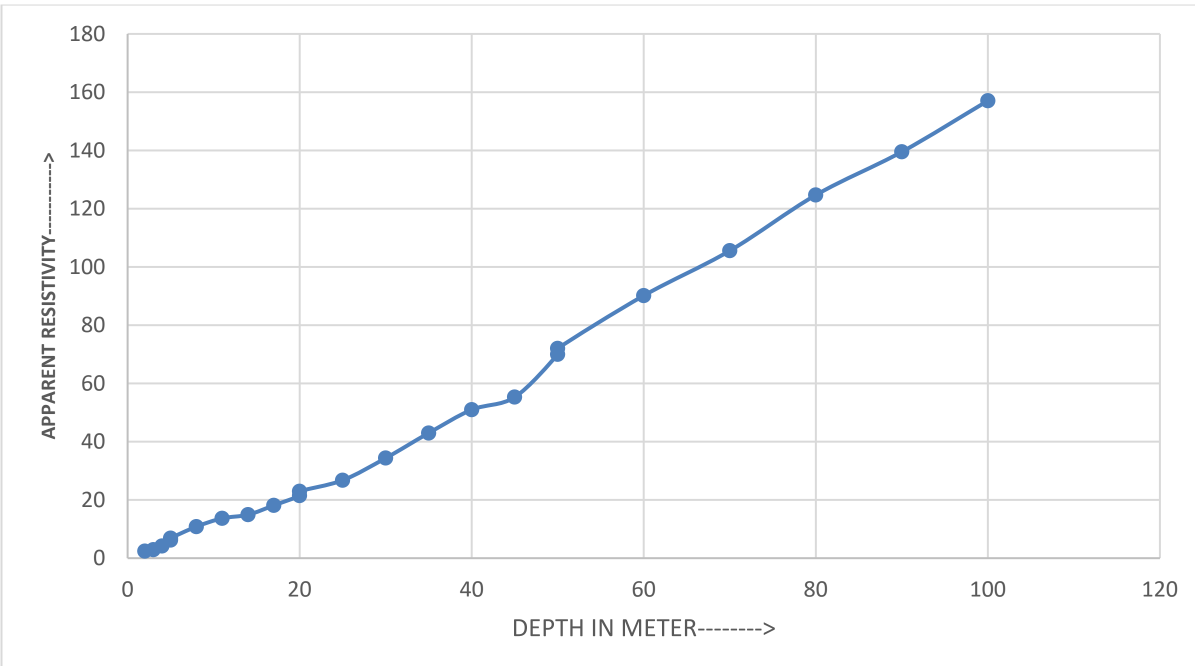
- LOCATION – IN MIRAGPUR MINE (24 HACT)
- LAT - 21°37'55.78"N LONG - 79°49'54.35"E

S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	SPACING FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	4.71	0.513	2.42
2.	3	1	12.56	0.232	2.91
3.	4	1	23.56	0.177	4.17
4.	5	1	37.69	0.165	6.21
5.	5	2	16.49	0.416	6.85
6.	8	2	47.12	0.230	10.83
7.	11	2	91.89	0.148	13.68
8.	14	2	150.8	0.099	14.92
9.	17	2	223.84	0.081	18.13
10.	20	2	311.02	0.069	21.46
11.	20	5	117.81	0.195	22.97
12.	25	5	188.50	0.142	26.76
13.	30	5	274.89	0.125	34.36
14.	35	5	376.99	0.114	42.97
15.	40	5	494.8	0.103	50.96
16.	45	5	628.32	0.088	55.29
17.	50	5	777.54	0.090	69.97
18.	50	10	376.99	0.191	72.00
19.	60	10	549.78	0.164	90.16
20.	70	10	753.98	0.140	105.55
21.	80	10	989.6	0.126	124.68

22.	90	10	1257	0.111	139.52
23.	100	10	1555	0.101	157.05

VES -1

GRAPH B/W APPARENT RESISTIVITY& DEPTH



PROBABLE SUB SURFACE LITHOLOG

S,N.	Sub surface data (litho-log) expected	Depth below Ground Level (m)	
		from	to
1.	Probability of Soil	0	3
2.	Probability of red laterite soil	3	5
3.	Probability of yellow soil or weathered Mica Schist	5	14
4.	Probability of hard & dense Mica schist	14	40
5	Probability of fractured, layered, jointed Mica schist	40	45
6.	Probability of hard compact Mica Schist	45	100

VES -2

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

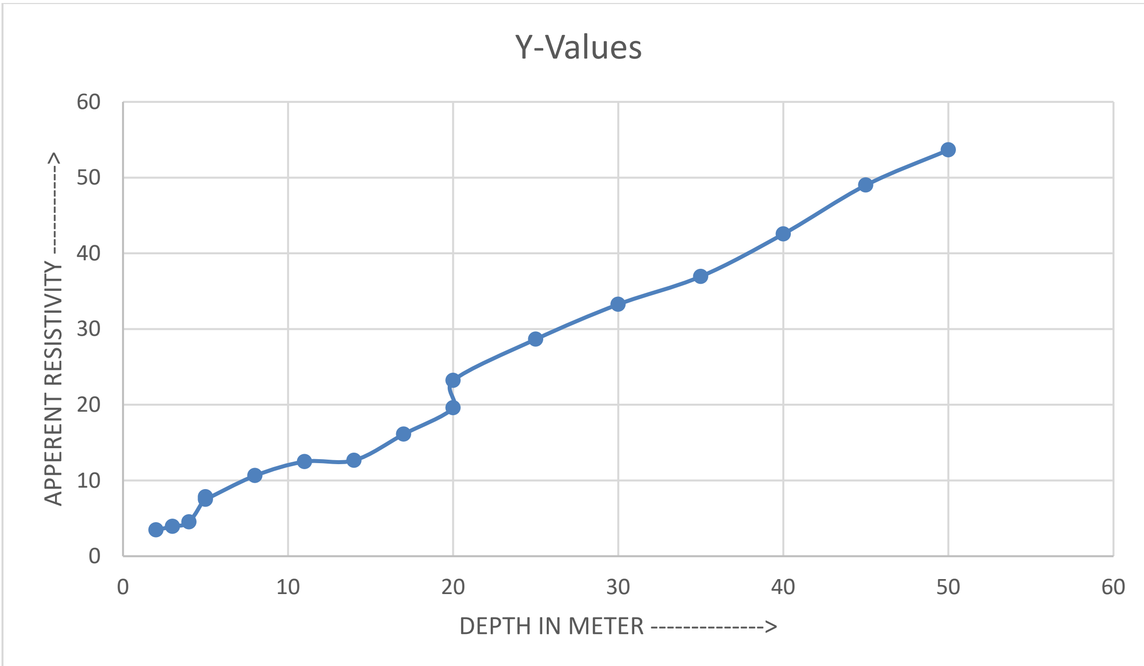
DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

- LOCATION – NEAR KALA GADDA (OLD PIT)
- LAT - 21°37'52.40"N LONG - 79°50'6.30"E

S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	SPACING FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	4.71	0.738	3.47
2.	3	1	12.56	0.313	3.93
3.	4	1	23.56	0.192	4.52
4.	5	1	37.69	0.208	7.83
5.	5	2	16.49	0.456	7.51
6.	8	2	47.12	0.226	10.64
7.	11	2	91.89	0.136	12.49
8.	14	2	150.8	0.084	12.66
9.	17	2	223.84	0.072	16.11
10.	20	2	311.02	0.063	19.59
11.	20	5	117.81	0.197	23.20
12.	25	5	188.50	0.152	28.65
13.	30	5	274.89	0.121	33.26
14.	35	5	376.99	0.098	36.94
15.	40	5	494.8	0.086	42.55
16.	45	5	628.32	0.078	49.00
17.	50	5	777.54	0.069	53.65

VES -2

GRAPH B/W APPARENT RESISTIVITY & DEPTH



PROBABLE SUB SURFACE LITHOLOG

S,N.	Sub surface data (litho log) expected	Depth below Ground Level (m)	
		from	to
1.	Probability of Soil	0	4
2.	Probability of red laterite soil	4	8
3.	Probability of yellow soil or weathered Mica Schist	8	15
4.	Probability of hard compact Mica Schist	15	50

VES -3

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

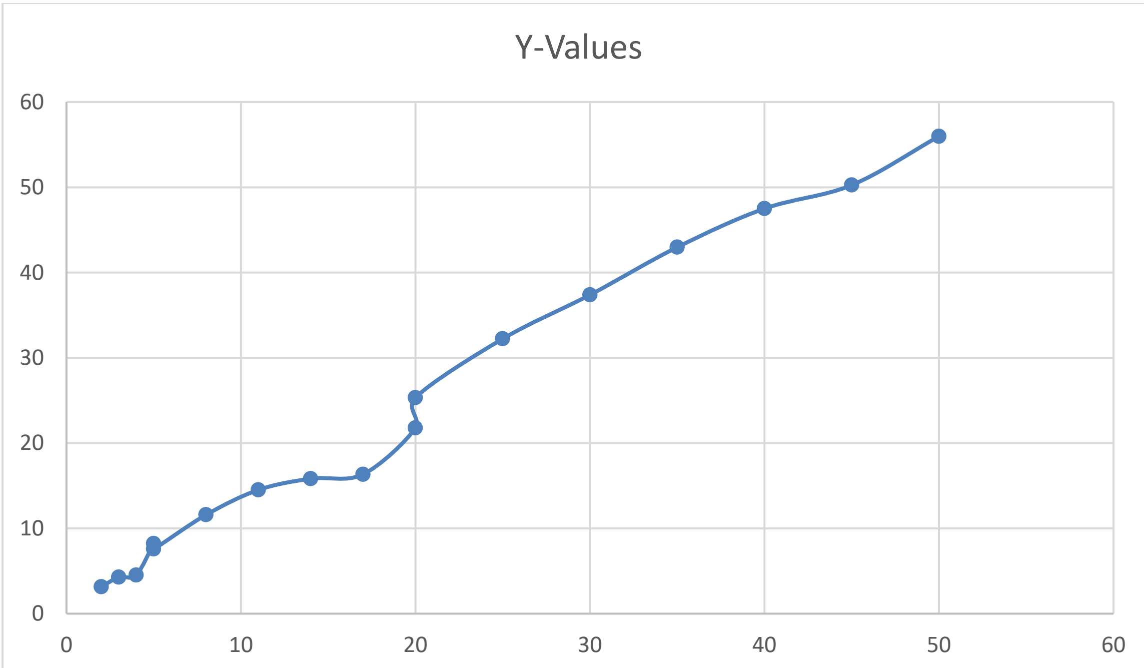
DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

- LOCATION – NEAR MIRAGPUR TO RANI MOHGAON ROAD
- LAT - 21°37'51.10"N LONG - 79°50'12.10"E

S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	SPACING FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	4.71	0.668	3.14
2.	3	1	12.56	0.341	4.28
3.	4	1	23.56	0.192	4.52
4.	5	1	37.69	0.218	8.21
5.	5	2	16.49	0.460	7.58
6.	8	2	47.12	0.246	11.59
7.	11	2	91.89	0.158	14.51
8.	14	2	150.8	0.105	15.83
9.	17	2	223.84	0.073	16.34
10.	20	2	311.02	0.070	21.77
11.	20	5	117.81	0.215	25.32
12.	25	5	188.50	0.171	32.23
13.	30	5	274.89	0.136	37.38
14.	35	5	376.99	0.114	42.97
15.	40	5	494.8	0.096	47.50
16.	45	5	628.32	0.080	50.26
17.	50	5	777.54	0.072	55.98

VES -3

GRAPH B/W APPARENT RESISTIVITY & DEPTH



PROBABLE SUB SURFACE LITHOLOG

S,N.	Sub surface data (litho log) expected	Depth below Ground Level (m)	
		from	to
1.	Probability of Soil	0	4
2.	Probability of red laterite soil	4	8
3.	Probability of yellow soil or weathered Mica Schist	8	18
4.	Probability of hard compact Mica Schist	18	50

VES -4

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

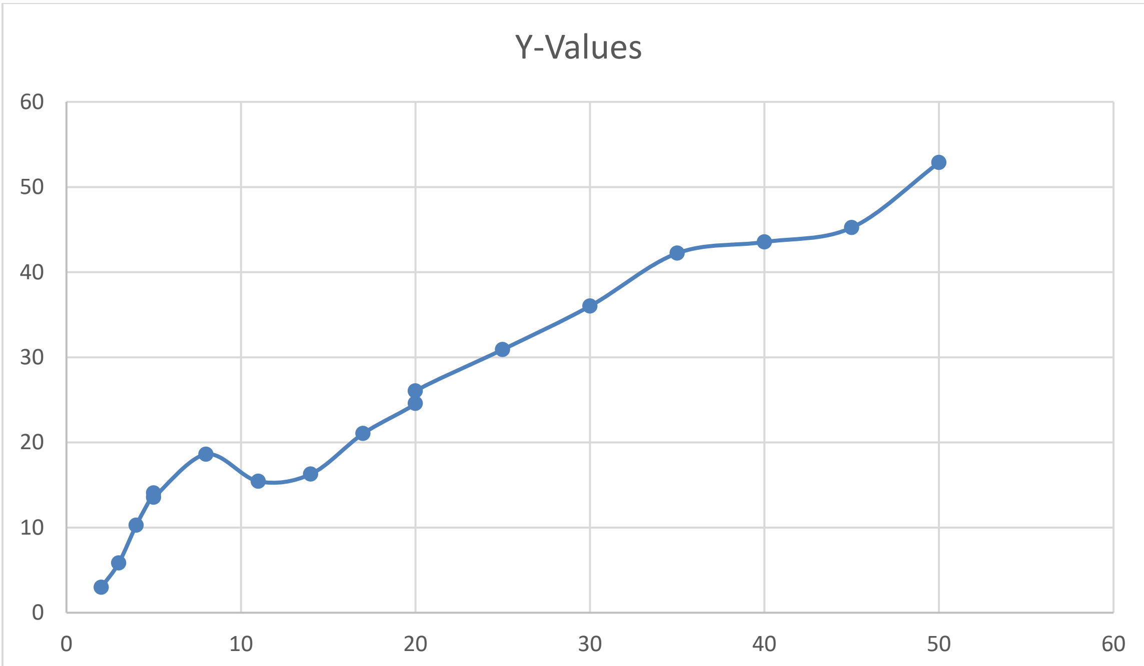
DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

- LOCATION – NEAR CHOPRA MINE
- LAT - 21°37'49.45"N LONG - 79°50'25.70"E

S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	SPACING FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	4.71	0.633	2.98
2.	3	1	12.56	0.465	5.84
3.	4	1	23.56	0.436	10.27
4.	5	1	37.69	0.373	14.05
5.	5	2	16.49	0.822	13.55
6.	8	2	47.12	0.395	18.61
7.	11	2	91.89	0.168	15.43
8.	14	2	150.8	0.108	16.28
9.	17	2	223.84	0.094	21.04
10.	20	2	311.02	0.079	24.57
11.	20	5	117.81	0.221	26.03
12.	25	5	188.50	0.164	30.91
13.	30	5	274.89	0.131	36.01
14.	35	5	376.99	0.112	42.22
15.	40	5	494.8	0.088	43.54
16.	45	5	628.32	0.072	45.23
17.	50	5	777.54	0.068	52.87

VES -4

GRAPH B/W APPARENT RESISTIVITY & DEPTH



PROBABLE SUB SURFACE LITHOLOG

S,N.	Sub surface data (litho-log) expected	Depth below Ground Level (m)	
		from	to
1.	Probability of Soil	0	2
2.	Probability of red laterite soil	2	8
3.	Probability of yellow soil or weathered Mica Schist	8	20
4.	Probability of hard & dense Mica schist	20	35
5	Probability of fractured, layered, jointed Mica schist	35	45
6.	Probability of hard compact Mica Schist	45	50

VES -5

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

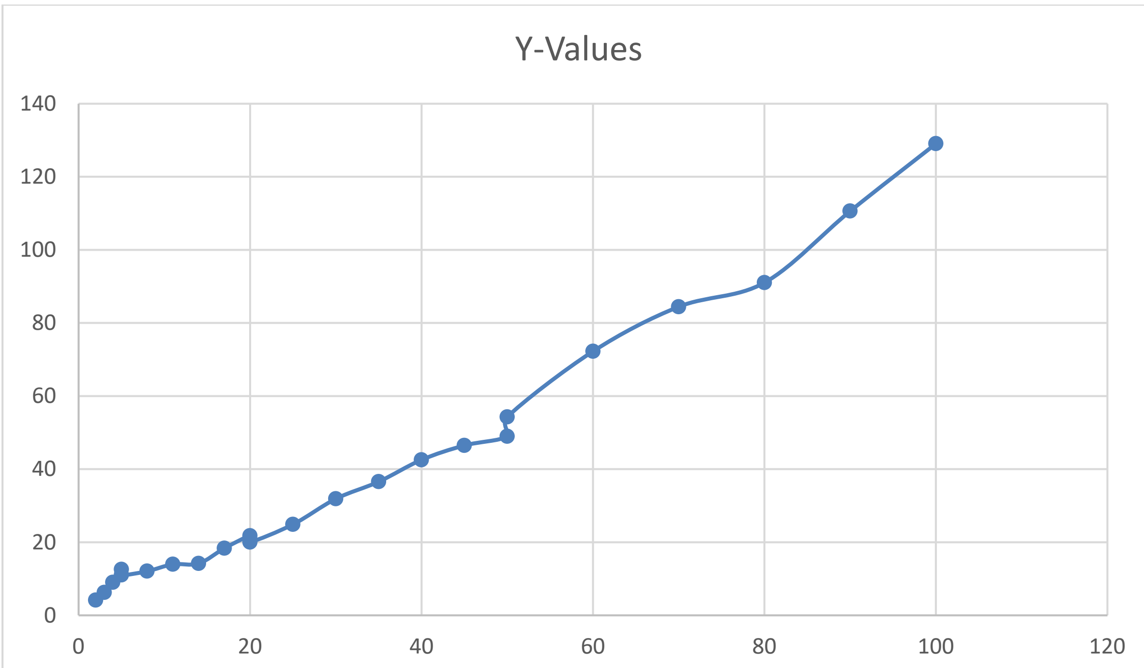
- LOCATION – IN FRONT OF PANDHARWANI MINE GATE
- LAT - 21°37'42.45"N LONG - 79°50'40.75"E

S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	SPACING FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	4.71	0.887	4.17
2.	3	1	12.56	0.497	6.24
3.	4	1	23.56	0.383	9.02
4.	5	1	37.69	0.333	12.55
5.	5	2	16.49	0.668	11.01
6.	8	2	47.12	0.256	12.06
7.	11	2	91.89	0.152	13.96
8.	14	2	150.8	0.094	14.17
9.	17	2	223.84	0.082	18.35
10.	20	2	311.02	0.070	21.77
11.	20	5	117.81	0.170	20.02
12.	25	5	188.50	0.132	24.88
13.	30	5	274.89	0.116	31.88
14.	35	5	376.99	0.097	36.56
15.	40	5	494.8	0.086	42.55
16.	45	5	628.32	0.074	46.49
17.	50	5	777.54	0.063	48.98
18.	50	10	376.99	0.144	54.28
19.	60	10	549.78	0.131	72.24
20.	70	10	753.98	0.112	84.44
21.	80	10	989.6	0.092	91.04

22.	90	10	1257	0.088	110.61
23.	100	10	1555	0.083	129.06

VES -5

GRAPH B/W APPARENT RESISTIVITY & DEPTH



PROBABLE SUB SURFACE LITHOLOGY

S,N.	Sub surface data (litho-log) expected	Depth below Ground Level (m)	
		from	to
1.	Probability of Soil	0	2
2.	Probability of red laterite soil	2	5
3.	Probability of yellow soil or weathered Mica Schist	5	17
4.	Probability of hard & dense Mica schist	17	45
5	Probability of fractured, layered, jointed Mica schist	45	50
6.	Probability of hard compact Mica Schist	50	100

5. Approved Mine Plan

5.1: Year Wise Mine plan Including Excavation Depth, Area and Mine Seepage

Miragpur Manganese mine is located in Miragpur village, Tehsil Khairlanji, District Balaghat, Madhya Pradesh. Miragpur village is in south west portion in Balaghat district, Madhya Pradesh. The total lease area of Miragpur Mine is 24.288 ha & 4.339 ha. It extracts Mn by underground methods.

Method of Mining: Stopping is the opening of large underground rooms, or stope, by the excavation of ore. Stopping is practiced in underground mineral mining when the surrounding rock is strong enough to permit the drilling, blasting, and removal of ore without caving. Existing open pit size-4180 m² as on 1-04-2016- This is the Main Pit which was proposed to be extended along strike towards the western lease boundary and depth extension proposed up 330MRL

The u/g mining of ore-deposits in the Lease area is divided in two phases.

i) **PHASE-1**:-consists of mining in the area already explored by drilling. This part of lease shall have (a) Open cast workings and (b) U/G workings below the UPD of open cast workings.

ii) **PHASE-2**:-During Phase-1 workings, exploration will be carried out by drilling as proposed in the remaining area still unexplored. When exploration yields positive result and ore-reserves are established, further development and stopping will follow in the Phase-2.

Table 5.1: Details of Earlier Approved Mining Plans / Schemes ofMining

Date and reference of last approved MP/SOM/RMP/MMP				
Sl. No.	**Type of document & rule under which prepared**	**Approval letter No. & date**	**Lease area for which approval given (ha)**	**Proposal from –to (period of years)**
1.	Mining Plan	BGT/Mn/MPLN/907/NGP Dated 30-11-2005	Lease area: 24.288ha	2006-07 to 2010-11
2.	Scheme of Mining	-	Lease area: 24.288ha	2011-12 to 2015-16
3	Modification in approved Mining Plan	BGT/Mn/MPLN/907/NGP Dated 11-03-2016	Lease area: 24.288ha	2016-17 to 2020-21

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

Modification in Approved Mining Plan	17(3) of MCR,2016	i)Increase in Production ii)Lease period extension from 20 to 50 years	24.288 Ha	03-11-2016	2016-17 to 2020-21

The formation of the area belongs to Mansar formation of Sausar Group of Mesoproterozoic in age. Lease area is explored by present pit up to MRL 350 and 1323 meter of exploratory drilling comprising 21 bore holes. Exploration proved "Mn" "Ore Body" of 8.0 meter average thickness.

5.2 Year wise proposal and achievement from the mine is given in table below

	Proposal					
	Year	**Soil/murrum m^3**	**Waste m^3**	**Total O.B. m^3**	**Mineral mt. Manganese(ROM)**	**SR= OB : ore in m^3**
Proposal period	2016-17	17521.00	58916.00	58916.00	68572.00	Nil
	2017-18	12000.00	33949.00	33949.00	58432.80	Nil
	2018-19	29853.00	33949.00	33949.00	39602.5	Nil
	2019-20	29853.00	33949.00	33949.00	79590	Nil
	2020-21	29853.00	33949.00	33949.00	124691	Nil
	Total	**119080.00**	**194712**	**194712**	**370888.30**	

	Achievement					
	Year	Soil/murrum m^3	Waste m^3	Total O.B. m^3	Mineral mt. Manganese(ROM)	SR= OB : ore in m^3
Proposal period	2016-17	-	-	-	328	Nil
	2017-18	-	-	-	1231	Nil
	2018-19	-	-	-	1087	Nil
	2019-20	-	-	-	104	Nil
	2020-21	-	-	-	Awaited	Nil
	Total	-	-	-	**2750**	

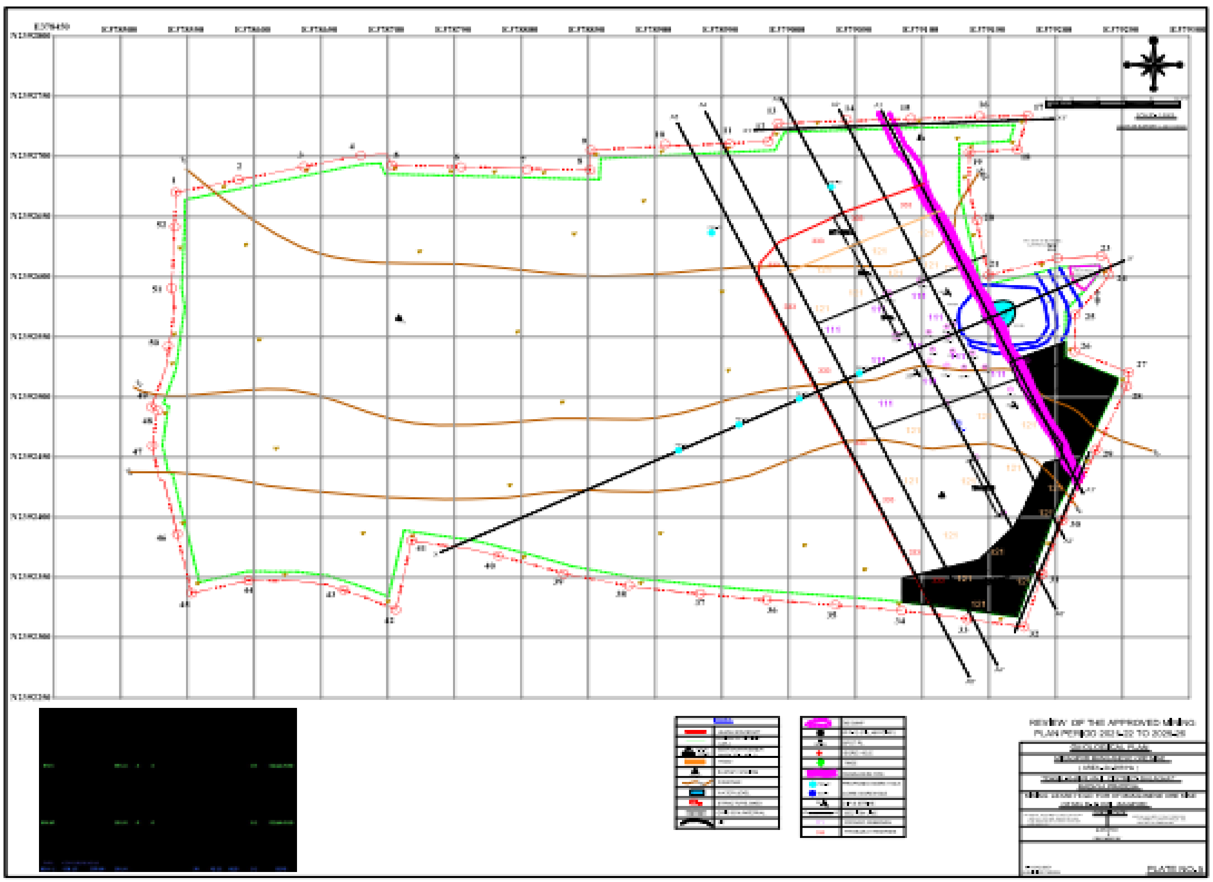


Fig 5.1 Approved Mine plan of Miragpur Mine, Khairlangi Balaghaat

Fig 5.2 Mining phase of driling at Miragpur mine

6. Use of water obtained from mine dewatering

As per the approved mine plan the Miragpur mine has a discharge of 8 KLD or 8m^3/day The entire water is utilize as per the Table 6.1.

Table 6.1 Water utilization in Miragpur mine (Area = 24.288 ha)

Sr.no	Purposes	Environmental Clearance (68KLD)	
		Actual Discharge	Proposed (KLD)
1	Dust suppression	**8 KLD**	10
2	Green belt		10
3	Domestic		6
4	Drilling		10 (Utilized)
5	Sand Stowing		20
	Total		**56**

Table 6.1a. Water utilization in Miragpur mine (Area = 4.339 ha)

Sr.no	Purposes	Environmental Clearance (4 KLD)	
		Actual Discharge	Proposed (KLD)
1	Dust suppression	**0 KLD**	1
2	Green belt		1
3	Domestic		1
4	Drilling		1
	Total		**4**

6.1 For Drinking – The mine discharge is not used for drinking. Drinking water for the mine is obtained from existing dug well within ML area.

6.2 Irrigation- During monsoon small quantity of water is released from storage tank for irrigation. However, 10KLD mine discharge is used for maintaining green belt.

6.3 Recharge- The mine discharge after three step of de-siltation is stored in a recharge cum storage pond of nearly 0.15ha with a depth of av 1.5m thus having storage capacity of 0.25ham nearly 25% can be taken as recharge from this tank

6.4 Runoff to stream- No discharge is released to any stream from the Miragpur mine.

6.5 Benefitted area- Nearby villagers of village Miragpur

6.6 Dust suppression, green belt development- as shown in table 8KLD is used for this purpose.

7. Comprehensive assessment of the impact on the ground water regime

Comprehensive assessment of the impact on the ground water regime in and around the project area highlighting the risks and proposed management strategies proposed to overcome any significant environmental issues.

The present phase of Miragpur Mine is an underground mine for proposal of production of Mn ore of 1300 tons/Yr. There is one existing pit. Total 21 bore holes have been drilled as per last approved plan. No fresh reserves are estimated, reserves are kept as per last approved plan. Existing open pit size-4180 m² as on 1-04-2016- This is the Main Pit which was proposed to be extended along strike towards the western lease boundary and depth extension proposed up 330 MRL. The surface elevation at 24.288 ha mine lease area varies between 345 and 342 m amsl. It is proposed to extend and expand the existing o/c workings in the strike direction to the east and west both and the Pit will be further deepened. However, beyond the existing pit in the east and west direction, there is virgin ground where surface RL is 360/361MRL.There exist no natural surface water drainage/ nala/stream within the mine lease area. Groundwater occurrence is restricted only to the phreatic aquifer developed in the weathered zones of quartz mica schist, the host rock. The extracted groundwater from mine is fully utilized for mining operation and maintaining green belt within ML area after de-siltation at three levels. As such there is no significant impact of mining on groundwater regime in this hard rock terrain as the radius of influence is very much restricted due to high heterogeneity.

Fig 7.1 Tube well and mine pit within mine lease area of the mine

7.1. Impactionsurface water sources– The Miragpur Mine is situated on a local high within a regional low as depicted in the Fig 7.2. No nala/stream exists or generates from ML area of Miragpur mine. The ML area is not situated within any wetland zone and not part of any national park etc. Other existing small ponds/ water bodies within core and buffer zone has been investigated and the water quality is found normal.

7.1.1 Diversion of existing channels [constructed dam/barrages/weir/canals/hydro-electric projects] – No existing channel, constructed dam/barrages/weir/canals/hydro-electric projects etc need to be diverted due to the project. Thus 7.1.1 is not applicable.

7.1.2 Change in land use [change in flood plain, lotic & lentic systems etc.]-No nala/stream/ river exist or generates from ML area of Pandharwani mine. The ML area is not situated within any wetland zone thus change in land use in flood plain, lotic & lentic systems etc is not applicable.

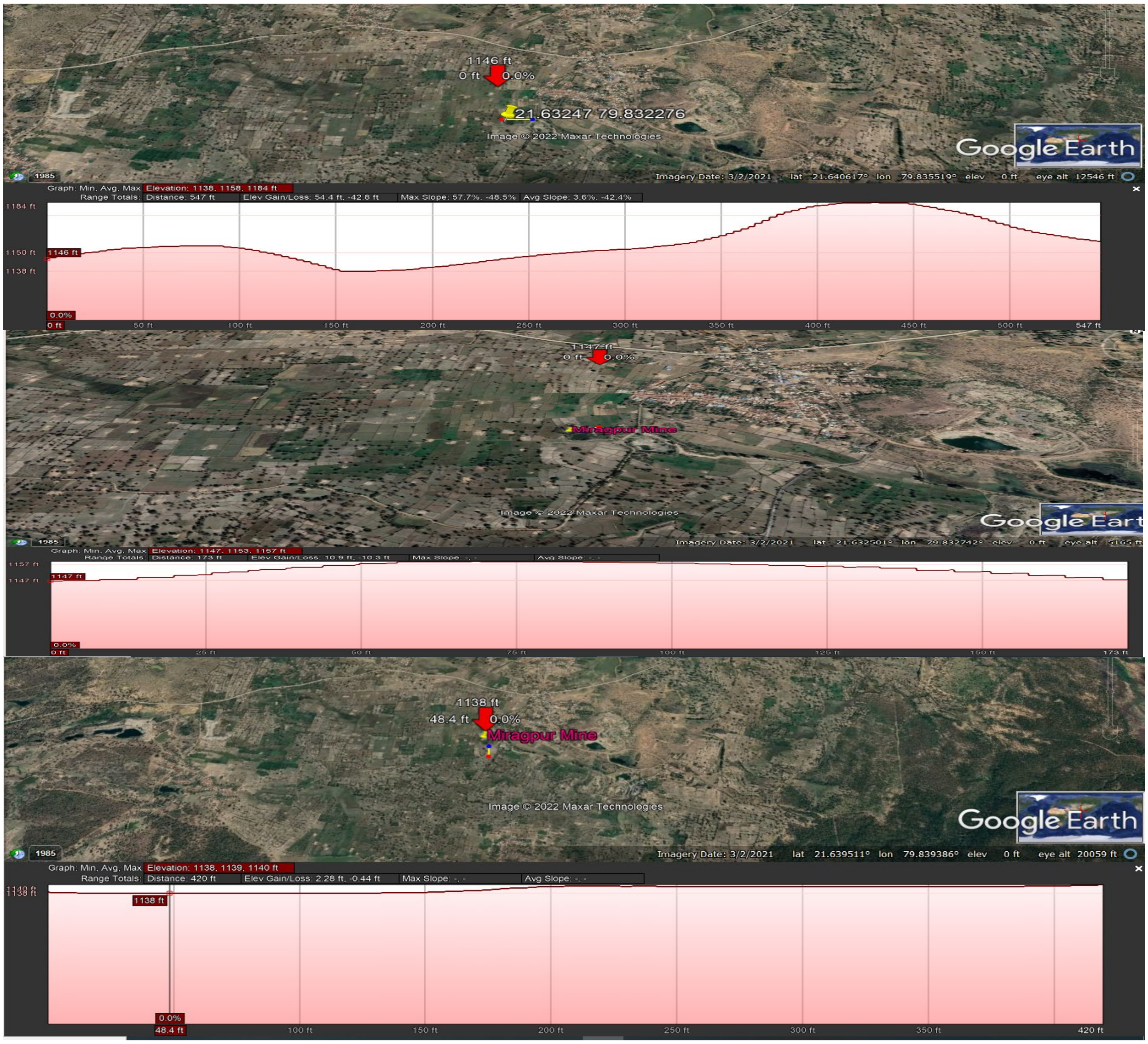


Fig 7.2 Google elevation profile of study area around Miragpur Mine from three direction.

7.1.3 Current& Potential threats- The ML area is situated onto a water divide from where no nala stream is generating nor any spring ever exist in the area. However, due to moderate rainfall of >1150mm with about 70 rainy days good quantum of runoff (~ 7.7ham/yr) generates from the area as calculated considering about 45% runoff coefficient-

24.288 ha x 1.151m x 0.45= 12.57ham/yr.

Garland drains are existing to channelize the generated runoff for impounding the water into a water conservation tank. Runoff collected within the pre-existing abandon opencast pit of Pandharwani mine lease area is also gainfully utilized for conservation. It is observed that the core zone having average groundwater level 6m bgl in comparison to that of buffer zone av 5m bgl. This can be due to the higher surface elevation of core zone, which is found av. 342 m amsl, in comparison to buffer zone of 315m amsl. To negotiate any potential threat of groundwater decline in the core zone area rainwater harvesting involving abandon mine pits and ponds are in practice.

7.2 Impact on groundwater sources– The Miragpur mine lease area is in Khairlangi block of Balaghat district, MP which is categorized under safe category (Stage of GW Extraction 33%) by the latest estimation carried out by CGWB (2020). The groundwater levels measured in study area remain shallow (4-8m) throughout the year with 2-3m fluctuation. The area is part of hard rock terrain and consist only phreatic aquifer developed over the weathered zone of quartz mica schist. The thickness of the weathered zone is restricted to top 12-17 m as observed along open case mine pits and by geophysical investigations. Both dug wells and hand pumps are tapping this phreatic aquifer. Bore wells are scanty having a depth of maximum 30m tapping weathered zone and occasional fractures. Existing open pit size-4180 m². This is the Main Pit which was proposed to be extended along strike towards the western lease boundary and depth extension proposed up 330MRL. From the bottom of Open cast working of Incline shafts were proposed for development u/g ore body. Little water extracted from mine as mine discharge (8KLD) is mainly the seepage from phreatic zone through pre-existing exploratory holes within mine tunnel or from wall seepage from top. The phreatic aquifer zone is protected and recharged by construction of rainwater harvesting ponds and through abandon open case pits in the core zone of mining.

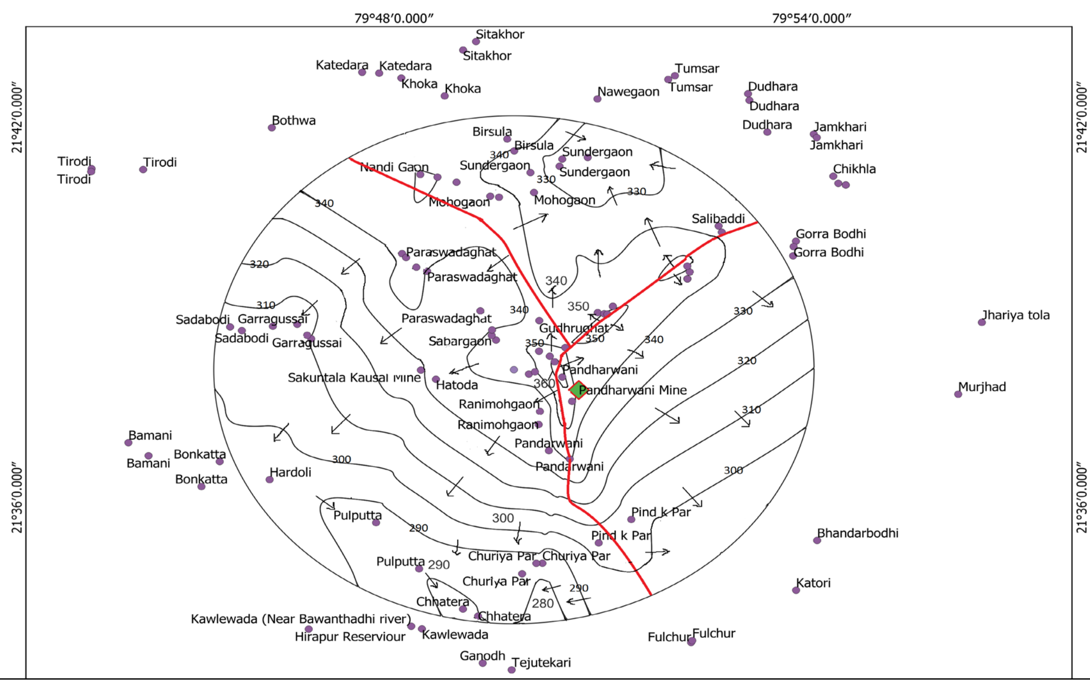
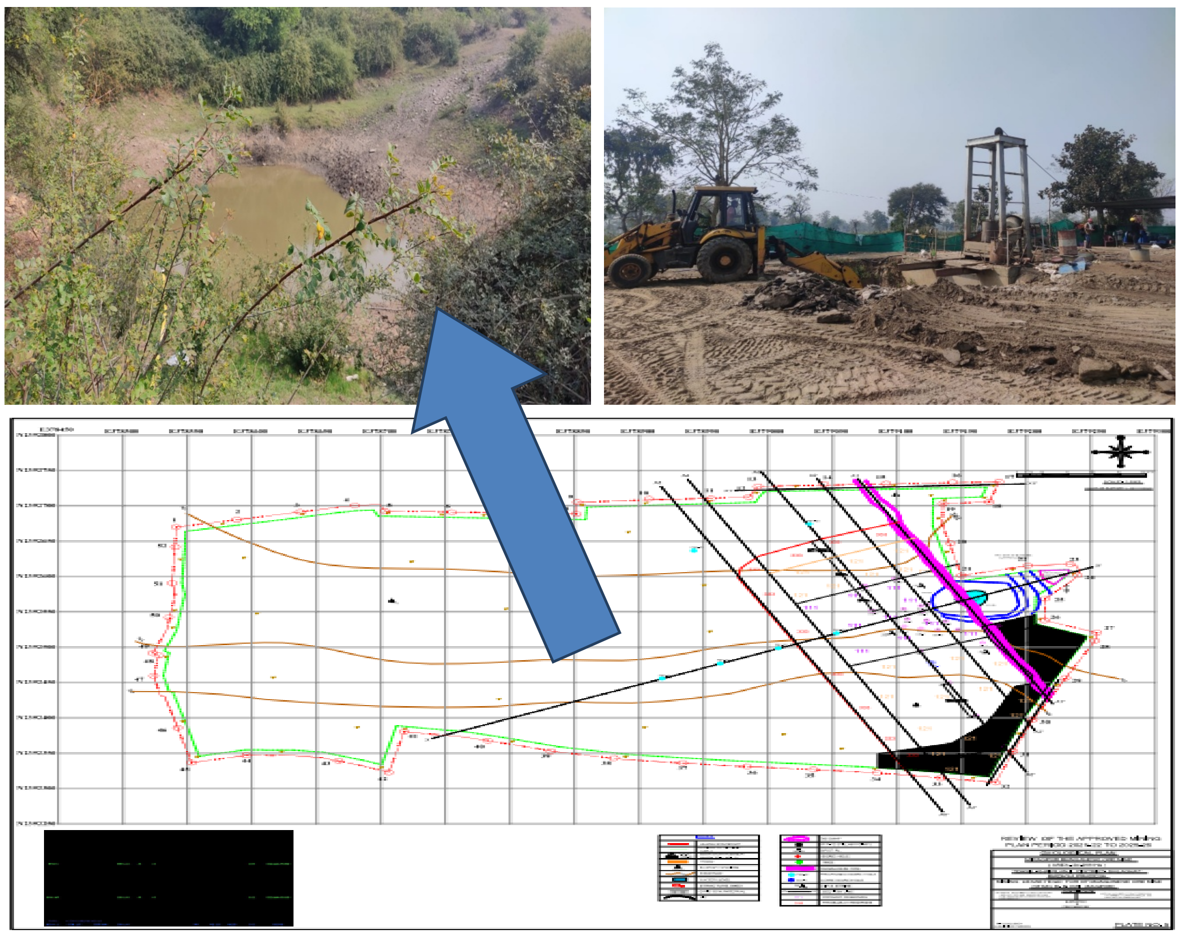


Fig 7.3 Groundwater contour map of Miragpur mine area.
INDEX-Red line shows groundwater divide, arrows indicating groundwater flow direction, values indicate groundwater elevation (m amsl), dots indicate data point used for generation of GW contour, buffer zone is marked

7.2.1 A description of the impacts on environmental features that have occurred, or are likely to occur, because of any past ground water abstraction. Existing open pit size-4180 m² as on 1-04-2016- This is the Main Pit which was proposed to be extended along strike towards the western lease boundary and depth extension proposed up 330MRL. As such, o/c workings are restricted to a depth of 14m at 347 MRL in view of the land degradation as the area is agricultural land and locals resist it. From the bottom of Open cast working of Incline shafts were proposed for development u/g ore body. It is proposed to extend and expand the existing o/c workings in the strike direction to the east and west both and the Pit will be further deepened. However, beyond the existing pit in the east and west direction, there is virgin ground where surface RL is 360/361MRL. The pit so developed is presently used as first settling pit for mine discharge. All runoff generated within the pit of abandon OC mine thus also collected and stored at final conservation pond. It was observed in the LULC map that area covered under water body has increased from 60 ha to 123ha (Table 1.2).



7.4 Existing abandon open cast mine pit and water harvesting pit near Miragpur mine (photo March 2022) and mine plan. Note the bottom of OC pit in plan and photo shown by arrow.

7.2.2 An assessment of the likely impacts on environmental that will occur, or are likely to occur, because of the ground water abstraction for a five-year period starting on the consultation day for the report; and over the projected life of the resource project area, affected area and radius of influence. The Miragpur mining lease was granted to M/s D.P. Rai in the year 2006 for 20 year over an area of 24.288 ha & 4.339 ha (As per mine plan). Existing open pit mine have an area

4180 m² up to MRL 350 and 1323 meter of exploratory drilling comprising 21 bore holes. It is proposed to extend and expand the existing o/c workings in the strike direction to the east and west both and the Pit will be further deepened. However, beyond the existing pit in the east and west direction, there is virgin ground where surface RL is 360/361MRL. It is proposed to start u/g mining as soon as minimum cover required for u/g mining is achieved. O/C workings are completed in the second year (ending 2022-23). U/G workings will be commenced from 347MRL (UPD) in the year 2023-24 & continue for three years (2023-24,2024-25 & 2025-26) & Conceptual period.

7.3. Socio-Economic Aspects:

7.3.1 Settlements and population dynamics around project area

The study area comes under rural. There exists about 35 villages in the study area and their details are given in Table 7.1 and 7.2.

Table 7.1 Crop production details of Balaghat District Madhya Pradesh in kharif and Rabi

	Kharif		**Rabi**	
Sr. no	Crops	(Ha)	Crops	(Ha)
1	Rice	244.9	Linseed	19.0
2	Minor Millets	12.8	Wheat	18.4
3	Pigeonipea	7.1	Chickpea	10.4
4	Maize	05.6	Rapeseed/ mustard	7.30

There is no impact of groundwater withdrawal by Miragpur Mn Mine on the study area, study can recommend NOC may be extended for next 5 yr with existing 8KLD extractions from groundwater system.

7.3.2 Dependency on sources of water [surface or sub-surface] the area by and large depends on rainfed agriculture with supportive irrigation. Surface water irrigation using canal water is the main source of irrigation within the buffer zone. Local canals network is developed using the water of minor irrigation projects like Hirapur, Tirodi, Sitalgarh and Sadabodi Dam/Reservoirs. Water bodies developed on abandon mine pits are also used as sources of water for irrigation along with some dug wells. Drinking water is mainly catered by groundwater through dug wells and hand pumps. Industrial use of water in the study area is largely remainswithin the mining sector. Several open cast and underground mine lease area exist within the study area. Mine discharge is the main source of water for mining operat ion. No other significant industrial use exists in the area.

Table 7.2 Population data of study area in parts of Khairlanji, Tirodi and Lalbarra blocks						
S. No.	**Location**	**House**	**Total Population**	**Male**	**Female**	**Area (Ha)**
1	Bhandarbodhi	838	3520	1690	1830	1412.2
2	Birsula	186	2620	1309	1311	363.3
3	Bonkatta	852	3403	1741	1662	195.3
4	Chhatera	430	1746	893	853	422.6
5	Chikhla	607	2316	1166	1150	873.3
6	Churiya Par	249	960	484	476	606.1
7	Dudhara	285	984	492	492	257.2
8	Fulchur	489	1858	891	967	742.3
9	Garragussai	119	498	242	246	221.1
10	Goorabodi	239	761	392	369	352.2
11	Gudhrughat	452	1732	830	902	403.8
12	Hardoli	732	3126	1523	1603	704.6
13	Hatoda	328	1333	664	669	483.55
14	HirapurReservio ur	134	507	241	266	302
15	Jamkhari	172	554	259	295	311.6
16	Katedara	319	1415	733	712	466.1
17	Katori	701	2726	1365	1361	932
18	Kawlewada	571	2179	1067	1112	541.34
19	Khoka	280	1269	635	634	283.12
20	Miragpur	389	1418	712	706	328.2
21	Mohogaon	401	1477	746	731	378.42
22	Murjhad	216	907	450	457	448.71
23	Nandi Gaon	426	1848	923	925	447.1
24	Nawegaon	322	1340	659	681	282.9
25	Pandarwani	190	711	332	379	281.1
26	Paraswadaghat	662	2583	1230	1353	889.47
27	Pind k Par	460	1927	949	978	593.42
28	Pulputta	613	2691	1332	1359	697.7
29	Sabargaon	434	1533	748	785	547.83
30	Sadabodi	181	721	354	367	208.83
31	Salibardi	771	2839	1375	1464	870.3
32	Shankar Pipariya	452	1559	776	783	465.9
33	Sukdighat	295	1207	606	601	438.2
34	Tekadighat	409	1594	768	826	646.9
35	Tumsar	201	766	379	387	213.6

7.3.3 Ground water uses [e.g. irrigation (irrigation method, number of watering) water supply etc.] Groundwater plays secondary role in irrigation in the study area. The main crop is kharif uses supportive irrigation largely through canals of minor irrigation projects. Mine out pits locally also support the crop water requirement. Dug well fitted with electrical pumps are used to support kharif and rabi crops in the area. The unit draft of dug wells varies from 0.0027 to 0.036 mcm/ year. Mine discharge is being used for horticulture within core and buffer zone.

7.3.4 Improvement / decline in agricultural yield in last 5 years and likely impact after NOC

The average agriculture yield has not changed in last 5 year. The area is of hard rock terrain and the aquifer is quartz mica schist having radius of influence less than 500m as observed the mine core area. So, no likely negative impact of NOC is inferred. Rather LULC shows increase of water body area may provide additional irrigation source

7.3.5 Impact of existing project on local communities [based on local interactions (interactions must be with stakeholders like fishermen community, farmers etc.]

M/s D.P. Rai, Nagpur, is a partnership firm registered under Indian Partnership Act, 1932. Miragpur Manganese mine is engaged in the mining activities since decades. Miragpur Manganese mine is located in Miragpur village, Tehsil Khairlanji, District Balaghat, Madhya Pradesh. It extracts Mn by both underground. The industry has provided employment to the region. The groundwater withdrawal of maximum 8KLD has not created any adverse impact on the groundwater regime of the area. The average water level in study area in pre monsoon period is 5 to 10 m and 2.5 to 6 m during monsoon period. The biggest advantage of the study area is that a seasonal river called Bawanthadi flow in monsoon period of July to October that protects the area from any adverse impact on groundwater. Further the Miragpur Mn mine has taken up the rainwater harvesting and artificial recharge structure in the lease area. LULC data shows marginal decline in cultivated land in the 10km radius. However, as a whole no complain is observed.

8. Proposed measures for disposal of wastewater by mine drawing saline water.

The water in the study area including mine discharge is fresh and the TDS is ranges between 150 and 1900 ppm in general so disposal of saline water not applicable.

9.0 Water Conservation

Measures to be adopted for water conservation which includes recycling, reuse, treatment, etc. This includes the water balance chart being adopted by the firm along with details of water conservation methods to be adopted. - Brief write up along with capacity and flow chart of Sewage Treatment Plants / Effluent Treatment Plants / Combined Effluent Treatment Plants existing/ proposed within the project. - Details of water conservation measures to be adopted to reduce/ save the ground water. - Total water balance chart showing the usage of water for various processes.

The entire mine discharge (8KLD) is consumed for various mine operation/dust suppression/ plantation-horticultural use (Table 9.1).The mine discharge except high suspended particle is fresh. No sewage treatment plant /effluent treatment plan is in operation, or it is required for mine discharge.

Water conservations can be proposed for enhanced by including efficient measures of water use for mining and domestic consumption, effective reuse and recycles of water and treated water, adoption of appropriate rainwater harvesting and artificial recharge methods. It is therefore following sub topics are incorporated in this chapter.
9.1 Water use and water balance
9.2 RWH and Artificial Recharge

9.1 Water use and water balance

Miragpur Manganese mine is engaged in the mining activities since decades. Water is being used for dust suppression, greenbelt, domestic drilling and sand stowing purposes shown in the table no 3.1

9.2. Rainwater Harvesting & Artificial recharge:

Miragpur mine having an area of 24.288ha & 4.339 ha and land use is discussed in chapter 1.4 and table 1.1. The mine has taken up concentrated effort conserve each drop of rain water that the campus receives annually. Storm water garland drain has been constructed all along the mining area, office and staff quarter. A mine pit is also constructed along the mine for collection of mine discharge water and rainwater. The mine pit is having an area of 0.14 ha (1400m²) and depth of 3m.The mine pit having total storage capacity is 0.42 ha (4200m²). The collected water is again used in agriculture purposes of the surrounding areas. The run-off co-efficient has been taken 85% here. The recharge structures are shown below

Recharge Water= Area x normal rain fall x runoff coefficient

Q= 4200 x 1.471 x 0.5 = 3089.1 m³

Table9.1 Water utilization in Miragpur mine (Area = 24.288 ha)			
Sr.no	**Purposes**	**Environmental Clearance (68KLD)**	
		Actual Discharge	**Proposed (KLD)**
1	Dust suppression		10
2	Green belt	**8 KLD**	10
3	Domestic		6
4	Drilling		10 (Utilized)
5	Sand Stowing		20
Total			**56**

Table9.1a. Water utilization in Miragpur mine (Area = 4.339 ha)			
Sr.no	**Purposes**	**Environmental Clearance (4 KLD)**	
		Actual Discharge	**Proposed (KLD)**
1	Dust suppression		1
2	Green belt	**0 KLD**	1
3	Domestic		1
4	Drilling		1
Total			**4**

Fig 9.2 Design of proposed rooftop rain water harvesting structure

Table 9.2 Ponds and water bodies of study area									
S. N.	Location	Latitude	Longitude	Elevation	EC (µS)	pH	TDS (ppt)	DO (mg/l)	Water body
1	Pandharwani	21.63169	79.840268	364.51	540	8.1	120	6.2	Pit Mine
2	Goorabodi	21.65752	79.870229	343	580	8.1	250	9.4	Pond
3	Yerwaghat	21.65932	79.870783	335.56	950	7.3	320	5.88	Pond
4	Gorra Bodhi	21.66741	79.89621	337.4	780	8.2	280	4.8	Pond
5	Chikhla	21.68219	79.908152	343.59	980	8.2	320	6.2	Pond
6	Nandi Gaon	21.68292	79.814956	342.53	850	8.1	320	10.34	Pond
7	Mohogaon	21.68023	79.8335	334.1	790	8.5	335	6.46	Pond
8	Sundergaon	21.68946	79.846363	320.15	790	8.1	250	6.9	Pond
9	Khoka	21.71033	79.801737	346.83	450	8.4	310	5.9	Pond
10	Tirodi	21.68648	79.727579	358.18	440	7.3	160	2.7	MOIL Reservoir
11	SakuntalaKausal Mine	21.63351	79.806412	328.59	610	8.1	310	4.79	Mine Pit
12	Churiya Par	21.5827	79.835526	280.27	640	8.3	220	4.93	Pond
13	HirapurReserviour	21.56538	79.779562	299.59	550	8.1	160	6.1	Reservoir
14	Fulchur	21.56236	79.871388	294.63	910	8.4	350	5.77	Pond
15	Miragpur mine	21.63247	79.832276	344.78	630	8.1	320	5.48	Recharge pit
16	Pandharwani Mine	21.62528	79.84262	360.09	450	8.3	150	6.9	Recharge structure

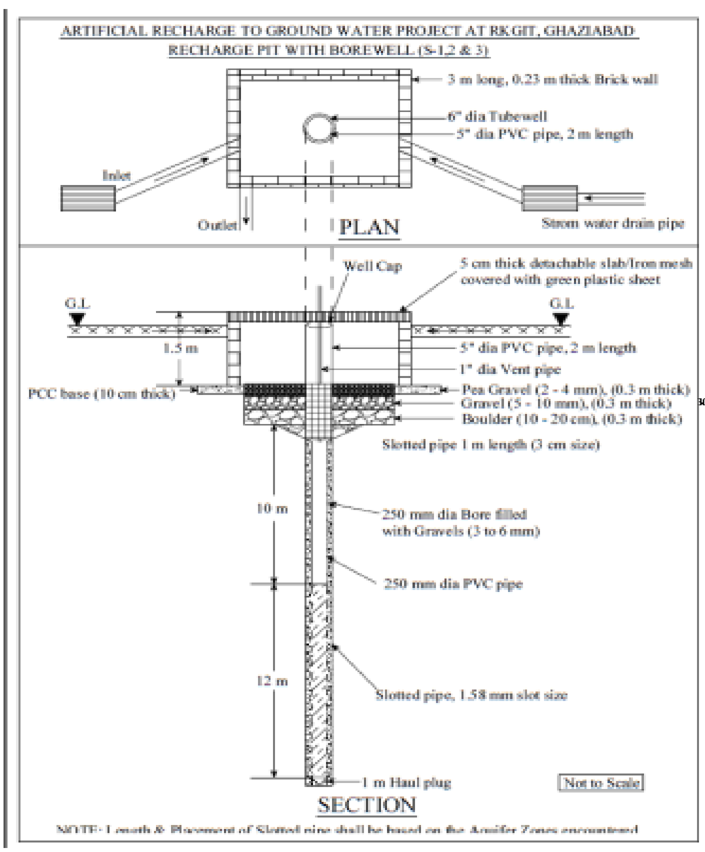
9.3. Monitoring, Measurement and Capacity building

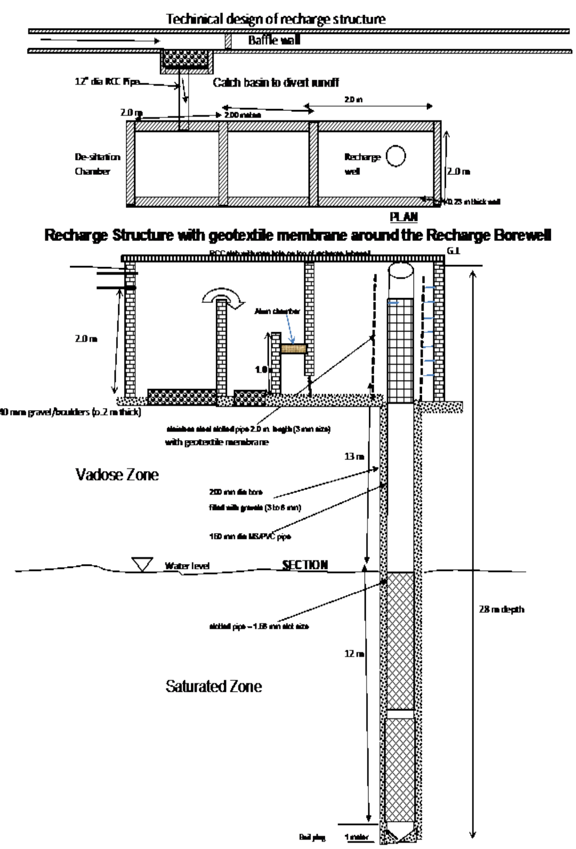
Monitoring and measurements of several parameters are part of water conservation strategy towards the motive of efficient management of water. The withdrawal of groundwater is regularly monitored and measured from the existing dug well. The water level is found at 5-10 m bgl in pre-monsoonal period, which varies from 2.5-6 m bgl in the monsoonal period. The Miragpur mine conducts regular capacity building of its maintenance staff that monitors and measures and keeping record of various data related to water use and water conservation. The workers have been trained for keeping record and onward submission of data as per the requirement.

For monitoring of groundwater level in the area of Miragpur mine, Balaghat as per the guideline of CGWA, a piezometer has to be constructed at the area. The installation of piezometer is proposed exclusively for monitoring of groundwater level deploying automatic water level recorder with telemetric arrangement of data transmission.

Proposed Roof top rainwater harvesting structure

A roof top rainwater harvesting is proposed using standard deign as given below for mine office and associated building at the mine core zone by drilling of 30m deep 6'' dia bore well (**Fig 9.2**) in addition to existing recharge structure **(Fig 9.1).**





10. Any other details pertaining to the project

Manganese ore-Manganese ore horizon comprising of mostly manganese ore and manganiferous quartzite of Mansar Formation. The manganese ore is massive in nature containing mainly psilomelane. Mn ore band, running from (N200W to S200E) direction with an average thickness of ore is 8 (Eight) meters. Dip of the ore body is approx. 250 towards (SW).

Annexure-1 DATASET PANDHARWANIAREA, BALAGHAT											
S. N.	Location	Latitude	Longitude	Elevation	EC (mS)	pH	TDS (ppt)	Water Level(m)	Diameter(m)	DO (mg/l)	Type of water body
1	Pandharwani	21.631688	79.840268	364.51	540	8.1	120			6.2	Pit Mine
2	Miragpur	21.635695	79.838438	363.08	1700	6.8	860			6.54	Hand Pump
3	Miragpur	21.637156	79.837283	355.2	1690	7.2	850				Hand Pump
4	Miragpur	21.639436	79.840974	349.52	1420	7.5	230			2.38	Hand Pump
5	Sukdighat	21.648613	79.848755	342.09	1560	7.2	650	7	2.7	4.53	Dug well
6	Sukdighat	21.648322	79.850303	351.71	1830	7.2	920			2.72	Hand Pump
7	Sukdighat	21.648242	79.851071	353.48	2550	7.3	1230				Dug well
8	Sukdighat	21.650272	79.852384	346.06	2100	7.1	1000			2.4	Hand Pump
9	Sukdighat	21.650272	79.852384	346.06	1990	7.8	1050	6.7	2.5		Dug well
10	Goorabodi	21.657518	79.870229	343.65	1105	7.5	220			2.5	Hand Pump
11	Goorabodi	21.657518	79.870229	343	580	8.1	250			9.4	Pond
12	Goorabodi	21.657518	79.870229	343.56	1250	7.2	300			3.05	Hand Pump
13	Yerwaghat	21.65932	79.870783	335.56	950	7.3	320			5.88	Pond
14	Goorabodi	21.66087	79.870203	353.74	740	7.1	370				Hand Pump
15	Salibardi	21.671405	79.877707	336.32	680	6.5	150				Hand Pump
16	Salibardi	21.669789	79.878459	335.46	650	7	250				Hand Pump
17	Gorra Bodhi	21.667408	79.89621	337.4	780	8.2	280			4.8	Pond
18	Gorra Bodhi	21.665994	79.895665	331.16	680	7.4	320	4.8	2	4.2	Dug well
19	Chikhla	21.66357	79.895535	333.95	1220	7.5	620	6	2.8	2.05	Dug well
20	Chikhla	21.684507	79.905157	328.48	1450	7.2	720				Hand

											Pump
21	Chikhla	21.682636	79.906358	332.58	1910	6.9	960	8	2	3.61	Dug well
22	Chikhla	21.682192	79.908152	343.59	980	8.2	320			6.2	Pond
23	Chikhla	21.682192	79.908152	343.59	530	7.8	260				Hand Pump
24	Miragpur	21.638487	79.8347	353.81	650	7.3	320				Hand Pump
25	Sabargaon	21.641404	79.824406	343.13	1780	6.4	890				Hand Pump
26	Sabargaon	21.642618	79.823377	342.44	3800	6.8	1900	6.5	2	2.6	Dug well
27	Sabargaon	21.644069	79.823462	340.76	2960	6.9	1480				Hand Pump
28	Paraswadaghat	21.649093	79.820654	328.59	660	7.5	320				Hand Pump
29	Paraswadaghat	21.659513	79.807917	338.8	1005	7.3	520	7	2.5	7.2	Dug well
30	Paraswadaghat	21.660558	79.80533	351.76	910	7.8	450				Hand Pump
31	Paraswadaghat	21.664135	79.801919	340.53	2680	7.1	1340				Hand Pump
32	Paraswadaghat	21.66312	79.802876	343.89	3630	6.8	1820				Hand Pump
33	Nandi Gaon	21.684963	79.806272	339.63	600	7.7	300				Hand Pump
34	Nandi Gaon	21.684272	79.810401	339.84	1920	6.9	970				Hand Pump
35	Nandi Gaon	21.682917	79.814956	342.53	850	8.1	320			10.34	Pond
36	Mohogaon	21.679234	79.823017	339.12	530	7.7	260				Hand Pump
37	Mohogaon	21.678983	79.825131	346.41	1360	7.2	690				Hand Pump
38	Mohogaon	21.68023	79.8335	334.1	790	8.5	335			6.46	Pond
39	Sundergaon	21.68713	79.839619	326.1	720	7.3	360				Hand Pump
40	Sundergaon	21.689001	79.840266	326.3	2640	6.7	1330				Hand Pump
41	Sundergaon	21.685458	79.832651	333.14	890	7.3	440				Hand Pump
42	Sundergaon	21.689457	79.846363	320.15	790	8.1	250			6.9	Pond
43	Nawegaon	21.704839	79.848695	333.17	1590	7.2	790				Hand Pump
44	Tumsar	21.70996	79.865638	332.46	1730	7.2	860				Hand Pump
45	Tumsar	21.710944	79.867237	329.69	1390	7.3	690				Hand Pump
46	Dudhara	21.706201	79.884752	316.42	700	7.2	340				Hand Pump

47	Dudhara	21.704471	79.885074	328.17	760	7.3	380				Hand Pump
48	Dudhara	21.696104	79.889369	314.15	720	7.6	240				Hand Pump
49	Jamkhari	21.695575	79.900478	321.87	1280	7.4	640				Hand Pump
50	Jamkhari	21.694672	79.901208	319.15	1020	7.4	390				Hand Pump
51	Gudhrughat	21.64652	79.834762	340.56	580	7.9	280	4.2	1.5	5.3	Dug well
52	Birsula	21.691179	79.828772	334.89	1020	7.4	540				Hand Pump
53	Birsula	21.694301	79.827105	351.11	1080	7.7	560	4.5	2		Dug well
54	Sitakhor	21.717681	79.816533	341.65	540	7.4	260	5	2		Dug well
55	Sitakhor	21.719929	79.81962	340.24	680	7.3	340				Hand Pump
56	Khoka	21.705623	79.812121	347.08	820	7.7	310	1.45			Borewell
57	Khoka	21.710329	79.801737	346.83	450	8.4	310			5.9	Pond
58	Katedara	21.711607	79.796432	340.47	1040	7.2	340				Hand Pump
59	Katedara	21.711856	79.792357	342.87	880	7.5	440	4	1.5		Dug well
60	Bothwa	21.697268	79.770729	352.42	1430	7.1	740				Hand Pump
61	Tirodi	21.686482	79.727579	358.18	440	7.3	160			2.7	MOIL Reservio ur
62	Tirodi	21.685706	79.727475	334.49	840	7.4	320				Hand Pump
63	Tirodi	21.686257	79.739922	332.9	720	7.1	310	4.5	2		Dug well
64	Bamani	21.614417	79.736391	306.33	820	7.1	444	3.5	2		Dug well
65	Bamani	21.610979	79.741213	290.99	1600	7	800				Hand Pump
66	Bonkatta	21.602868	79.753879	286.6	910	7.1	440	6	1.4		Dug well
67	Bonkatta	21.609446	79.758254	295.86	1250	6.9	620				Hand Pump
68	Garragussai	21.641741	79.780165	310.59	740	6.9	220				Hand Pump
69	Garragussai	21.645568	79.776808	301.68	1111	6.7	560	4.3	2.1		Dug well
70	Garragussai	21.645046	79.770978	306.13	1720	7.2	900	5.1	2		Dug well
71	Sadabodi	21.644859	79.760747	305.02	1410	7.2	710				Hand Pump
72	Sadabodi	21.643897	79.763553	309.29	1360	7.4	680	4.4	1.5		Dug well
73	Garragussai	21.642687	79.779196	307.21	710	8	190				Dug well
74	SakuntalaKau sal Mine	21.633512	79.806412	328.59	610	8.1	310			4.79	Mine Pit
75	Hatoda	21.631088	79.810027	336.75	550	7.5	220				Hand Pump
76	Ranimohgaon	21.622631	79.83492	329.12	2210	7.2	1005				Hand

											Pump
77	Ranimohgaon	21.61919	79.834619	329.81	1050	7.5	510	6	2	4.03	Dug well
78	Pandarwani	21.61232	79.837064	337.82	990	7.2	450				Hand Pump
79	Pandarwani	21.61013	79.842064	341.23	880	7.2	380				Hand Pump
80	Pind k Par	21.594223	79.856797	302.82	1050	7.3	460				Hand Pump
81	Pind k Par	21.58805	79.848991	304.45	630	7.4	230				Hand Pump
82	Churiya Par	21.582704	79.835526	280.27	640	8.3	220			4.93	Pond
83	Churiya Par	21.582679	79.834056	285.04	1960	7.5	980				Hand Pump
84	Churiya Par	21.579936	79.830656	296.62	1050	7.5	490	4.5	1.5		Dug well
85	Chhatera	21.568803	79.820107	279.78	850	7.6	430				Hand Pump
86	Chhatera	21.57065	79.816498	275.29	690	7.3	290				Hand Pump
87	Pulputta	21.581237	79.805994	280	888	7.3	340				Hand Pump
88	Pulputta	21.593379	79.795693	283.87	1280	7.8	640				Hand Pump
89	Hardoli	21.6047	79.770202	293.23	680	7.3	320				Hand Pump
90	HirapurReser viour	21.565377	79.779562	299.59	550	8.1	160				Reservoir
91	Kawlewada (Near Bawanthadhi river)	21.566132	79.804115	283.19	830	7.3	360	6	1.5		Dug well
92	Kawlewada	21.565443	79.806668	284.96	740	7.8	370				Hand Pump
93	Ganodh	21.556435	79.821225	280.44	1160	7.2	580				Hand Pump
94	Tejutekari	21.554654	79.828149	272.35	1580	7.33	800				Hand Pump
95	Shankar Pipariya	21.547736	79.846168	276	2000	7.3	1000				Hand Pump
96	Fulchur	21.561858	79.871117	293.72	2580	7.3	1290				Hand Pump
97	Fulchur	21.562363	79.871388	294.63	910	8.4	350			5.77	Pond
98	Katori	21.5756	79.896254	279.11	1870	7.4	940	4.2	1.5		Dug well
99	Bhandarbodh i	21.588696	79.901293	277.19	890	7.5	320				Hand Pump
100	Murjhad	21.627167	79.935067	285.51	1020	7.4	250				Hand Pump
101	Jhariya tola	21.646052	79.94073	301.22	890	7.4	430				Hand

											Pump
102	Miragpur mine	21.63247	79.832276	344.78	630	8.1	320			5.48	Recharge pit
103	Miragpur Handpump	21.633039	79.83373	348.97	710	7.6	350				Hand Pump
104	Pandharwani Mine	21.628271	79.844225	344.4	300	7.4	150	5	3	3.8	Dug well
105	Pandharwani Mine	21.628271	79.844225	344.4	680	7.3	340			2.44	Hand Pump
106	Pandharwani Mine	21.625276	79.84262	360.09	450	8.3	150			6.9	Recharge structure

S. N.	Location	Latitude	Longitude	Elevation	EC (mS)	pH	TDS (ppt)	Water Level (m)	DO (mg/l)	Type of water body
Buffer Zone										
1	Goorabodi	21.657518	79.870229	343.65	1105	7.5	220		2.5	Hand Pump
2	Goorabodi	21.657518	79.870229	343.56	1250	7.2	300		3.05	Hand Pump
3	Goorabodi	21.66087	79.870203	353.74	740	7.1	370			Hand Pump
4	Salibardi	21.671405	79.877707	336.32	680	6.5	150			Hand Pump
5	Salibardi	21.669789	79.878459	335.46	650	7	250			Hand Pump
6	Chikhla	21.684507	79.905157	328.48	1450	7.2	720			Hand Pump
7	Chikhla	21.682192	79.908152	343.59	530	7.8	260			Hand Pump
8	Paraswadaghat	21.649093	79.820654	328.59	660	7.5	320			Hand Pump
9	Paraswadaghat	21.660558	79.80533	351.76	910	7.8	450			Hand Pump
10	Paraswadaghat	21.664135	79.801919	340.53	2680	7.1	1340			Hand Pump
11	Paraswadaghat	21.66312	79.802876	343.89	3630	6.8	1820			Hand Pump
12	Nandi Gaon	21.684963	79.806272	339.63	600	7.7	300			Hand Pump
13	Nandi Gaon	21.684272	79.810401	339.84	1920	6.9	970			Hand Pump
14	Mohogaon	21.679234	79.823017	339.12	530	7.7	260			Hand Pump
15	Mohogaon	21.678983	79.825131	346.41	1360	7.2	690			Hand Pump
16	Sundergaon	21.68713	79.839619	326.1	720	7.3	360			Hand Pump
17	Sundergaon	21.689001	79.840266	326.3	2640	6.7	1330			Hand Pump
18	Sundergaon	21.685458	79.832651	333.14	890	7.3	440			Hand Pump
19	Nawegaon	21.704839	79.848695	333.17	1590	7.2	790			Hand Pump
20	Tumsar	21.70996	79.865638	332.46	1730	7.2	860			Hand Pump
21	Tumsar	21.710944	79.867237	329.69	1390	7.3	690			Hand Pump
22	Dudhara	21.706201	79.884752	316.42	700	7.2	340			Hand Pump
23	Dudhara	21.704471	79.885074	328.17	760	7.3	380			Hand Pump
24	Dudhara	21.696104	79.889369	314.15	720	7.6	240			Hand Pump
25	Jamkhari	21.695575	79.900478	321.87	1280	7.4	640			Hand Pump
26	Jamkhari	21.694672	79.901208	319.15	1020	7.4	390			Hand Pump
27	Birsula	21.691179	79.828772	334.89	1020	7.4	540			Hand Pump
28	Sitakhor	21.719929	79.81962	340.24	680	7.3	340			Hand Pump
29	**Khoka**	**21.705623**	**79.812121**	**347.08**	**820**	**7.7**	**310**	**145**		**Borewell**
30	Katedara	21.711607	79.796432	340.47	1040	7.2	340			Hand Pump
31	Bothwa	21.697268	79.770729	352.42	1430	7.1	740			Hand Pump
32	Tirodi	21.685706	79.727475	334.49	840	7.4	320			Hand Pump
33	Bamani	21.610979	79.741213	290.99	1600	7	800			Hand Pump
34	Bonkatta	21.609446	79.758254	295.86	1250	6.9	620			Hand Pump
35	Garragussai	21.641741	79.780165	310.59	740	6.9	220			Hand Pump
36	Sadabodi	21.644859	79.760747	305.02	1410	7.2	710			Hand Pump
37	Hatoda	21.631088	79.810027	336.75	550	7.5	220			Hand Pump
38	Pind k Par	21.594223	79.856797	302.82	1050	7.3	460			Hand Pump
39	Pind k Par	21.58805	79.848991	304.45	630	7.4	230			Hand Pump
40	Churiya Par	21.582679	79.834056	285.04	1960	7.5	980			Hand Pump
41	Chhatera	21.568803	79.820107	279.78	850	7.6	430			Hand Pump
42	Chhatera	21.57065	79.816498	275.29	690	7.3	290			Hand Pump
43	Pulputta	21.581237	79.805994	280	888	7.3	340			Hand Pump
44	Pulputta	21.593379	79.795693	283.87	1280	7.8	640			Hand Pump
45	Hardoli	21.6047	79.770202	293.23	680	7.3	320			Hand Pump
46	Kawlewada	21.565443	79.806668	284.96	740	7.8	370			Hand Pump
47	Ganodh	21.556435	79.821225	280.44	1160	7.2	580			Hand Pump
48	Tejutekari	21.554654	79.828149	272.35	1580	7.33	800			Hand Pump
49	Shankar Pipariya	21.547736	79.846168	276	2000	7.3	1000			Hand Pump
50	Fulchur	21.561858	79.871117	293.72	2580	7.3	1290			Hand Pump
51	Bhandarbodhi	21.588696	79.901293	277.19	890	7.5	320			Hand Pump
52	Murjhad	21.627167	79.935067	285.51	1020	7.4	250			Hand Pump
53	Jhariya tola	21.646052	79.94073	301.22	890	7.4	430			Hand Pump
CORE ZONE										
1	Ranimohgaon	21.622631	79.83492	329.12	2210	7.2	1005			Hand Pump
2	Miragpur Handpump	21.633039	79.83373	348.97	710	7.6	350			Hand Pump
3	Pandharwani Mine	21.628271	79.844225	344.4	680	7.3	340		2.44	Hand Pump
4	Miragpur	21.639436	79.840974	349.52	1420	7.5	230		2.38	Hand Pump
5	Miragpur	21.635695	79.838438	363.08	1700	6.8	860		6.54	Hand Pump
6	Miragpur	21.637156	79.837283	355.2	1690	7.2	850			Hand Pump
7	Miragpur	21.638487	79.8347	353.81	650	7.3	320			Hand Pump
8	Pandarwani	21.61232	79.837064	337.82	990	7.2	450			Hand Pump
9	Pandarwani	21.61013	79.842064	341.23	880	7.2	380			Hand Pump
10	Sukdighat	21.648322	79.850303	351.71	1830	7.2	920		2.72	Hand Pump
11	Sukdighat	21.650272	79.852384	346.06	2100	7.1	1000		2.4	Hand Pump
12	Sabargaon	21.641404	79.824406	343.13	1780	6.4	890			Hand Pump
13	Sabargaon	21.644069	79.823462	340.76	2960	6.9	1480			Hand Pump

8. Impact assessment of underground mining of Manganese on Ground Water in and around Pandarwani, MP-

Click to view

Comprehensive Report on:

Groundwater Condition in both core and buffer zoneof Pendharwani Manganese Mine, Khairlangi Block, Balaghat District,Madhya Pradesh

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

hp

M/s D P Rai, Nanhka,10 East High Court Road, Ramdaspet, Nagpur- 440010 Maharashtra, Ph. No 7122522724, Email id: dprai.mines@gmail.com

March, 2022

By MRCAWTM

Comprehensive Report on:

Groundwater Condition in both core and buffer zoneof Pendharwani Manganese Mine, Khairlanji Block, Balaghat District,Madhya Pradesh

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

M/s D P Rai,Nanhka,10East High Court Road, Ramdaspet,Nagpur-440010
Maharashtra, Ph. No 7122522724, **Email id: dprai.mines@gmail.com**

By MRCAWTM - March 2022

Executive summary

An Underground Mine of Manganese Ore of M/s D P Raiis located at coordinate 79°50'38.90"E, 21°37'41.42"Nof village Pandharwani, Balaghat district Madhya Predesh adjacent to the State Maharastra boarder. The mine was established in March 2000.The mine was previously developed as an open cast mine and later approval were obtained for underground mining for ore extraction since July 2018.The present study is made for obtaining and NOC from CGWA for extraction of maximum 41KLD groundwater during mining operation as per the approved mine plan. The mine discharge will remain below 100 KLD during all future expansion of mining operation during next 5 -10 years. The present report is based on the hydrogeological investigation made within core zone and its 10km radius buffer zone for assessment of impact of dewatering of groundwater by the mine and will be submitted to CGWA for obtaining renewal of NOC.

The study area falls under Wanganga river subbasin of Godavari basin and comprises of parts of Khairlangi Block of MP and Bhandara block of Maharastra both falls under safe blocks as per the report on Dynamic Groundwater Resource of India, published by CGWB in 2019-20. The study area is having largely one geological formation, Mansar Group of rocks of Proterozoic quartzite mica schist in the area. These are constituting hard rock aquifer of phreatic nature. The Thickness of aquifer is about 12-17m.The 14.9ha mine lease area is located near water divide and having radiating flow direction, but no river/ stream generates from this area. The av annual groundwater level in the core zone remain 6m bgl in comparison to 5m level of buffer zone.Groundwater quality is fresh and potable in both core and buffer zone area and TDS remains below 1900 ppm varies from 150 to 1900 ppm in the study area.

As per the approved mine plan the dewatering of groundwater maximum 41KLD was obtained but the quantum of water generates as mine discharge remain largely below this limit around 30 KLD to 35KLD ingeneral. The water generated during miningprocess is containing heavy silt load. Thus, three step de-siltation process is maintained before the entire water isreused in maintaining the green belt/horticulture and dust suppressionwithin the ML area and formining operation.Rainwater is harvested within the ML area through construction of water conservation pond. Roof top Rainwater harvesting structure is proposed as per building bylaw. The annual conservation through RWH&AR is about 0.75ham at present and will increase due to construction of rooftop RWH structure.

There is limited long term impact of groundwater dewatering by Pandharwani mine on the study area,Thus the study recommend NOC may be provided for next 5 yr with maximum 41 KLD extraction from groundwater system as mine discharge.

MANAV RACHNA
vidyanatariksha

Acknowledgments and Certificate

Impact assessment and report preparation work as per the CGWA guideline was entrusted to MRCAWTM, Manav Rachna as accredited Groundwater Institution of CGWA by M/s D P Rai Nagpur is thankfully acknowledged.

Discussions with Mr Abhishek Rai, Chairman cum Managing Director, regarding the history of mine establishment and its process of miningof Mn ore has helped us in understanding the process well and plan our investigations according to scope of work is gratefully acknowledged. Help rendered by Shri Ram Narayan Tadhe, Manager & Mr Himanshu, Geologist in every stage of planning and execution, investigations in and around plant area and report preparation is thankfully acknowledged. He also provided all the available relevant data and records many of them are reproduced in this report and forms part of annexure section.

At mine level, during days of field investigation we have received warm welcome and all hospitality and requisite support from mine team. We thankfully acknowledge Sh Tarae Mines Manager and his team for their cooperation.

The report has been prepared by Ms Sheha Rai, Asstt Prof MRCAWTM and Sandeep Kumar RA MRCAWTM under the supervision of Prof (Dr) Arunangshu Mukherjee, Director MRCAWTM. Ms Alifia Ibkar, RA MRCAWTM helped Mr Sandeep Kumar in the field work and data collection.

It is to certify that MRCAWTM have investigated the area of Padharwani Mine Khairlangi Balagahat and based on actual data collected from field and literature survey done, has prepared the report as per the format of CGWA.

(Dr Arunangshu Mukherjee)
Director, MRCAWTM

MR Centre for Advance Water Technology & Management
Manav Rachna International Institute of Research & Studies
(Deemed to be University under section 3 of the UGC Act, 1956)
Sector-43, Delhi – Surajkund Road, Aravali Hills, Faridabad - 121004

CONTENTS

Executive summary
Acknowledgement
Format of Report

LIST OF TABLES

LIST OF FIGURES

Comprehensive Report on Groundwater Condition in both core and buffer zone of Pendharwani Manganese Mine, Khairlangi Block, Balaghat District, Madhya Pradesh

[Report submitted for obtaining NOC form CGWA under Section 5 of the Environment (Protection) act, 1986 (29 of 1986) as per the new notification no 2941 of 24th Sept 2020]

Format for Impact Assessment Report as per the CGWA Norms

S No	Point of Report	Reply Enclosed
[1.]	Brief about the proposed project giving location details, coordinates, google/ toposheet maps, etc. demarcating the project area	**Yes** [Chapter-1]
1.1	*Land Use Land Cover of the surrounding area, Percentage of LULC categories*	**Yes**
1.2	*Topography and drainage.*	**Yes**
1.3	Details of wetlands [Highlight protected wetlands / Ramsar sites / NLCP lakes/ other important wetlands in terms of dependencies of local communities if any]	**Yes**
[2]	Ground water situation in and around the project area including water level and quality data and maps along with quality issues, if any. In case of mines, ground water conditions in both core and buffer zone should be described.	**Yes** [Chapter-2]
2.1	Brief geology of the area	**Yes**
2.2	Hydrogeology of the area	**Yes**
	2.2.1 Aquifer description [type, depth, storativity, permeability and porosity]	**Yes**
	2.2.2 Ground water flow and aquifer interaction [flow direction, Ground water – surface water connectivity]	**Yes**
	2.2.3 Ground water level trend analysis [pre – monsoon and post – monsoon] for 10 years	**Yes**
	2.2.4 Hydrograph of the water level for 10 years	**Yes**
	2.2.5 Predicted water level declines for affected aquifers [Ground water modeling]	**Not Required** as per norms
	2.2.6 Ground water quality [pre - monsoon and post – monsoon]	**Yes**
	2.2.7 Water quality of nearby water bodies	**Yes**
[3.]	Details of the tubewells/ borewells proposed to be constructed. This includes the aquifer parameters, drilling depth, diameter, tentative lithological log, details of pump to be lowered, H.P. of pump, tentative discharge of tubewells/ borewells, etc. Locations to be marked on thesite plan/ map.	**Yes** [Chapter-2]
[4.]	Details of Geophysical studies carried out in and around the project area. Ground water resources computation of the block in which the project falls	**Yes** [Chapter-4]
	4.1 Results of Geophysical analysis [vertical electrical sounding (VES), horizontal profiling and imaging, transient electromagnetism method (TEM)] etc	**Yes**
[5.]	Approved Mine plan in case	**Yes** (Chapter-5)
	5.1 Year wise mine plan including excavation depth, area and mine seepage.	**Yes**
[6.]	Proposed usage of pumped water in case of infrastructure dewatering projects.	**Yes** (Chapter-6)
6.1	*For drinking, irrigation etc.*	**Yes**
6.2	*Recharge*	**Yes**
6.3	*Runoff to stream*	**Yes**

6.4	*Benefitted area*	**Yes**

SNo	Point of Report	Reply Enclosed
6.5	Dust suppression, Green belt development etc	**Yes**
[7.]	Comprehensive assessment of the impact on the ground water regime in and around the project area highlighting the risks and proposed management strategies proposed to overcome any significant environmental issues.	**Yes** [Chapter-4]
7.1	Impact on surface water sources	**Yes (Chapter – 7)**
7.2	*Impact on groundwater sources*	**Yes**
	7.2.1. A description of the impacts on environmental values that have occurred, or are likely to occur, because of any past ground water abstraction.	**Yes**
	7.2.2 An assessment of the likely impacts on environment that will occur, or are likely to occur, because of the ground water abstraction for a five years period starting on the consultation day for the report; and over the projected life of the resource project area, affected area and radius of influence in case of dewatering	**Yes**
7.3	*Socio-Economic Aspects:*	**Yes**
	7.3.1 Settlements and population dynamics around project area	**Yes**
	7.3.2 Dependency on sources of water [surface or sub-surface]	**Yes**
	7.3.3 Ground water uses [e.g. irrigation (irrigation method, number of watering) water supply etc.]	**Yes**
	7.3.4 Improvement / decline in agricultural yield in last 5 years and likely impact after NOC	**Yes**
	7.3.5 Impact of proposed / existing project on local communities [based on local interactions (interactions must be with stakeholders like fishermen community,farmers etc.]	**Yes**
[8.]	Proposed measures for disposal of waste water by industries drawing saline water.	**Not Applicable**
[9.]	Measures to be adopted for water conservation which includes recycling, reuse, treatment, etc. This includes the water balance chart being adopted by the firm along with details of water conservation methods to be adopted.	**Yes** [Chapter-3]
	Brief write up along with capacity and flow chart of Sewage Treatment Plants / Effluent Treatment Plants / Combined Effluent Treatment Plants existing/ proposed within the project.	**Yes**
	Details of water conservation measures to be adopted to reduce/ save the groundwater.	**Yes**
	- Total water balance chart showing the usage of water for various processes.	**Yes**
[10.]	Any other details pertaining to the project.	Annexure (s)

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Report on:

Hydrogeological Investigation and Impact Assessment Report for Pandharwani Manganese Ore Mine Balaghat District, MP

1. Introduction

The report is prepared as per the format prescribed by the CGWA for impact assessment study of Mining, the Introductory chapter comprises the following subtitle for describing its

1.1 Objectives
1.2 Scope of the study
1.3 Project Description-Mine, product and location
1.4 Land Use Land Cover and percentage of LULC categories
1.5 Topography and drainage
1.6 Details of wetlands

1.1 Objective

The Central Government had constituted the Central Ground Water Board as Authority vide notification number S.O. 38 €, dated the 14th January,1997 to exercise powers under sub section (3) of section 3 of the Environment (Protection) act, 1986 (29 of 1986) for the purposes of regulation and control of Ground Water Management and Development. The Authority has been regulating ground water development and management by way of issuing 'No Objection Certificates' for ground water extraction to Industries or Infrastructure projects or Mining Projects etc., and framed and issued guidelines in this connection from time to time. The entire process of grant of No Objection Certificate (NOC) shall be online through a web based application system. The latest guideline issued by Gazette Notification no 2941 on24th September 2020 supersedes all earlier guidelines issued by the Central Ground Water Authority (CGWA). CGWA vide email dated [2]1st Nov 2020 and [1]3th Jan 2021 instructed the M/s D.P. Rai, Nagpur, Mahrashtra to submit Impact assessment report along with undertaking for processing their application for regularization of groundwater abstraction for mining. There by M/s D.P. Rai, Nagpur, Mahrashtra engaged the MRCAWTM, CGWA Accredited Groundwater Institution (Certificate No.-CGWA/RGI/025)vide work order dated 30th Dec 2021 to carry out the hydrogeological investigation along with impact assessment study incorporating socio-economic assessment study on groundwater regime due to withdrawal/ dewatering of groundwater by **Pandharwani Manganese Ore Mine**, **Balaghat** of M/s D.P. Rai, Nagpur, Mahrashtra as per the prescribed format of CGWA.

1.2 Scope of Study

The scope of study includes hydrological study around mine and providing certificated report along with providing guidance on techno-legal aspects and compliance for obtaining NOC for CGWA as per latest guidelines.Detailed hydrogeological investigations within core and buffer zones (10km radius study area) of**Pandharwani Manganese Ore Mine** , **Balaghat**leased toM/s D.P. Rai, Nagpur, Mahrashtra and assessment of impact of mining on groundwater regime in the study area which covers parts of Khairlanji block/tehsil, Balaghat district of Madhya Pradesh and some villages of Bhandra district, Maharashtra.As the mine is generating only 41m3/day discharge thus groundwater modeling is not required along with impact assessment report for this case as per the CGWA guideline.

1.3 Project description

M/s D.P. Rai, Nagpur, is a partnership firm registered under Indian Partnership Act, 1932. Pandharwani Manganese ore mine is engaged in the mining activities since decades.Presently mining is throughunderground method. The total lease area of Pandharwani Mine is 14.99 ha. and having approved mine plan (MP/Balaghat/Manganese/RMP83/17-28 4659 Jabalpur dated 26/04/2018) valid- from 2018-19 to 2022-23.The ore body exist between 225-209 MRL at an av. depth of 125m from surface. Ore body width ranges between 10-12m in general. However, in SW direction at 265 MRL and 250 MRL in ore drive, the width has increased to 20 m width over a strike length of 50m before it terminates and plunges. The explored strike length of ore body is 200m.The firm is well equipped with tools qualified personnel and required plans. The annual production of ore is 10000 Tons. Mn % in ore ranges between 23 and 36%.

Location

Pandharwani Manganese Ore Mine is located inPandharwani village, Tehsil Khairlanji, District Balaghat, Madhya Pradesh. Pandharwani village is situated in the south west portion in Balaghat district, Madhya Pradesh. The study area falls under survey of India toposheet no F44N14. Pandharwani mine is situated 50km from Balaghat Town and 25 km from Khairlanji tehsil headquarters and 130 km from Nagpur railway station.Mining lease area is surrounded by the agriculture land and small hillocks of weathered soil. Many shallow depths abounded open cast mines pits are present within the study area. The opening of Pandharwani underground mine is located at coordinate 21°37'41.8"N 79°50'39.2"E (**Fig1.1**). The lease area of underground mine is not located within 10km radius of National Park /Wild Life Sanctuary / Protected area and don’t falls under Coastal Regulation Zone (CRZ).

1.4 Land use and Land cover (LULC) change in the study area:

The total lease area of the Pandharwani UG mine is 14.9 ha (14900 m²) having a perimeter of 1144m. The mine is situated in outer part of the Pandharwani village surrounded by hills and forest area. The land use of the mining area is given in **Table no 1.1** and the percentage has been represented through a pie diagram in **Fig 1.2**. The nearest village is Jatapur Khappa located 0.8 km away from Pandharwani mine. Around 40 villages are located under 10km radius zone of the study area. (Annexure-1).

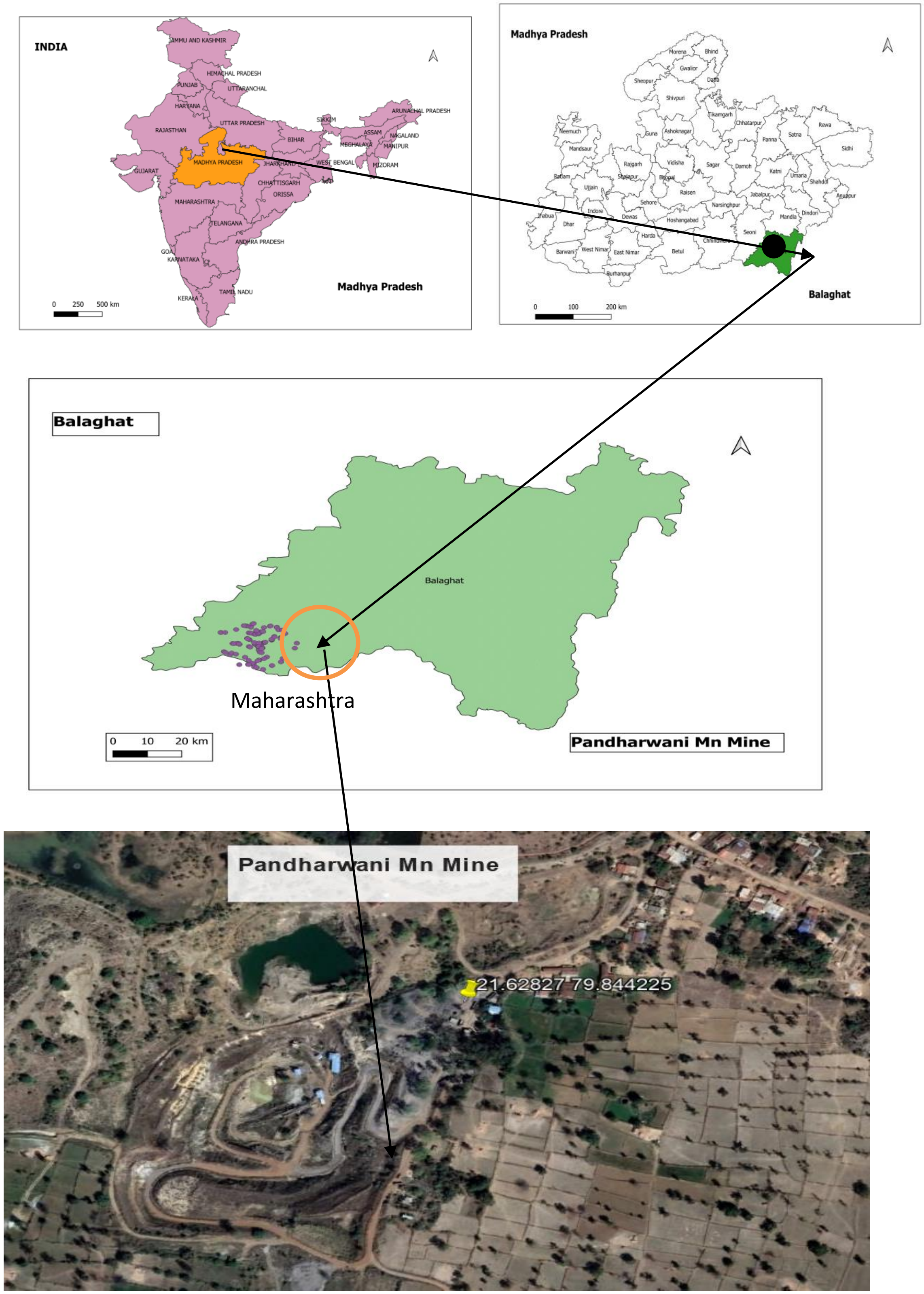


Fig 1.1: Location map of study area and Pandharwani Mn Mine, Balaghat district, MP

Comparison of LULC during 2015 and 2021 within the 10 kms radius of mine area show marginal changes in agriculture use, forest cover, built up area, as shown in figs and tables -1.2 & 1.3, however area under water body has increased from 60 ha to 124 ha due to accumulation of water into someabandon mine pitsand due to construction of water conservation structures in the area.

Fig 1.2: Google image showing Pandharwani Mn Mine

Table 1.1 LAND USE BREAK UP OF PANDHARWANI MINE			
Sl No.	**Area description**	**Area (m²)**	**Percentage %**
1	Area under mining	49700	69.57
2	Mine pit	3108	4.35
3	Infrastructure (Office & staff quarter)	1950	2.72
4	Green area	2362	3.30
5	Paved area and passage	10000	13.99
6	Waste dump site	1463	2.04
7	Mineral storage	2846	3.98
	Total	**71429**	**100**

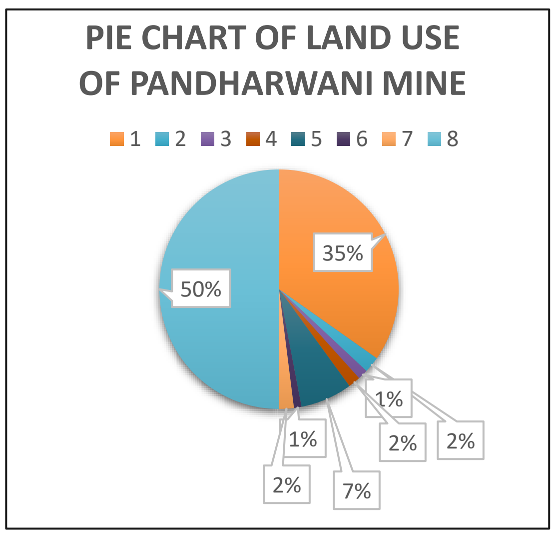


Fig 1.3: Pie diagram of land use in Pandharwani mine.

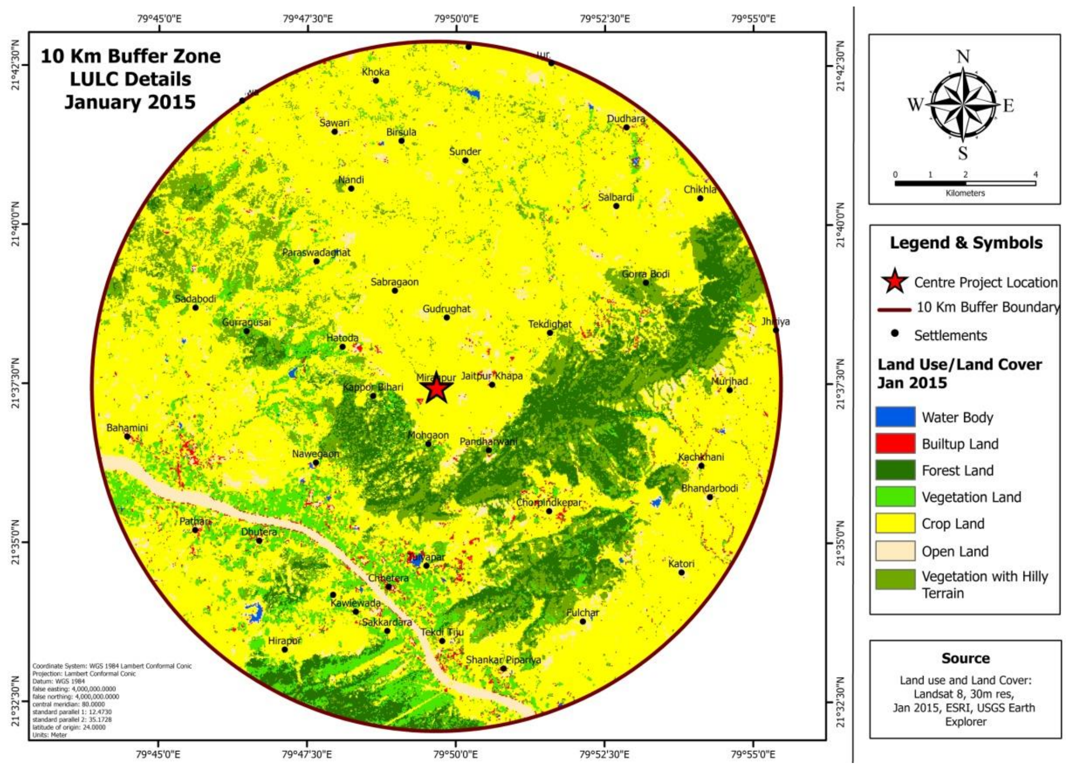


Fig 1.4: Map showing LULC of Pandharwani Mn Mine of 10km buffer zone (Jan 2015)

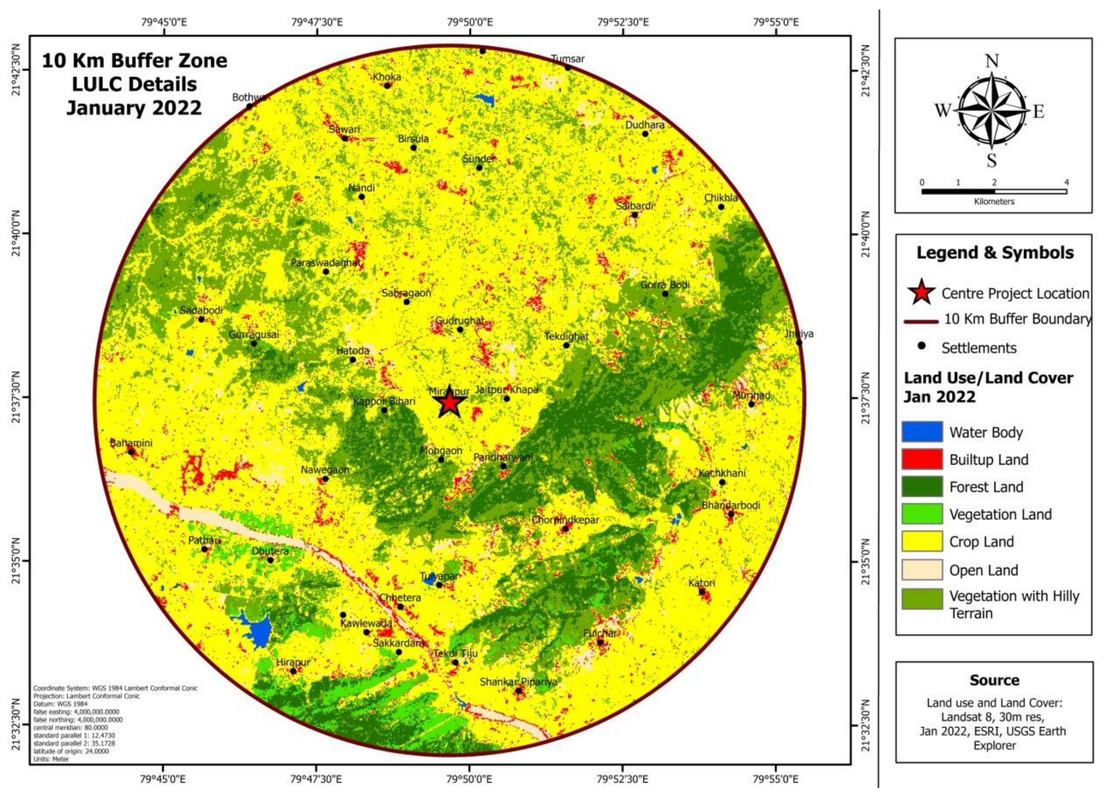


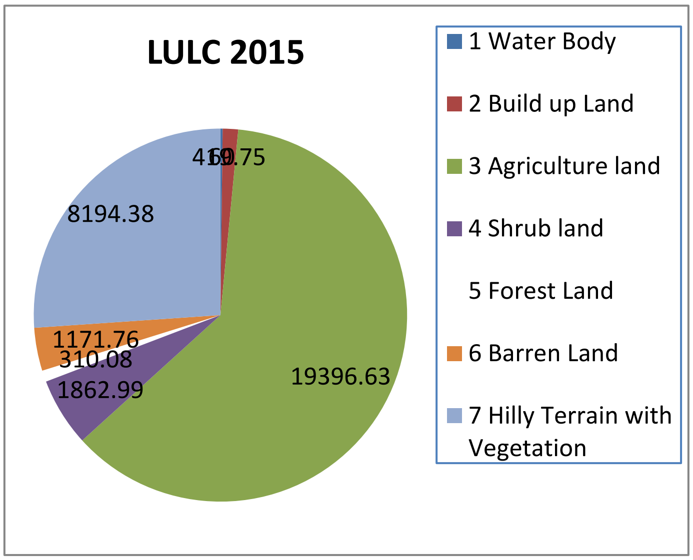
Fig 1.5: Map showing LULC of Pandharwani Mn Mine of 10km buffer zone (Jan 2022)

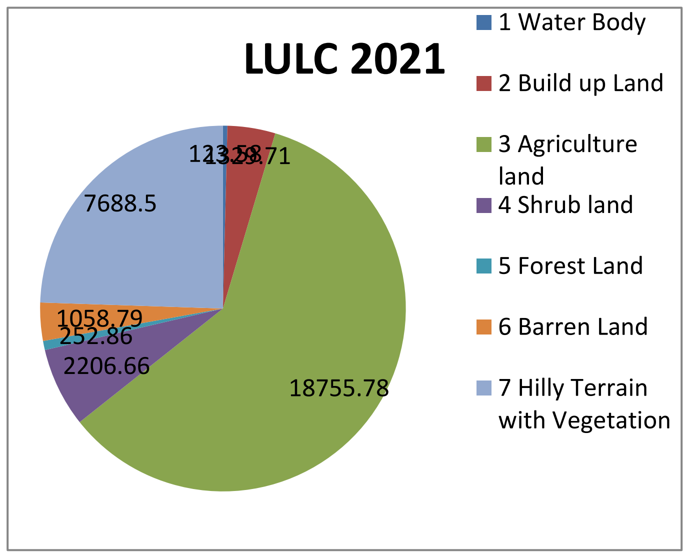
Table 1.2 LULC 2015 of Study Area

Sr.no	LULC Type2021	Area (Ha)
1	Water Body	123.58
2	Build up Land	1329.71
3	Agriculture land	18755.78
4	Shrub land	2206.66
5	Forest Land	252.86
6	Barren Land	1058.79
7	Hilly Terrain with Vegetation	7688.5
Total Area (10km Buffer zone)		**31415.88**

Table: 1.3 LULC 2021 of Study Area

Sr.no	LULC Type 2015	Area (Ha)
1	Water Body	60
2	Build up Land	419.75
3	Agriculture land	19396.63
4	Shrub land	1862.99
5	Forest Land	310.08
6	Barren Land	1171.76
7	Hilly Terrain with Vegetation	8194.38
Total Area (10km Buffer zone)		**31415.59**





1.5 Topography and Drainage:

The Pandharwani mine belongs to Mansar Formation of Sausar Series. The Terrain is almost flat having some exposed rocks. The highest elevation is 466m amsl and lowest elevation is 267m amsl.The digital elevation model presented in Fig 1.6. The gradient of the study area has been measured by remote sensing data using elevation map in Fig 1.7. The western part and southern half of study area having southerly slope whereas the central (including mine area) and northeastern part having northeasterly slope. The area south of Bawanthadi river is having northerly slope.

Drainage:

There is no water body and Nallah in the lease area. At a distance of 8km NW direction a seasonal river called Bawanthadi flows in E-W direction. Bawanthadi is a tributary of river Wainganga of Godavari basin. Wainganga river entering Balaghat district from its Northwestern part from the Seoni district, creates the boundary between Sehoni and Balghat district and flowing south through the lowlands, it enter the Bhandara district. The Rajiv Sagar (Bawanthadi) interstate irrigation project, between the states of Madhya Pradesh and Maharashtra, envisages construction of a dam across river Bawanthadi. It has been constructed near village Kudwa in Katangi Tehsil of Balaghat district, M.P. and village Sitekasa of Tumsar Tehsil of Bhandara district, Maharashtra.

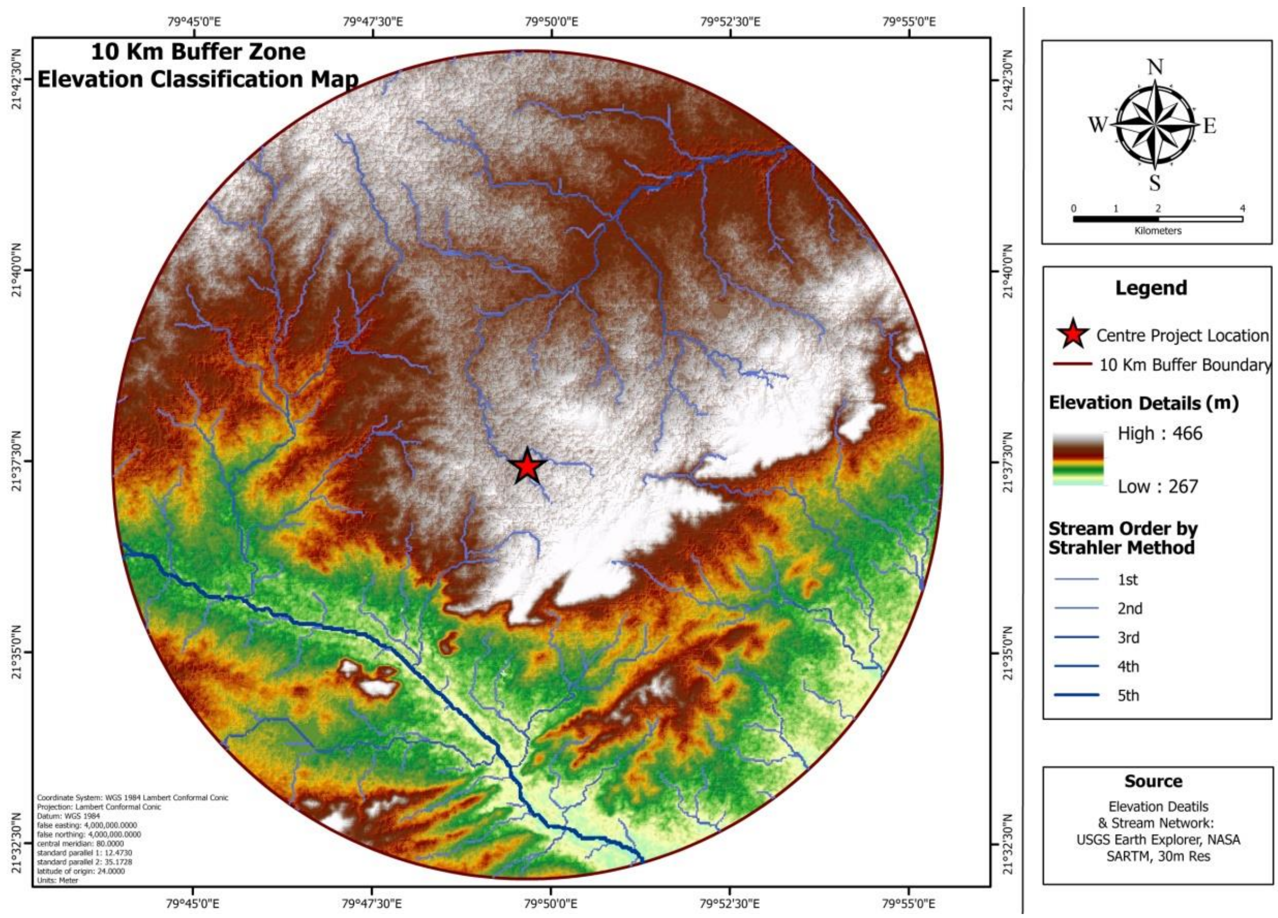


Fig 1.6: Digital elevation map in 10km buffer zone

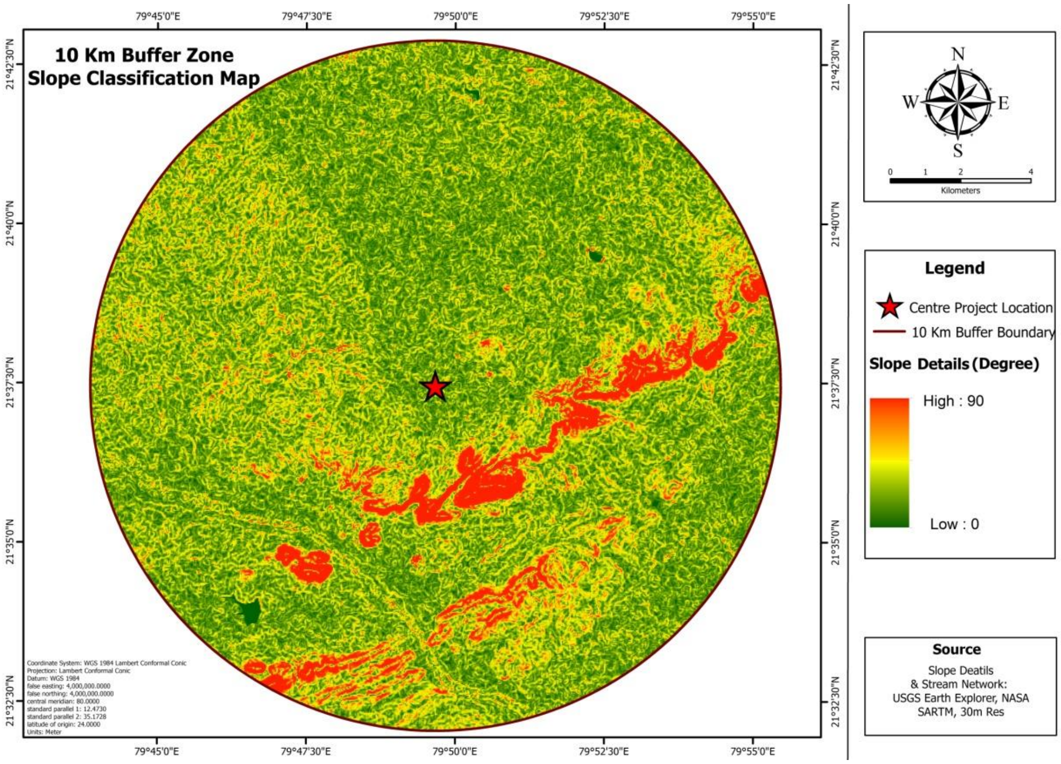


Fig 1.7: Slope map of Pandharwani Mn mine in 10km buffer zone

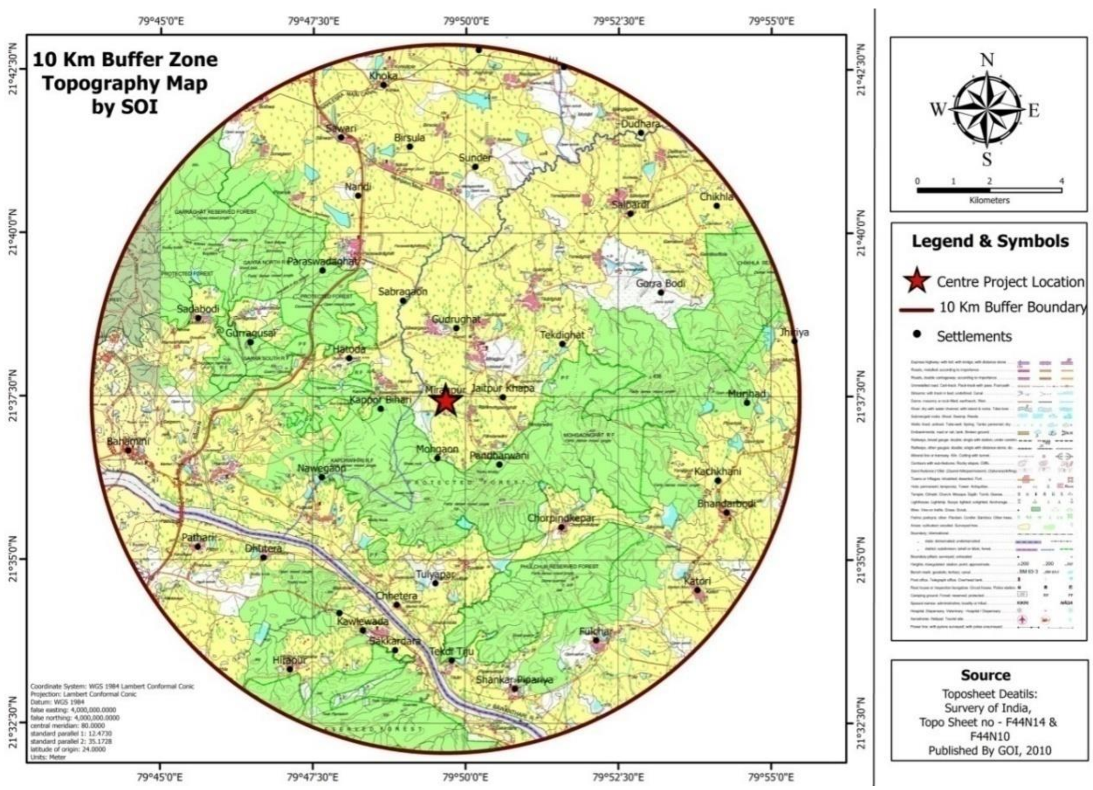


Fig 1.8: Topography Map of 10km buffer zone

2. Groundwater Situations

Large part of the study area belongs to Khairlanji block which is located in Southwestern part of Balaghat District Madhya Pradesh. Ground water is the main source of drinking as well as domestic purpose. However, the requirement of water in irrigation and agriculture is fulfilled mainly by river as well as rainwater. The rainwater also is the main source for recharge of groundwater of the area. The following major subtopics that are covered in this particular chapter are:

2.1 Geology and Geomorphology
2.2. Climate and Rainfall pattern
2.3 Groundwater regime monitoring
2.4 Long term groundwater trend
2.5 Groundwater resources
2.6 Groundwater quality

2.1. Geology and Geomorphology

Manganese deposit of Madhya Pradesh – Maharashtra belongs to Sausar Group of rocks, displayed in accurate shape band which runs over 200 km. from Ukwa in M.P. to Kachidhana via Tumsar-Bhandara& Nagpur dist. of Maharashtra. Mansar Formation of Sausar Group is folded and re-folded and thrusted by many cycles of deformations. Sausar sequence is rested over rocks of Gneissic complex with unconformity. Dolomites, Limestone, Mica Schist, quartzite, Biotite Granulite are the rock types associated with this series. Mica Schist, quartz mica schist along with Manganese have been made exposed in mine area by previous opencast activities. Mica Schist is coarse to fine grain rock with fish skin luster. .

Geological Formation in the Study area

- Alluvium Soil
- Mica Schist with Quartzite
- Manganese ore with Gondite
- **Alluvium soil:** On the basis of field study it has been observed that the lateritic soil is found with brown to red color. The average thickness of the soil is cover is 3m in study area.
- **Mica Schist with Quartzite:** It has been observed that the formation in the study area is trend in ENE-WSW and the trend of Manganese ore body is NNW-SSW. Mica Schist is coarse to fine grained with fish skin luster. Mica Schist is crenulated, filled with needles of stretched vitreous quartz. Quartz associated with schist is thick vitreous but crushed at places due to deformation.
- **Manganese ore with Gondite**: Manganese ore in Pandharwani mine belong to Mansar Formation.Manganese ore is dark steel grey with Braunite as principal mineral associated with other oxide and silicate. Thetrendof themanganeseore deposit is mostly NNE-SSW and the angle of dip is varying from about 75° to 80°.

The manganese deposit of the Balaghat district, M.P., founds as NNE-SSW to ENE-WSW trending conformable bands in the form of lenses of varying sizes, enclosed within the metasedimentary sequence of Sausar Group of rocks of Precambrian age (Banerjee, et. al. 2007). The Madhya Pradesh-Maharashtra manganese belt is the largest manganese ore deposits of India which are intensely deformed and metamorphosed varies from green schist facies to upper amphibolite facies with gradual increase in the grade of metamorphism from East to West The regionally metamorphosed syngenetic sedimentary bodies of manganese ores in the Sausar Group of Balaghat district, Madhya Pradesh exhibit a definite trend in the formation and transformation of manganese oxide phases with progressive metamorphism. A regional trend is clearly noticeable from the paragenesis of Ore minerals in the manganese ore bodies from different metamorphic zones. Braunite forms at a very low temperature, appearing in the chlorite zone of regional metamorphism, and it continues in stable form right up to the sillimanite zone. Bixbyite as a high temperature mineral appears first in biotite zone and also appears in the sillimanite and almandine zone in the Balaghat

Stratigraphic succession of Sausar Group

(Bandyopadhyay, et. al., 1995,)

FORMATION	LITHOLOGY
Bichua Formation	Dolomite, Marble, Calc silicate gneiss schist.
Junewani Formation	Metapelite (Mica Schist), Quartzite, granulite, biotite-Gneiss (Reworked basement).
Charboli Formation	Quartzite, feldspathic Schists, Gneisses, Autoclastic Quartz, Conglomerate.
Mansar Formation	Metapelite (mica-schists and gneisses), graphitic Schists, Phyllite quartzite, major manganese deposits and gondite.
Lohangi Formation	Calc-Silicate Schists and gneisses, marble, Manganese deposits.
Sitasaongi Formation	Quartz mica Schists, Feldspathic Schists, mica gneiss, Quartzite, Conglomerate.
Tirodi Gneiss	Biotite gneiss, Amphibolite, Calc-Silicate Gneiss (Tirodi Gneiss), Granulites, Mica Feldspathic Schists.
----------Unconformity----------	
Older Metamorphics	Charnockite, Orthogneisses and Granite Biotite Gneisses, hornblende Gneisses, Amphibolites and calcgranulites

Geomorphology: Morphologically the area having Alluvial plains, intermonnate valleys, denudational hills and peneplains. Natural levees can be seen in the bank of Bawanthadi river. Strems are showing dendritic pattern, drainage density is modarate.

Climate and Rainfall:

The mining area is situated in Khairlanji block of Balaghat district, but the study area covers the southwestern part of Balaghat district and northern part Tumsar block of Bhandara district in Maharashtra State, India. The nearest Meteorological station is at Satona (Hydromet Division, IMD), which is located around 60 kms from the study area. Therefore, the data collected from IMD Satna and from the state data of Madhya Pradesh and Maharashtra have been considered to discuss the climate and rainfall of the study area (**Table 2.1 to 2.4**)

Winds

The wind velocity is higher during the pre-monsoon period as compared to post monsoon period. The maximum wind velocity 7.7 km/hr observed during the month of June and minimum 3.9 km/hr during the month of December.

Temperature

The Climate of the district is sub- tropical or moderate characterized by a hot summer and general dryness except during the southwest monsoon season. The cold season usually begins from the month of December and continues to February. December is the coldest month with mean minimum temperature of around 8◦C The winter is followed by the summer season which starts from March and continues to the middle of June having mean daily maximum temperature of 43◦C in the month of May. The period from the middle of June to September is the southwest monsoon which is followed by the post monsoon or transition period in the months of October and November.

Humidity

The relative humidity is maximum during the southwest monsoon which ranges between 70-75%, it is comparatively drier in the rest of the year. The driest part of the year is the summer season, when relative humidity is less 34%. May is the driest month of the year. As per the geographical position, the study area is located in hot tropical, the daily maximum temperature ranging from 30°C to 40°C. Due to the high temperature, the loss of moisture through evaporation is considerably high. During monsoon period the net evaporation is less than the precipitation, resulting in surplus water which is lost either surface runoff or recharge of groundwater.

Rainfall

Rain fall is the major source of the water of the area is discussed. The area is characterized by semi-arid type of climate, which is mainly having moderate dryness except during the monsoonal months. The normal annual rainfall of Balaghat district is 1471.6 mm. Balaghat district receives maximum rainfall during southwest monsoon period i.e. June to September and a very little rainfall during north-east monsoon (October to December). in the wake of thunderstorms and western disturbances. Thus, surplus water for ground water recharge is available only during the southwest monsoon period.

Table 2.1 Decadal Rainfall in Balaghat District (Source: WRIS online portal) 2011-2020

Year	Actual Rainfall (mm)	Deviation (%)	Year	Actual Rainfall (mm)	Deviation (%)	Average Rainfall (mm)
2011	1131.59	-1.69	2016	1055.89	-8.27	1151.14
2012	1067.65	-7.25	2017	908.02	-21.11	
2013	1481.32	28.68	2018	1036.58	-9.95	
2014	1154.34	0.27	2019	1263.39	9.75	
2015	1018.4	-11.53	2020	1394.22	21.11	

Table 2.2 District wise average Annual Rainfall of and Departure(%) from Normal rainfall					
District	Normal rainfall (mm) 1980-2010	Average rainfall (mm) 2011-2020	Actual rainfall (mm) 2021	Departure (%) in 2021 from Normal Rainfall	Departure (%) in 2021 from Average Rainfall
Balaghat	1471.6	1151.14	1062.69	-27.7	-7.03

Table 2.3-Monthly rainfall of 5 years in mm

Year	January		February		March		April		May		June		July		August		September		October	Nov	Dec	
	Rain fall	% Dep.	Rainfa ll	% Dep.	Rainf all	% Dep.	Rain fall	% Dep.	Rainf all	% Dep.	Rainfal l	% Dep.	Rainfal l	% Dep.	Rainfall	% Dep.	Rainfall	% Dep.	Rainfall			
2013	18.4	-37	5.8	-71	37.4	220	6.4	36	2.6	-52	124.1	0	800.6	155	276.3	-16	195.1	7	4.9			
2014	0		0	-100	34.2	192	24.2	415	25	363	53.8	-57	378.7	20	209.6	-36	50.2	-72	3.6			
2015	0		71	253	21.6	85	0.6	-67	1	-81	145.1	17	146.9	-53	176.4	-46	172.9	-5	0			
2016	0.9	-97	8.5	-58	0.3	-97	3	-36	7.7	43	205.5	65	206.9	-34	212.5	-35	101.1	-44	4.1			
2017	12.9	-59	0		1.4	-88	3.8	-19	14.5	169	25.8	-79	207.6	-34	192.5	-42	152	-16	220.4			
Avg.	6.44		17.06		18.98		7.6		10.2		110.9		348.14		213.46		139.26		46.6	12.6	1.76	932.9

Table 2.4 Average Monthly Meteorological Data of study area (source: IMD)

Month	Temperature (° C)		Rel. Humidity (%)		Vapour Pressure (hpa)		Mean Wind Speed (Km/hr)	Average Rainfall (mm) (2012-16)	Cloud Amount (oktas)	
	Min.	Max.	Morning	Evening	Morning	Evening			Morning	Evening
January	4	29.2	60	48	10.15	10.1	4	6.44	1.2	1.3
February	6.6	33.1	51	37	10.95	10.8	5.6	17.06	1	1
March	11.4	38.6	41	27	11.36	10.5	5.8	18.98	1.1	1.2
April	16.9	42.6	34	22	12.9	12.7	7.5	7.6	1.2	1.5
May	22.3	45	45	26	18.6	14.9	7.6	10.16	1.3	1.4
June	23.1	41.8	59	49	25.7	24.5	8.1	110.86	4	4.6
July	22.8	37	79	71	28.9	29.8	7.9	348.14	5.8	5.8
August	22.4	33.5	80	72	29.7	28.9	7.1	213.46	5.7	5.9
September	21.6	33.8	79	71	27.9	27.8	6.9	139.26	4.3	5
October	14.1	33.7	67	60	21.8	22.3	4.5	46.6	2.3	2.4
November	8	31.8	56	51	16.3	14.1	3.3	12.6	1.3	0.9
December	5	29.5	59	45	10.8	10.5	3.8	1.76	1	1

2.2 Groundwater regime monitoring

The study area comprises 10km radius zone in Pandharwani Manganese mine that fall largely under Khairlanji block, Balaghat district, Madhya Pradesh and partlyin Tumsar Tehsil of Bhandara district, Maharashtra.Detailed hydrogeological study of both core zone and buffer zone of mine area is carried out. The study area having single aquifer formed in hard rock comprise Quartz Mica Schist.. Total groundwater extraction from the Pandharwani mine is 41KLD is through pump. Dug well are used for drinking and domestic purpose.

2.2.1 Detailed study of core and buffer zone

Major source of the water in the study area is south-west monsoon and very small contribution from north- east monsoon during winter. As per the field study it has been observed that in the study area groundwater is withdrawal from dug well **(Fig 2.1**) and hand pump. Most of dug wells in study area having depth 4 to 8 m ground water. It varies during summer between 5m to 10m and 2.5m to 6.0m in winter. It has been observed that the borewells are often 20 to 40m in depth. Ground water is lying in weathered part of hard rock aquifer. Hard rock's comprise in the study area is Sausar sequence rested over rocks of Gneissic complex with unconformity. Dolomites, Limestone, Mica Schist, quartzite, Biotite Granulite are the rock types associated with this series. The movement of the ground water in deeper rocks is controlled by the nature, size opening and continuity of joints & fracture present in them. Wells in hard rock generally yield 50 to 70 m3 /day of all the rock types. Schist, Phyllite and their variants form very poor aquifers yielding 10 to 30 m3 /day for heavy drawdown. Well inventory of study area in Pre Monsoon (Feb 2022) period showing water level varies within the range from 1.4 m to 8m bgl **(Table 2.5).**

Fig 2.1 Dug well in the core zone of Pandharwani mine near crusher zone

Table2.5: Well inventory data of Dug wells of Core and buffer zone of Pandharwani Mine

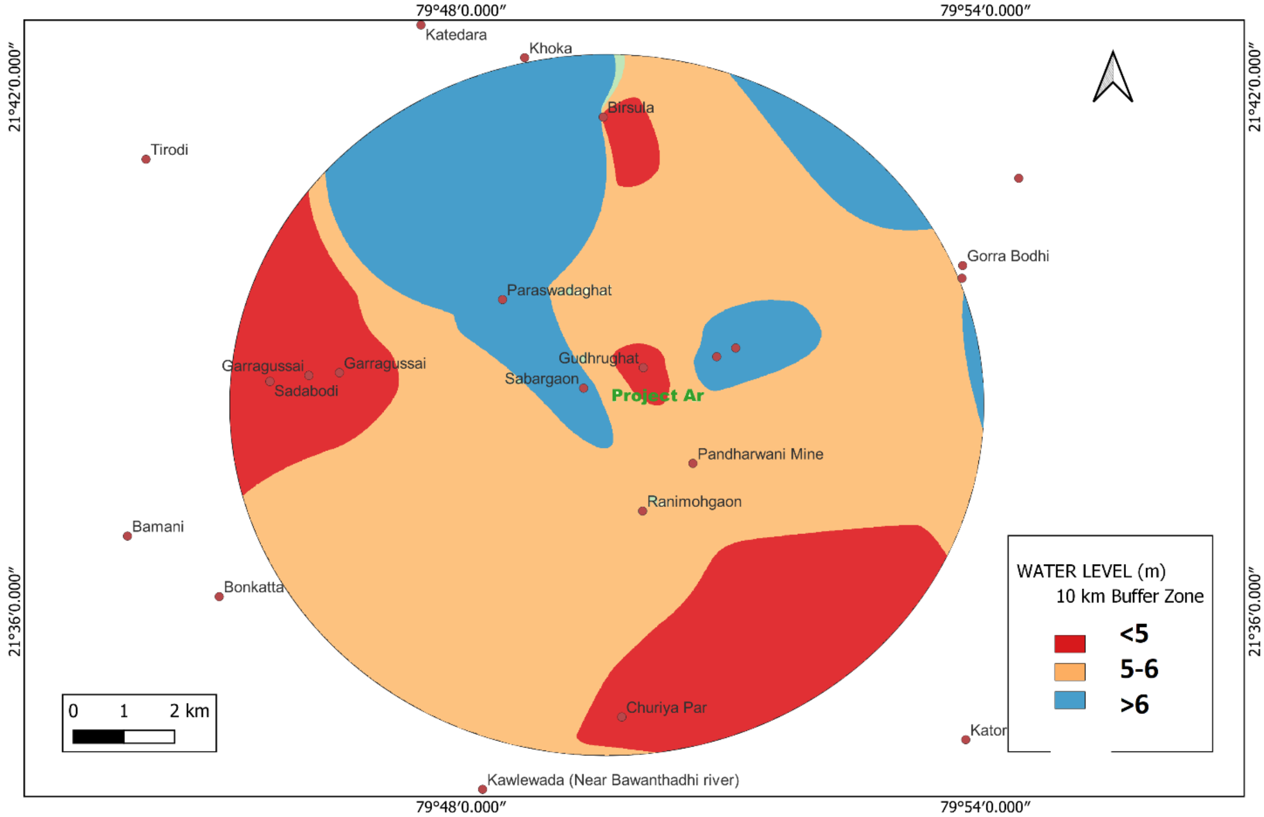
(Lat & Long data are as per GPS reading, DO, EC, pH, and TDS measured on site using calibrated Hanna portable equipment during Feb 2022).

S. N.	Village	Latitude	Longitude	Elevation (m amsl)	Water Level (m)	Diameter (m)	Depth (m)	DO (mg/l)	EC (µS)	pH	TDS (ppm)
Core Zone of Mine											
1	Sukdighat	21.64861	79.848755	342.09	7	2.7	8.5	4.53	1560	7.2	650
2	Sukdighat	21.64824	79.851071	353.48					2550	7.3	1230
3	Sukdighat	21.65027	79.852384	346.06	6.7	2.5	8.75		1990	7.8	1050
4	Pandharwani Mine lease	21.62827	79.844225	344.4	5	3	9.25	3.8	300	7.4	150
5	Ranimohgaon	21.61919	79.834619	329.81	6	2	8.25	4.03	1050	7.5	510
6	Gudhrughat	21.64652	79.834762	340.56	4.2	1.5	8.50	5.3	580	7.9	280
7	Sabargaon	21.64262	79.823377	342.44	6.5	2	9.0	2.6	3800	6.8	1900
8	Paraswadaghat	21.65951	79.807917	338.8	7	2.5	9.9	7.2	1005	7.3	520
Buffer Zone of Mine											
9	Birsula	21.6943	79.827105	351.11	4.5	2	8.0		1080	7.7	560
10	Sitakhor	21.71768	79.816533	341.65	5	2	8.60		540	7.4	260
11	Katedara	21.71186	79.792357	342.87	4	1.5	7.55		880	7.5	440
12	Tirodi	21.68626	79.739922	332.9	4.5	2	8.0		720	7.1	310
13	Bamani	21.61442	79.736391	306.33	3.5	2	7.0		820	7.1	444
14	Bonkatta	21.60287	79.753879	286.6	6	1.4	8.25		910	7.1	440
15	Garragussai	21.64557	79.776808	301.68	4.3	2.1	7.85		1111	6.7	560
16	Garragussai	21.64505	79.770978	306.13	5.1	2	6.8		1720	7.2	900
17	Sadabodi	21.6439	79.763553	309.29	4.4	1.5	8.25		1360	7.4	680
18	Garragussai	21.64269	79.779196	307.21					710	8	190
19	Churiya Par	21.57994	79.830656	296.62	4.5	1.5	8.55		1050	7.5	490
20	Kawlewada (Near Bawanthadhi river)	21.56613	79.804115	283.19	6	1.5	8.8		830	7.3	360
21	Katori	21.5756	79.896254	279.11	4.2	1.5	7.90		1870	7.4	940
22	Gorra Bodhi	21.66599	79.895665	331.16	4.8	2	9.0	4.2	680	7.4	320
23	Chikhla	21.66357	79.895535	333.95	6	2.8	8.5	2.05	1220	7.5	620
24	Chikhla	21.68264	79.906358	332.58	8	2	9.5	3.61	1910	6.9	960

Fig 2.2: Map showing study area divided by state boundary of Madhya Pradesh and Maharashtra. Note the location of Pandharwani Mn Mine at center and position of other villages on google image along with prominent roads. Inventory of wells of these villages are carried out under groundwater regime monitoring.

Fig 2.3: Key map showing Tube well, Dug well and Handpump locations within the mine area (green color) of Pandharwani Mn Mine on google image and photo graph of measuring groundwater parameter**.**

Fig 2.4 DTW map of core and buffer zone of Padharwani Mine area



Groundwater Flow: The groundwater contour map generated using the intense monitoring in core and buffer zone of mining is depicted in **Fig 2.5.**The map showing clear cut development of groundwater dived running through the mine area. The GW flow direction largely coincides with the surface water flow direction as shown in fig 1.6. Thus mine is on groundwater divide and any dewatering from mine will not effects significantly the flow direction of groundwater of the area.

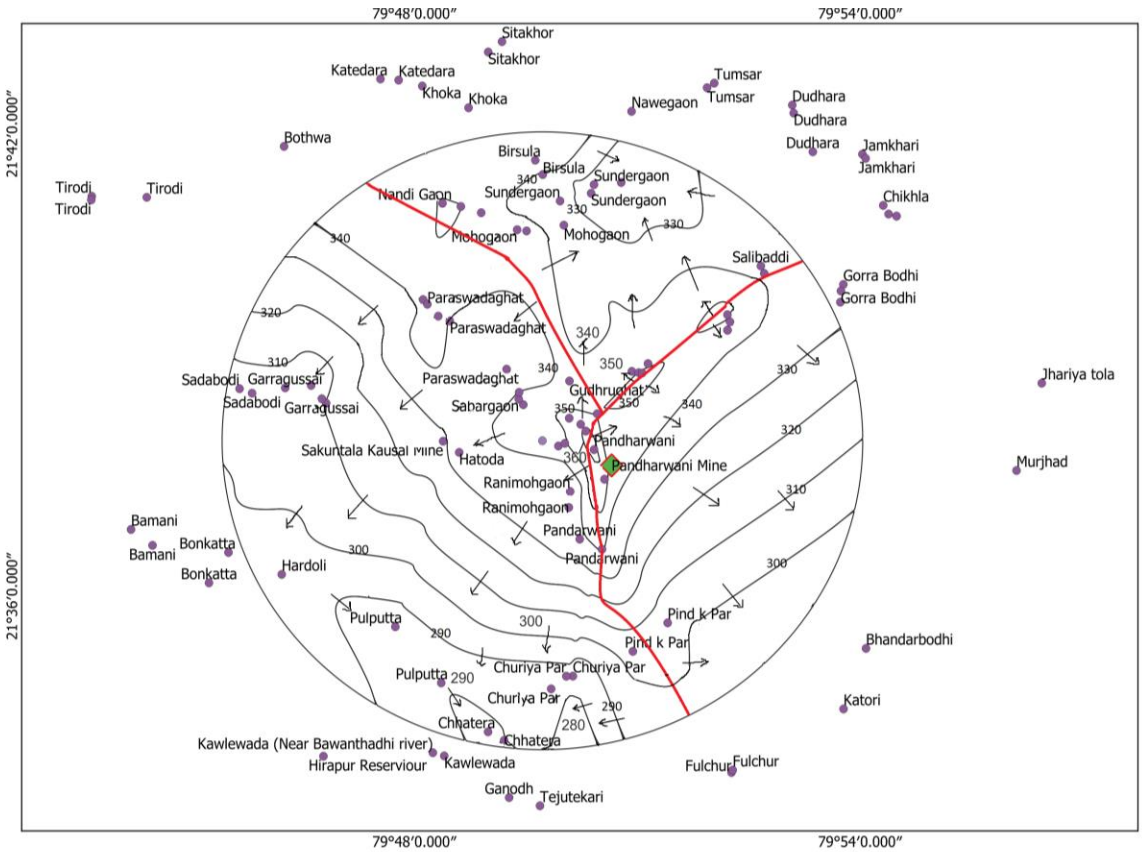


Fig 2.5: Groundwater contour map of Pandharwani mine area

INDEX – red line shows groundwater divide, arrows indicate groundwater flow direction, values indicate groundwater elevation (m amsl), dots indicate data point used for generation of gw contour, buffer zone is marked by 10 km radius circle. Note the mine position (green box) situated near gw divide

2.3Long term groundwater trend

The study area comprises 10km radius zone in Pandharwani Manganese mine that largely fall under Khairlanji block, Balaghat district, Madhya Pradesh and partly toTumsar Tehsil of Bhandara district, Maharashtra. The source of ground water such as dug well, hand pump and pond are used for domestic, irrigation and drinking in the core zone villages. Out of 23 observation location of dug well, it has been observed that the water level (Pre monsoon 2022) of more than 10 villages around the buffer zone and core zone area is varying from 4 to 8m bgl.

Long term trend analysis of data obtained from CGWB shows no significant change-rise or fall as depicted in **Fig 2.6 and 2.7.**

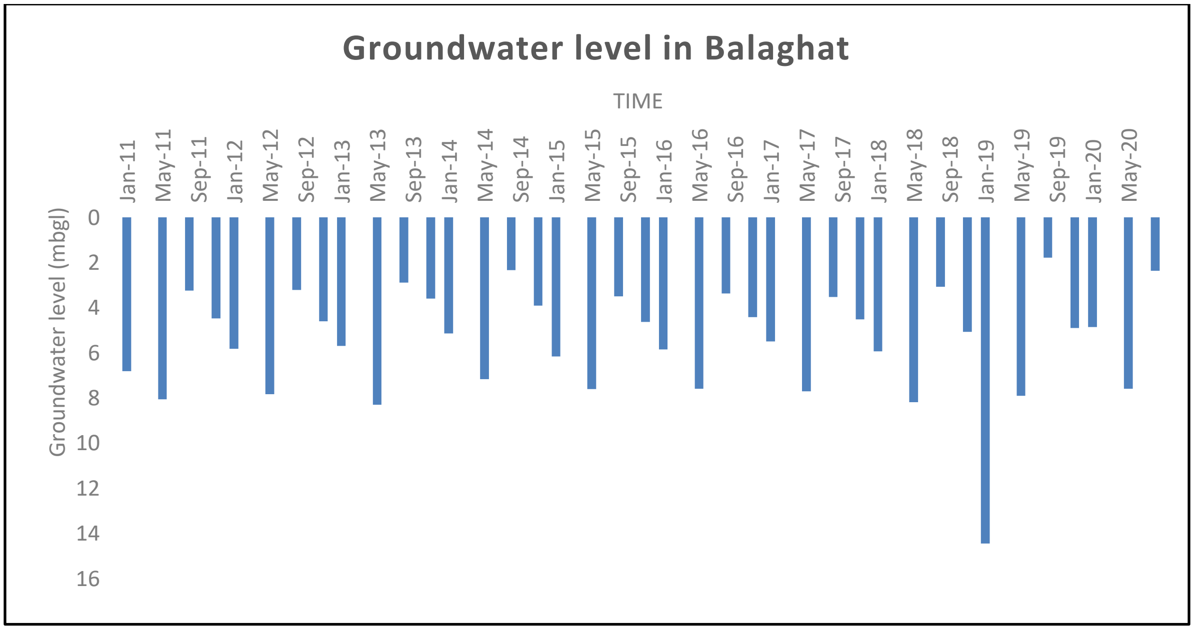


Fig 2.6: Long term well hydrograph of wells of Balaghat district, Madhya Pradesh

(source: WRIS online portal)

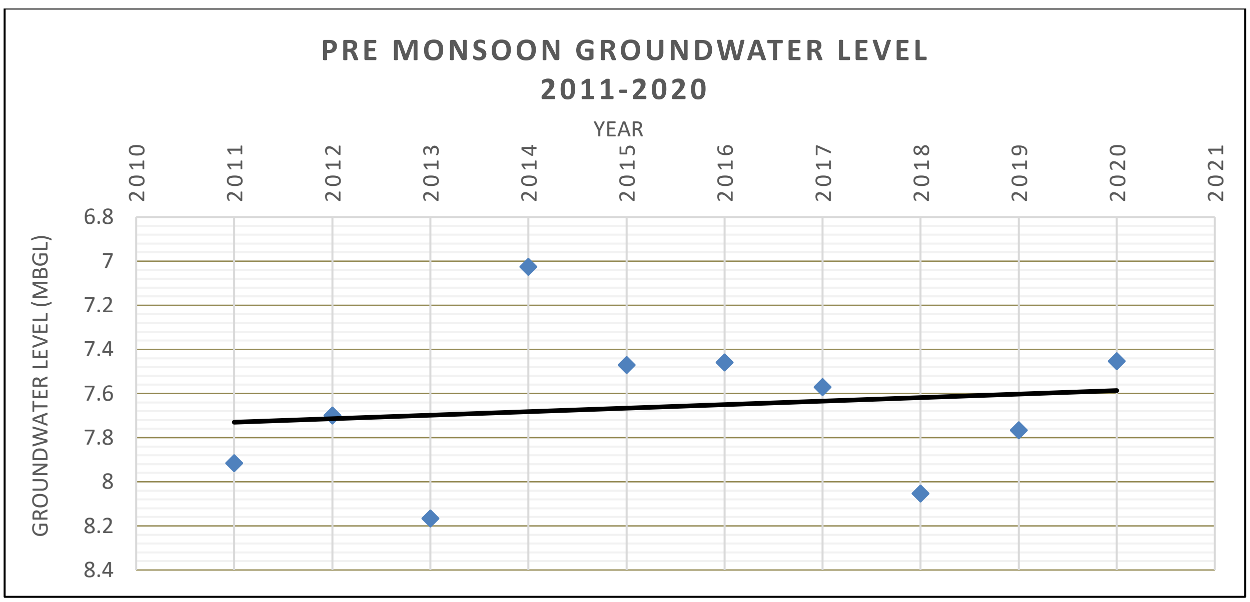


Fig 2.7a: Long term pre monsoon groundwater trend in Balagaht district showing slightly increasing trend

2.3.1 Dynamic Groundwater Resource of study area:

The groundwater resource as estimated by CGWB (2020) is presented in the table 2.6 for two blocks of MP and Maharashtra and are in safe category.

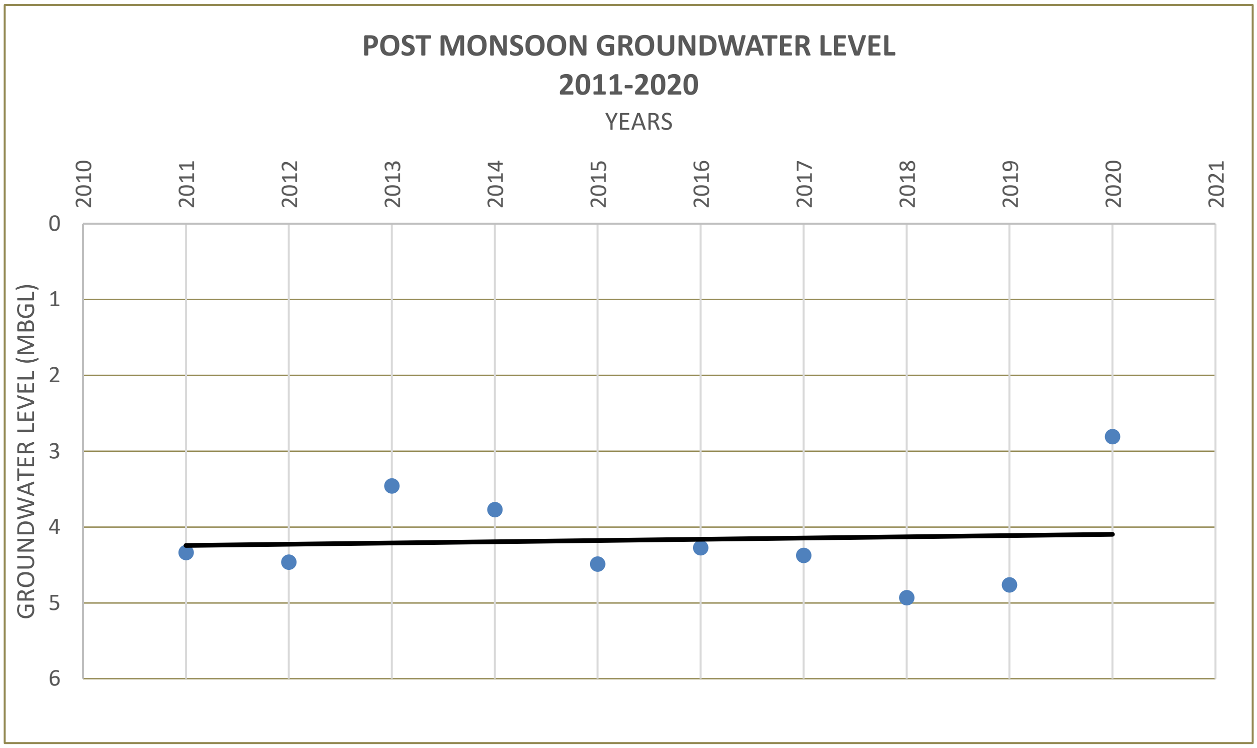


Fig 2.7b: Long term postmonsoon groundwater level tends in Balagaht district (Source: CGWB)

Table: 2.6 Block wise Dynamic Groundwater Resources of Kharlanji, MP and Tumsar, Maharashtra

Sr no	State	District	Assessment Unit Name	Assessment Unit Type	Recharge from Rainfall-MON	Recharge from Other Sources-MON	Recharge from Rainfall-NM	Recharge from Other Sources-NM	Total Annual Ground Water Recharge (Ham)
1	Madhya Pradesh	Balaghat	Kharlangi	Block	5218	314	534.26	318	6384.26
2	Maharashtra	Bhandara	Tumsar	Block	4666.057	1079.197	95.083	2387.81	8228.14

2.4 Groundwater Quality

Based on the above study, different ground water parameters were computed, which include pH, TDS, EC, DO, Temperature. Ground water in study area is potable with pH ranging 6.4 to 8.5 and total dissolved solid (TDS) ranging from 120 to 1900 ppt and EC ranging from 300 to 3800 µS.

(Fig 2.8 and 2.9)

Groundwater quality in the study area is fresh and all major and trace elements are found within the BIS 10500 permissible limit. Thus is suitable for all domestic, industrial and irrigational use. The general parameters of groundwater in study area as analyses are given in Table 2.5.The comparison of data reveals that the area mining (Project Area) is having less TDS).

2.4.1 Groundwater quality of Mining area

Assessment Unit Name	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)	Irrigation Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semi critical/ Safe)
Kharlangi	430.0	5954.26	1643	1987	388.00	33.371	Safe
Tumsar	411.4	7816.74	3123.72	3744.41	680.53	47.903	Safe

Groundwater quality has been analyzed by collecting groundwater samples of existing tube well in study area. The groundwater test result through NABL accredited Lab show low in TDS in the range of 402 mg/l and all other parameters well within permissible range as shown in table 2.5.

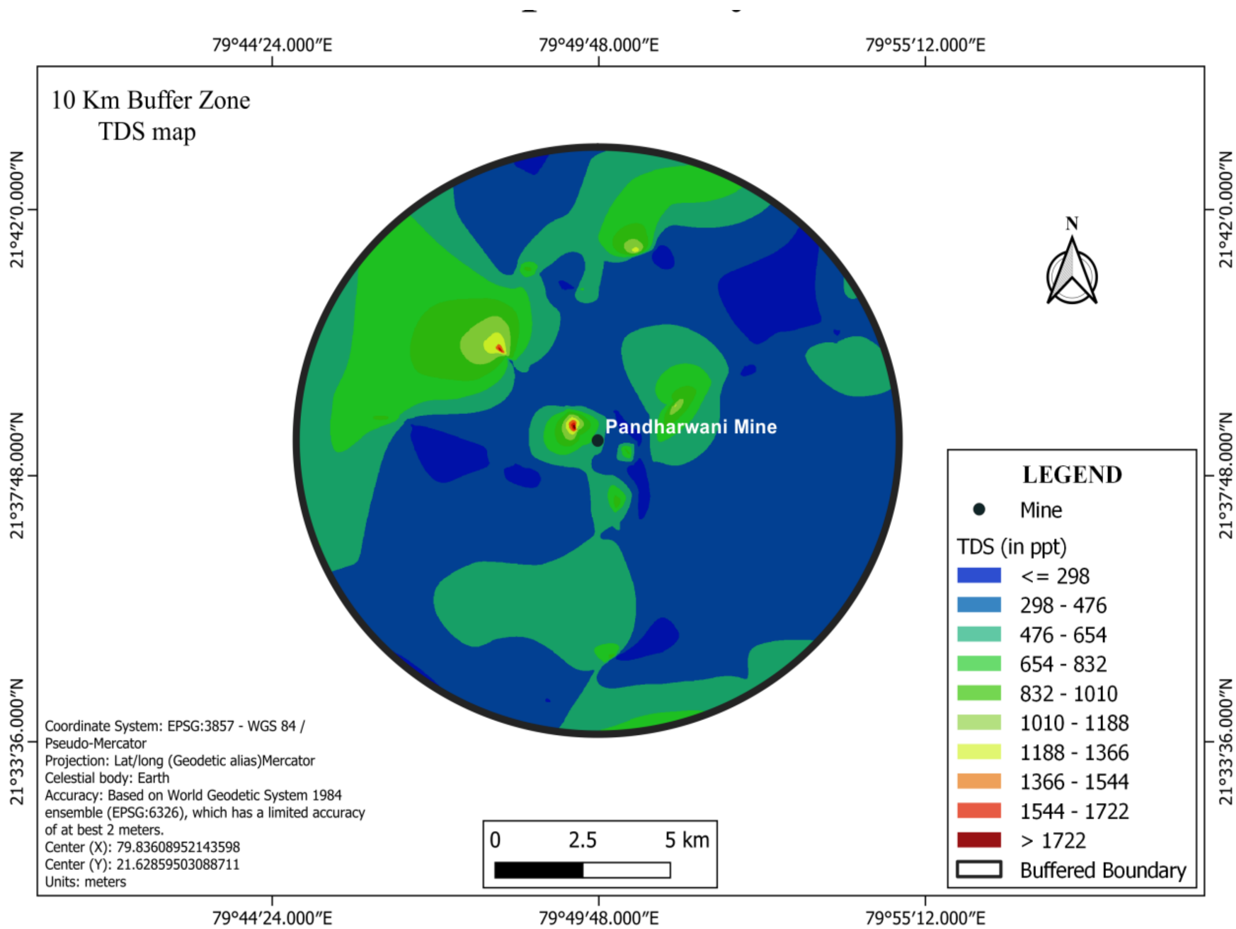


Fig 2.8: TDS map of study area

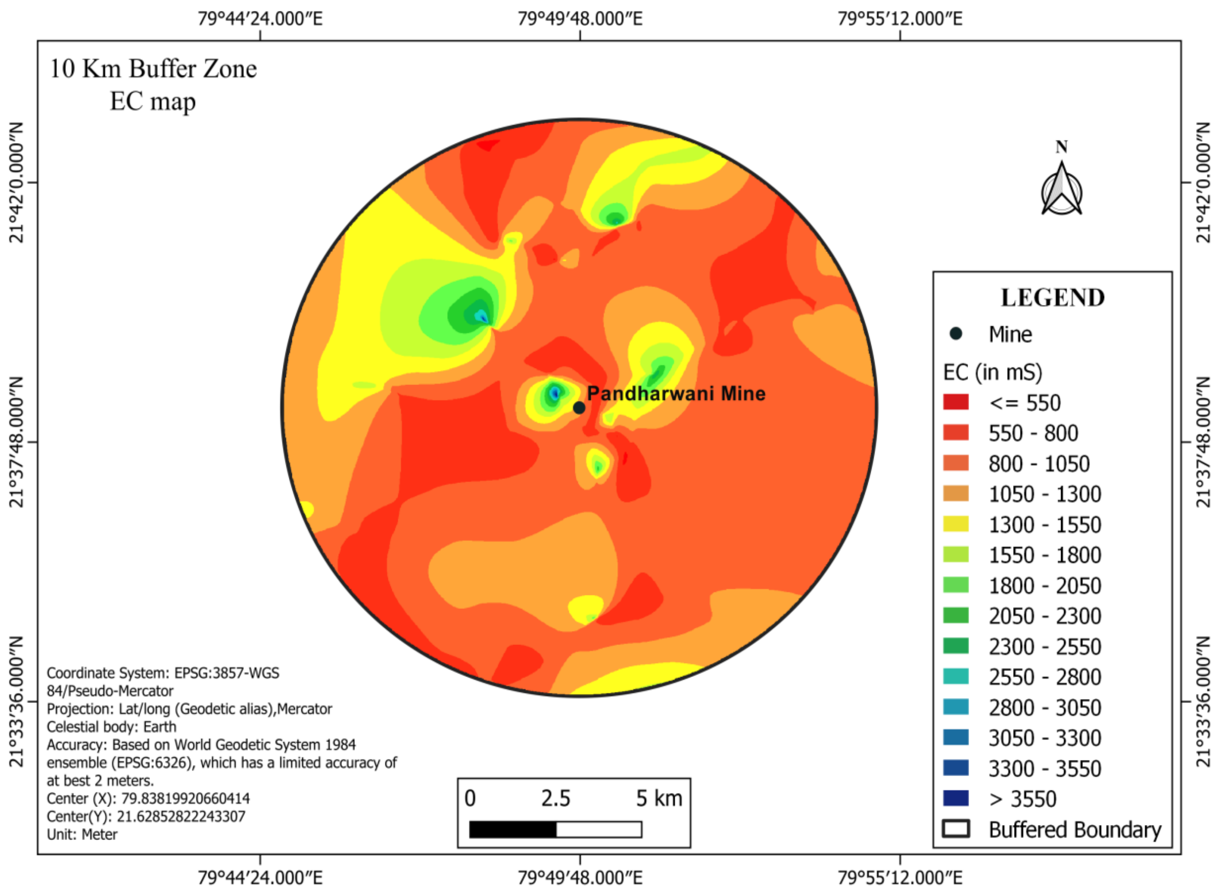


Fig 2.9: EC map of Study area Pandharwani mine

Creative Enviro Services

Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL), National Accreditation Board for training And Education (NABET) and ISO 9001:2015, ISO 14001:2004, OHSAS 18001:2007

Cert No.: TC-6872

TEST REPORT

Name & Address of the Customer To, **M/s D.P. RAI** **"NANHAKA" 10, EAST HIGH COURT ROAD, RAMDASPERTH , NAGPUR (MS)**	**ULR No: TC687218000000109P** Despatch No: 2073 Issue Date : 13/07/2021 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 25/06/2021
Method of test : APHA 23rd edition	**Date of Receipt**	: 01/07/2021
Packing :- Plastic bottle	**Period of testing**	:
Sample Condition at receipt: packed	**Method of sampling**	: BIS/3025
Sample Particulars: Ground Water	**Sample tested as received**	: OK
Sample collected by: CES Representative	**Page no.**	
No. of Sample - 18	**Serial No. of Sample**	109/7

Sr. No	Test Parameters	Unit	Method No.	Pandarwani Mine (109/7)
1	pH	-	4500 H+B	7.52
2	Conductivity	µmhos/cm	2510 B	986.10
3	Turbidity	NTU	2130 B	4.20
4	Total Solid	mg/lit	2540 B	487.00
5	Total Dissolved Solid	mg/lit	2540 C	402.00
6	Total suspended solid	mg/lit	2540 D	85.00
7	Total Alkalinity	mg/lit	2320 B	126.00
8	Total Hardness as CaCO3	mg/lit	2340 C	428.00
9	Ca Hardness as CaCO3	mg/lit	3500 B	212.00
10	Mg Hardness as $CaCO_3$	mg/lit	3500 B	216.00
11	*Calcium as Ca	mg/lit	3500 B	84.96
12	*Magnesium as Mg	mg/lit	3500 B	52.48
13	Sulphates as SO4	mg/lit	4500- SO_4 E	94.58
14	Chlorides as Cl	mg/lit	4500-Cl^- B	131.96
15	Iron as Fe	mg/lit	3500- Fe B	<0.05
16	Nitrate as NO_3	mg/lit	4500-NO_3 B	19.58
17	Nitrite as NO_2 -N	mg/lit	4500- NO_2 B	<0.10
18	Phosphate as P	mg/lit	4500-PD	<0.10
19	Fluoride as F	mg/lit	4500- F D	<0.10
20	Copper as Cu	mg/lit	3500-Cu B	<0.10
21	Chromium as Cr^{6+}	mg/lit	3500-Cr^+ B	<0.10
22	*Coliform	MPN/100ml	IS:15185	<2.00
23	Manganese as Mn	mg/lit	3500- Mn B	<0.20

For Creative Enviro Services

Authorised Signatory

42, Doorsanchar Nagar, Near Savoy Complex, E-8 Extension, Gulmohar, Bhopal-462 039 (M.P.)
Telephone : 0755-4299319, Fax : 0755-4243510, Mobile : 9425009319
Email: creativelab.bpl@gmail.com, creative.bpl@gmail.com, Websearch : www.creativeenviroservices.com

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Cert No.: TC-6872

TEST REPORT

Name & Address of the Customer To, **M/s D.P. RAI** **"NANHAKA" 10, EAST HIGH COURT ROAD,** **RAMDASPERTH , NAGPUR (MS)**	**ULR No: TC687218000000109P** 2073 **Despatch No:** **Issue Date :** 13/07/2021 **Client Ref:** Nil **Date :** Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 25/06/2021
Method of test : APHA 23rd edition	**Date of Receipt**	: 01/07/2021
Packing :- Plastic bottle	**Period of testing**	:
Sample Condition at receipt: packed	**Method of sampling**	: BIS/3025
Sample Particulars: Ground Water	**Sample tested as received**	: OK
Sample collected by: CES Representative	**Page no.**	
No. of Sample - 18	**Serial No. of Sample**	109/7

Sr. No	Test Parameters	Unit	Method No.	Pandarwani Mine (109/7)
24	Zinc as Zn	mg/lit	3111-Zn B	<0.05
25	Total Chromium	mg/lit	3500-Cr+ B	<0.05
26	Cadmium as Cd	mg/lit	3111-Cd B	<0.05
27	Lead as Pb	mg/lit	3111-Pb B	<0.05
28	Mercury as Hg	mg/lit	3112- Hg B	<0.01
29	Nickel as Ni	mg/lit	3111-Ni B	<0.05
30	Arsenic as As	mg/lit	3114-As B	<0.05
31	Sodium Na	mg/lit	3500- Na B	34.67
32	Potassium K	mg/lit	3500- K B	4.53
33	Boron as B	mg/lit	4500-B B	<0.1
34	Selenium as Se	mg/lit	3114-Se B	<0.05
35	COD	mg/lit	5220 B	<4.00
36	BOD (3 day 27degree)	mg/lit	IS 3025, P- 44	<2.00

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Table 2.7: Analytical results of groundwater samples collected in Pandharwani mine

Water Quality Data in Piper Trilinear Diagram: Different graphical methods can be adopted for representing geochemical variation which gives a better insight into the groundwater quality monitoring. One such efficient method of representation is plotting of Hill Piper Trilinear diagram in which data are plotted in two triangle fields and one diamond field. The diamond is then classified under various categories emphasizing their characteristics. (**Fig 2.10 and 2.11**)

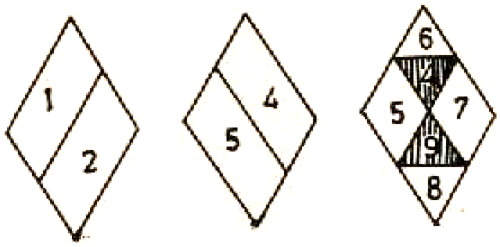


Fig 2.10: Sub-divisions of the diamond field

On the basis of data collection from CGWB report (2019-2020). It has been observed that out of 41 samples are concentrated in Area 6 indicating that: Non-carbonate hardness exceeds 50% i.e., Ca + Mg - (SO4 + Cl + NO3). Few samples come under Area 4 representing strong acids (SO4 + Cl + NO3) exceed weak acids (CO3 + HCO3). Only 2 samples can be noticed under Area 7: Non-carbonate alkali exceeds 50% i.e., Na + K- (SO4 + Cl + NO3).

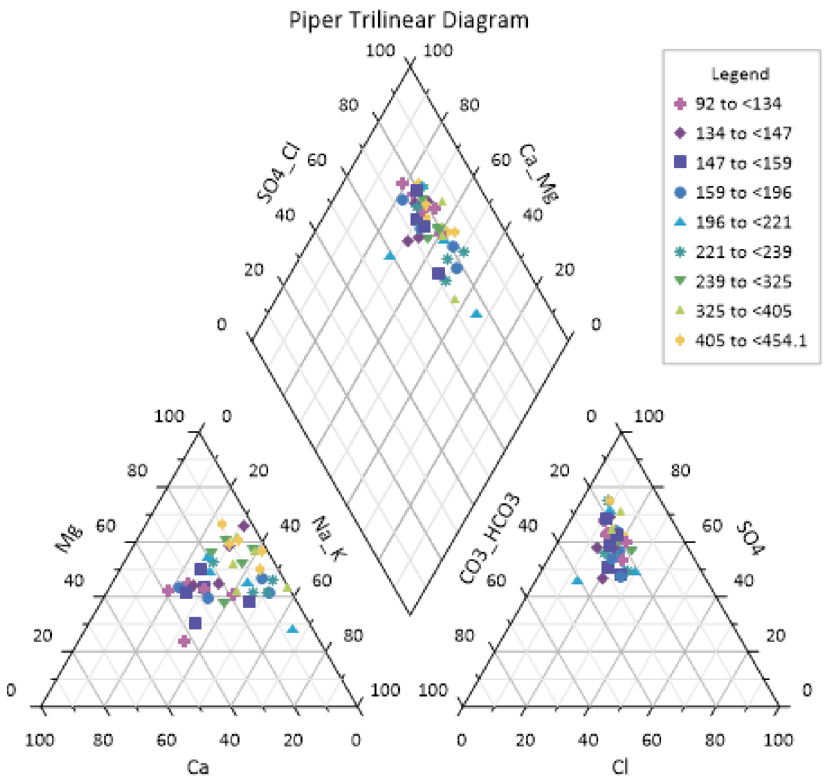


Fig: 2.11 Distribution of water samples in Piper Trilinear Diagram

7.1 USSL Diagram: The United States Salinity Laboratory (USSL) (1954) and Wilcox (1955) established standards for irrigation water quality classification. The Fig.7.5 is a simple scatter chart of sodium hazard (SAR) on the Y-axis versus salinity hazard (EC) on the X-axis.Using the SAR and the EC value of 41 water samples of Balaghat area determines the quality classification of the water.

Based on the EC, irrigation water can be classified into four categories; include:

I. Low-salinity water (C_1) can be used for irrigation with most crops on most soils with little likelihood that **soil salinity** will develop.

II. Medium-salinity water (C_2) can be used if a moderate amount of leaching occurs. Plants with moderate salt- tolerance can be grown in most cases without special practices for salinity control.

III. High-salinity water (C_3) cannot be used on soils, special management for salinity control may be required and plants with good salt tolerance should be selected.

IV. Very high salinity water (C_4) is not suitable for irrigation under ordinary conditions.

Sodium Adsorption Ratio: High sodium in irrigation water reduces the permeability of soil.The USSL diagram based on SAR divided to four categories included:

$$SAR = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$$

I. Low-sodium water (S_1) can be used for irrigation on almost all soils.

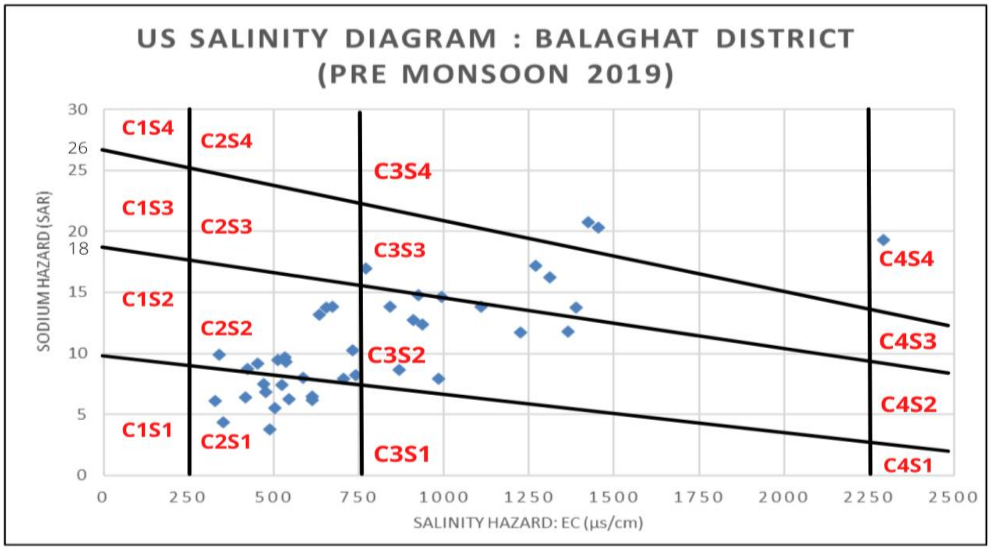
II. Medium-sodium water (S_2) will present an appreciable sodium hazard in certain fine-textured soils. This water may be used on coarse-textured or organic soils with good permeability.

III. High-sodium water (S_3) may produce harmful levels of exchangeable sodium in most soils and will require special soil management.

IV. Very high sodium water (S_4) is generally unsatisfactory for irrigation unless special action is taken, such as addition of gypsum to soil (Lyerly and Longenecker, 1957).

Data Analysis:

On the basis of samples collected from the study area, it can be observed that out of 41 samples of Pre and Post Monsoon 2019, most of the samples are concentrated under C2S1, C2S2 and C3S2categories indicating low to medium sodium hazards with medium to high salinity. Out of these, few samples are scattered under C3S3 and C3S4 categories representing high salinity with high sodium hazard and high salinity with very high sodium hazard respectively**(Fig 2.12).**



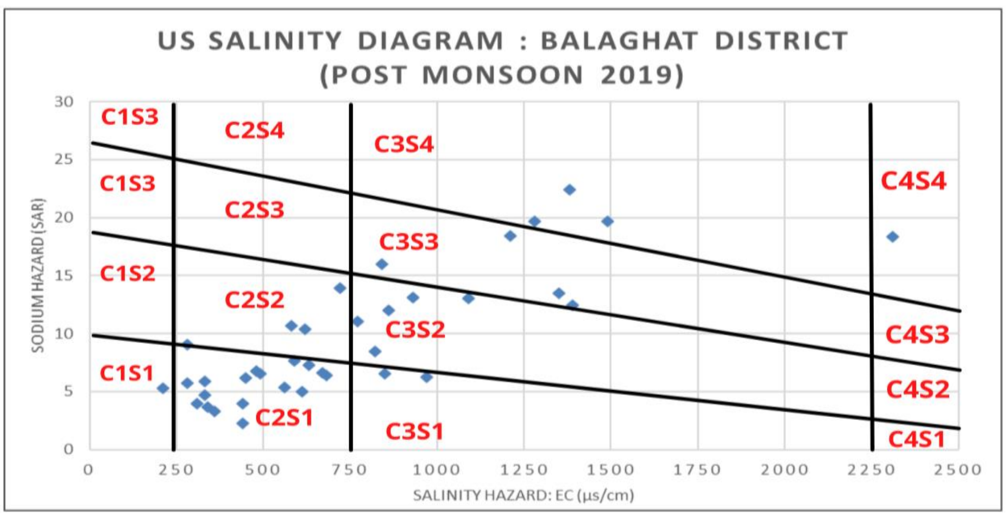


Fig:2.12 US Salinity diagram of Pre Monsoon 2019 and Post Monsoon 2019, Balaghat

3. Details of bore well proposed to be constructed

No well is proposed to be drilled- thus point not applicable.

4. Geophysical Survey of Study area

Surface geophysical investigation involving resistivity survey was taken up in the area covering nearly 1.5 line km area. Five VES (vertical Electrical sounding) was conducted to know the subsurface geohydrological condition in the core zone. The data so obtained is interpreted for use in combination with lithologs obtained during exploratory drilling carried out for ore.

4.1 Geophysical Studies in an around the Mine area

Geophysical/Vertical Electrical Sounding is a technique to delineate the weathered, fractured zone and hydro geological suitability. VES technique is effective to delineate the hard terrain. Geophysical / VES investigation has been carried out at five locations in an around the mine area. Schlumberger electrode configuration in the study area has been conducted to delineate the distribution of subsurface rocks. The usual practice in the field is to apply an electrical direct current (DC) between two electrodes implanted in the ground and to measure the difference of potential between two additional electrodes that do not carry current. Total five numbers of VES (VES 1 to VES 5) have been carried out at site for detection of ground water in alluvium zone of subsurface and different type of rocks. All the data sheets are given below with tabulated interpretation & recommendations.

RESISTIVITY SURVEY

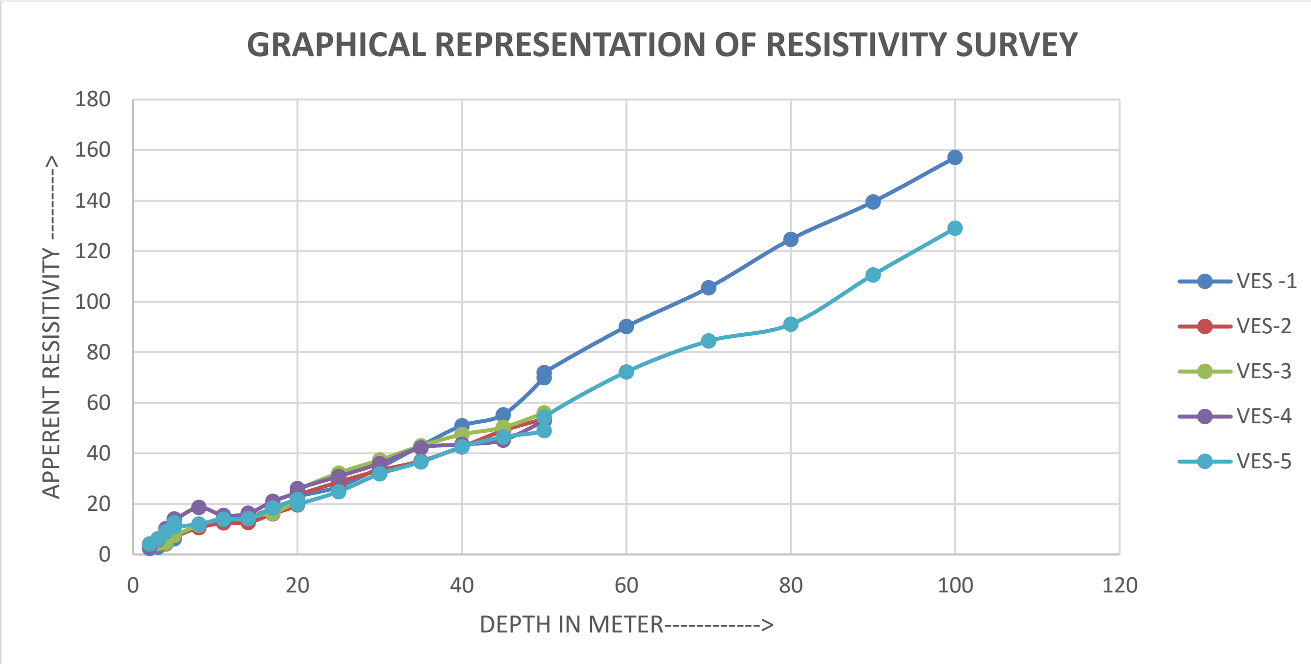
GROUND WATER INVESTIGATION

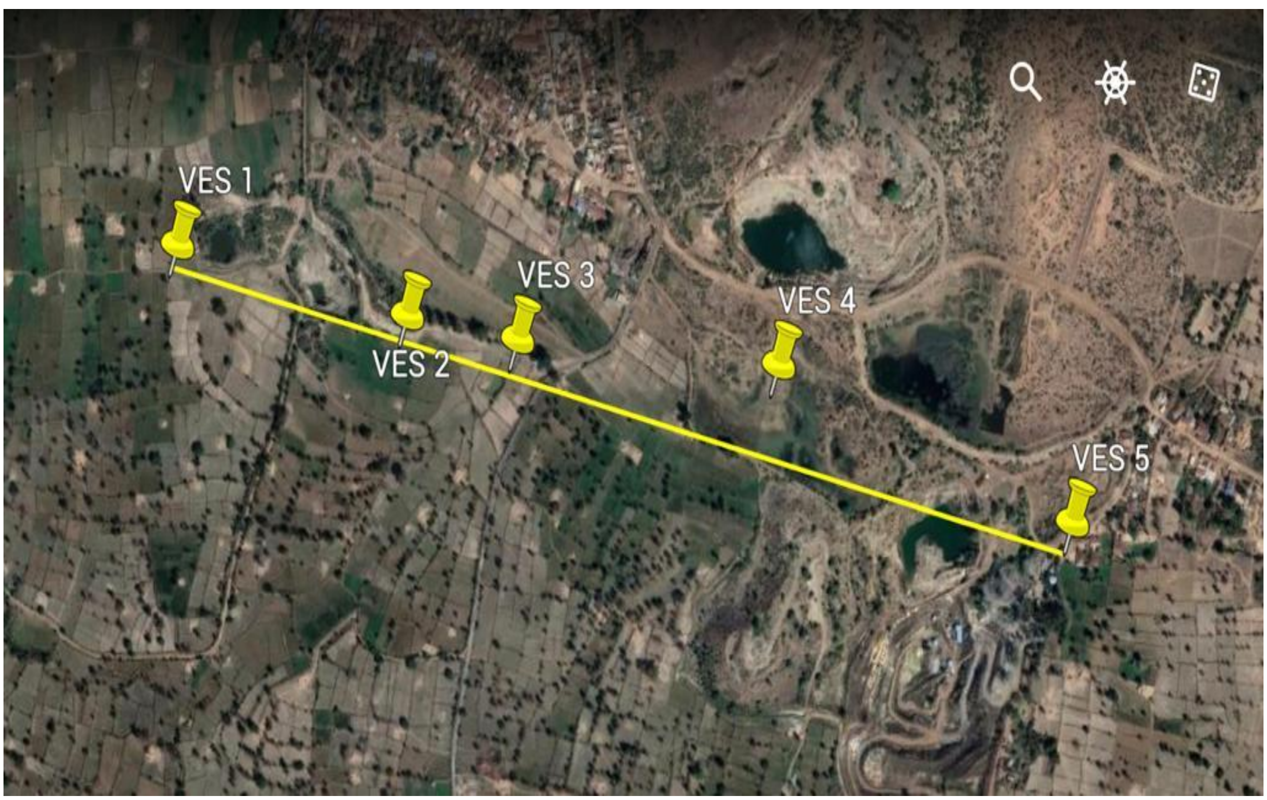
DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

- FROM VES-1 TO VES-5

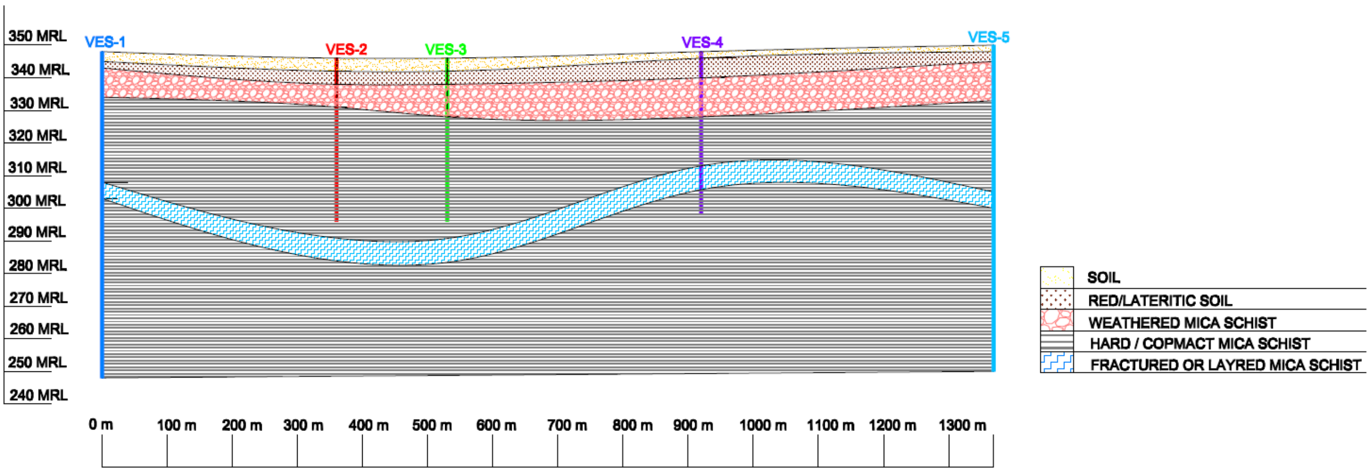
S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	VES-1 APPARENT RESISTIVITY (OHM -Mtr)	VES-2 APPARENT RESISTIVITY (OHM -Mtr)	VES-3 APPARENT RESISTIVITY (OHM -Mtr)	VES-4 APPARENT RESISTIVITY (OHM -Mtr)	VES-5 APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	2.42	3.47	3.14	2.98	4.17
2.	3	1	2.91	3.93	4.28	5.84	6.24
3.	4	1	4.17	4.52	4.52	10.27	9.02

4.	5	1	6.21	7.83	8.21	14.05	12.55
5.	5	2	6.85	7.51	7.58	13.55	11.01
6.	8	2	10.83	10.64	11.59	18.61	12.06
7.	11	2	13.68	12.49	14.51	15.43	13.96
8.	14	2	14.92	12.66	15.83	16.28	14.17
9.	17	2	18.13	16.11	16.34	21.04	18.35
10.	20	2	21.46	19.59	21.77	24.57	21.77
11.	20	5	22.97	23.20	25.32	26.03	20.02
12.	25	5	26.76	28.65	32.23	30.91	24.88
13.	30	5	34.36	33.26	37.38	36.01	31.88
14.	35	5	42.97	36.94	42.97	42.22	36.56
15.	40	5	50.96	42.55	47.50	43.54	42.55
16.	45	5	55.29	49.00	50.26	45.23	46.49
17.	50	5	69.97	53.65	55.98	52.87	48.98
18.	50	10	72.00				54.28
19.	60	10	90.16				72.24
20.	70	10	105.55				84.44
21.	80	10	124.68				91.04
22.	90	10	139.52				110.61
23.	100	10	157.05				129.06


GRAPHICAL REPRESENTATION OF RESISTIVITY SURVEY
APPERENT RESISITIVITY ----------->
DEPTH IN METER------------>
0
20
40
60
80
100
120
140
160
180
0
20
40
60
80
100
120
VES -1
VES-2
VES-3
VES-4
VES-5


VES 1
VES 2
VES 3
VES 4
VES 5

GRAPHICAL REPRESENTATION OF REISTIVITY SURVEY



VES -1

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

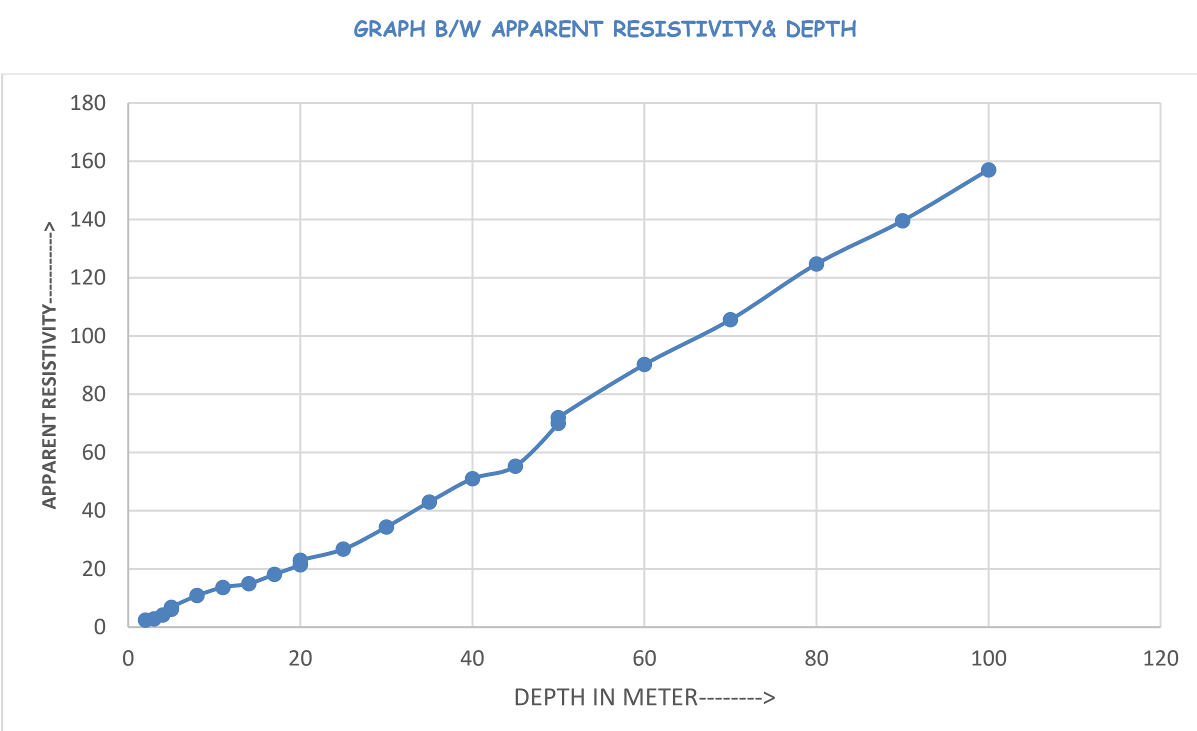
DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

- LOCATION – IN MIRAGPUR MINE (24 HACT)
- LAT - 21°37'55.78"N LONG - 79°49'54.35"E

S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	SPACING FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	4.71	0.513	2.42
2.	3	1	12.56	0.232	2.91
3.	4	1	23.56	0.177	4.17
4.	5	1	37.69	0.165	6.21
5.	5	2	16.49	0.416	6.85
6.	8	2	47.12	0.230	10.83
7.	11	2	91.89	0.148	13.68

8.	14	2	150.8	0.099	14.92
9.	17	2	223.84	0.081	18.13
10.	20	2	311.02	0.069	21.46
11.	20	5	117.81	0.195	22.97
12.	25	5	188.50	0.142	26.76
13.	30	5	274.89	0.125	34.36
14.	35	5	376.99	0.114	42.97
15.	40	5	494.8	0.103	50.96
16.	45	5	628.32	0.088	55.29
17.	50	5	777.54	0.090	69.97
18.	50	10	376.99	0.191	72.00
19.	60	10	549.78	0.164	90.16
20.	70	10	753.98	0.140	105.55
21.	80	10	989.6	0.126	124.68
22.	90	10	1257	0.111	139.52
23.	100	10	1555	0.101	157.05

VES -1



PROBABLE SUB SURFACE LITHOLOG

S,N.	Sub surface data (litho-log) expected	Depth below Ground Level (m)	
		from	to
1.	Probability of Soil	0	3
2.	Probability of red laterite soil	3	5
3.	Probability of yellow soil or weathered Mica Schist	5	14
4.	Probability of hard & dense Mica schist	14	40
5	Probability of fractured, layered, jointed Mica schist	40	45
6.	Probability of hard compact Mica Schist	45	100

VES -2

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

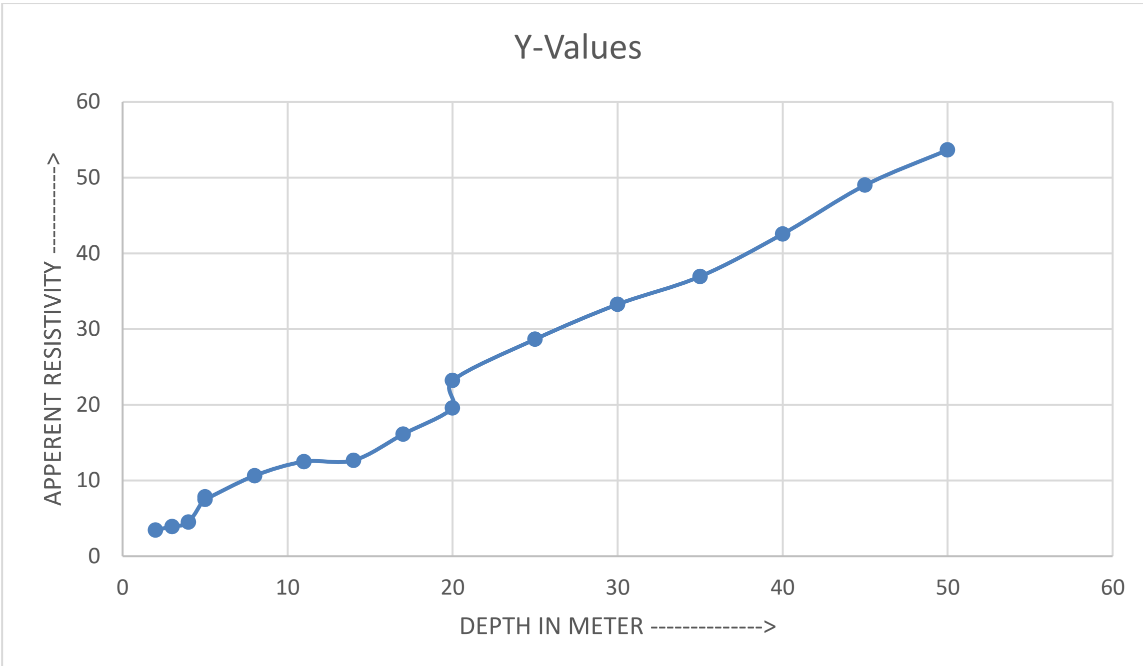
- LOCATION – NEAR KALA GADDA (OLD PIT)
- LAT - 21°37'52.40"N LONG - 79°50'6.30"E

S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	SPACING FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	4.71	0.738	3.47
2.	3	1	12.56	0.313	3.93
3.	4	1	23.56	0.192	4.52
4.	5	1	37.69	0.208	7.83
5.	5	2	16.49	0.456	7.51
6.	8	2	47.12	0.226	10.64
7.	11	2	91.89	0.136	12.49
8.	14	2	150.8	0.084	12.66

9.	17	2	223.84	0.072	16.11
10.	20	2	311.02	0.063	19.59
11.	20	5	117.81	0.197	23.20
12.	25	5	188.50	0.152	28.65
13.	30	5	274.89	0.121	33.26
14.	35	5	376.99	0.098	36.94
15.	40	5	494.8	0.086	42.55
16.	45	5	628.32	0.078	49.00
17.	50	5	777.54	0.069	53.65

VES -2

GRAPH B/W APPARENT RESISTIVITY & DEPTH



PROBABLE SUB SURFACE LITHOLOG

S,N.	Sub surface data (litho log) expected	Depth below Ground Level (m)	
		from	to
1.	Probability of Soil	0	4
2.	Probability of red laterite soil	4	8
3.	Probability of yellow soil or weathered Mica Schist	8	15
4.	Probability of hard compact Mica Schist	15	50

VES -3

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

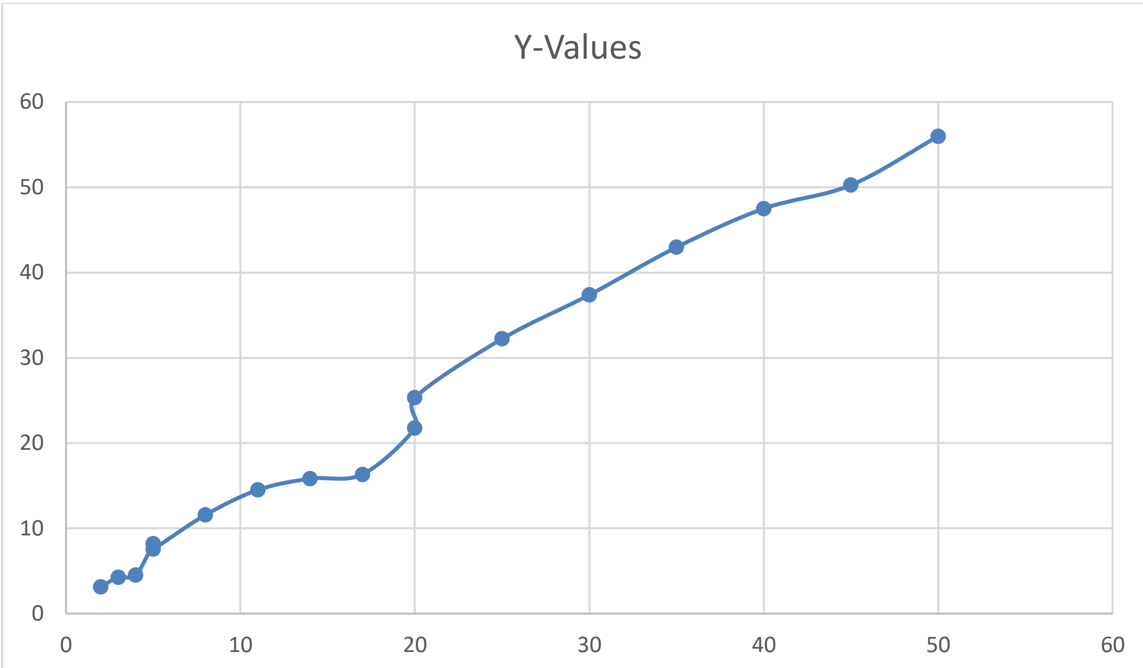
DATA SHEET DEPTH PROBE SCHLUMBERGER ELECTRODE CONFIGURATION

- LOCATION – NEAR MIRAGPUR TO RANI MOHGAON ROAD
- LAT - 21°37'51.10"N LONG - 79°50'12.10"E

S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	SPACING FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	4.71	0.668	3.14
2.	3	1	12.56	0.341	4.28
3.	4	1	23.56	0.192	4.52
4.	5	1	37.69	0.218	8.21
5.	5	2	16.49	0.460	7.58
6.	8	2	47.12	0.246	11.59
7.	11	2	91.89	0.158	14.51
8.	14	2	150.8	0.105	15.83
9.	17	2	223.84	0.073	16.34
10.	20	2	311.02	0.070	21.77
11.	20	5	117.81	0.215	25.32
12.	25	5	188.50	0.171	32.23
13.	30	5	274.89	0.136	37.38
14.	35	5	376.99	0.114	42.97
15.	40	5	494.8	0.096	47.50
16.	45	5	628.32	0.080	50.26
17.	50	5	777.54	0.072	55.98

VES -3

GRAPH B/W APPARENT RESISTIVITY & DEPTH



PROBABLE SUB SURFACE LITHOLOG

S,N.	Sub surface data (litho log) expected	Depth below Ground Level (m)	
		from	to
1.	Probability of Soil	0	4
2.	Probability of red laterite soil	4	8
3.	Probability of yellow soil or weathered Mica Schist	8	18
4.	Probability of hard compact Mica Schist	18	50

VES -4

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

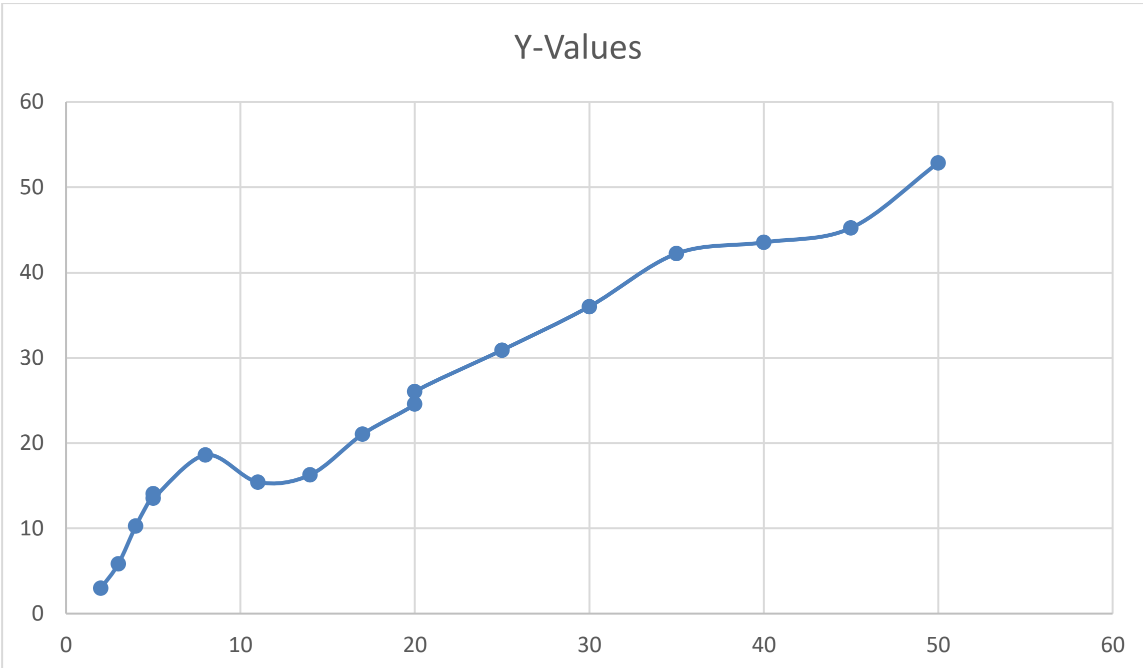
DATA SHEET DEPTH PROBE SCHLUMBERGER ELECTRODE CONFIGURATION

- LOCATION – NEAR CHOPRA MINE
- LAT - 21°37'49.45"N LONG - 79°50'25.70"E

S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	SPACING FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	4.71	0.633	2.98
2.	3	1	12.56	0.465	5.84
3.	4	1	23.56	0.436	10.27
4.	5	1	37.69	0.373	14.05
5.	5	2	16.49	0.822	13.55
6.	8	2	47.12	0.395	18.61
7.	11	2	91.89	0.168	15.43
8.	14	2	150.8	0.108	16.28
9.	17	2	223.84	0.094	21.04
10.	20	2	311.02	0.079	24.57
11.	20	5	117.81	0.221	26.03
12.	25	5	188.50	0.164	30.91
13.	30	5	274.89	0.131	36.01
14.	35	5	376.99	0.112	42.22
15.	40	5	494.8	0.088	43.54
16.	45	5	628.32	0.072	45.23
17.	50	5	777.54	0.068	52.87

VES -4

GRAPH B/W APPARENT RESISTIVITY & DEPTH



PROBABLE SUB SURFACE LITHOLOG

S,N.	Sub surface data (litho-log) expected	Depth below Ground Level (m)	
		from	to
1.	Probability of Soil	0	2
2.	Probability of red laterite soil	2	8
3.	Probability of yellow soil or weathered Mica Schist	8	20
4.	Probability of hard & dense Mica schist	20	35
5	Probability of fractured, layered, jointed Mica schist	35	45
6.	Probability of hard compact Mica Schist	45	50

VES -5

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

DATA SHEET DEPTH PROBE SCHLUMBERGER ELECTRODE CONFIGURATION

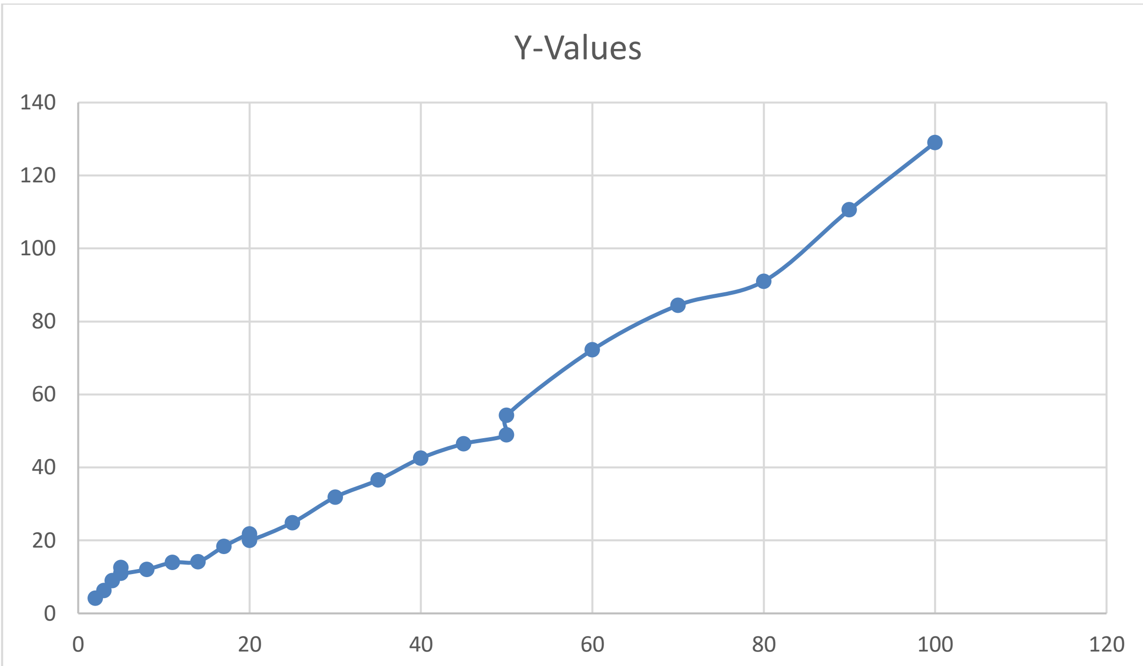
- LOCATION – IN FRONT OF PANDHARWANI MINE GATE
- LAT - 21°37'42.45"N LONG - 79°50'40.75"E

S.N	AB/2 (in Mtr)	MN/2 (in Mtr)	SPACING FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVITY (OHM -Mtr)
1.	2	1	4.71	0.887	4.17
2.	3	1	12.56	0.497	6.24
3.	4	1	23.56	0.383	9.02
4.	5	1	37.69	0.333	12.55
5.	5	2	16.49	0.668	11.01
6.	8	2	47.12	0.256	12.06
7.	11	2	91.89	0.152	13.96
8.	14	2	150.8	0.094	14.17
9.	17	2	223.84	0.082	18.35
10.	20	2	311.02	0.070	21.77
11.	20	5	117.81	0.170	20.02
12.	25	5	188.50	0.132	24.88
13.	30	5	274.89	0.116	31.88
14.	35	5	376.99	0.097	36.56
15.	40	5	494.8	0.086	42.55
16.	45	5	628.32	0.074	46.49
17.	50	5	777.54	0.063	48.98
18.	50	10	376.99	0.144	54.28
19.	60	10	549.78	0.131	72.24
20.	70	10	753.98	0.112	84.44
21.	80	10	989.6	0.092	91.04

22.	90	10	1257	0.088	110.61
23.	100	10	1555	0.083	129.06

VES -5

GRAPH B/W APPARENT RESISTIVITY & DEPTH



PROBABLE SUB SURFACE LITHOLOGY

S,N.	Sub surface data (litho-log) expected	Depth below Ground Level (m)	
		from	to
1.	Probability of Soil	0	2
2.	Probability of red laterite soil	2	5
3.	Probability of yellow soil or weathered Mica Schist	5	17
4.	Probability of hard & dense Mica schist	17	45
5	Probability of fractured, layered, jointed Mica schist	45	50
6.	Probability of hard compact Mica Schist	50	100

5. Approved Mine Plan

5.1: Year Wise Mine plan Including Excavation Depth, Area and Mine Seepage

Pandharwani Manganese mine is located inPandharwani village, Tehsil Khairlanji, District Balaghat, Madhya Pradesh. Miragpur village is in south west portion in Balaghat district, Madhya Pradesh. The total lease area of Pandharwani Mine is 14.99 ha. It extracts Mn by both underground methods.

Table 5.1: Details of Earlier Approved Mining Plans / Schemes of Mining

	Date and reference of earlier approved MP/SOM:			
Sr. no	**Leas area**	**Type of document & rule under which prepared**	**Approval letter No & date**	**Proposal Period**
1	14.90 Ha	Mining Plan	BGT/Mn/MPLN-32/NGP, Dated: 15.10.98	For renewal of Mining Lease. Valid from 1998-99 to 2002-03
2	14.90 Ha & 4.232 Ha	Modified composite Mining Plan	BGT/Mn/MPLN-37/NGP, Dated: 31.3.2000	For balance period –valid up to 2002-03
3.	14.90 Ha & 4.232 Ha	Composite Mining Scheme	BGT/Mn/MPLN- 32/NGP Dated 16.03.06	Valid- from 2003-04 to 2007-08
4.	14.90 Ha & 4.32 Ha	Composite Mining Scheme	BGT/Mn/MPLN- 32/NGP Dated 27.10.2011	Valid- from 2008-09 to 2012-13
5.	14.90 Ha	Scheme of Mining	BGT/Mn/MPLN- 32/NGP Dated 07.05.2014	Valid- from 2013-14 to 2017-18
5.	14.90 Ha	**Review of Mining Plan**	MP/Balaghat/Manganese/RMP- 83/17-28 4659 Jabalpur dated26/04/2018	Valid- from 2018-19 to 2022-23

	Details of last modifications, if any (for approved MP/RMP, indicating date of approval, reason for modification of previous approved period):					
Sr. No.	**Modification (MP/SOM)**	**Rule under which modified**	**Reasons for modification**	**Area**	**Date of approval**	**Period of modification**
a)	Modification in Approved Mining Plan	Rule 17(3) of MCR 2016 & 23 of MCDR 2017	Addition of **ENTRIES**to u/g & increase in production	14.90 Ha	Under submission	2019-20 to 22-23

Mining Method

Earlier the mine was operating through the opencast mining method upto June,2018. The surface level of opencast mining is at 350mRL and reached upto 300mRL.

Underground Mining has been started from July, 2022 and continues till date. The Mining method adopted here is stopping mining method.

Stopping, is **the opening of large underground rooms, or stopes, by the excavation of ore**. Stopping is practiced in underground mineral mining when the surrounding rock is strong enough to permit the drilling, blasting, and removal of ore without caving. The maximum depth achieved through the underground mining is 115 m i.e. at 235 MRL.

Ultimate purpose of mine development is stopping for winning in-situ ore-deposits Mine development facilitates formation of blocks of minerals for ease in ventilation, travelling, movement of machines and to provide free faces for stopping. It takes minimum period of 3 years for development depending on the extent of ore-reserves etc.

The ore-deposits at this mine have depth persistence up to 250 MRL in NE part of workings, i.e. from NE Lease boundary up to end of open cast. The Incline shaft is driven from the end of open cast working from open pit bottom at 305 MRL and then extended up to surface by a RCC column.

Table 5.2: Details of Stoping Parameters

STOPING PARAMETERS		
i)	Number of Stope Panels	2 No.
ii)	No. of stopes already stopped	nil
iii)	Level interval	15m
iv)	Thickness of crown pillar	17m-
v)	Thickness of Sill pillar	No Sill Pillars are proposed
vi)	Thickness of Rib pillar	No rib pillar is proposed.
vii)	Size and interval of Stope pillar	4x4m at 11m intervals
viii)	Size/shape of man way	Not proposed. Access from upper level
ix)	Size/shape of ore pass	Not proposed. Direct hoisting from stopping level.
x)	Method of stowing/back filling	Stowing with Processed OB materials in the size range of 3mm-20mm

Thus, u/g mine workings are classified as NE block & SW block. The development in NE block is completed up to 250 MRL barring some preparation for stopping. In SW block, ore-deposits are found to be persisting in strike and depth compared to NE block. Strike extension in SW has already surpassed the zone considered/contemplated in ore-reserves calculation based on BH information. The ore is thicker and extended more in SW direction, hence the development take place in this direction. The present working level in SW is 235mRL.

Table 5.3: Actual and Planned production of the mine *(Reference- Approved Mine Plan)*

YEAR	EXISTING Total Volume =7500.00 M3	ROM Generation from Total Volume (20%)	Clean Ore (90%) (T)	Mineral Rejects (10%) (M3)	Gross Waste Volume = (2+5) (M3)	Mine Seepage (KLD)
1	2	3	4	5	6	7
2019-20	1500	1050	945	30	1230	21
2020-21	2000	1400	1260	40	1640	25
2021-22	2000	1400	1260	40	1640	30
2022-23	2000	1400	1260	40	1640	25
TOTAL	7500	5250	4725	150	6150	101

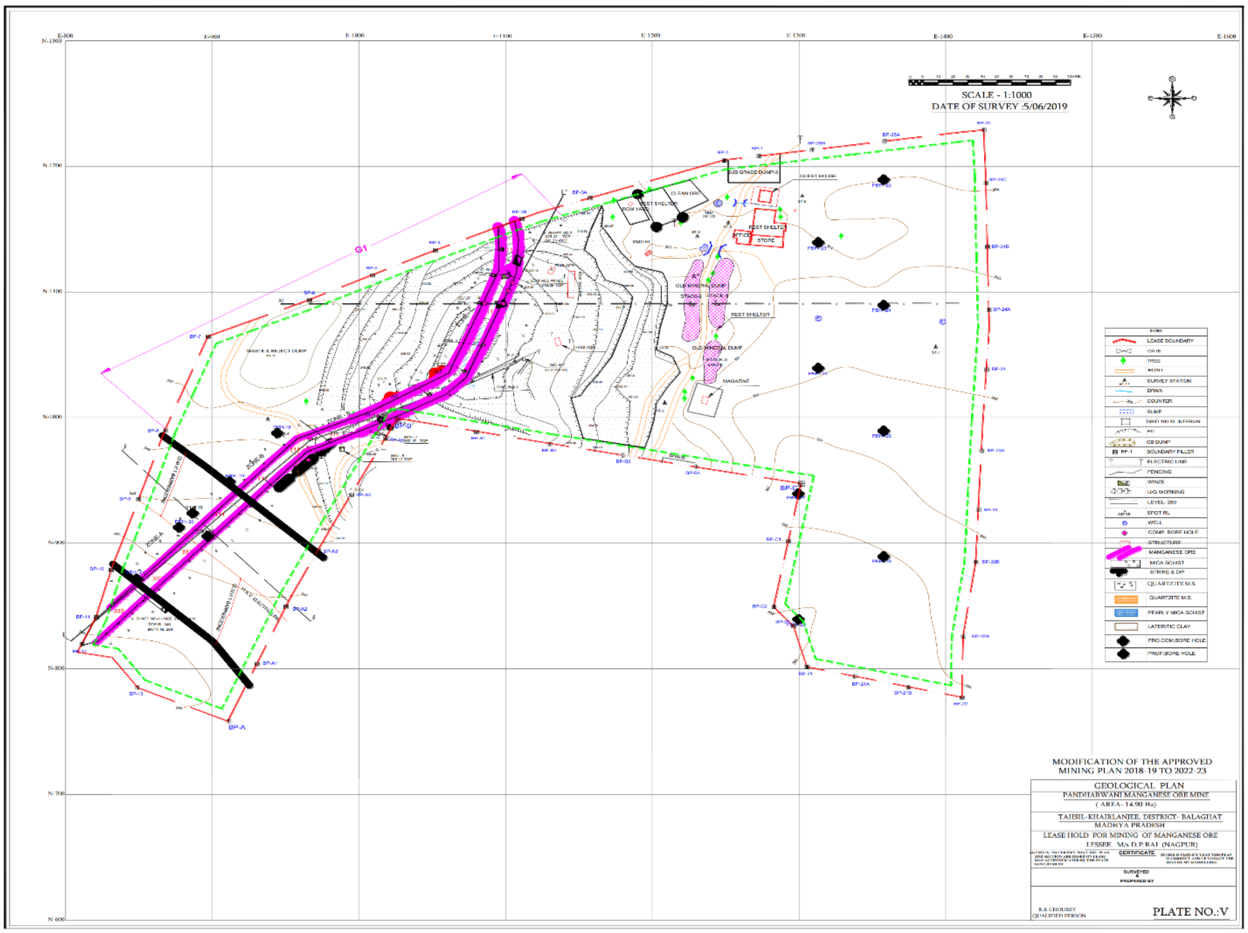


Fig 5.1 Approved Mine plan of Pandharwani Mine, Khairlanji, Balaghat

Fig 5.2 Manual banificiation of ore at Pandharwani Mine

Fig 5.3 Mining phase of underground mine at Padharwani

6. Use of water obtained from mine dewatering

As per the approved mine plan the Pandharwani mine has a discharge of 41KLD or 41m^3/day The entire water is utilize as per the Table 6.1.

Table 6.1: Water Utilization inPandharwani Mine Area (Area = 14.90 Ha)			
Sr.no	**Purposes**	**Environmental Clearance (KLD)**	
		Proposed (KLD)	**Actual (KLD)**
1	Dust suppression	41KLD	5
2	Green belt		4
3	Domestic		2
4	Drilling		10
5	Sand stowing		20
Totals			**41KLD**

6.1 For Drinking – The mine discharge is not used for drinking. Drinking water for the mine is obtained from existing dug well within ML area.

6.2 Irrigation- During monsoon small quantity of water is released from storage tank for irrigation. However, 4KLD mine discharge is used for maintaining green belt.

6.3 Recharge- The mine discharge after three step of de-siltation is stored in a recharge cum storage pond of nearly 0.5ha with a depth of av 1.5m thus having storage capacity of 0.75ham nearly 30% can be taken as recharge from this tank

6.4 Runoff to stream- No discharge is released to any stream from the Pandharwani mine.

6.5 Benefitted area- Nearby villagers of village Padharwani

6.6 Dust suppression, green belt development- as shown in table 9KLD is used for this purpose.

7. Comprehensive assessment of the impact on the ground water regime

Comprehensive assessment of the impact on the ground water regime in and around the project area highlighting the risks and proposed management strategies proposed to overcome any significant environmental issues.

The present phase of Pandharwani Mine is an underground mine for production of Mn ore of 10000 tons/Yr. The mine is to operate between MRL 225 to 205. The surface elevation at 14.9 ha mine lease area varies between 345 and 340 m amsl. There exist no natural surface water drainage/ nala/stream within the mine lease area. Groundwater occurrence is restricted only to the phreatic aquifer developed in the weathered zones of quartz mica schist, the host rock. The UG mining operation are restricted within the hard and massive zone. Thus, the underground mining generates very limited quantity (41KLD) of water as mine discharge, mostly coming in the form of seepage from top phreatic zone (top 10-12m). The extracted groundwater from mine is fully utilized for mining operation and maintaining green belt within ML area after de-siltation at three level. As such there is no significant impact of mining on groundwater regime in this hard rock terrain as the radius of influence is very much restricted due to high heterogeneity. The existing dug well (Photo below-**Fig 7.1**) in front of mine office Pandharwani mine is in use for domestic and drinking purpose maintaining water level throughout the year is hardly 500m from active mining phase. The mine is in operation for last >15 years but the dug well maintain its water level steadily.

Fig 7.1 Dug well within mine lease area of the mine

7.1. Impact on surface water sources– The Pandharwani Mine is situated on a local high within a regional low as depicted in the **Fig 7.2.** No nala/stream exist or generates from ML area of Pandharwani mine. The ML area is not situated within any wetland zone and not part of any national park etc. Other existing small ponds/ water bodies within core and buffer zone has been investigated and the water quality is found normal.

7.1.1 Diversion of existing channels [constructed dam/barrages/weir/canals/hydro-electric projects] – No existing channel, constructed dam/barrages/weir/canals/hydro-electric projects etc need to be diverted due to the project. Thus 7.1.1 is not applicable.

7.1.2 Change in land use [change in flood plain, lotic & lentic systems etc.]-No nala/stream/ river exist or generates from ML area of Pandharwani mine. The ML area is not situated within any wetland zone thus change in land use in flood plain, lotic & lentic systems etc is not applicable.

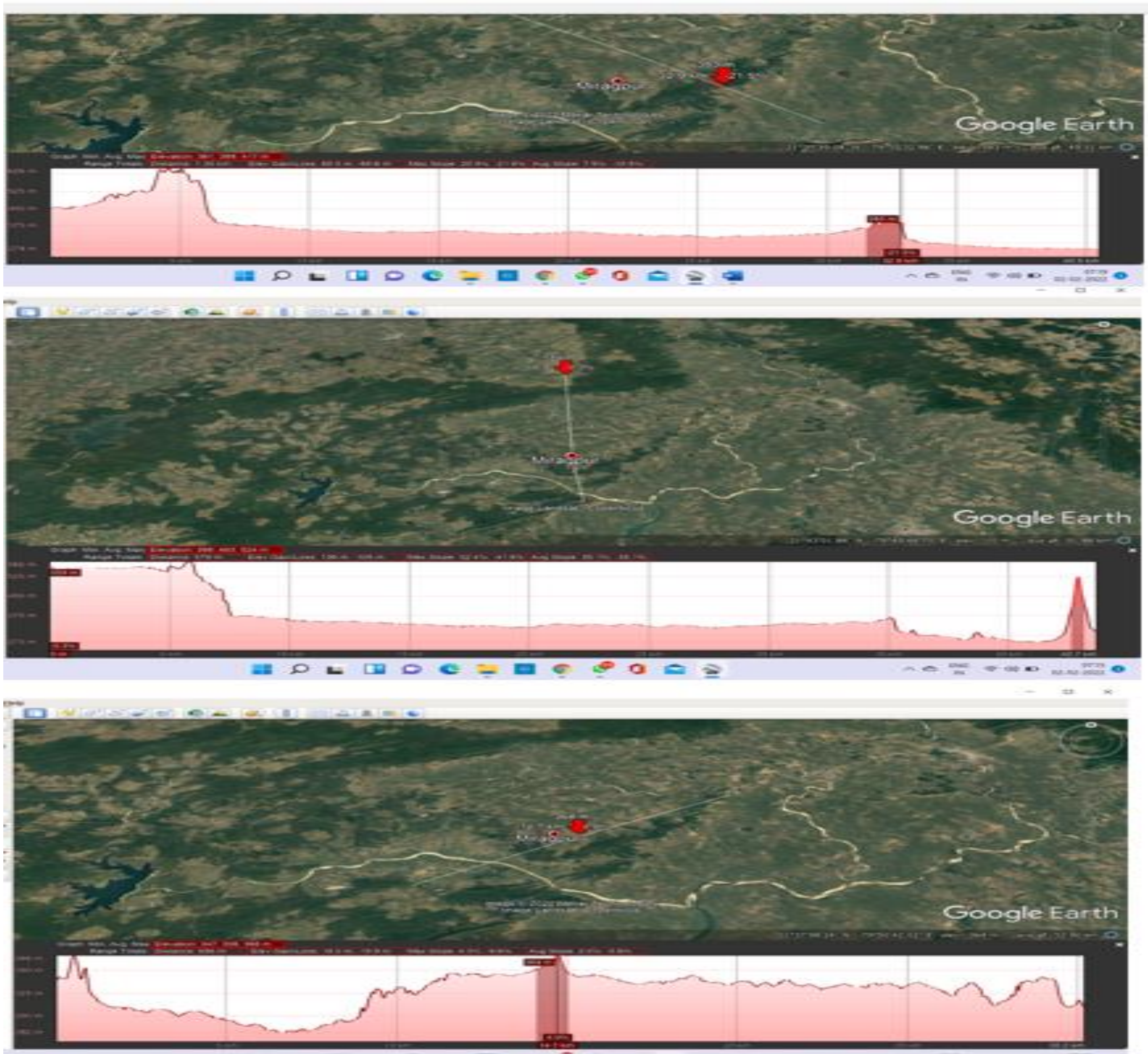


Fig 7.2 Google elevation profile of study area around Pandharwani Mine from three directions

7.1.3 Current & Potential threats- The ML area is situated onto a water divide from where no nala stream is generating nor any spring ever exist in the area. However, due to moderate rainfall of >1150mm with about 70 rainy days good quantum of runoff (~ 7.7ham/yr) generates from the area as calculated considering about 45% runoff coefficient-

14.9ha x 1.151m x 0.45=7.7ham/yr.

Garland drains are existing to channelize the generated runoff for impounding the water into a water conservation tank. Runoff collected within the pre-existing abandon opencast pit of Pandharwani mine lease area is also gainfully utilized for conservation. It is observed that the core zone having average groundwater level 6m bgl in comparison to that of buffer zone av 5m bgl. This can be due to the higher surface elevation of core zone, which is found av. 342 m amsl, in comparison to buffer zone of 315m amsl. To negotiate any potential threat of groundwater decline in the core zone area rainwater harvesting involving abandon mine pits and ponds are in practice.

7.2 Impact on groundwater sources– The Pandharwani mine lease area is in Khairlangi block of Balaghat district, MP which is categorized under **safe** category (Stage of GW Extraction 33%) by the latest estimation carried out by CGWB (2020). The groundwater levels measured in study area remain shallow (4-8m) throughout the year with 2-3m fluctuation. The area is part of hard rock terrain and consist only phreatic aquifer developed over the weathered zone of quartz mica schist. The thickness of the weathered zone is restricted to top 12-17 m as observed along open case mine pits and by geophysical investigations. Both dug wells and hand pumps are tapping this phreatic aquifer. Bore wells are scanty having a depth of maximum 30m tapping weathered zone and occasional fractures. The present ML is for development of underground mine to extract ore from MRL 225-205 that is about 115m below surface elevation. Present active mining zone is devoid of any water bearing formation and are aquifuge in nature. Little water extracted from mine as mine discharge (41KLD) is mainly the seepage from phreatic zone through pre-existing exploratory holes within mine tunnel or from wall seepage from top. The phreatic aquifer zone is protected and recharged by construction of rainwater harvesting ponds and through abandon open case pits in the core zone of mining.

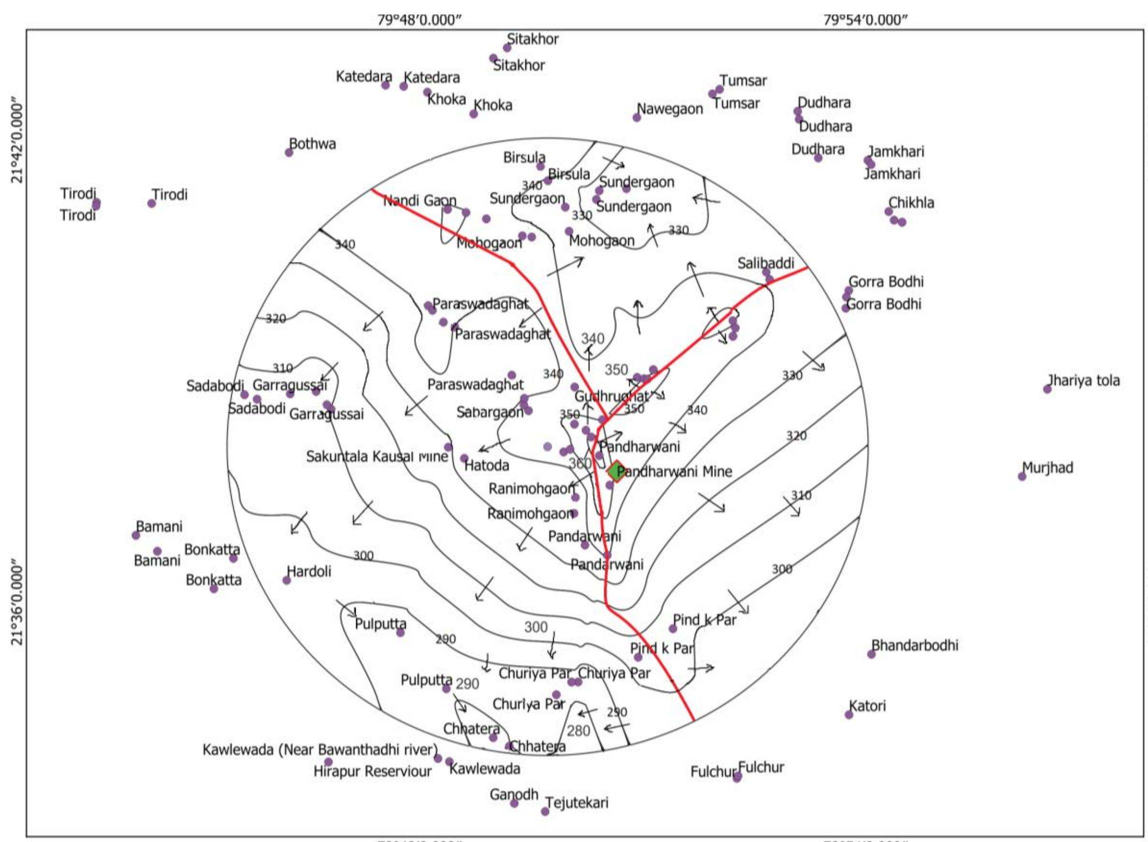
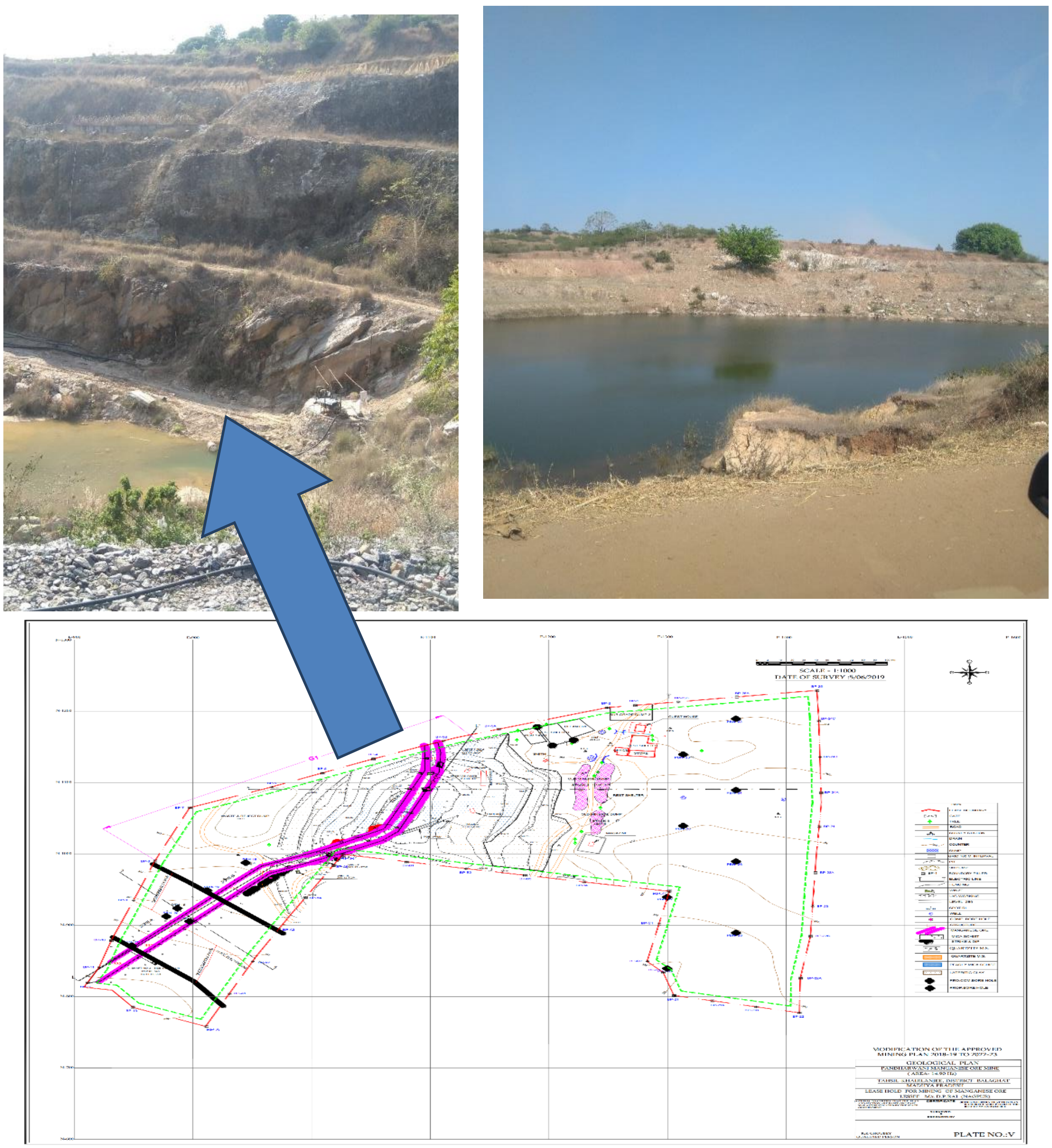


Fig 7.3 Groundwater contour map of Pandharwani mine area.

INDEX-Red line shows groundwater divide, arrows indicating groundwater flow direction, values indicate groundwater elevation (m amsl), dots indicate data point used for generation of GW contour, buffer zone is marked by 10km radius circle. Note the mine position (green box) situated near GW divide.

7.2.1. A description of the impacts on environmental values that have occurred, or are likely to occur, because of any past ground water abstraction. The ML of Pandharwani mine was obtained in the year 2000 for open cast (OC) mine. The OC miningafter completion closed in the year 2018byachieving bottom level of MRL300 starting from MRL 348. UG mine was started in July 2018. The pit so developed is presently used as first settling pit for mine discharge. Water from this pit is pumped out to second de-siltation chamber using a 200m long open cannel by gravity drain. This further reduces the suspended load. The overflow of second pit accumulates to the final settlement cum water conservation pond. All runoff generated within the pit of abandon OC mine thus also collected and stored at final conservation pond. It was observed in the LULC map that area covered under water body has increased from 60 ha to 123ha (Table 1.2).



7.4 Existing abandon open cast mine pit and water harvesting pit near Pandharwani mine (photo March 2022) and mine plan. Note the bottom of OC pit in plan and photo shown by arrow.

7.2.2 An assessment of the likely impacts on environmental that will occur, or are likely to occur, because of the ground water abstraction for a five-year period starting on the consultation day for the report; and over the projected life of the resource project area, affected area and radius of influence.

The underground mining has obtained its present approved depth of mining MRL225, and the phase development is in progress at this depth. This zone is aquifuge in nature not producing any mine discharge. Even for blast hole drilling water from storage is in use. However, approval for further mining down to depth of MRL 205 is being applied. Since no water bearing fracture zones are available in beyond the depth of 17m therefore it is likely to have no significant change of mine discharge over the projected life of mine. Further, due to high heterogeneity of aquifer in the area the radius of influence is observed less than 500m and vertical seepage is not going to change as mine opening remain same as it is.

7.3. Socio-Economic Aspects:

7.3.1 Settlements and population dynamics around project area

The study area comes under rural. There exists about 35 villages in the study area and their details are given in Table 7.1 and 7.2.

Table 7.1 Crop production details of Balaghat District Madhya Pradesh in kharif and Rabi

	Kharif		**Rabi**	
Sr. no	Crops	(Ha)	Crops	(Ha)
1	Rice	244.9	Linseed	19.0
2	Minor Millets	12.8	Wheat	18.4
3	Pigeonipea	7.1	Chickpea	10.4
4	Maize	05.6	Rapeseed/ mustard	7.30

There is no impact of groundwater withdrawal by Pandharwani Mn Mine on the study area, study can recommend NOC may be extended for next 5 yr with existing 41KLD extractions from groundwater system

7.3.2 Dependency on sources of water [surface or sub-surface] The area by and large depends on rain-fed agriculture with supportive irrigation. Surface water irrigation using canal water is the main source of irrigation within the buffer zone. Local canals network isdeveloped using the water of minor irrigation projects like Hirapur, Tirodi, Sitalgarh and Sadabodi Dam/Reservoirs. Water bodies developed on abandon mine pits are also used as sources of water for irrigation along with some dug wells. Drinking water is mainly catered by groundwater through dug wells and hand pumps. Industrial use of water in the study area is largely remains within the mining sector. Several open cast and underground mine lease area exist within the study area. Mine discharge is the main source of water for mining operation. No other significant industrial use exists in the area.

7.3.3 Ground water uses [e.g. irrigation (irrigation method, number of watering) water supply etc.] Groundwater plays secondary role in irrigation in the study area. The main crop is kharif uses supportive irrigation largely through canals of minor irrigation projects. Mine out pits locally also support the crop water requirement. Dug well fitted with electrical pumps are used to support kharif and rabi crops in the area. The unit draft of dug wells varies from 0.0027 to 0.036 mcm/year.Mine discharge is being used for horticulture within core and buffer zone.

Table 7.2 Population data of study area in parts of Khairlanji, Tirodi and Lalbarra blocks

S. No.	Location	House	Total Population	Male	Female	Area (Ha)
1	Bhandarbodhi	838	3520	1690	1830	1412.2
2	Birsula	186	2620	1309	1311	363.3
3	Bonkatta	852	3403	1741	1662	195.3
4	Chhatera	430	1746	893	853	422.6
5	Chikhla	607	2316	1166	1150	873.3
6	Churiya Par	249	960	484	476	606.1
7	Dudhara	285	984	492	492	257.2
8	Fulchur	489	1858	891	967	742.3
9	Garragussai	119	498	242	246	221.1
10	Goorabodi	239	761	392	369	352.2
11	Gudhrughat	452	1732	830	902	403.8
12	Hardoli	732	3126	1523	1603	704.6
13	Hatoda	328	1333	664	669	483.55
14	HirapurReservio ur	134	507	241	266	302
15	Jamkhari	172	554	259	295	311.6
16	Katedara	319	1415	733	712	466.1
17	Katori	701	2726	1365	1361	932
18	Kawlewada	571	2179	1067	1112	541.34
19	Khoka	280	1269	635	634	283.12
20	Miragpur	389	1418	712	706	328.2
21	Mohogaon	401	1477	746	731	378.42
22	Murjhad	216	907	450	457	448.71
23	Nandi Gaon	426	1848	923	925	447.1
24	Nawegaon	322	1340	659	681	282.9
25	Pandarwani	190	711	332	379	281.1
26	Paraswadaghat	662	2583	1230	1353	889.47
27	Pind k Par	460	1927	949	978	593.42
28	Pulputta	613	2691	1332	1359	697.7
29	Sabargaon	434	1533	748	785	547.83
30	Sadabodi	181	721	354	367	208.83
31	Salibardi	771	2839	1375	1464	870.3
32	Shankar Pipariya	452	1559	776	783	465.9
33	Sukdighat	295	1207	606	601	438.2

34	Tekadighat	409	1594	768	826	646.9
35	Tumsar	201	766	379	387	213.6

7.3.4 Improvement / decline in agricultural yield in last 5 years and likely impact after NOC

The average agriculture yield has not changed in last 5 year. The area is of hard rock terrain and the aquifer is quartz mica schist having radius of influence less than 500m as observed the mine core area. So, no likely negative impact of NOC is inferred. Rather LULC shows increase of water body area may provide additional irrigation source

7.3.5 Impact of existing project on local communities [based on local interactions (interactions must be with stakeholders like fishermen community, farmers etc.]

M/s D.P. Rai, Nagpur, is a partnership firm registered under Indian Partnership Act, 1932. Pandharwani Manganese mine is engaged in the mining activities since decades. Pandharwani Manganese mine is located in Pandharwani village, Tehsil Khairlanji, District Balaghat, Madhya Pradesh. It extracts Mn by both underground. The industry has provided employment to the region. The groundwater withdrawal of maximum 41KLD has not created any adverse impact on the groundwater regime of the area. The average water level in study area in pre monsoon period is 5 to 10 m and 2.5 to 6 m during monsoon period. The biggest advantage of the study area is that a seasonal river called Bawanthadi flow in monsoon period of July to October that protects the area from any adverse impact on groundwater. Further the Pandharwani Mn mine has taken up the rainwater harvesting and artificial recharge structure in the lease area. LULC data shows marginal decline in cultivated land in the 10km radius. However, as a whole no complain is observed.

8. Proposed measures for disposal of wastewater by mine drawing saline water.

The water in the study area including mine discharge is fresh and the TDS is ranges between 150 and 1900 ppm in general so disposal of saline water not applicable.

9.0 Water Conservation

Measures to be adopted for water conservation which includes recycling, reuse, treatment, etc. This includes the water balance chart being adopted by the firm along with details of water conservation methods to be adopted. - Brief write up along with capacity and flow chart of Sewage Treatment Plants / Effluent Treatment Plants / Combined Effluent Treatment Plants existing/ proposed within the project. - Details of water conservation measures to be adopted to reduce/ save the ground water. - Total water balance chart showing the usage of water for various processes.

The entire mine discharge (41KLD) is consumed for various mine operation/dust suppression/ plantation-horticultural use (Table 9.1).The mine discharge except high suspended particle is fresh and three step of de-siltation is being practice as discussed previously before the water is stored for further use and or conservation. No sewage treatment plant /effluent treatment plan is in operation, or it is required for mine discharge.

Water conservations can be enhanced by including efficient measures of water use for mining and domestic consumption, effective reuse and recycles of water and treated water, adoption of appropriate rainwater harvesting and artificial recharge methods. It is therefore following sub topics are incorporated in this chapter.

9.1 Water use and water balance

9.2 RWH and Artificial Recharge

9.1 Water use and water balance

Pandharwani Manganese mine is engaged in the mining activities since decades.Water is being used for dust suppression, greenbelt, domestic drilling and sand stowing purposes shown in the table no 3.1

9.2. Rainwater Harvesting & Artificial recharge:

Pandharwani mine having an area of14900 m²having a perimeter of 1144m and its land use is discussed in chapter 1.4 and table 1.1. The mine has taken up concentrated effort conserve each drop of rain water that the campus receives annually. Storm water garland drain has been constructed all along the mining area, office and staff quarter. A settling pond has been constructed adjacent to the shaft which acts as a collection center of mine discharge. Another cemented settling pond has been constructed on the other side for the collection of mine water. A recharge structure has been constructed, where water gets collected from the uplands through drains. This is again connected to a large recharge structure having an area of 3108 m3 and depth of 3 m. This structure ism2 able to collect water from area of 54758 m2 and can recharge about 31486 m3/yr calculated below. The collected water is again used in agriculture purposes of the surrounding areas. The run-off co-efficient has been taken 85% here. The settling ponds and recharge structures are shown below.

Recharge Water= Area x normal rain fall x runoff coefficient

Q=54758x1.15x0.5=31486m3

Table 9.1: Water Utilization in Pandharwani Mine Area (Area = 14.90 Ha)			
Sr.no	**Purposes**	**Environmental Clearance (KLD)**	
		Proposed (KLD)	**Actual (KLD)**
1	Dust suppression	41KLD	5
2	Green belt		4
3	Domestic		2
4	Drilling		10
5	Sand stowing		20
Totals			**41KLD**


Fig:9.1 Existing rainwater harvesting pond cum storage tank in study area

Fig: 9.2 Showing two settling ponds for collection of mine discharge

Table 9.2 Ponds and water bodies of study area									
S. N.	**Location**	**Latitude**	**Longitude**	**Elevation**	**EC (µS)**	**pH**	**TDS (ppt)**	**DO (mg/l)**	**Water body**
1	Pandharwani	21.63169	79.840268	364.51	540	8.1	120	6.2	Pit Mine
2	Goorabodi	21.65752	79.870229	343	580	8.1	250	9.4	Pond
3	Yerwaghat	21.65932	79.870783	335.56	950	7.3	320	5.88	Pond
4	Gorra Bodhi	21.66741	79.89621	337.4	780	8.2	280	4.8	Pond
5	Chikhla	21.68219	79.908152	343.59	980	8.2	320	6.2	Pond
6	Nandi Gaon	21.68292	79.814956	342.53	850	8.1	320	10.34	Pond
7	Mohogaon	21.68023	79.8335	334.1	790	8.5	335	6.46	Pond
8	Sundergaon	21.68946	79.846363	320.15	790	8.1	250	6.9	Pond
9	Khoka	21.71033	79.801737	346.83	450	8.4	310	5.9	Pond
10	Tirodi	21.68648	79.727579	358.18	440	7.3	160	2.7	MOIL Reservoir
11	SakuntalaKausal Mine	21.63351	79.806412	328.59	610	8.1	310	4.79	Mine Pit
12	Churiya Par	21.5827	79.835526	280.27	640	8.3	220	4.93	Pond
13	HirapurReservi our	21.56538	79.779562	299.59	550	8.1	160	6.1	Reservoir
14	Fulchur	21.56236	79.871388	294.63	910	8.4	350	5.77	Pond
15	Miragpur mine	21.63247	79.832276	344.78	630	8.1	320	5.48	Recharge pit
16	Pandharwani Mine	21.62528	79.84262	360.09	450	8.3	150	6.9	Recharge structure

Fig: 9.3 Recharge Structure in Study area

Fig: 9.4 Agriculture land in the mine area

9.3. Monitoring, Measurement and Capacity building

Monitoring and measurements of several parameters are part of water conservation strategy towards the motive of efficient management of water. The withdrawal of groundwater is regularly monitored and measured from the existing dug well. The water level is found at 5-10 m bgl in pre-monsoonal period, which varies from 2.5-6 m bgl in the monsoonal period. The Pandharwani mine conducts regular capacity building of its maintenance staff that monitors and measures and keeping record of various data related to water use and water conservation. The workers have been trained for keeping record and onward submission of data as per the requirement.

For monitoring of groundwater level in the area of Pandharwani mine, Balaghatas per the guideline of CGWA, a piezometer has to be constructed at the area. The installation of piezometer is proposed exclusively for monitoring of groundwater level deploying automatic water level recorder with telemetric arrangement of data transmission.

Proposed Roof top rainwater harvesting structure

A roof top rainwater harvesting is proposed using standard deign as given below for mine office and associated building at the mine core zone by drilling of 30m deep 6’’ dia bore well (**Fig 9.5**) in addition to existing recharge structure (Fig 9.1).

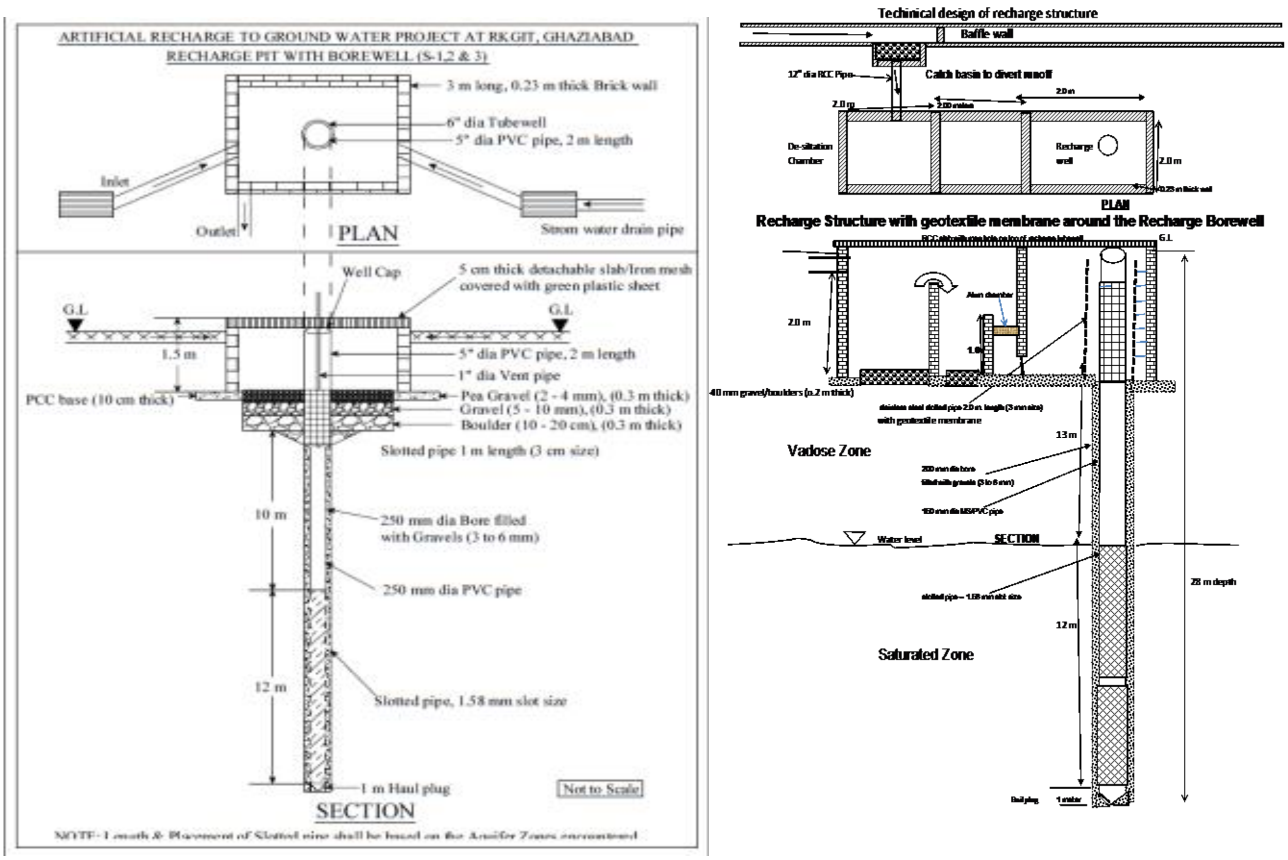


Fig 9.5 Design of proposed rooftop rain water harvesting structure

10. Any other details pertaining to the project

Manganese ore- Manganese ore horizon comprising of mostly manganese ore and manganiferous quartzite of Mansar Formation. The manganese ore is massive in nature containing mainly psilomelane. The trend of the manganese ore deposit is mostly NNE-SSW and the angle of dip is varying from about 750 to 800 due WEST as such there is every possibility of availability manganese ore in the hanging wall side. Ore body width ranges between 10-12m in general. However, in SW direction at 265 MRL and 250 MRL in ore drive, the width has increased to 20 m width over a strike length of 50m before it terminates and plunges.

Annexure-1 DATASET PANDHARWANIAREA, BALAGHAT											
S. N.	**Location**	**Latitude**	**Longitude**	**Elevation**	**EC (mS)**	**pH**	**TDS (ppt)**	**Water Level(m)**	**Diameter(m)**	**DO (mg/l)**	**Type of water body**
1	Pandharwani	21.631688	79.840268	364.51	540	8.1	120			6.2	Pit Mine
2	Miragpur	21.635695	79.838438	363.08	1700	6.8	860			6.54	Hand Pump
3	Miragpur	21.637156	79.837283	355.2	1690	7.2	850				Hand Pump
4	Miragpur	21.639436	79.840974	349.52	1420	7.5	230			2.38	Hand Pump
5	Sukdighat	21.648613	79.848755	342.09	1560	7.2	650	7	2.7	4.53	Dug well
6	Sukdighat	21.648322	79.850303	351.71	1830	7.2	920			2.72	Hand Pump
7	Sukdighat	21.648242	79.851071	353.48	2550	7.3	1230				Dug well
8	Sukdighat	21.650272	79.852384	346.06	2100	7.1	1000			2.4	Hand Pump
9	Sukdighat	21.650272	79.852384	346.06	1990	7.8	1050	6.7	2.5		Dug well
10	Goorabodi	21.657518	79.870229	343.65	1105	7.5	220			2.5	Hand Pump
11	Goorabodi	21.657518	79.870229	343	580	8.1	250			9.4	Pond
12	Goorabodi	21.657518	79.870229	343.56	1250	7.2	300			3.05	Hand Pump
13	Yerwaghat	21.65932	79.870783	335.56	950	7.3	320			5.88	Pond
14	Goorabodi	21.66087	79.870203	353.74	740	7.1	370				Hand Pump
15	Salibardi	21.671405	79.877707	336.32	680	6.5	150				Hand Pump
16	Salibardi	21.669789	79.878459	335.46	650	7	250				Hand Pump
17	Gorra Bodhi	21.667408	79.89621	337.4	780	8.2	280			4.8	Pond
18	Gorra Bodhi	21.665994	79.895665	331.16	680	7.4	320	4.8	2	4.2	Dug well
19	Chikhla	21.66357	79.895535	333.95	1220	7.5	620	6	2.8	2.05	Dug well

20	Chikhla	21.684507	79.905157	328.48	1450	7.2	720				Hand Pump
21	Chikhla	21.682636	79.906358	332.58	1910	6.9	960	8	2	3.61	Dug well
22	Chikhla	21.682192	79.908152	343.59	980	8.2	320			6.2	Pond
23	Chikhla	21.682192	79.908152	343.59	530	7.8	260				Hand Pump
24	Miragpur	21.638487	79.8347	353.81	650	7.3	320				Hand Pump
25	Sabargaon	21.641404	79.824406	343.13	1780	6.4	890				Hand Pump
26	Sabargaon	21.642618	79.823377	342.44	3800	6.8	1900	6.5	2	2.6	Dug well
27	Sabargaon	21.644069	79.823462	340.76	2960	6.9	1480				Hand Pump
28	Paraswada ghat	21.649093	79.820654	328.59	660	7.5	320				Hand Pump
29	Paraswada ghat	21.659513	79.807917	338.8	1005	7.3	520	7	2.5	7.2	Dug well
30	Paraswada ghat	21.660558	79.80533	351.76	910	7.8	450				Hand Pump
31	Paraswada ghat	21.664135	79.801919	340.53	2680	7.1	1340				Hand Pump
32	Paraswada ghat	21.66312	79.802876	343.89	3630	6.8	1820				Hand Pump
33	Nandi Gaon	21.684963	79.806272	339.63	600	7.7	300				Hand Pump
34	Nandi Gaon	21.684272	79.810401	339.84	1920	6.9	970				Hand Pump
35	Nandi Gaon	21.682917	79.814956	342.53	850	8.1	320			10.34	Pond
36	Mohogaon	21.679234	79.823017	339.12	530	7.7	260				Hand Pump
37	Mohogaon	21.678983	79.825131	346.41	1360	7.2	690				Hand Pump
38	Mohogaon	21.68023	79.8335	334.1	790	8.5	335			6.46	Pond
39	Sundergaon	21.68713	79.839619	326.1	720	7.3	360				Hand Pump
40	Sundergaon	21.689001	79.840266	326.3	2640	6.7	1330				Hand Pump
41	Sundergaon	21.685458	79.832651	333.14	890	7.3	440				Hand Pump

42	Sundergaon	21.689457	79.846363	320.15	790	8.1	250			6.9	Pond
43	Nawegaon	21.704839	79.848695	333.17	1590	7.2	790				Hand Pump
44	Tumsar	21.70996	79.865638	332.46	1730	7.2	860				Hand Pump
45	Tumsar	21.710944	79.867237	329.69	1390	7.3	690				Hand Pump
46	Dudhara	21.706201	79.884752	316.42	700	7.2	340				Hand Pump
47	Dudhara	21.704471	79.885074	328.17	760	7.3	380				Hand Pump
48	Dudhara	21.696104	79.889369	314.15	720	7.6	240				Hand Pump
49	Jamkhari	21.695575	79.900478	321.87	1280	7.4	640				Hand Pump
50	Jamkhari	21.694672	79.901208	319.15	1020	7.4	390				Hand Pump
51	Gudhrughat	21.64652	79.834762	340.56	580	7.9	280	4.2	1.5	5.3	Dug well
52	Birsula	21.691179	79.828772	334.89	1020	7.4	540				Hand Pump
53	Birsula	21.694301	79.827105	351.11	1080	7.7	560	4.5	2		Dug well
54	Sitakhor	21.717681	79.816533	341.65	540	7.4	260	5	2		Dug well
55	Sitakhor	21.719929	79.81962	340.24	680	7.3	340				Hand Pump
56	Khoka	21.705623	79.812121	347.08	820	7.7	310	1.45			Borewell
57	Khoka	21.710329	79.801737	346.83	450	8.4	310			5.9	Pond
58	Katedara	21.711607	79.796432	340.47	1040	7.2	340				Hand Pump
59	Katedara	21.711856	79.792357	342.87	880	7.5	440	4	1.5		Dug well
60	Bothwa	21.697268	79.770729	352.42	1430	7.1	740				Hand Pump
61	Tirodi	21.686482	79.727579	358.18	440	7.3	160			2.7	MOIL Reserviour
62	Tirodi	21.685706	79.727475	334.49	840	7.4	320				Hand Pump

63	Tirodi	21.686257	79.739922	332.9	720	7.1	310	4.5	2		Dug well
64	Bamani	21.614417	79.736391	306.33	820	7.1	444	3.5	2		Dug well
65	Bamani	21.610979	79.741213	290.99	1600	7	800				Hand Pump
66	Bonkatta	21.602868	79.753879	286.6	910	7.1	440	6	1.4		Dug well
67	Bonkatta	21.609446	79.758254	295.86	1250	6.9	620				Hand Pump
68	Garragussai	21.641741	79.780165	310.59	740	6.9	220				Hand Pump
69	Garragussai	21.645568	79.776808	301.68	1111	6.7	560	4.3	2.1		Dug well
70	Garragussai	21.645046	79.770978	306.13	1720	7.2	900	5.1	2		Dug well
71	Sadabodi	21.644859	79.760747	305.02	1410	7.2	710				Hand Pump
72	Sadabodi	21.643897	79.763553	309.29	1360	7.4	680	4.4	1.5		Dug well
73	Garragussai	21.642687	79.779196	307.21	710	8	190				Dug well
74	SakuntalaKausal Mine	21.633512	79.806412	328.59	610	8.1	310			4.79	Mine Pit
75	Hatoda	21.631088	79.810027	336.75	550	7.5	220				Hand Pump
76	Ranimohgaon	21.622631	79.83492	329.12	2210	7.2	1005				Hand Pump
77	Ranimohgaon	21.61919	79.834619	329.81	1050	7.5	510	6	2	4.03	Dug well
78	Pandarwani	21.61232	79.837064	337.82	990	7.2	450				Hand Pump
79	Pandarwani	21.61013	79.842064	341.23	880	7.2	380				Hand Pump
80	Pind k Par	21.594223	79.856797	302.82	1050	7.3	460				Hand Pump
81	Pind k Par	21.58805	79.848991	304.45	630	7.4	230				Hand Pump
82	Churiya Par	21.582704	79.835526	280.27	640	8.3	220			4.93	Pond
83	Churiya Par	21.582679	79.834056	285.04	1960	7.5	980				Hand Pump
84	Churiya	21.579936	79.83065	296.6	105	7.5	490	4.5	1.5		Dug well

	Par		6	2	0						
85	Chhatera	21.568803	79.820107	279.78	850	7.6	430				Hand Pump
86	Chhatera	21.57065	79.816498	275.29	690	7.3	290				Hand Pump
87	Pulputta	21.581237	79.805994	280	888	7.3	340				Hand Pump
88	Pulputta	21.593379	79.795693	283.87	1280	7.8	640				Hand Pump
89	Hardoli	21.6047	79.770202	293.23	680	7.3	320				Hand Pump
90	HirapurReserviour	21.565377	79.779562	299.59	550	8.1	160				Reservoir
91	Kawlewada (Near Bawanthadhi river)	21.566132	79.804115	283.19	830	7.3	360	6	1.5		Dug well
92	Kawlewada	21.565443	79.806668	284.96	740	7.8	370				Hand Pump
93	Ganodh	21.556435	79.821225	280.44	1160	7.2	580				Hand Pump
94	Tejutekari	21.554654	79.828149	272.35	1580	7.33	800				Hand Pump
95	Shankar Pipariya	21.547736	79.846168	276	2000	7.3	1000				Hand Pump
96	Fulchur	21.561858	79.871117	293.72	2580	7.3	1290				Hand Pump
97	Fulchur	21.562363	79.871388	294.63	910	8.4	350			5.77	Pond
98	Katori	21.5756	79.896254	279.11	1870	7.4	940	4.2	1.5		Dug well
99	Bhandarbodhi	21.588696	79.901293	277.19	890	7.5	320				Hand Pump
100	Murjhad	21.627167	79.935067	285.51	1020	7.4	250				Hand Pump
101	Jhariya tola	21.646052	79.94073	301.22	890	7.4	430				Hand Pump
102	Miragpur mine	21.63247	79.832276	344.78	630	8.1	320			5.48	Recharge pit
103	Miragpur Handpump	21.633039	79.83373	348.97	710	7.6	350				Hand Pump
104	Pandharwani Mine	21.628271	79.844225	344.4	300	7.4	150	5	3	3.8	Dug well

105	Pandharwani Mine	21.628271	79.844225	344.4	680	7.3	340			2.44	Hand Pump
106	Pandharwani Mine	21.625276	79.84262	360.09	450	8.3	150			6.9	Recharge structure

S. N.	Location	Latitude	Longitude	Elevation	EC (mS)	pH	TDS (ppt)	Water Level (m)	DO (mg/l)	Type of water body
Buffer Zone										
1	Goorabodi	21.657518	79.870229	343.65	1105	7.5	220		2.5	Hand Pump
2	Goorabodi	21.657518	79.870229	343.56	1250	7.2	300		3.05	Hand Pump
3	Goorabodi	21.66087	79.870203	353.74	740	7.1	370			Hand Pump
4	Salibardi	21.671405	79.877707	336.32	680	6.5	150			Hand Pump
5	Salibardi	21.669789	79.878459	335.46	650	7	250			Hand Pump
6	Chikhla	21.684507	79.905157	328.48	1450	7.2	720			Hand Pump
7	Chikhla	21.682192	79.908152	343.59	530	7.8	260			Hand Pump
8	Paraswadaghat	21.649093	79.820654	328.59	660	7.5	320			Hand Pump
9	Paraswadaghat	21.660558	79.80533	351.76	910	7.8	450			Hand Pump
10	Paraswadaghat	21.664135	79.801919	340.53	2680	7.1	1340			Hand Pump
11	Paraswadaghat	21.66312	79.802876	343.89	3630	6.8	1820			Hand Pump
12	Nandi Gaon	21.684963	79.806272	339.63	600	7.7	300			Hand Pump
13	Nandi Gaon	21.684272	79.810401	339.84	1920	6.9	970			Hand Pump
14	Mohogaon	21.679234	79.823017	339.12	530	7.7	260			Hand Pump
15	Mohogaon	21.678983	79.825131	346.41	1360	7.2	690			Hand Pump
16	Sundergaon	21.68713	79.839619	326.1	720	7.3	360			Hand Pump
17	Sundergaon	21.689001	79.840266	326.3	2640	6.7	1330			Hand Pump
18	Sundergaon	21.685458	79.832651	333.14	890	7.3	440			Hand Pump
19	Nawegaon	21.704839	79.848695	333.17	1590	7.2	790			Hand Pump
20	Tumsar	21.70996	79.865638	332.46	1730	7.2	860			Hand Pump
21	Tumsar	21.710944	79.867237	329.69	1390	7.3	690			Hand Pump
22	Dudhara	21.706201	79.884752	316.42	700	7.2	340			Hand Pump
23	Dudhara	21.704471	79.885074	328.17	760	7.3	380			Hand Pump
24	Dudhara	21.696104	79.889369	314.15	720	7.6	240			Hand Pump
25	Jamkhari	21.695575	79.900478	321.87	1280	7.4	640			Hand Pump
26	Jamkhari	21.694672	79.901208	319.15	1020	7.4	390			Hand Pump
27	Birsula	21.691179	79.828772	334.89	1020	7.4	540			Hand Pump
28	Sitakhor	21.719929	79.81962	340.24	680	7.3	340			Hand Pump
29	**Khoka**	**21.705623**	**79.812121**	**347.08**	**820**	**7.7**	**310**	**145**		**Borewell**
30	Katedara	21.711607	79.796432	340.47	1040	7.2	340			Hand Pump
31	Bothwa	21.697268	79.770729	352.42	1430	7.1	740			Hand Pump
32	Tirodi	21.685706	79.727475	334.49	840	7.4	320			Hand Pump
33	Bamani	21.610979	79.741213	290.99	1600	7	800			Hand Pump
34	Bonkatta	21.609446	79.758254	295.86	1250	6.9	620			Hand Pump
35	Garragussai	21.641741	79.780165	310.59	740	6.9	220			Hand Pump
36	Sadabodi	21.644859	79.760747	305.02	1410	7.2	710			Hand Pump
37	Hatoda	21.631088	79.810027	336.75	550	7.5	220			Hand Pump
38	Pind k Par	21.594223	79.856797	302.82	1050	7.3	460			Hand Pump
39	Pind k Par	21.58805	79.848991	304.45	630	7.4	230			Hand Pump
40	Churiya Par	21.582679	79.834056	285.04	1960	7.5	980			Hand Pump
41	Chhatera	21.568803	79.820107	279.78	850	7.6	430			Hand Pump
42	Chhatera	21.57065	79.816498	275.29	690	7.3	290			Hand Pump
43	Pulputta	21.581237	79.805994	280	888	7.3	340			Hand Pump
44	Pulputta	21.593379	79.795693	283.87	1280	7.8	640			Hand Pump
45	Hardoli	21.6047	79.770202	293.23	680	7.3	320			Hand Pump
46	Kawlewada	21.565443	79.806668	284.96	740	7.8	370			Hand Pump
47	Ganodh	21.556435	79.821225	280.44	1160	7.2	580			Hand Pump
48	Tejutekari	21.554654	79.828149	272.35	1580	7.33	800			Hand Pump
49	Shankar Pipariya	21.547736	79.846168	276	2000	7.3	1000			Hand Pump
50	Fulchur	21.561858	79.871117	293.72	2580	7.3	1290			Hand Pump
51	Bhandarbodhi	21.588696	79.901293	277.19	890	7.5	320			Hand Pump
52	Murjhad	21.627167	79.935067	285.51	1020	7.4	250			Hand Pump
53	Jhariya tola	21.646052	79.94073	301.22	890	7.4	430			Hand Pump
CORE ZONE										
1	Ranimohgaon	21.622631	79.83492	329.12	2210	7.2	1005			Hand Pump
2	Miragpur Handpump	21.633039	79.83373	348.97	710	7.6	350			Hand Pump
3	Pandharwani Mine	21.628271	79.844225	344.4	680	7.3	340		2.44	Hand Pump
4	Miragpur	21.639436	79.840974	349.52	1420	7.5	230		2.38	Hand Pump
5	Miragpur	21.635695	79.838438	363.08	1700	6.8	860		6.54	Hand Pump
6	Miragpur	21.637156	79.837283	355.2	1690	7.2	850			Hand Pump
7	Miragpur	21.638487	79.8347	353.81	650	7.3	320			Hand Pump
8	Pandarwani	21.61232	79.837064	337.82	990	7.2	450			Hand Pump
9	Pandarwani	21.61013	79.842064	341.23	880	7.2	380			Hand Pump
10	Sukdighat	21.648322	79.850303	351.71	1830	7.2	920		2.72	Hand Pump
11	Sukdighat	21.650272	79.852384	346.06	2100	7.1	1000		2.4	Hand Pump
12	Sabargaon	21.641404	79.824406	343.13	1780	6.4	890			Hand Pump
13	Sabargaon	21.644069	79.823462	340.76	2960	6.9	1480			Hand Pump

Manav Rachna International Institute of Research and Studies

NAAC A++Grade, Deemed-to be- University

BROCHURE

Manav Rachna Centre for Advance Water Technology & Management (MRCAWTM)

July 2023

ABOUT THE CENTRE

Manav Rachna Centre for Advance Water Technology & Management (**MRCAWTM**) was established in 2017 to pursue teaching, research, consultancy and impart training programmes in hydrogeology, water resources engineering and management, water quality and collateral environment and ecology issues. The Centre forms a pool of professionals and researchers from the field of hydrology, hydrogeology, hydrochemistry, eco-hydrology and environment management. Besides, the Center has also developed a skill set on community centric water resource development, socio-hydrology and watershed based sustainable management. The Center aims to address real challenges faced by the stakeholders and also provides a platform for science and technology-based solutions through non-invasive investigation, water quality analysis, recycling of waste water, surface and ground water flow and resource analysis, satellite databased interpretation, local and regional scale hydro-statigraphic analysis, mathematical modeling of water resources and GIS based applications.

Aqua Excellence Awardee 2017

MRCAWTM is having five field units, one each at Barmer, Ballabhgarh, Khol-Rewari, Palwal and Panchkula where two to ten field specialists are working. MRCAWTM in its short period of journey, has been able to achieve significant milestones in the form of projects obtained, executed, and completed. So far 16 projects have been successfully completed between June 2018 and June 2023 of worth ~Rs2.63 Cr. Further, 07 more projects of Rs 12.34 Cr are in progress as on 1st July 2023. MRCAWTM is working for its vision of **clean water for all forever**. The major area of work is divided into 1. R&D Studies, 2. Technical Interventions, 3. Training and Capacity Building, 4. Outreach programs, 5. Product and Innovation. The Center has also established linkage with various Governmental, academic, and non-Governmental agencies through MoUs.

Vision: "Clean water for all forever" (सदा सबके लिए शुद्ध जल)

MRCAWTM has been able to **achieve Accreditation of CGWA, GOI** on 1st Oct 2021 for next 5 yrs. MRCAWTM has grabbed the **Aqua Foundation Excellence Award, 2017** under the category of Institutional Excellence in Resource Management. The faculties of Center have published high impact research papers in National and International Scientific Journals and written Books and Book chapters of reputed publishers.


Accreditation Board of CGWA

Certificate of Accreditation

M/s. Manav Rachna Centre for Advance Water Technology and Management, (MRCAWTM) of (MRIIRS)

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

- Impact Assessment Report without Modelling.
- Hydrogeological Report for mining projects.

Valid from : 01.10.2021
Valid thru : 30.09.2026

Certificate No. : CGWA/RGI/025
Dated : 30.11.2021

क्षेत्रीय निदेशक
Regional Director
RGNGWT&RI

सदस्य
Member
RGNGWT&RI

MOUs OF CENTER

Active MOUs of MR Center for Advance Water Technology and Management, MRIIRS

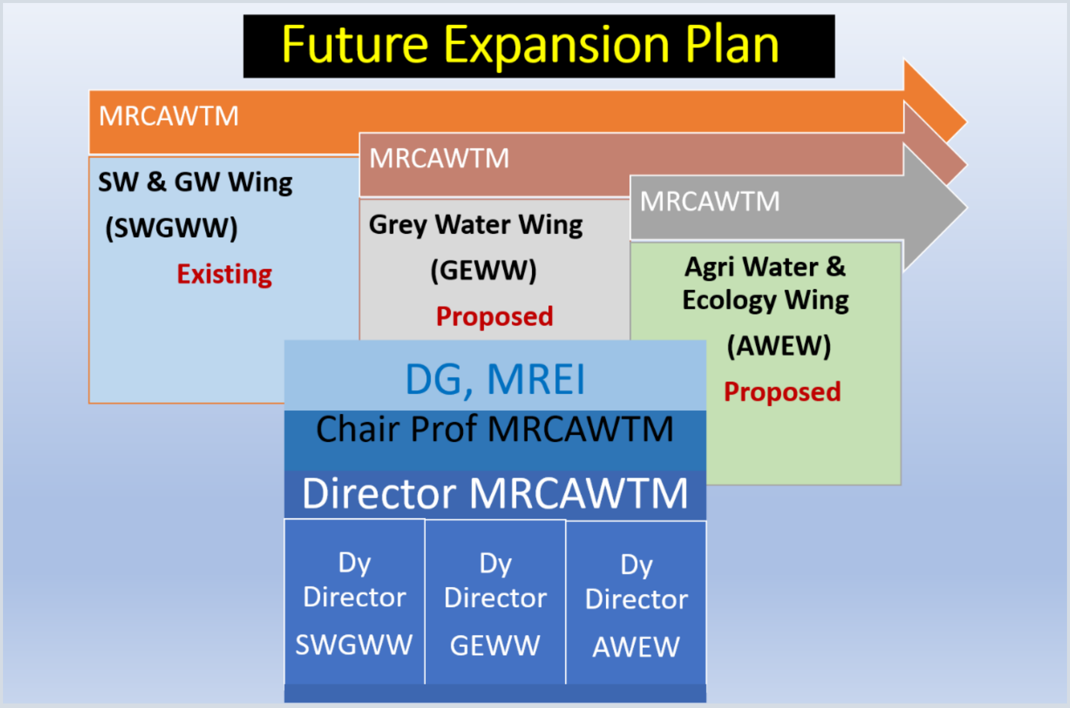
SNo	Name of Organization	Date of MOU	Activates Taken up under MOU	Valid for
1	Central Ground Water Board, MoJS, GOI	26.06.2020	Faculty exchange- CGWB Scientists were invited as External Examiners, MRIIRS Civil Eng, students visited CGWB Campus. MRCAWTM experts attended group discussion at CGWB, Joint Water Summit 2023 on 24th Feb23.	2 Years further Extended
2	Geovale Services Kolkata	18.08.2021	Geovale used our expertise on Rockworks for their project, MRCAWTM experts invited to attend one day workshop at Kolkata on 18th Jan23	4 Years
3	EMTRC New Delhi	21.09.2021	MRCAWTM expert assisted EMTRC in fly ash project.	3 Years
4	CAIRNS-Vedanta Oil & Gas Pvt Ltd Gurugram	11.06.2021	Joint monitoring of aquifers of Barmer area through half yearly hydrocensus of about 1000 water wells.	3 Years
5	IWRD, Govt of Haryana	11.08.2021	MRCAWTM is District Implementation Partner of IWRD in participatory ground water management in Gram Panchayat level in three districts of Haryana	4 Years
6	WCS Bhubaneswar	03.03.2022	MRCAWTM conducted 7 consultancy projects of Fe ore mines for WCS during last one year	5 Years
7	SGSD, Gurugram	01.07.2022	SGSD experts carried out civil construction of ASR systems established under MRCAWTM owned DST Project.	1 Year
8	Ministry of Jal Shakti, WR&RD	12.04.2023	Establishing a Program Support Unit for Namami Gange Under National Water Mission	3 Years

MRCAWTM is accredited under CGWA to prepare reports in the functional areas of 1. Groundwater Impact Assessment 2. Hydrogeological reports of Mining Projects

ON GOING PROJECTS OF MRCAWTM

Sn.	Ongoing Projects of MRCAWTM, MRIIRS	Funding Agency	From Date & Period	Objective
				As on 01st July 2023
1	Co-solving Water logging and Groundwater depletion issue in parts of Faridabad Smart City	WTI, DST, GOI	21 .05. 21 36 months	DST Project on solution to flash flood and groundwater (GW) depletion
2	Hydro Geological Survey for Aquifer Monitoring in Barmer Area, Rajasthan,	Cairn Oil & Gas Vedanta Ltd	02.07.21 36 months	Industrial project on impact study on GW use
3	Haryana Atal Bhujal Yojna-Cluster 06 (Faridabad-Rewari Districts)	IWRD Haryana	11.8.2021 48 months	Haryana Govt Project on improving sustainability of GW through participatory approach at Gram panchayat level in Haryana
4	Haryana Atal Bhujal Yojna-Cluster 07 (Palwal District)	IWRD Haryana	11.8.2021 48 months	
5	Haryana Jal Jeevan Mission – State Implementation Support Agency (SISA)	PHED Haryana	27.09.2021 24 months	Haryana Govt Project on assured household water supply in rural Haryana
6	Haryana Jal Jeevan Mission – Energy Audit State Implementation Support Agency	PHED Haryana	01.11.2022 12 months	Haryana Govt project on auditing energy consumption for GW abstraction
7	Groundwater condition study in core and buffer zone of proposed Iron ore mine around Villages, Eklama, District Kabirdham, CG	WCS Bhubaneswar	01.07.2023 04 months	Impact assessment of mining on GW for NOC under CGWA accreditation.

WAY FORWARD



Completed projects under MRCAWTM, as on 30th June 2023

No	Project Name and Status	Funding Agency	Date of Comp.	Objective
1	Technical guidance in construction of Rainwater Harvesting Structures in Faridabad City	M/s Navjoti Foundation, Gurugram	29.03.2023	Rainwater conservation
2	Impact assessment of mining of Iron ore on GW in and around Raikela Sundargarh Odisha.	M/s WCS Bhubaneshwar, Odissa	08.10.2022 04 months	Impact assessment of Mining on GW
3	Impact assessment of mining of Iron ore on GW in and around Dholta Pahar, Sundergarh, Odissa	M/s WCS Bhubaneshwar, Odissa	04.4.2022 08 months	Impact assessment of Mining on GW
4	Impact assessment of mining of Iron ore on GW in and around Netrabandh Pahar, Sundergarh,	M/s WCS Bhubaneshwar, Odissa	04.4.2022 04 months	Impact assessment of Mining on GW
5	Study for Rainwater harvesting around Iron ore mine of Dholta Pahar, Sundergarh, Odissa	M/s WCS Bhubaneshwar, Odissa	04.4.2022 04 months	Study for Rainwater harvesting in Mining area
6	Study for Rainwater harvesting around Iron ore mine of Netrabandh Pahar, Sundergarh, Odissa	M/s WCS Bhubaneshwar, Odissa	04.4.2022 04 months	Study for Rainwater harvesting in Mining area
7	Biodiversity study around Iron ore mine of Dholta Pahar, Sundergarh, Odissa	M/s WCS Bhubaneshwar, Odissa	04.4.2022 04 months	Study for Biodiversity in Mining area
8	Biodiversity study around Iron ore mine of Netrabandh Pahar Sundergarh, Odissa	M/s WCS Bhubaneshwar, Odissa	04.4.2022 04 months	Study for Biodiversity in Mining area
9	Impact assessment of underground mining of Manganese on GW in and around Miragpur, MP.	M/s D P Rai, Balaghat MP	April 2022 3 months	Impact assessment of Mining on GW
10	Impact assessment of underground mining of Manganese on GW in and around Pandarwani, MP.	M/s D P Rai, Balaghat MP	April 2022 3 months	Impact assessment of Mining on GW
11	Hydro Geological Survey for Aquifer Monitoring in Barmer Area, Rajasthan (2018-21).	Cairns O&G Vedanta Ltd	June 2021 36 months	Industrial project on impact study on GW use
12	Communicating Science through Model Water and Eco-Health Clinic for quality of life.	NCSTC, DST, GOI	May 2020 15 months	Water literacy through hands on experiments for students
13	USAID URBAN WASH Innovation Lab,	USAID-NIUA	Dec 2019 30 months	Awareness on water and sanitation
14	Detailed investigations in Khoh Village for Rainwater Harvesting,	MSF, Gurgaon	April, 2019 3months	Sustainable solutions of groundwater use
15	ISP system for treating saline Groundwater-Techno-Commercial, **abandoned** due to Change in policy of State of Haryana on saline water use	Maharani Innovative Paints Pvt Ltd. Prithla	Sept 2020 12 months	Use of saline water through eco-friendly technology
16	Reconnaissance survey for Water prospect in 10 adopted villages of Maruti-Suzuki Foundation	MSF, Gurgaon	Dec 2018	Sustainable solutions of groundwater use

DST FUNDED PROJECT-FARIDABAD

Co- solving Water Logging and Ground Water Depletion Issue in parts of Faridabad Smart City using Underground Taming of Flood Water for Aquifer Storage and Recovery:

WTC-DST GOI Supported Project No-DST/TMD/EWO/WTT/2K19/EWFH/237(G)&(C)

PI: Dr Arunangshu Mukherjee, Director, MRCAWTM and Co-PI: Dr Nidhi Didwania, BT, MRIIRS

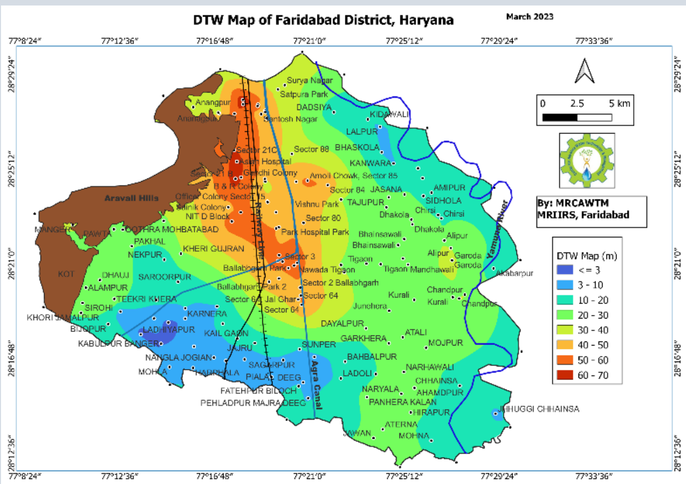
Steps followed for site selection and construction of ASRS at FSC area

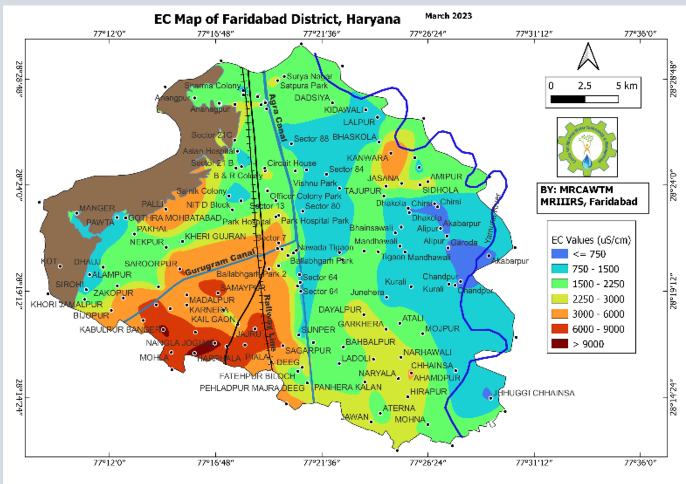
Site selection

1. Joint inspection for finalization of possible locations for construction of ASRS
2. Detailed field investigations on hydrogeology for identification of sites on agreed locations for construction of ASRS
3. Identification and hiring of agencies for Surface geophysical and DGPS study
4. Surface geophysical study and DGPS survey to pin point the site within identified locations.
5. Hydraulic investigations on identified and pinpointed site for catchment delineation
6. Finalization of site for construction of ASRS

Construction of ASRS at FSC area

7. Based on results of detailed hydraulic studies calculated the runoff generation and silt load and dimension of de-siltation, coagulation and filtration chambers for each site.
8. Preparation of working drawing and BOQ for tendering
9. Construction of ASRS involving various steps
    a. Selection of Rig as per the geology of the area for drilling
    b. Drilling of pilot hole on pinpointed site to decipher the aquifer geometry and nature-character of aquifer at selected site and preparation of litho-log
    c. Borehole logging to finalize the well assembly in accordance to the litho-log
    d. Lowing of assembly and construction of gravel pack tube well
    e. Slug test to determine the intake capacity of constructed tube well
    f. Mechanical digging of pits for construction of de-siltation, coagulation and filtration chamber.
    g. Construction of de-siltation, coagulation and filtration chambers as per calculated dimensions given in the working drawing.
    h. Filling of filter material in the filtration chamber constructed around tube well
    i. Roof casting of ASRS
    j. Hanging of Ferric chlorite dope through specially provided hanger in the coagulation chamber
10. Installation of Automatic water level recorder with telemetry at ASRS site
11. Testing of functioning of ASRS during monsoon and finalization of structure.
12. Feedback collection and monitoring of impact and radius influence of the constructed system. Popularization of the concept implemented through various media. Maintenance of constructed ASRS

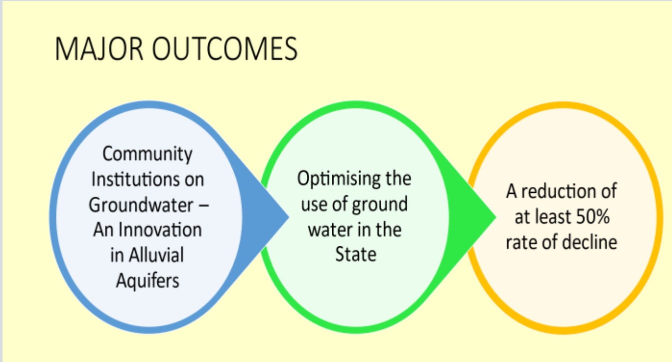


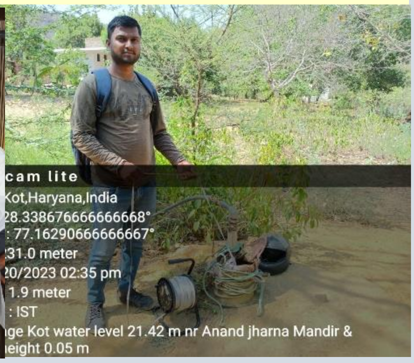


ATAL BHUJAL YOJANA HARYANA

(Sanction no- ABY/2122/26w/952-956 -Cluster06 and Sanction no -ABY/2122/27w/957-961 -Cluster07)

Under World Bank Assisted, Central Sector Scheme of GOI- Atal Bhujal Yojana is being implemented in 14 districts of Haryana by IWRD, Govt of Haryana. MRCAWTM has been engaged as District Implementation Partner for three districts- Faridabad, Rewari and Palwal for an initial duration of 48 months through two projects. The project is about participatory groundwater management utilizing funds through convergence mode. MRCAWTM has to develop Gram Panchayat wise Water Security Plans for 296 GPs of 7 administrative blocks involving Gram Sabha in the planning. The Village Water and Sanitation Committee has to be engaged for data collection for Supply side and Demand Side Management works. The project is approaching to fulfil following objectives:



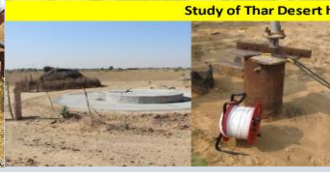


DESERT HYDROGEOLOGICAL STUDIES-BARMER

Hydrogeological studies in Barmer district covering 5900Km2 for last 5 years is summarised below

1. **Depth of wells drilled ranges from120 to 165m (Chowkhla 270 m)**
2. **Water level ranges from 82 to 108 mbgl,**
3. **Zone tapped largely from 90 to 163mbgl, at Chowkhla 234-268mbgl**
4. **Length of slotted casing used 24 to 34 m but one 45m**
5. **Dia of casing/ slotted pipe used 254mm, bore hole dia 508mm**
6. **Depth of lowering of pump 90 to 117m by and large**
7. **Pump HP 20 to 30**
8. **Lignite zone found in two locations at Sheo 60 to 64m and at Siyag 136m**
9. **The Jagadia sandstone aquifer at Siyag having water level 72m bgl**

Study of Thar Desert hydrogeology of Barmer District by MRCAWTM MRIIRS

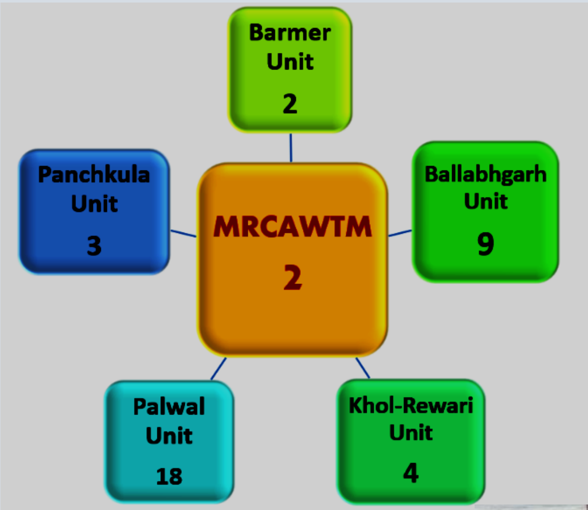


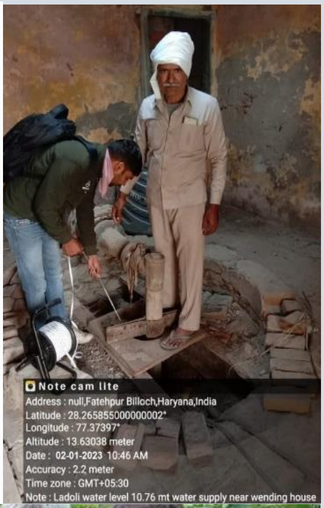
TEAM MRCAWTM

Founder Chair Professor — **Late Dr D K Chadha**, Former Chairman CGWB
(13th April 2017- 30th Dec 2020)

Working Team

Overarching leadership	Dr N C Wadhwa, DG, MREI
ED & Dean Research	Dr Sarita Sachdeva, Professor, Biotechnology
Chair Professor	Dr Dipankar Saha, Former Member CGWB
Director	Dr Arunangshu Mukherjee, Prof & Head, ES&E & Former Scientist, CGWB
Dy Director	Ms Sneha Rai, Assistant Prof, ES&E, SET, MRIIRS
Associates:	Prof Nidhi Didwania, Director, MRCMPP Prof Brijesh Kumar, Dean Academics and Dr H S Saini, Former Director GSI
Research Associates:	Dr S Ali Khan, Sh Sandeep Punia & Mrs Priya Pahil
Field Research Team	Barmer-(2) Ballabhgarh (9) Khol-Rewari (4) Palwal (18) and Panchkula (3) TOTAL=39 person





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