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]

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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.

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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 - 121

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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.

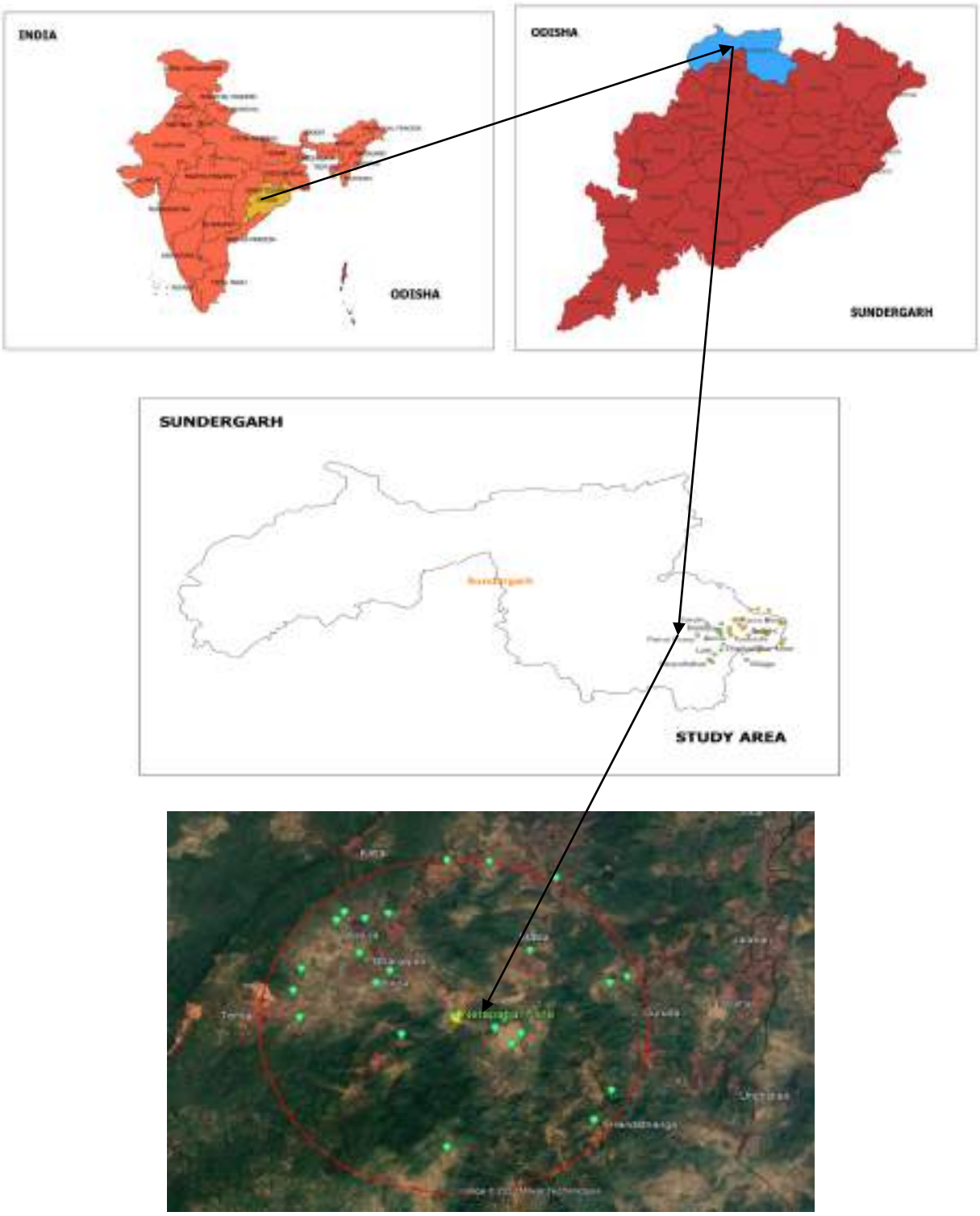


Fig 1.1: Location Map of Netrabandha Pahar Fe Ore Mine, Odisha

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.

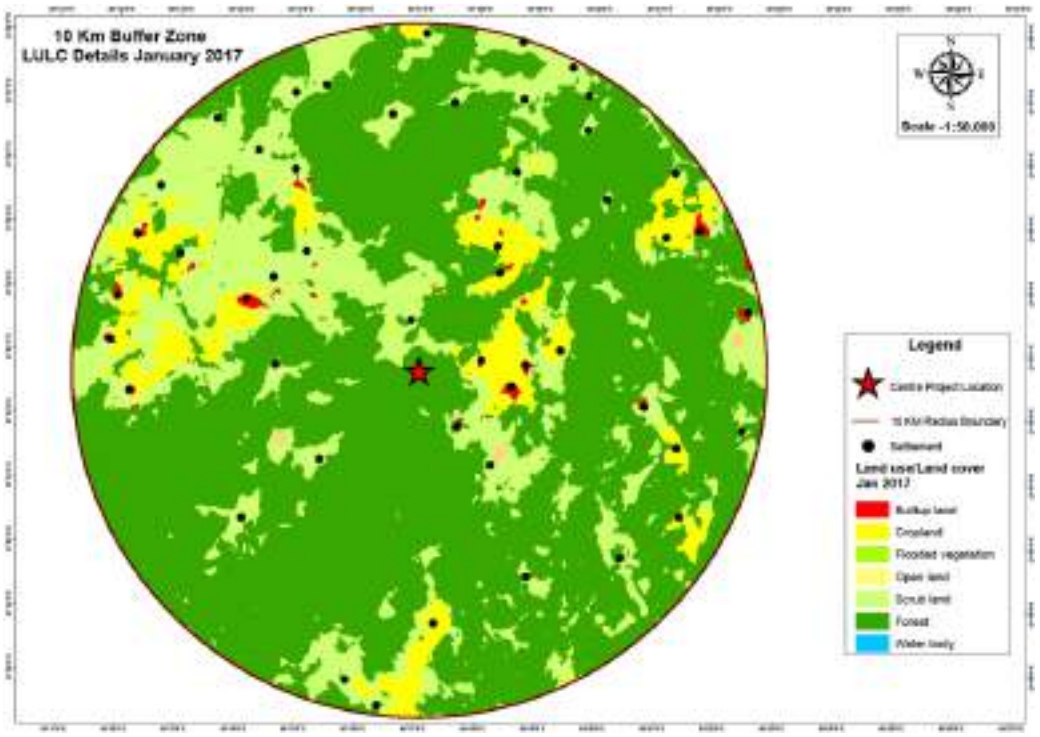


Fig: 1.3 Map showing LULC of Netrabandha Pahar (West) block Fe Ore Mine of 10km buffer zone (Jan 2017)

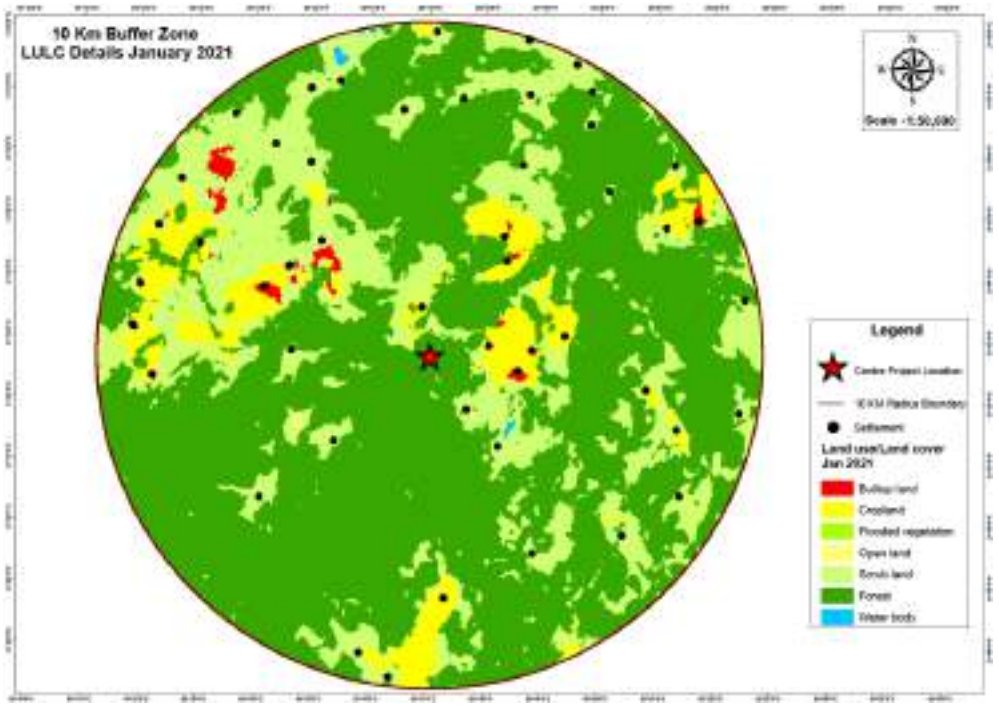
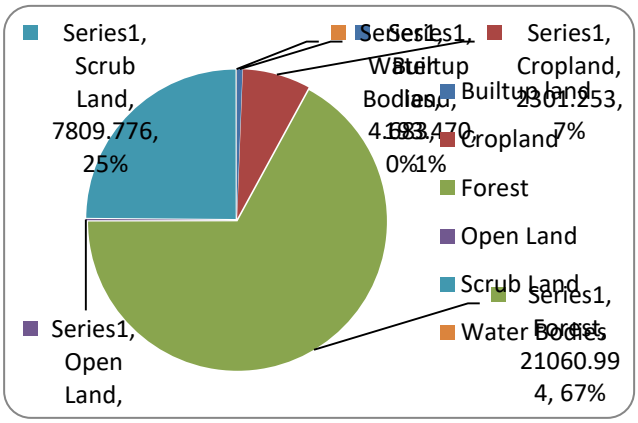


Fig 1.4: Map showing LULC of Netrabandha Pahar (West) Fe Ore Mine of 10km buffer zone (Jan 2021)

Table 1.1: LULC 2017 of study area

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 1.2 LULC 2021 of study area



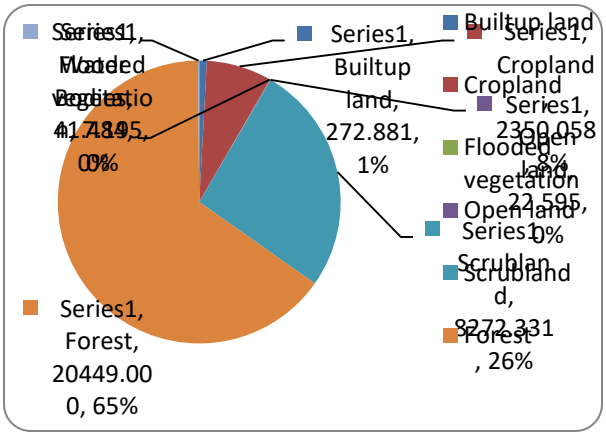


Table 1.3 LULC in core zone within the mine lease area				
Sl. No.	**Particular**	**Area put to use at Start of Year (ha) (A)***	**Additional Requirement (ha) (B)***	**Total (ha) (C = A + B)**
1	Area under Mining	0.00	4.012	4.012
2	Topsoil stacking	0.00	0.00	0.00
3	Overburden/Waste Dumping	0.00	1.375	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)

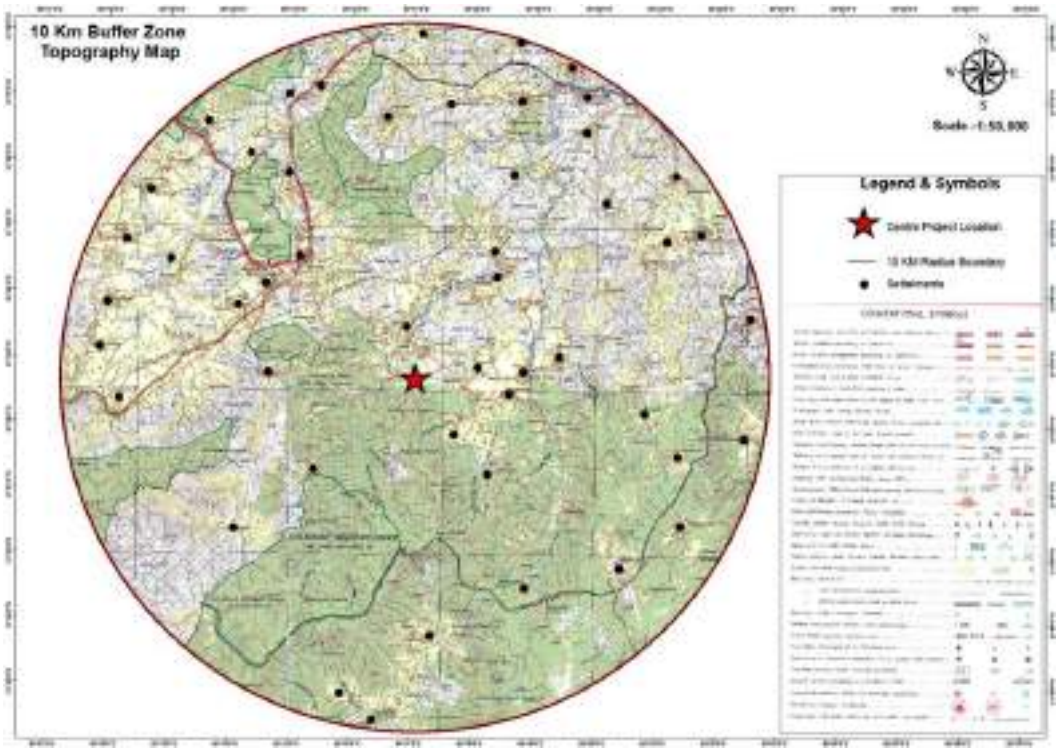


Fig 1.5: Topography Map of 10km buffer zone.

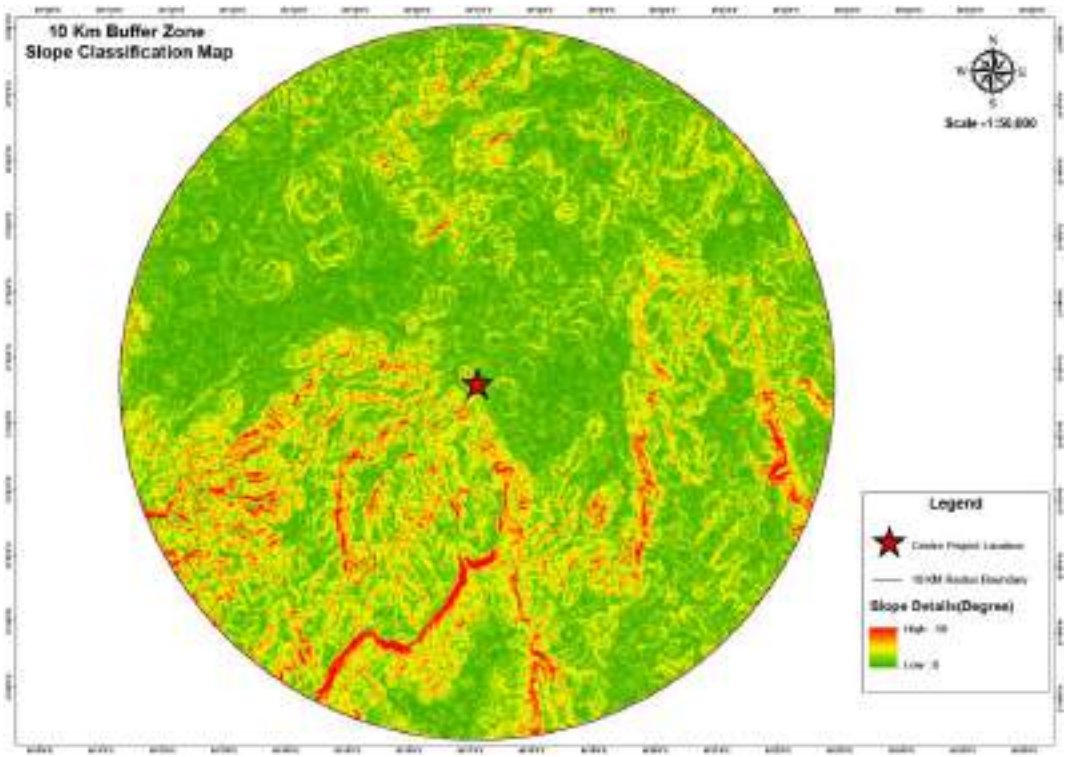


Fig 1.6: Slope map of Netrabandha Pahar (West) block Fe mine in 10km buffer zone.

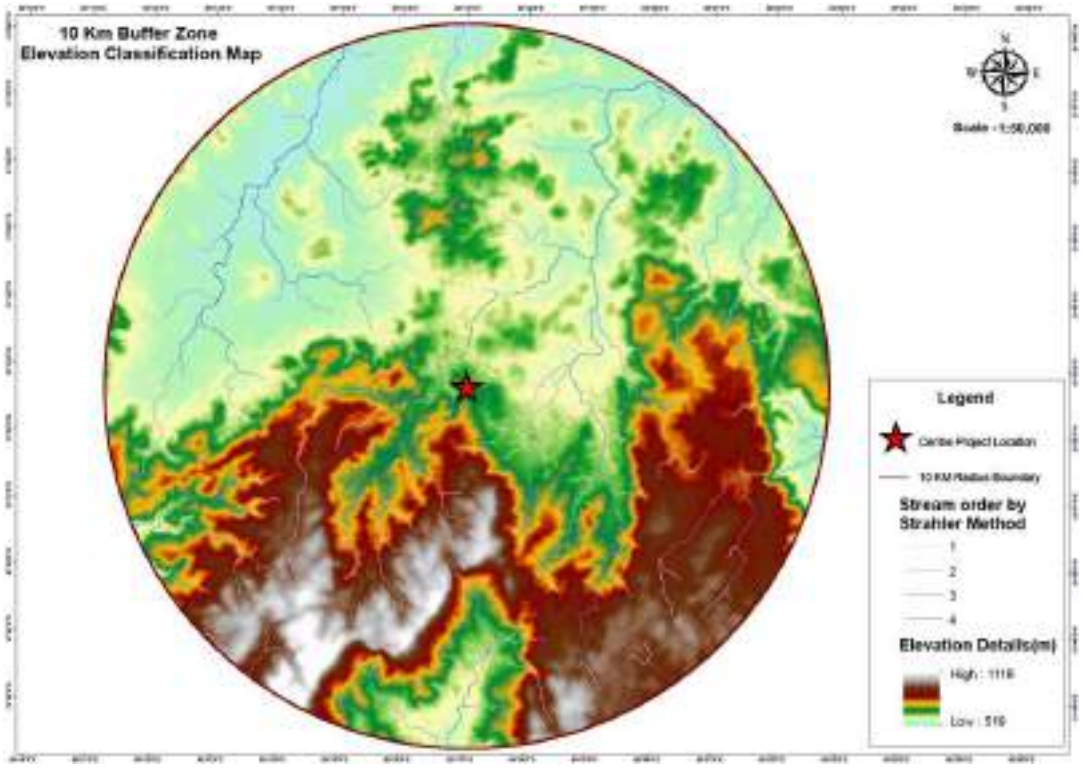


Fig 1.7: Drainage map and digital elevation map in 10km buffer zone

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)

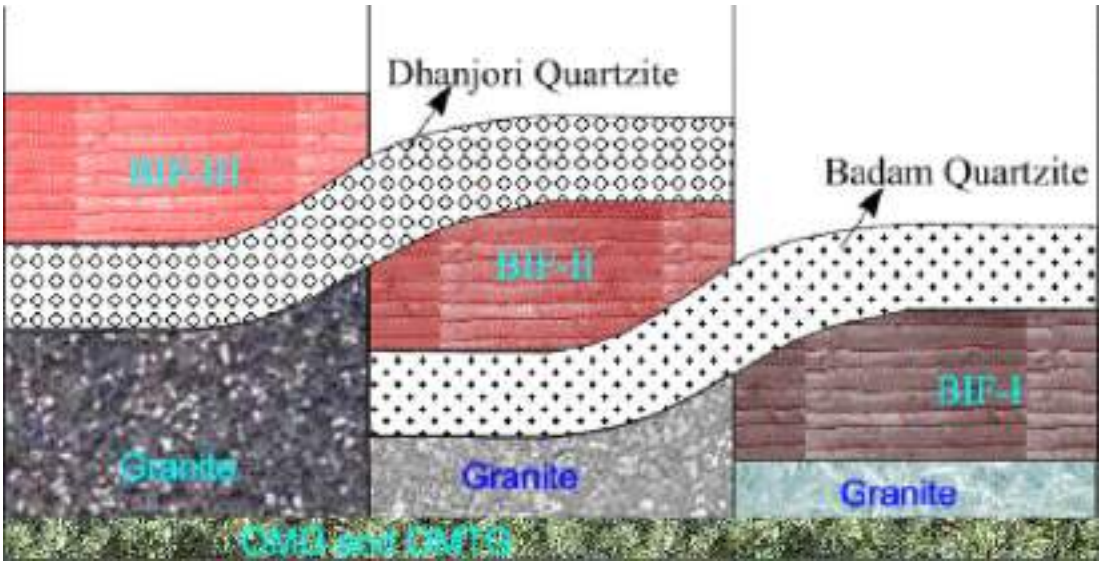


Fig 2.1: Schematic diagram of stratigraphic setting of three BIF of IOSG (Beura et al.2016

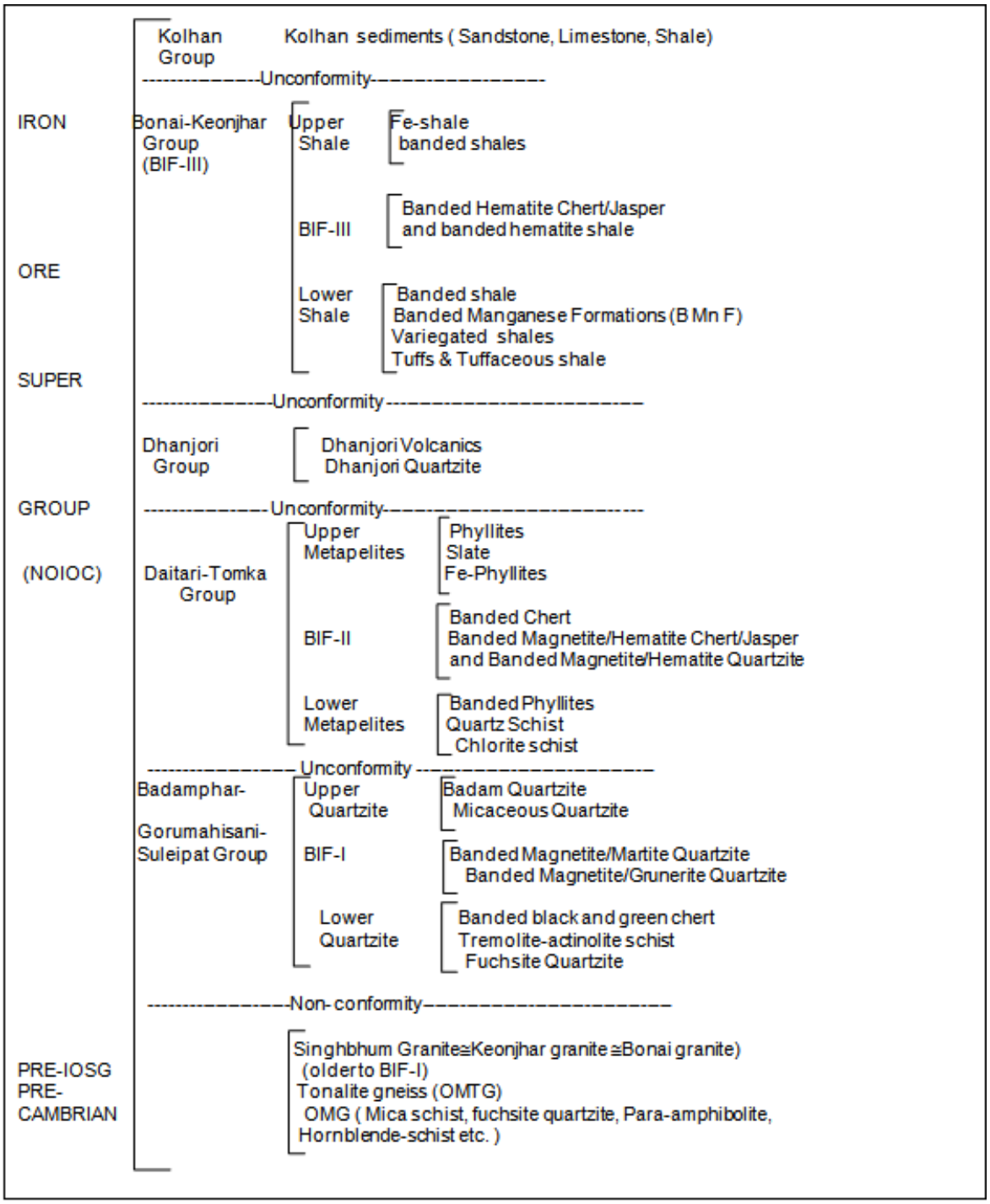


Fig 2.2: Stratigraphic Succession of Iron Ore Super Group of Odisha (Beura et al.2016).

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.

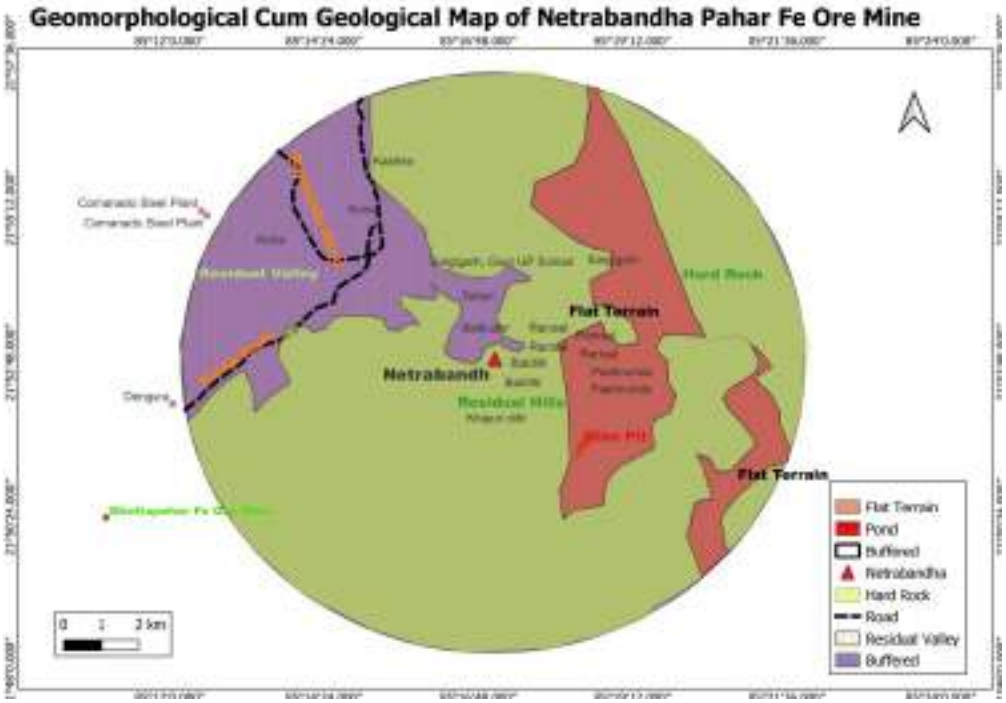


Fig 2.3: Geomorphological cum Geology map of Netrabandha Pahar (west) Fe Mine

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.

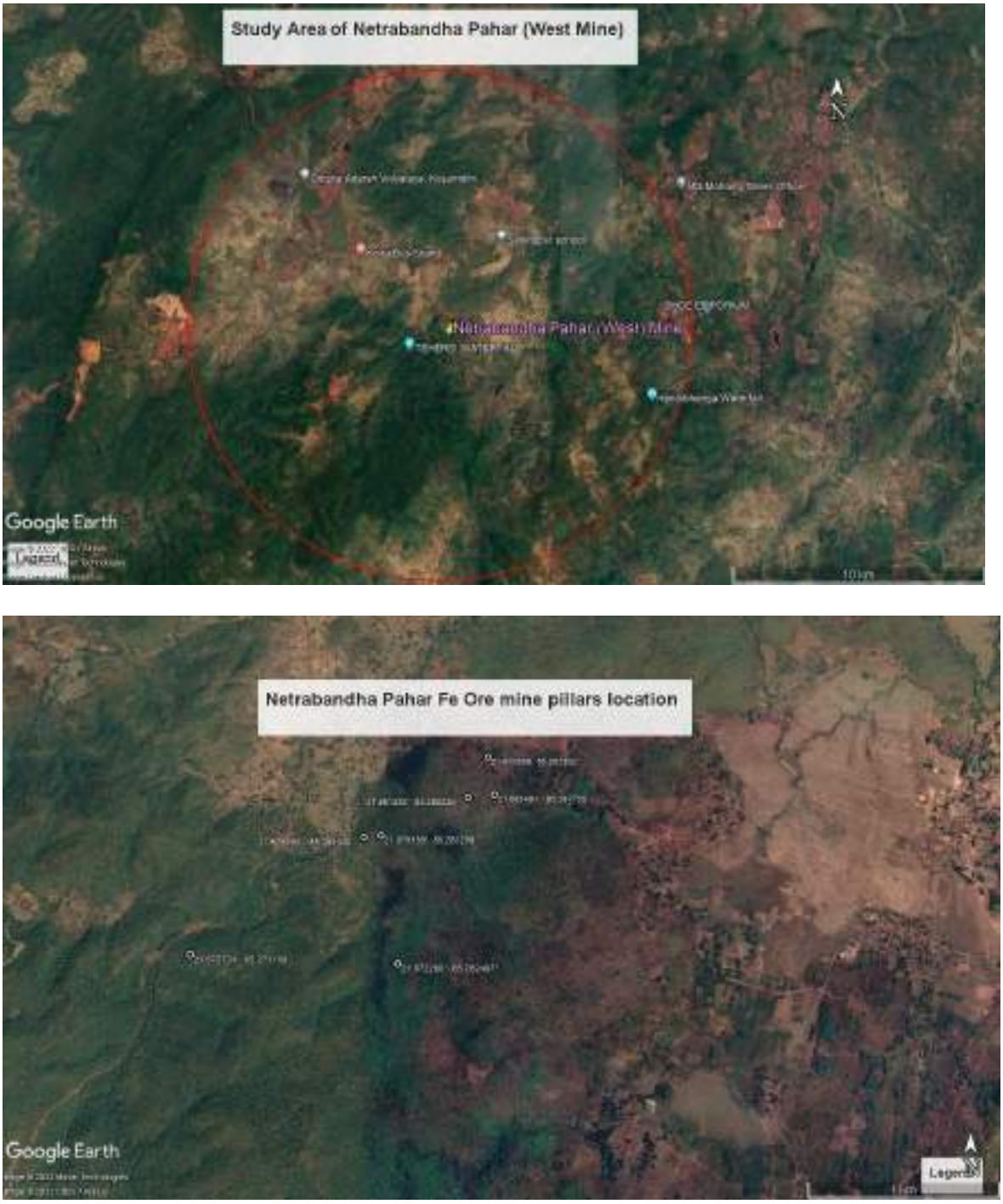


Fig 2.5: Map showing study area in the state Odisha. Pillar location of Netrabandha Pahar (West) at center and position of other villages on google image along with prominent roads. Inventory of wells of these villages are carried out under groundwater regime monitoring.

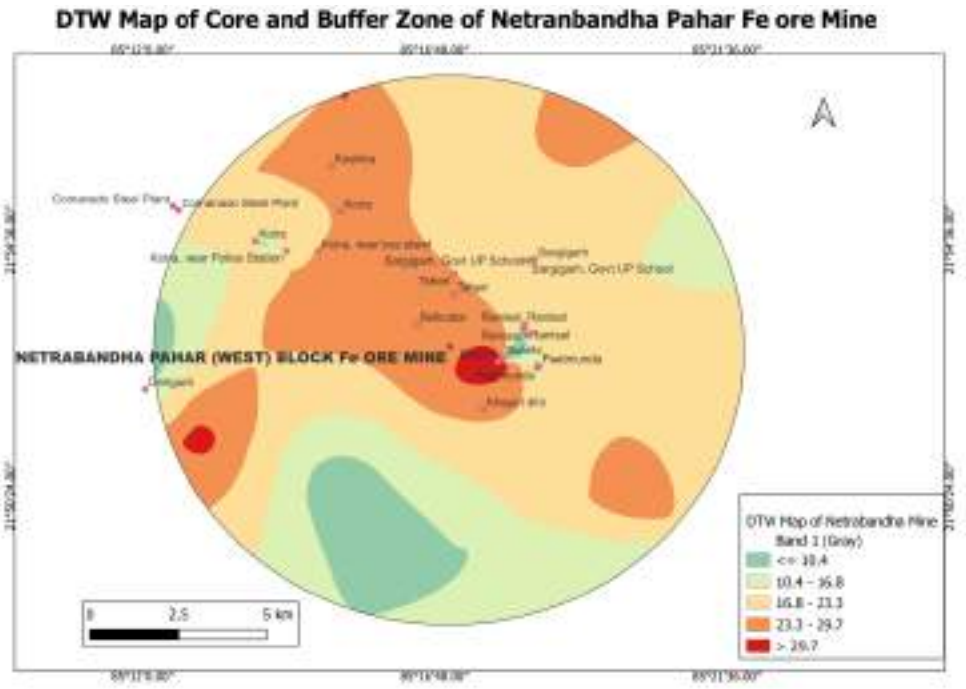


Fig 2.6: DTW map of core and buffer zone.

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.

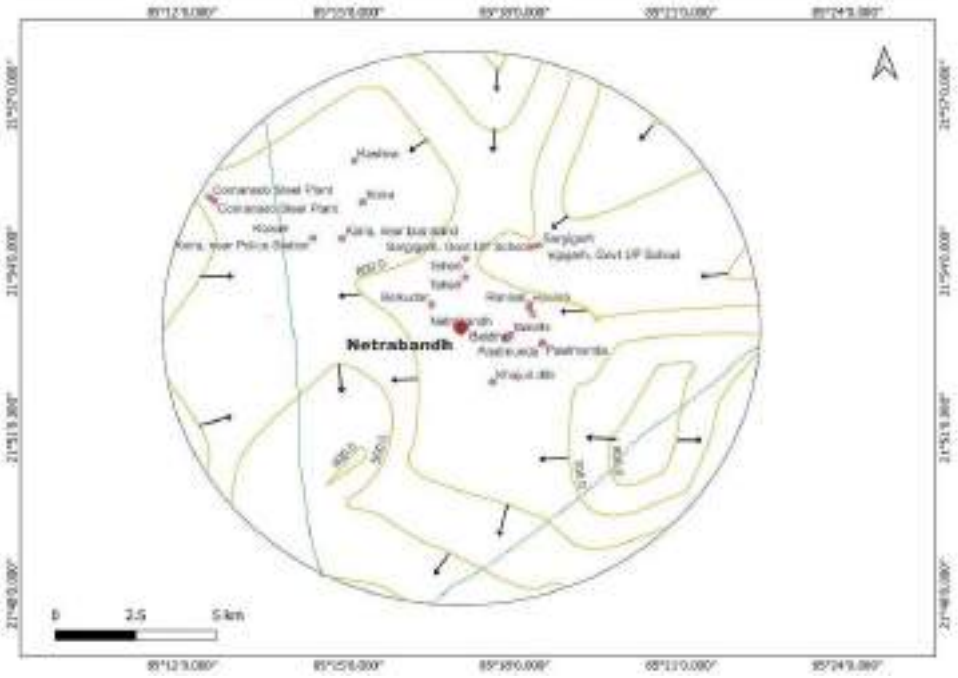


Fig 2.7: Groundwater contour map of Netrabandha Pahar (West bloc) Fe mine area

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**

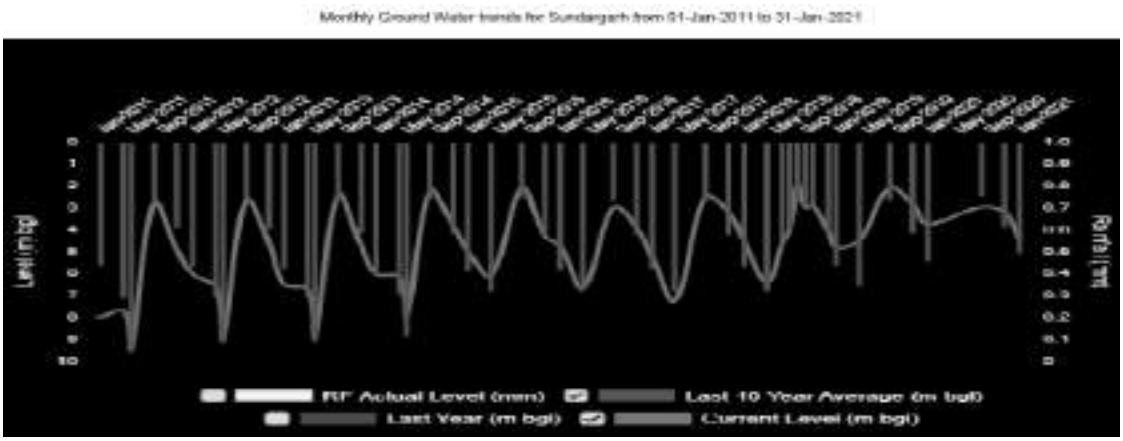


Fig 2.8: Long term well hydrograph of wells of Sundergarh district, Odisha (source: WRIS portal)

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).

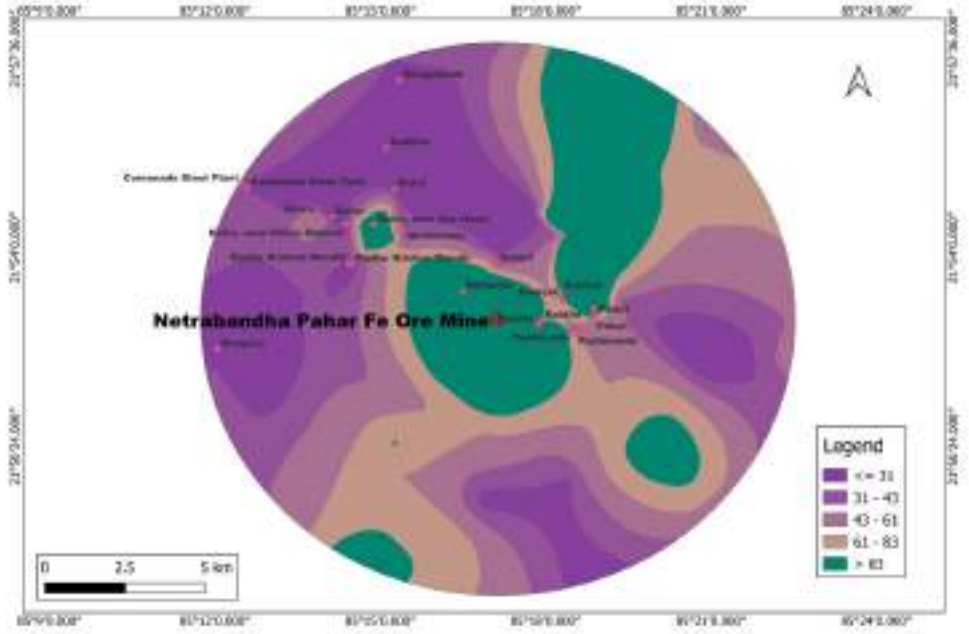


Fig 2.9: TDS map of Netrabandha Pahar block Fe ore mine

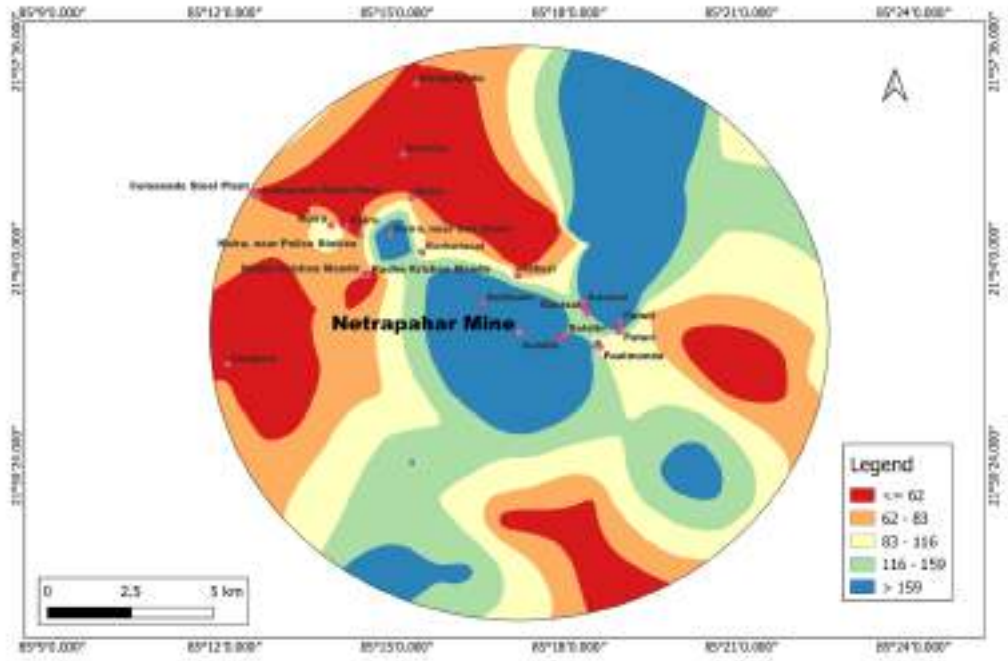


Fig 2.10: EC map of Netrabandha Pahar (West) block Fe ore mine

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.

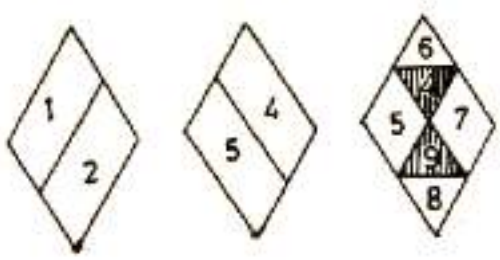


Fig2.11: Sub-divisions of the diamond field

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).

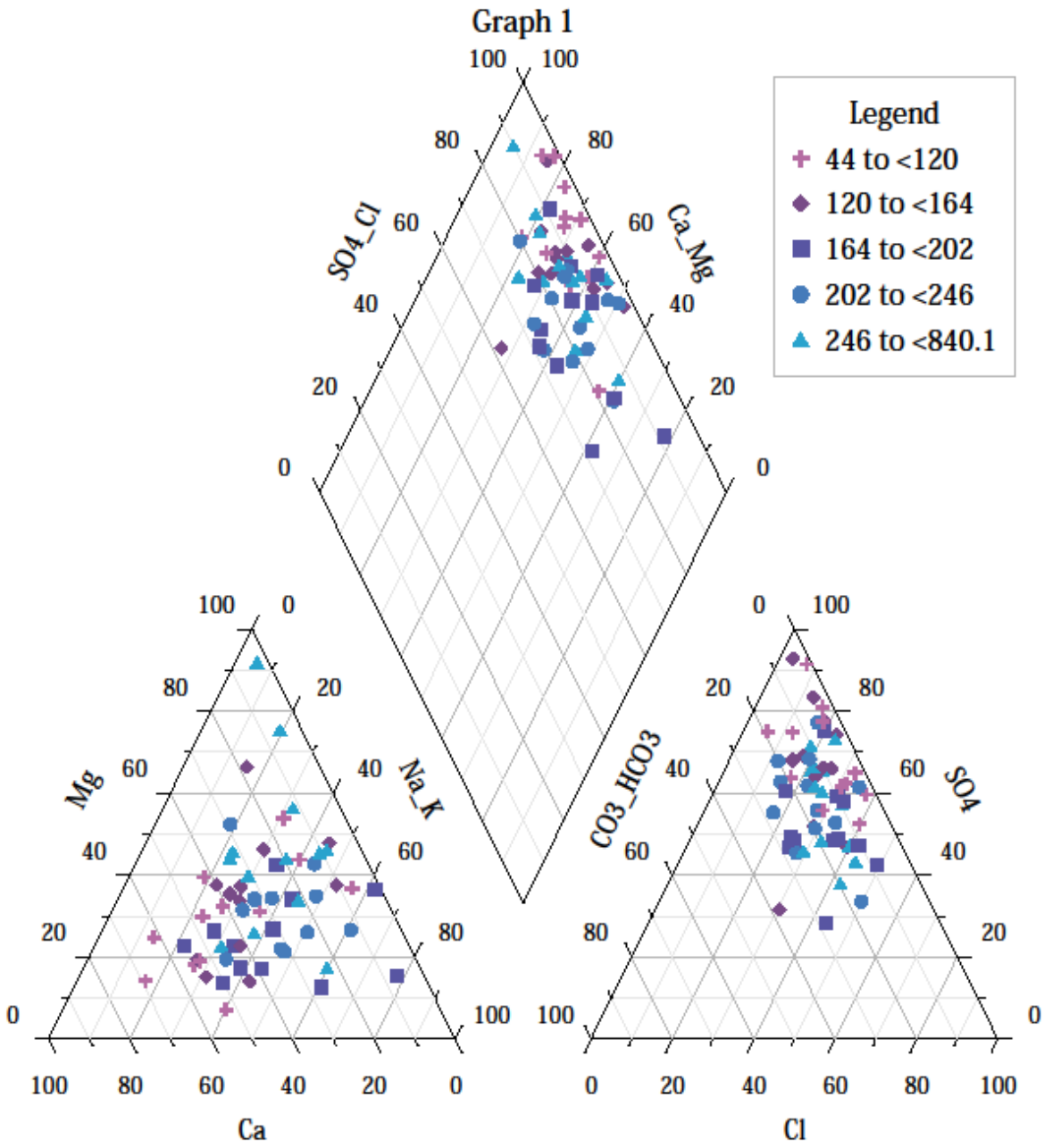


Fig 2.12: Water Quality Data in Piper Trilinear Diagram in study area

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).

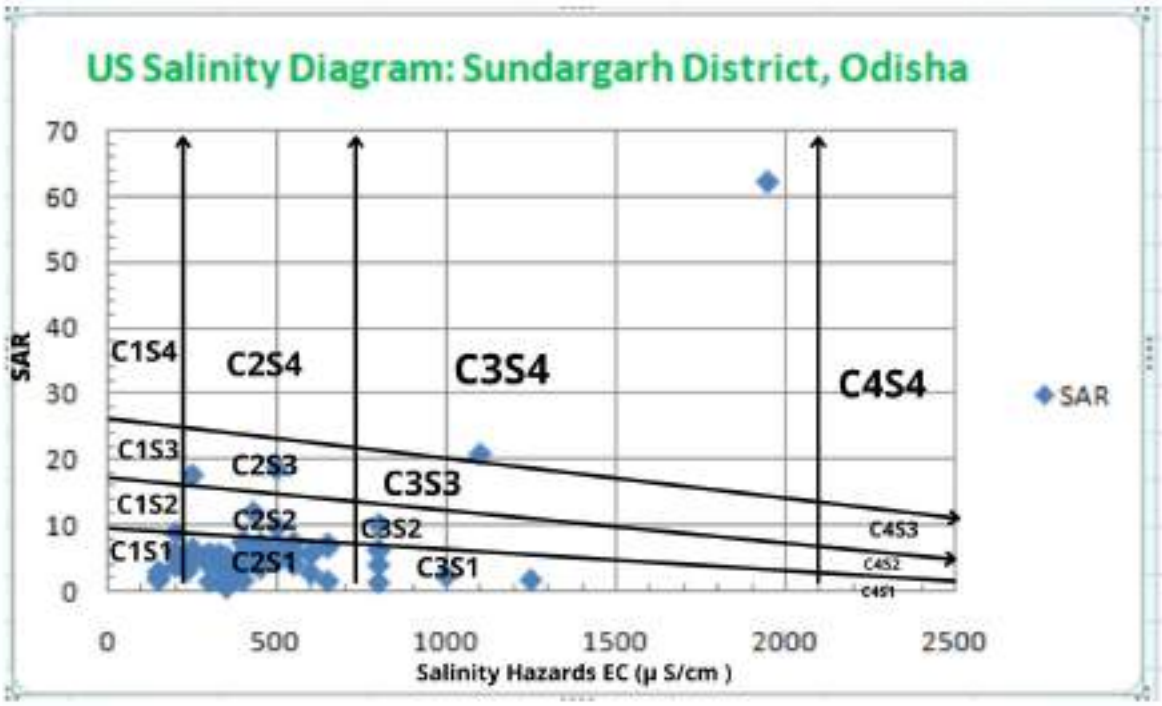


Fig 2.13: US Salinity diagram, Sundergarh district, Odisha

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

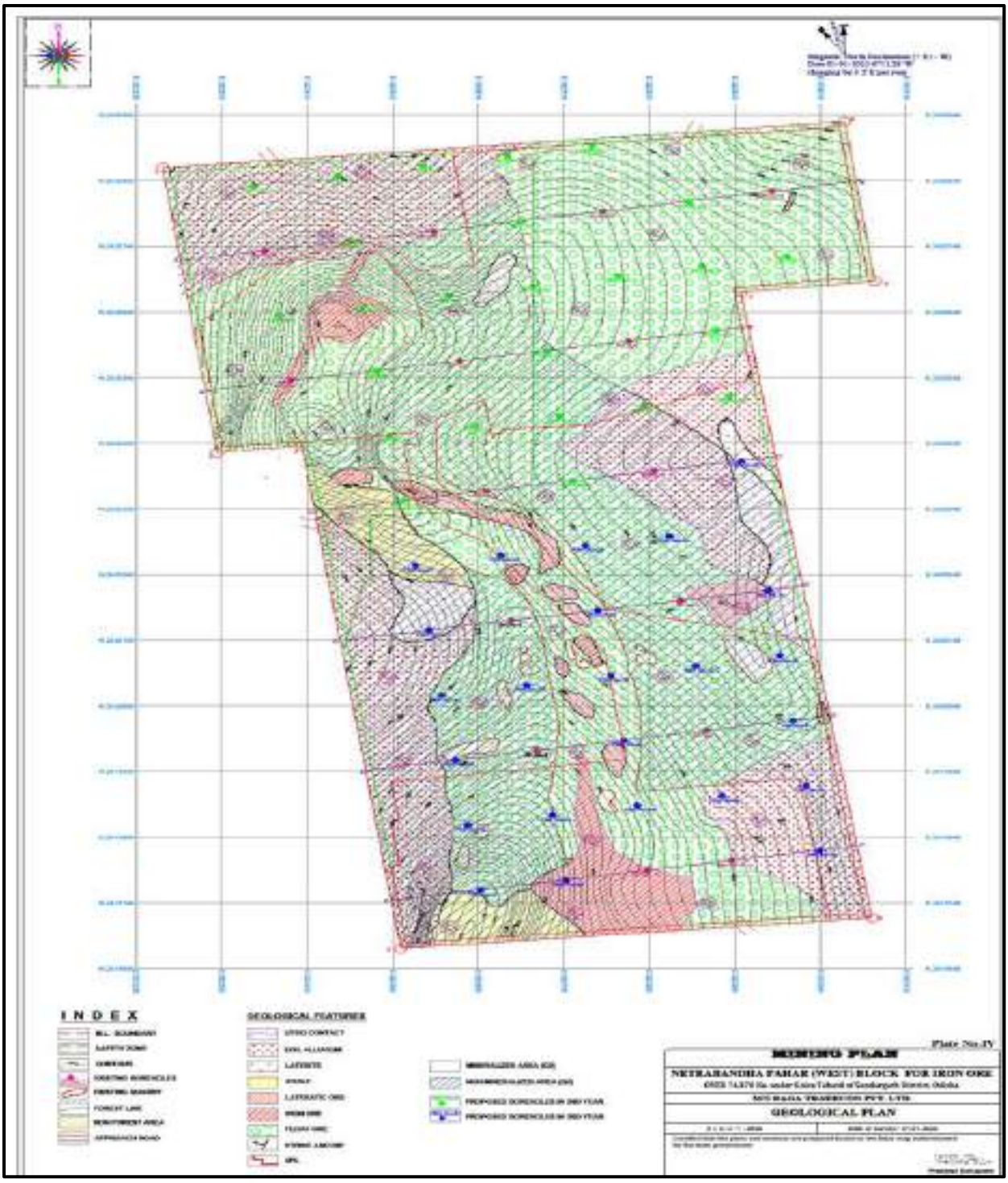


Fig3.1: Bore location in lease area of Netrabandha Pahar Fe ore mine

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 5^{th} 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: O	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)		12650160.234	2641128.80	15291289.034	+55%Fe	+55 %Fe
	122	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)		283309.12	298443.08	581752.2	+55%Fe	+55 %Fe
	222	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.

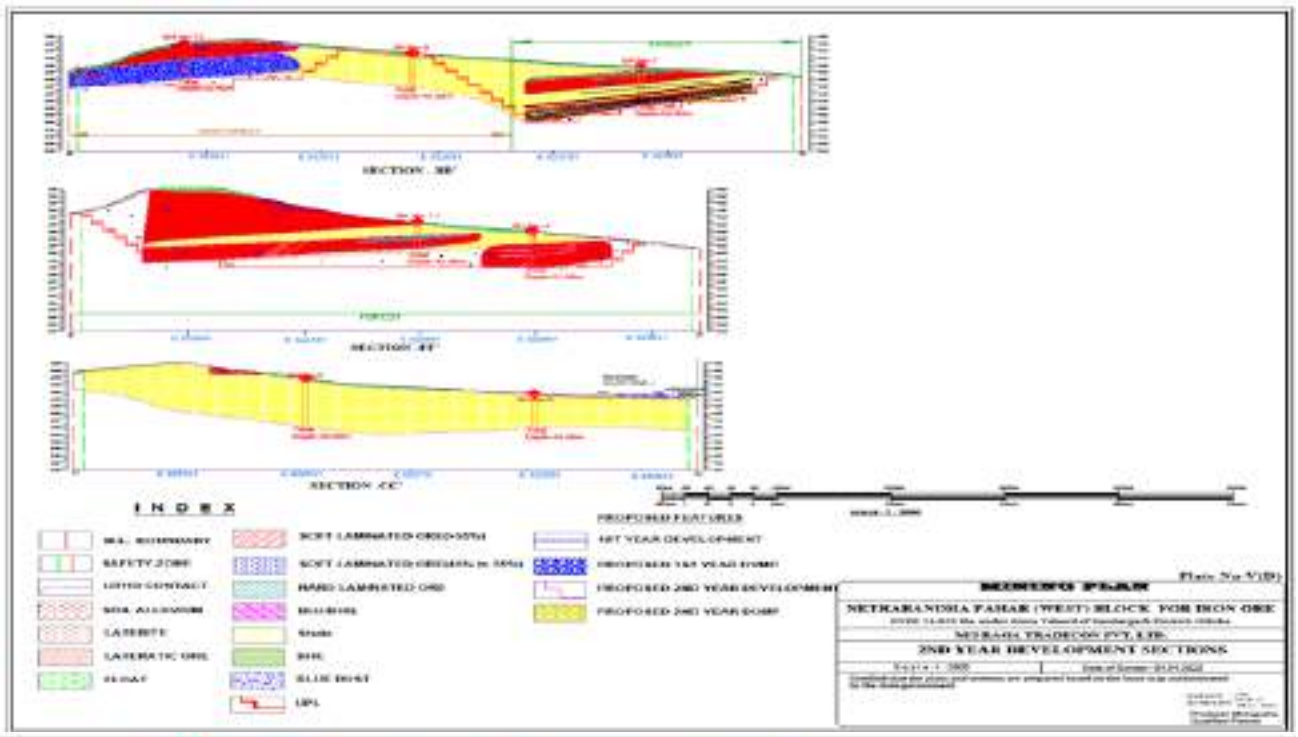
Transportation

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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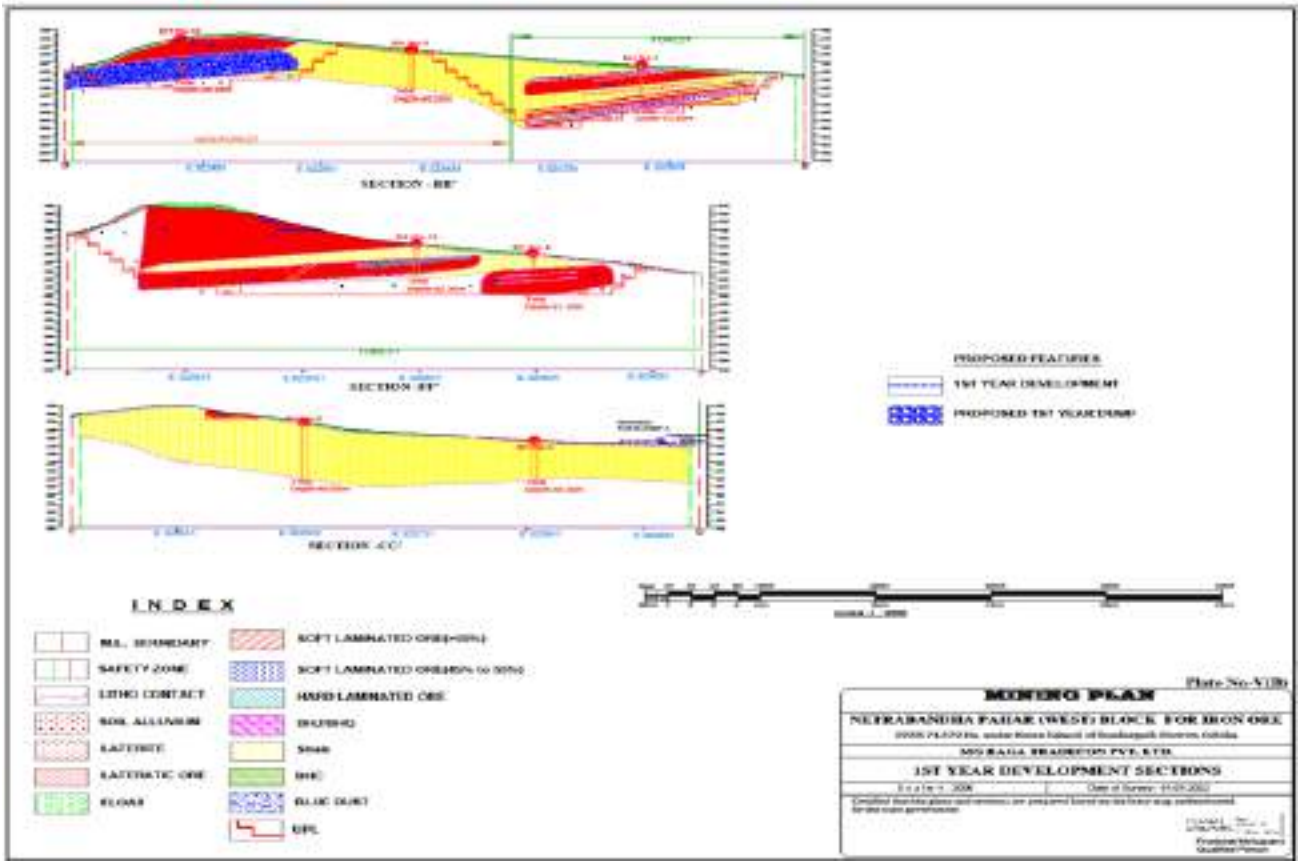
SECTION - EE'
SECTION - CC'
INDEX
MINING PLAN
NETRABANDHA PAHAR (WEST) BLOCK FOR IRON ORE
2ND YEAR DEVELOPMENT SECTIONS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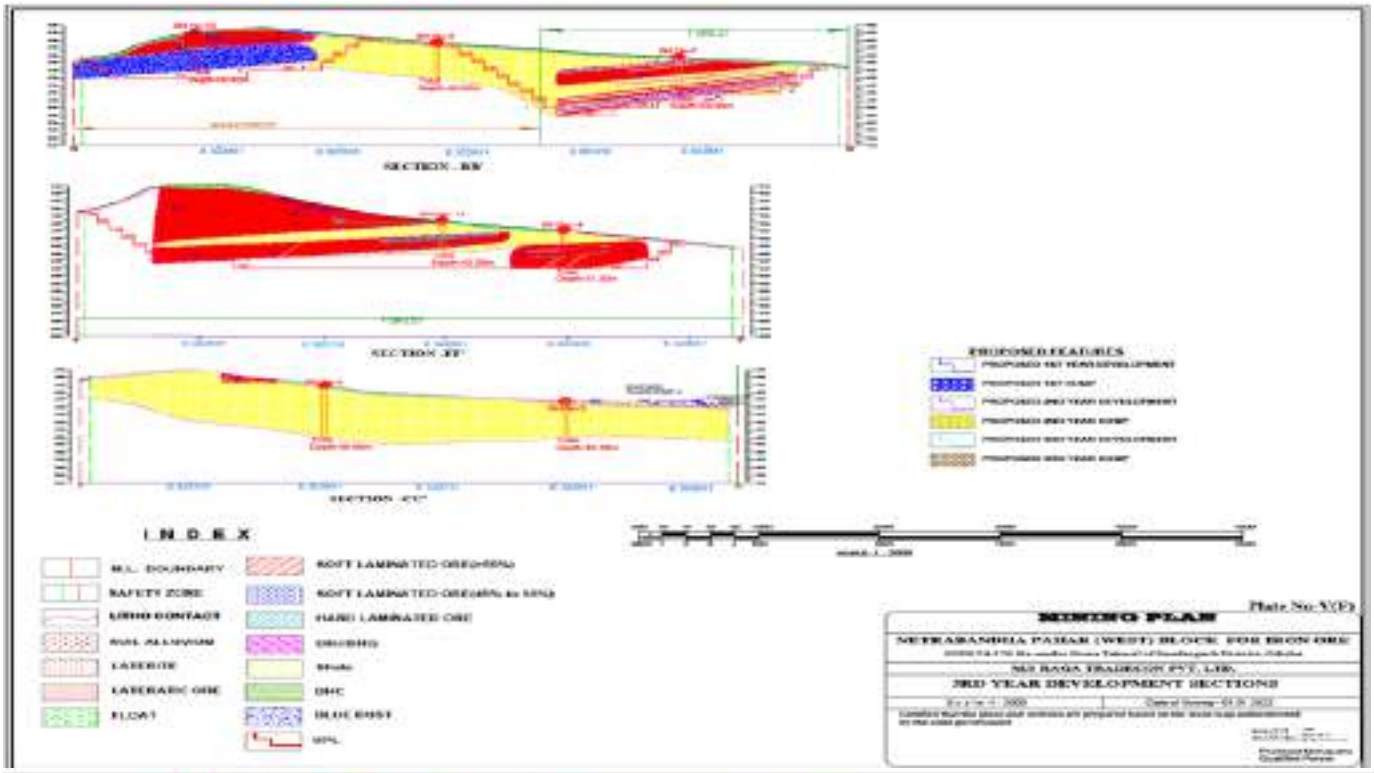
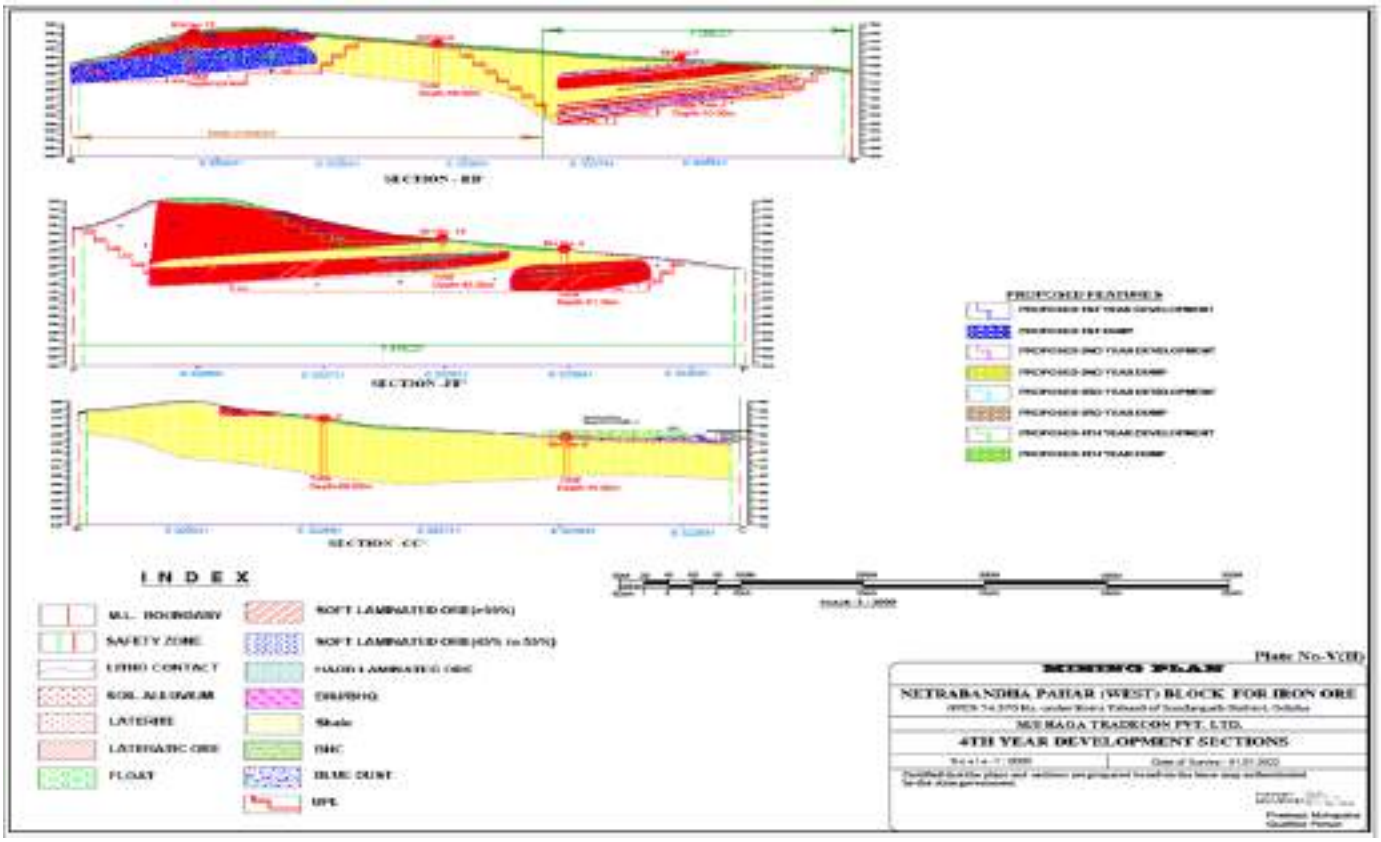
SECTION - EE'
SECTION - CC'
PROPOSED FEATURES
1ST YEAR DEVELOPMENT
INDEX
MINING PLAN
NETRABANDHA PAHAR (WEST) BLOCK FOR IRON ORE
1ST YEAR DEVELOPMENT SECTIONS


SECTION - BB
SECTION - FF
SECTION - CC
PROPOSED FEATURES
INDEX
M.L. BOUNDARY
SAFETY ZONE
LITHO CONTACT
SOIL ALLUVIUM
LATERITE
LATERITIC ORE
FLOAT
SOFT LAMINATED ORE(>65%)
SOFT LAMINATED ORE(65% to 55%)
HARD LAMINATED ORE
DISSEMD
Shale
DHC
BLUE DUST
DPL
MINING PLAN
NETRABANDHA PAHAR (WEST) BLOCK FOR IRON ORE
M/S RAGA TRADECON PVT. LTD.
3RD YEAR DEVELOPMENT SECTIONS
Plate No-V(B)


SECTION - BB
SECTION - FF
SECTION - CC
PROPOSED FEATURES
INDEX
M.L. BOUNDARY
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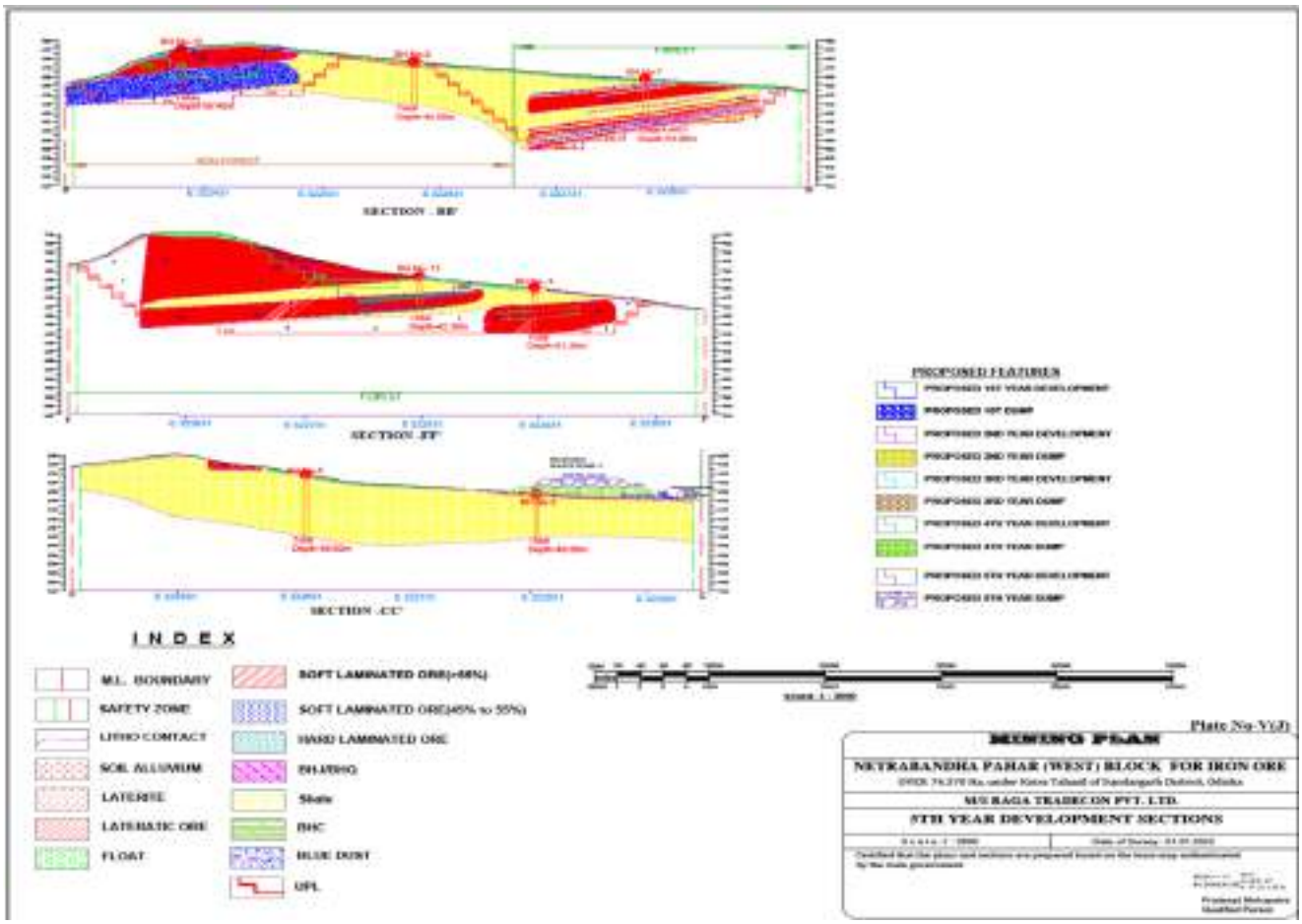
SOFT LAMINATED ORE(>65%)
SOFT LAMINATED ORE(65% to 55%)
HARD LAMINATED ORE
DISSEMD
Shale
DHC
BLUE DUST
DPL
MINING PLAN
NETRABANDHA PAHAR (WEST) BLOCK FOR IRON ORE
M/S RAGA TRADECON PVT. LTD.
4TH YEAR DEVELOPMENT SECTIONS
Plate No-V(B)



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**		

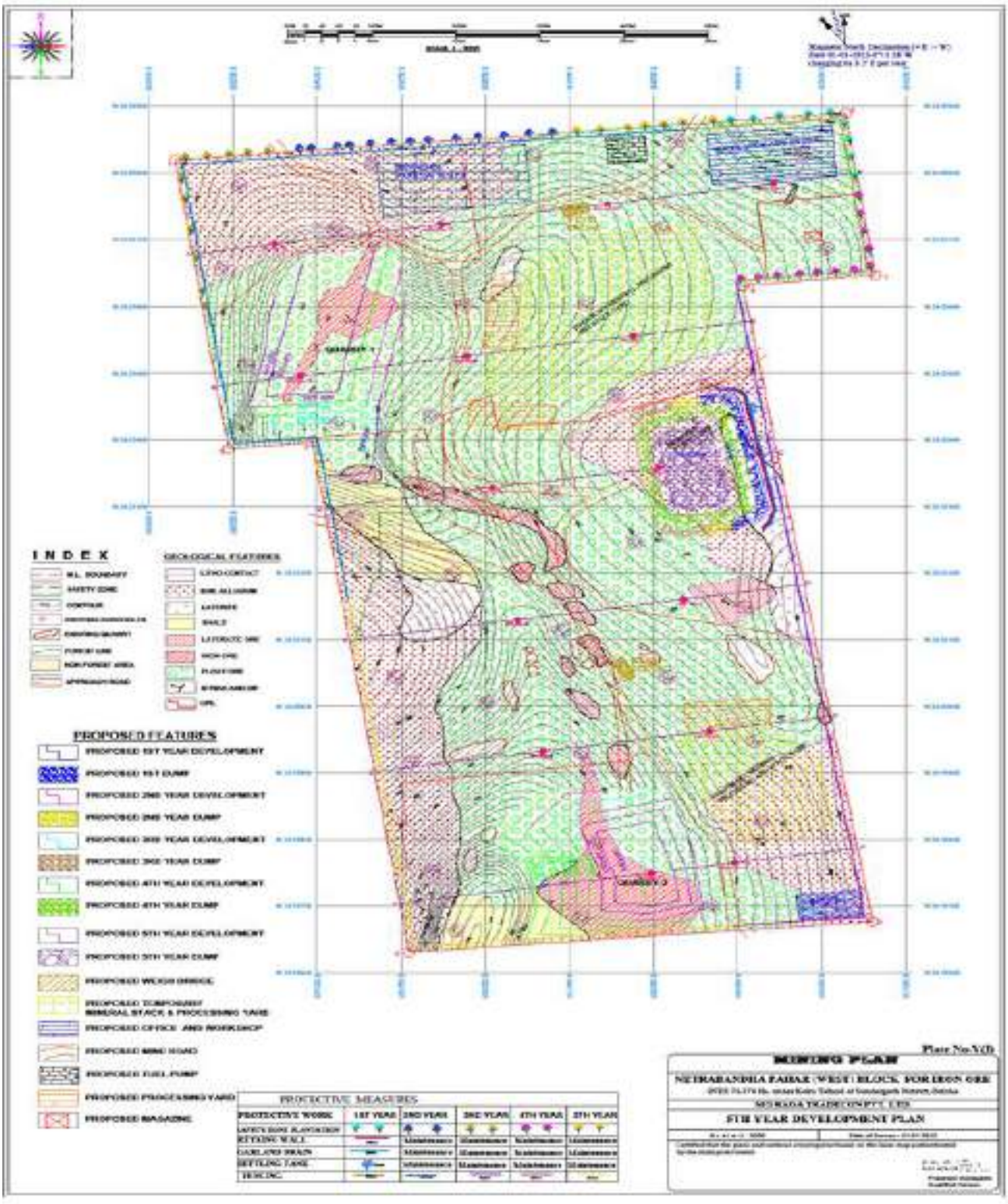


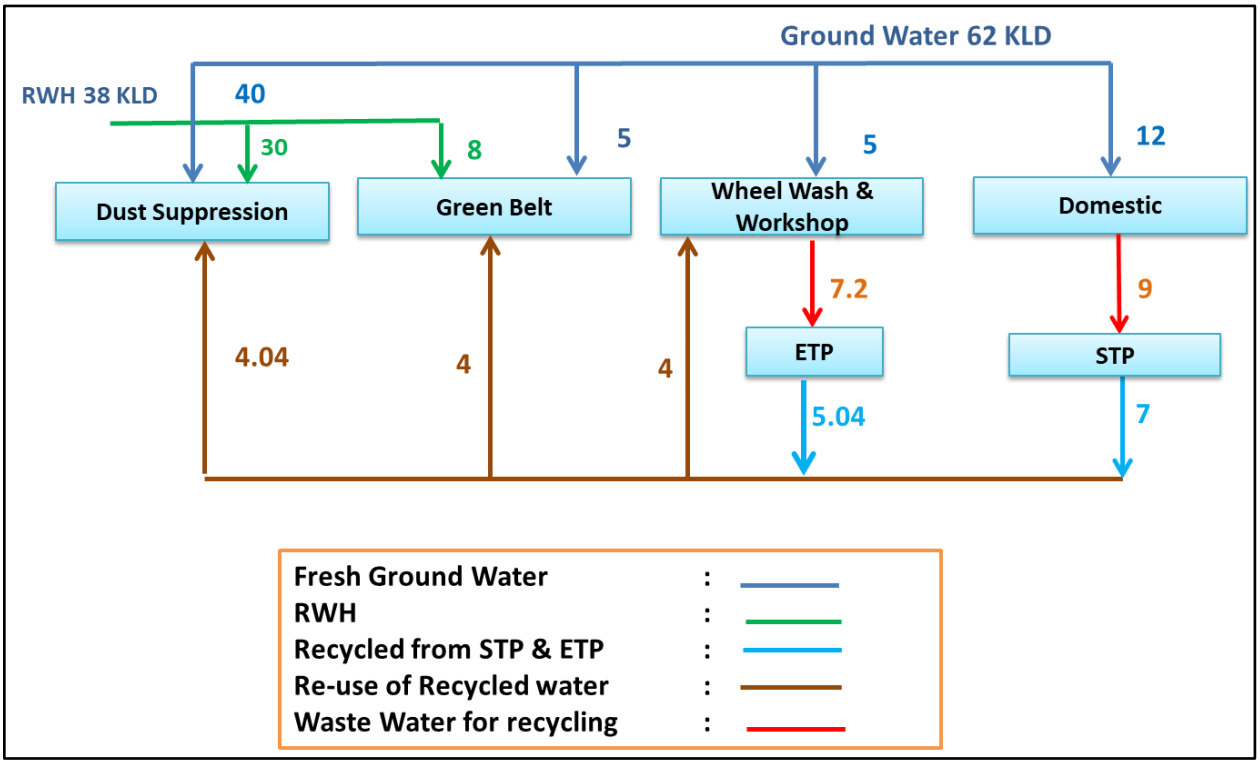
Fig 3.3: Five years development Plan

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.

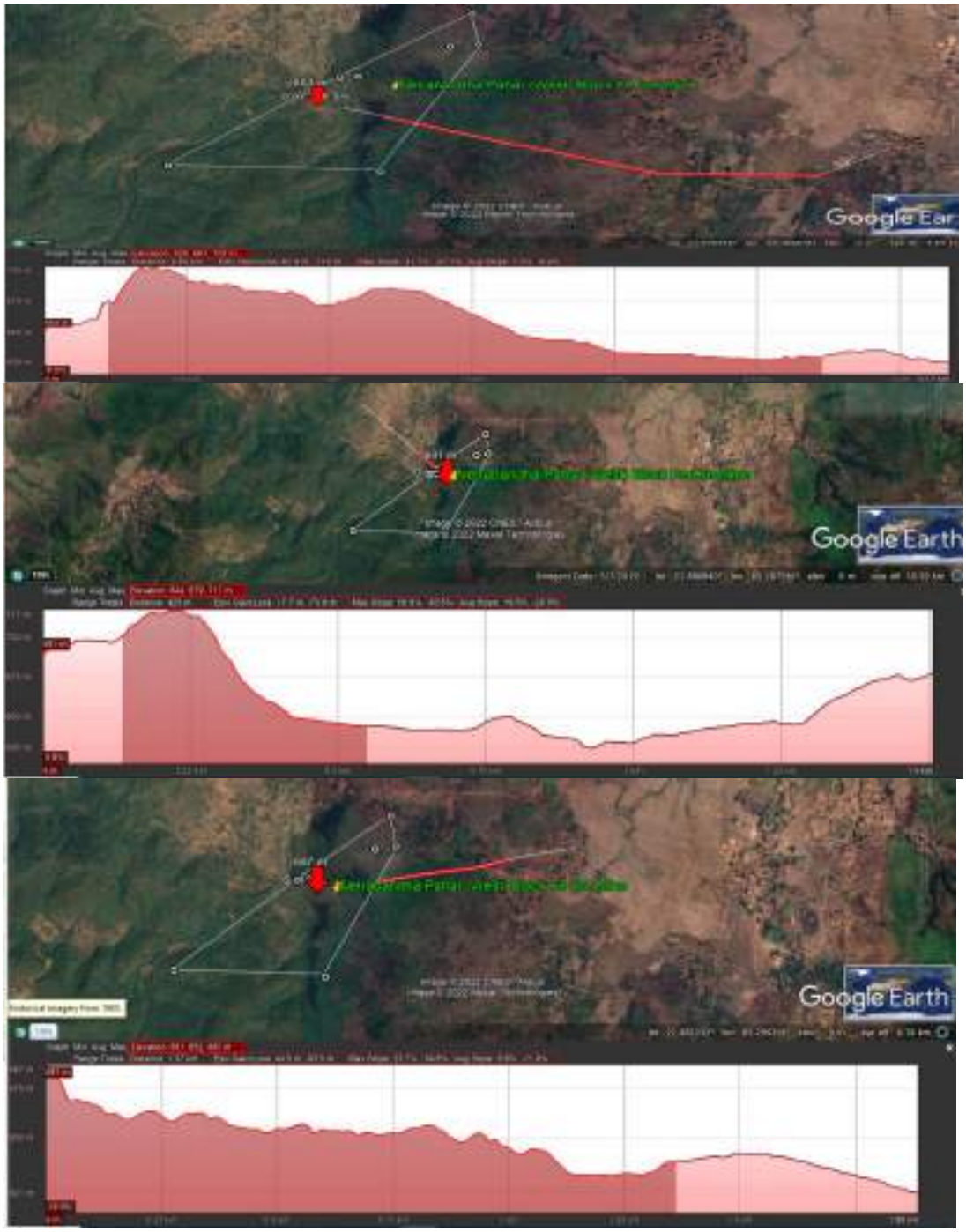


Fig 5.2: Google elevation profile of study area around Netrabandha Pahar Fe ore Mine from three directions

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
3	Ragi dry	205	Horsegram	774
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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

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)

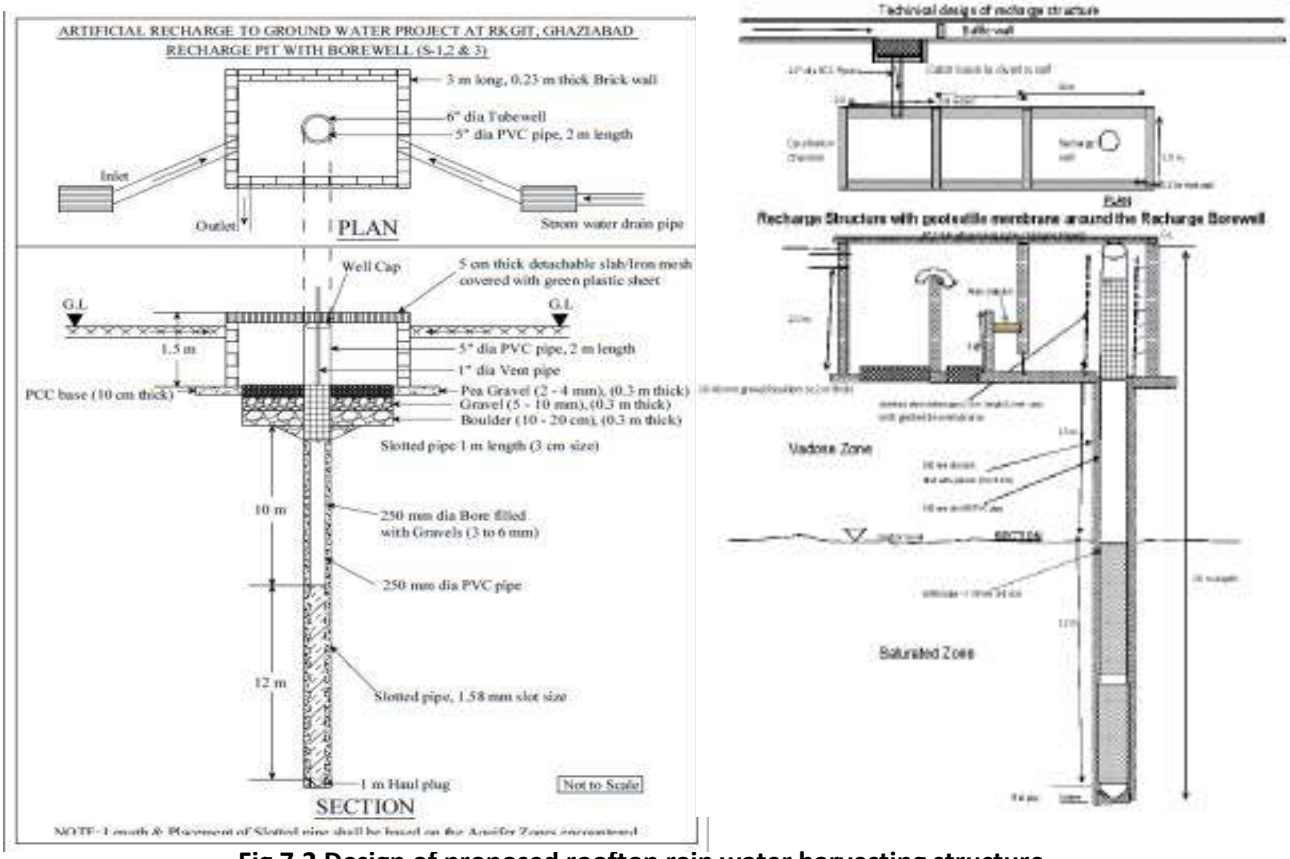

Fig 7.2 Design of proposed rooftop rain water harvesting structure

8. Any other details pertaining to the project: NA