March, 2022

By MRCAWTM

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

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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.

Acknowledgments and Certificate

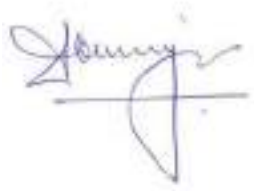
Impact assessment and report preparation work as per the CGWA guideline was entrusted to MRCAWTM, Manav Rachna as accredited Groundwater Institution of CGWA by M/s D P Rai Nagpur is thankfully acknowledged.

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

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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).

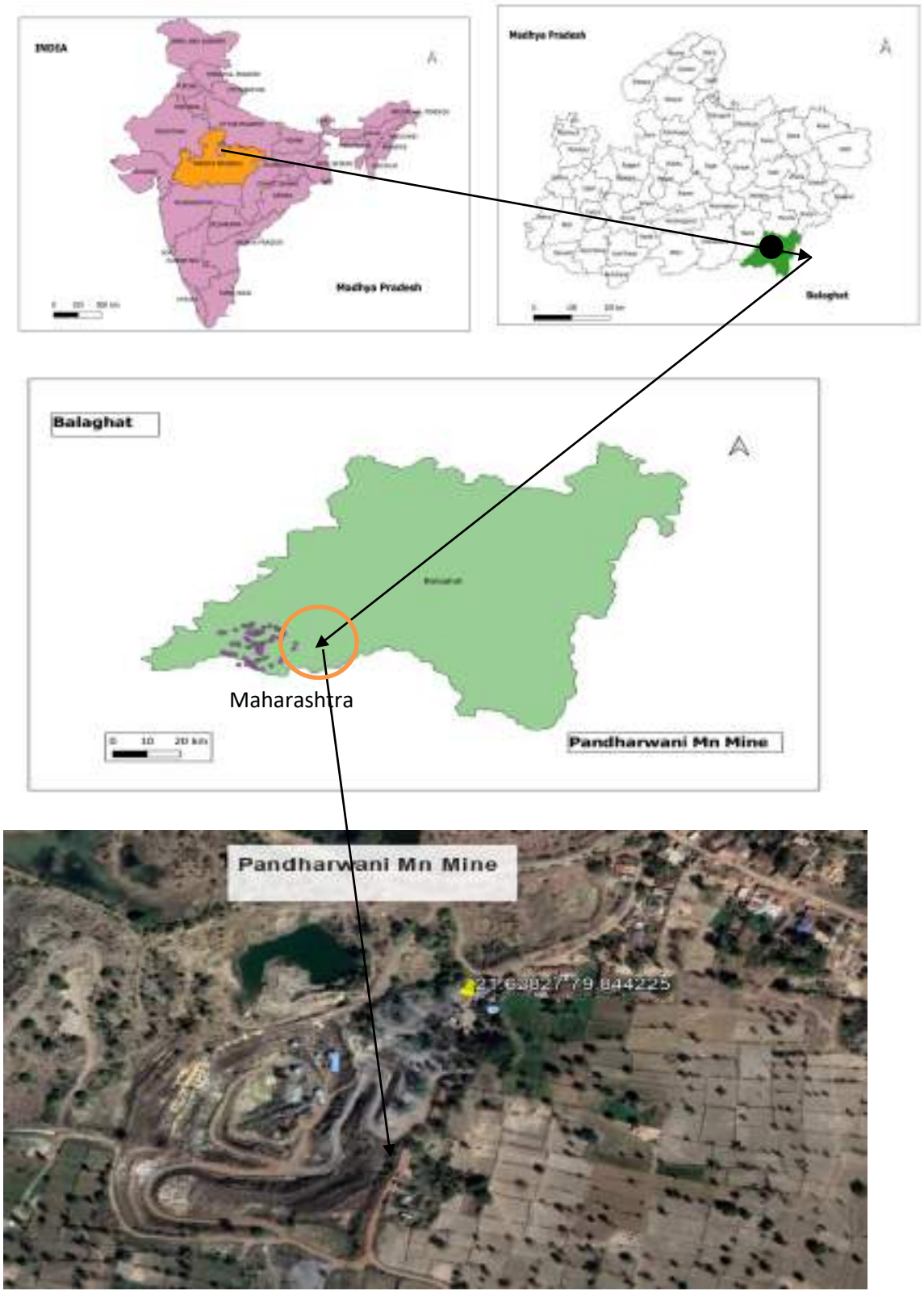


Fig 1.1: Location map of study area and Pandharwani Mn Mine, Balaghat district, MP

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 (m^2)**	**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**

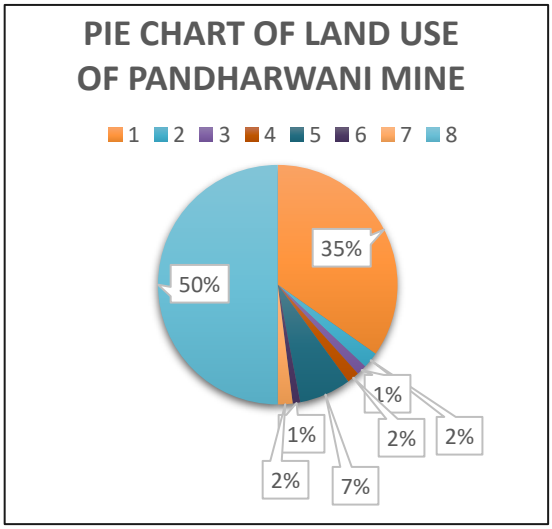


Fig 1.3: Pie diagram of land use in Pandharwani mine.

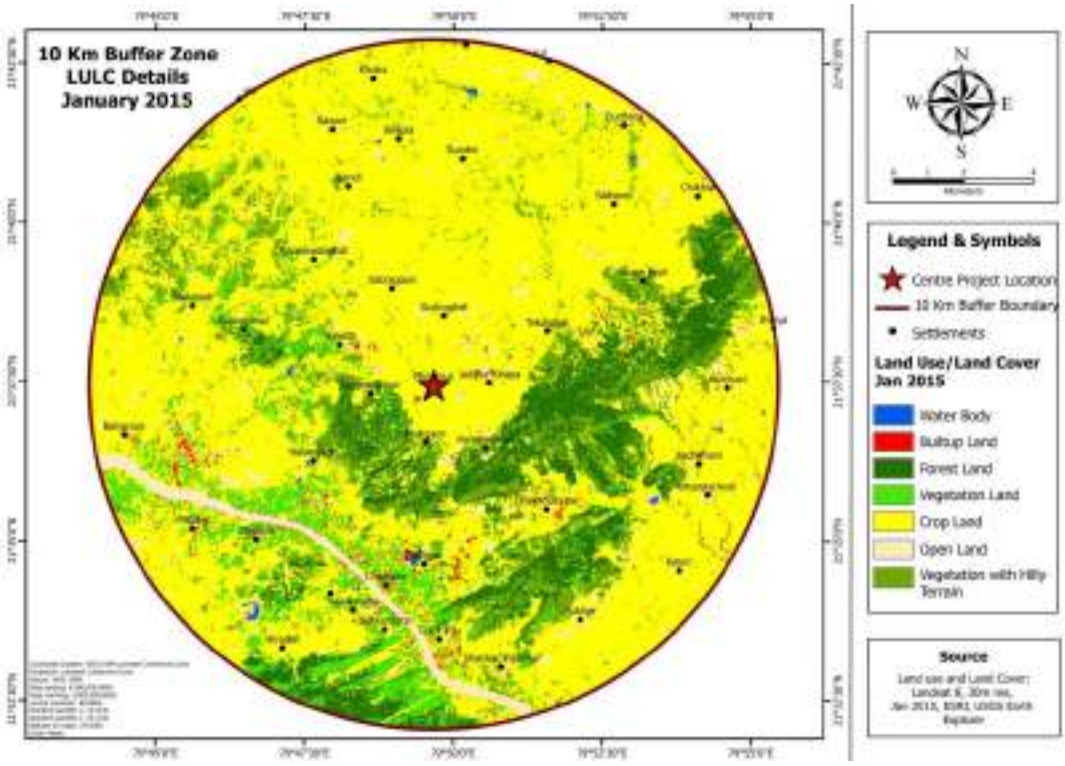


Fig 1.4: Map showing LULC of Pandharwani Mn Mine of 10km buffer zone (Jan 2015)

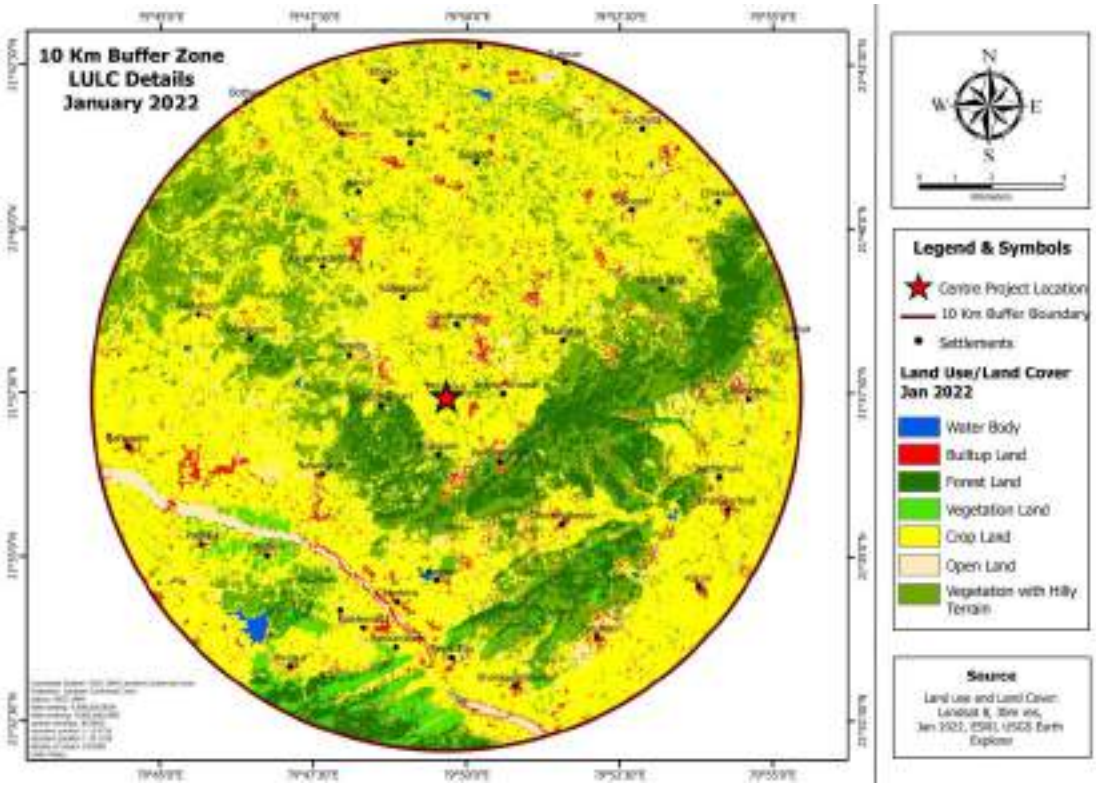


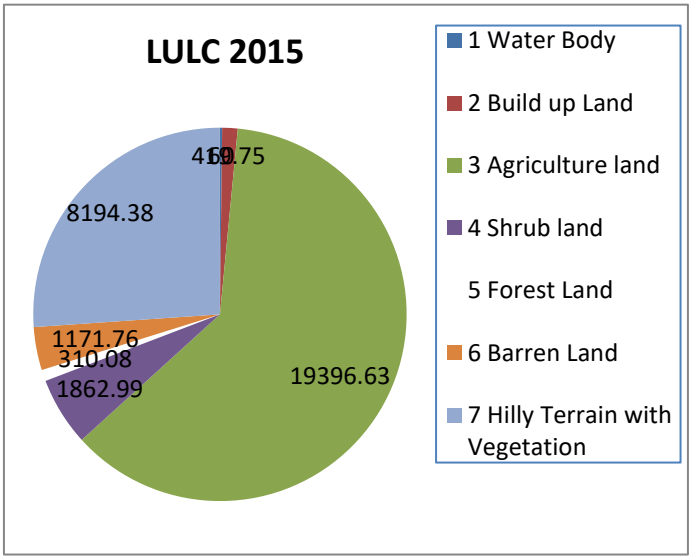
Fig 1.5: Map showing LULC of Pandharwani Mn Mine of 10km buffer zone (Jan 2022)

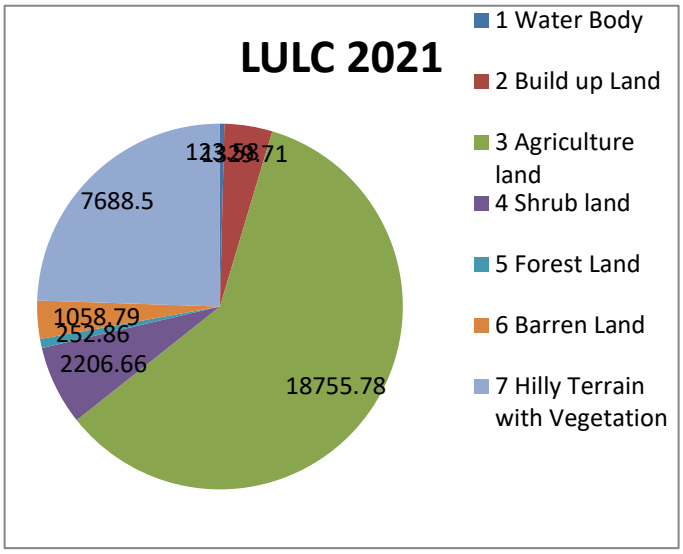
Table 1.2 LULC 2015 of Study Area

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.

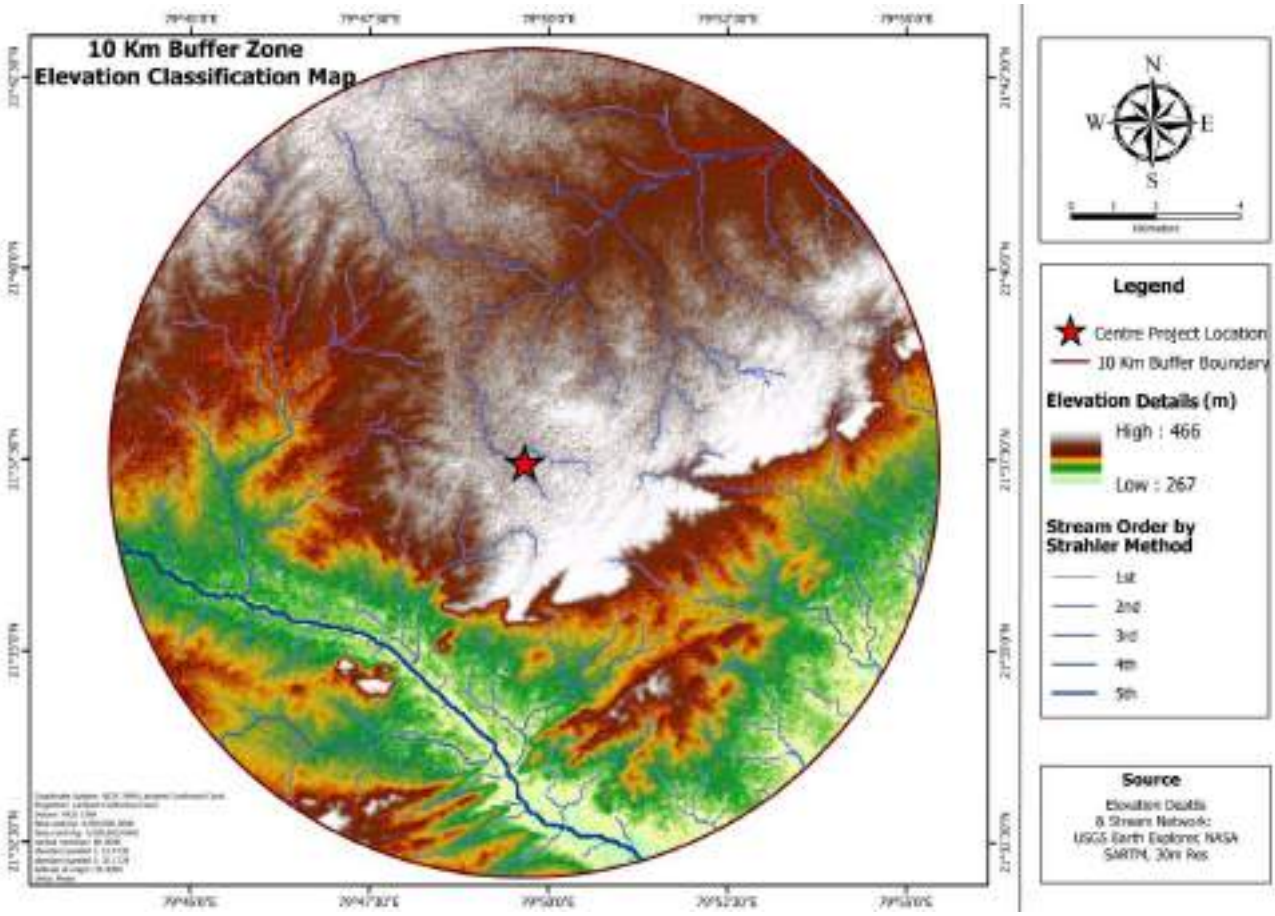


Fig 1.6: Digital elevation map in 10km buffer zone

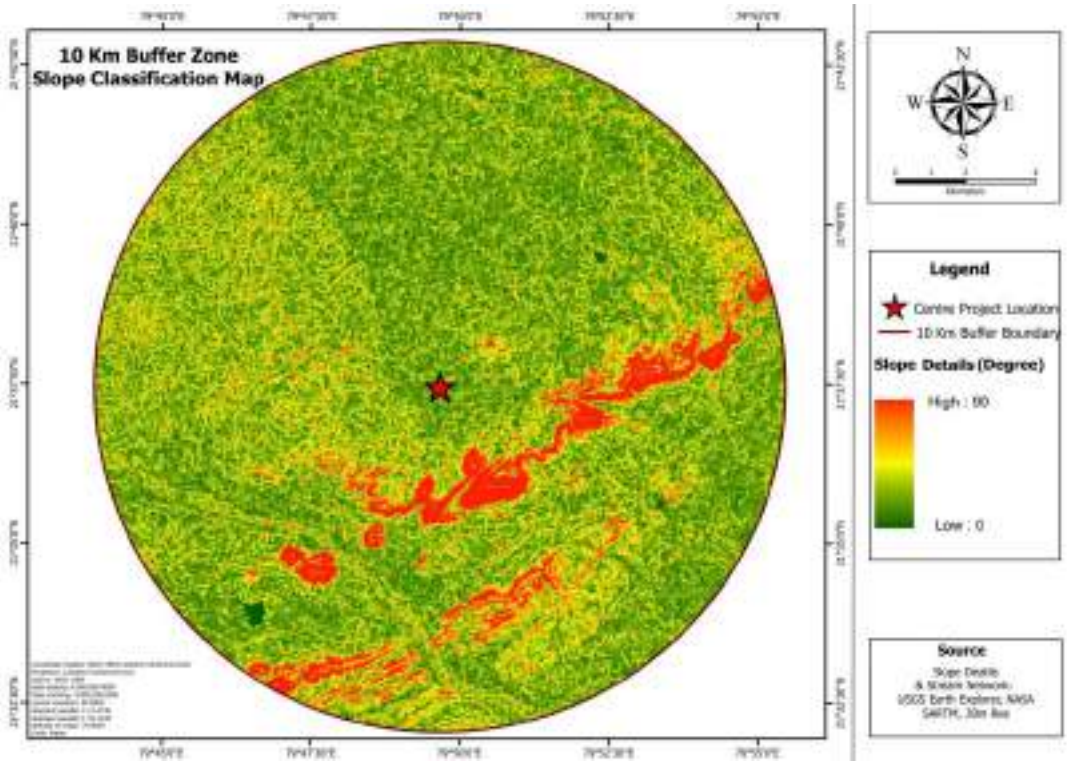


Fig 1.7: Slope map of Pandharwani Mn mine in 10km buffer zone

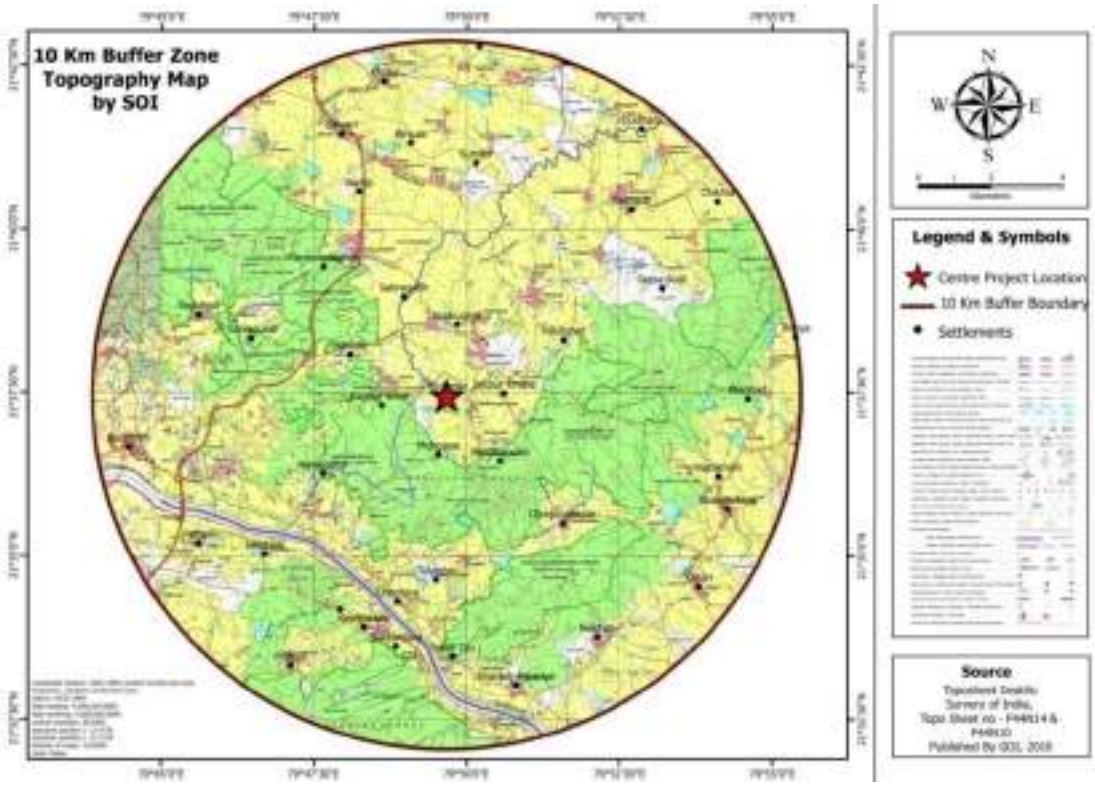


Fig 1.8: Topography Map of 10km buffer zone

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	
Oldar Metamorphics	Charnockite, Orthogneisses and Granite Biotite Gneisss, 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

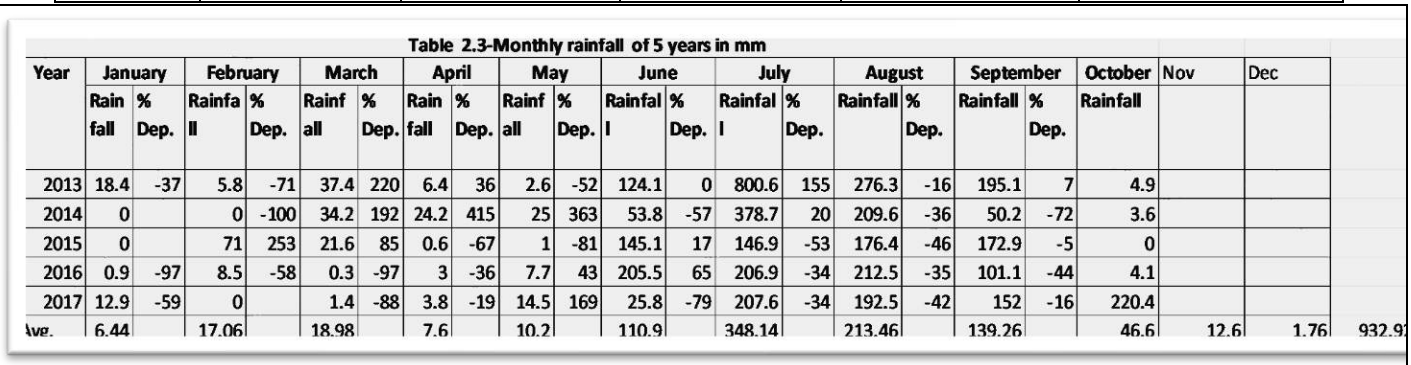


Table 2.3-Monthly rainfall of 5 years in mm

Year	January		February		March		April		May		June		July		August		September		October	Nov	Dec	
	Rain fall	% Dep.	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			
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

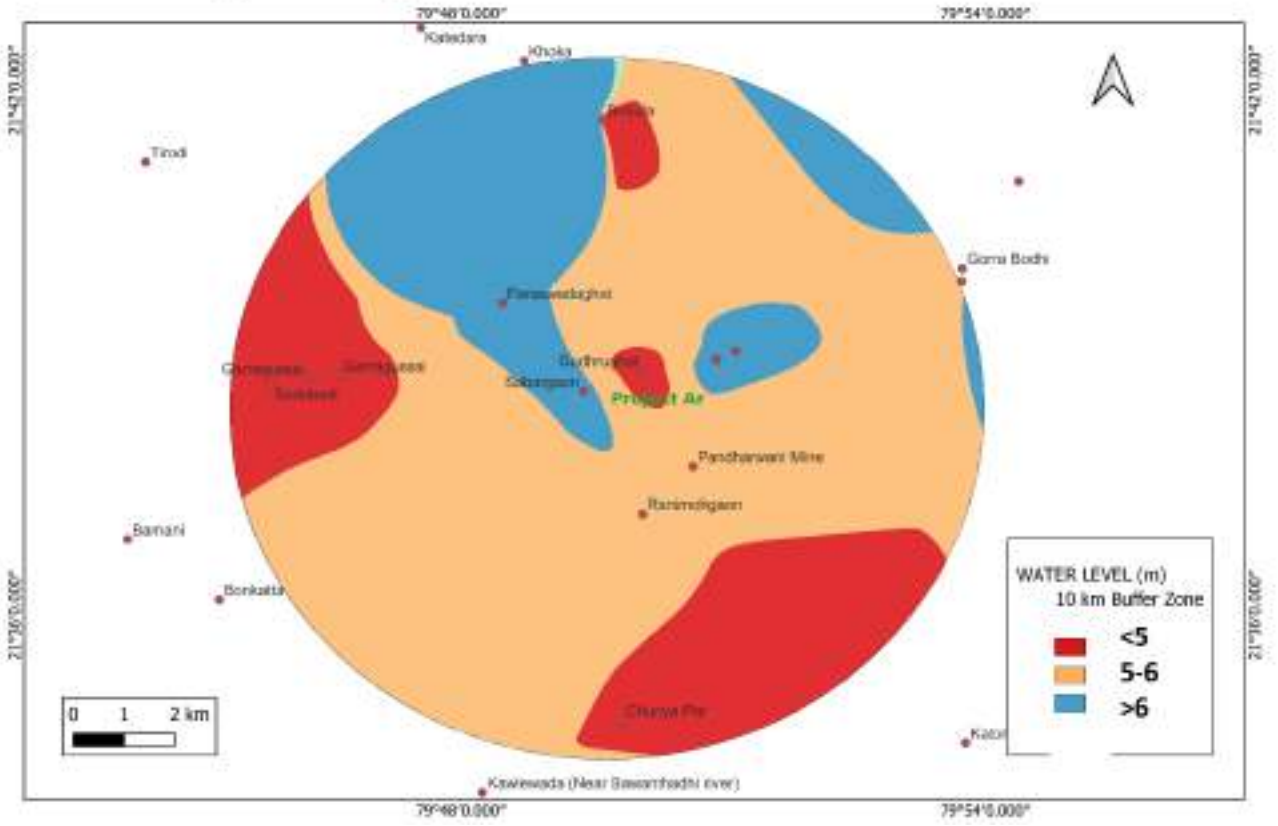
(Lat & Long data are as per GPS reading, DO, EC, pH, and TDS measured on site using calibrated Hanna portable equipment during Feb 2022).

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.

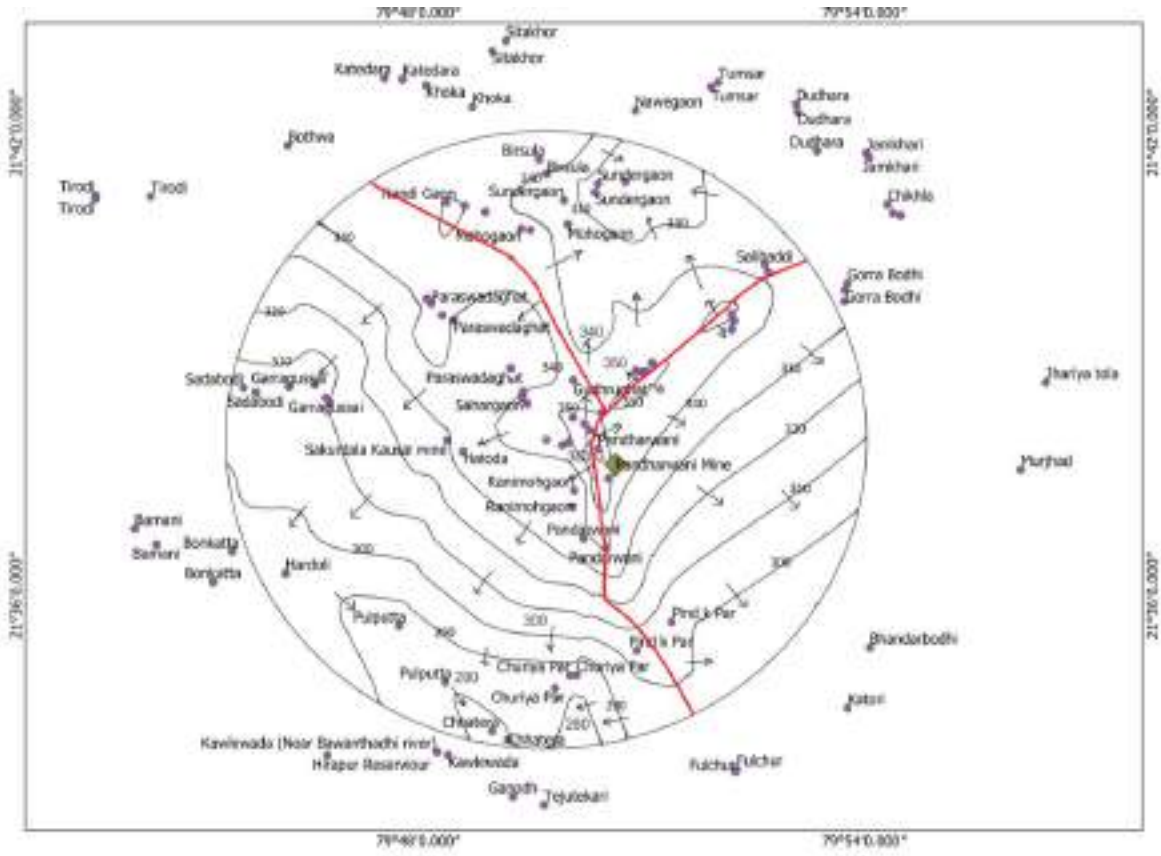


Fig 2.5: Groundwater contour map of Pandharwani mine area

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.**

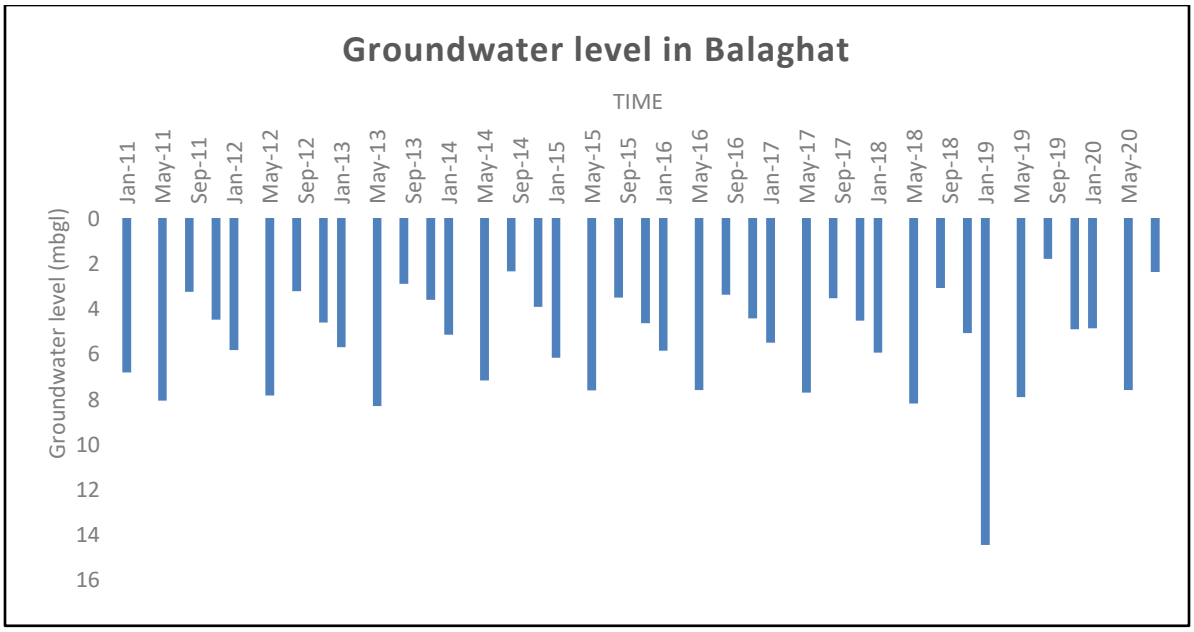


Fig 2.6: Long term well hydrograph of wells of Balaghat district, Madhya Pradesh
(source: WRIS online portal)

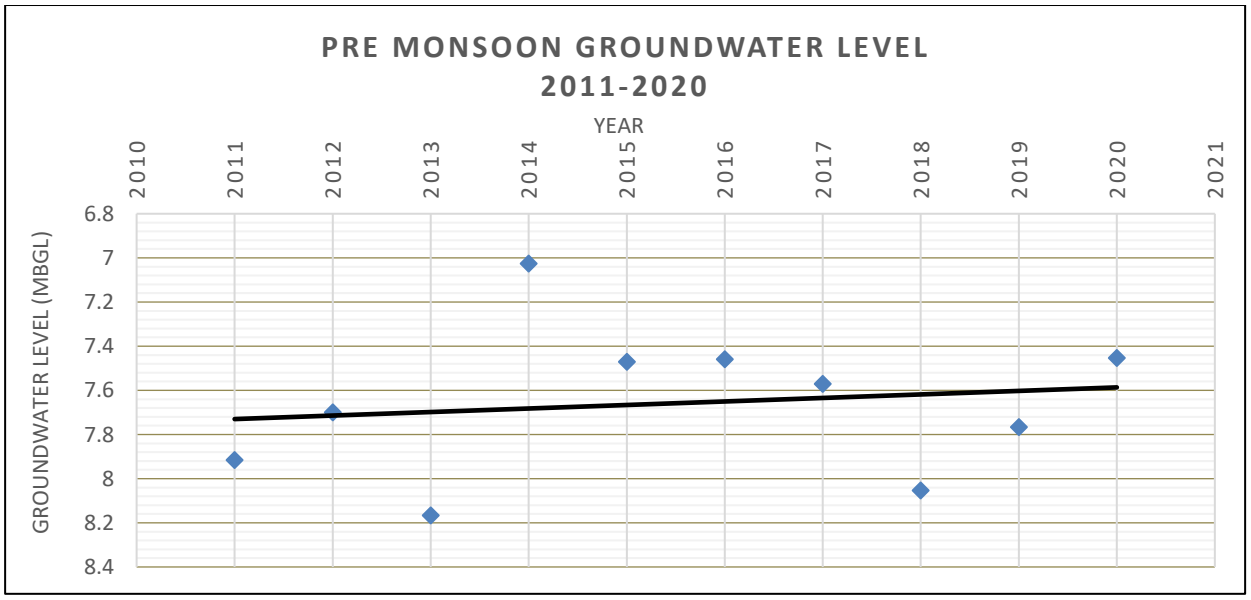


Fig 2.7a: Long term pre monsoon groundwater trend in Balagaht district showing slightly increasing trend

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.

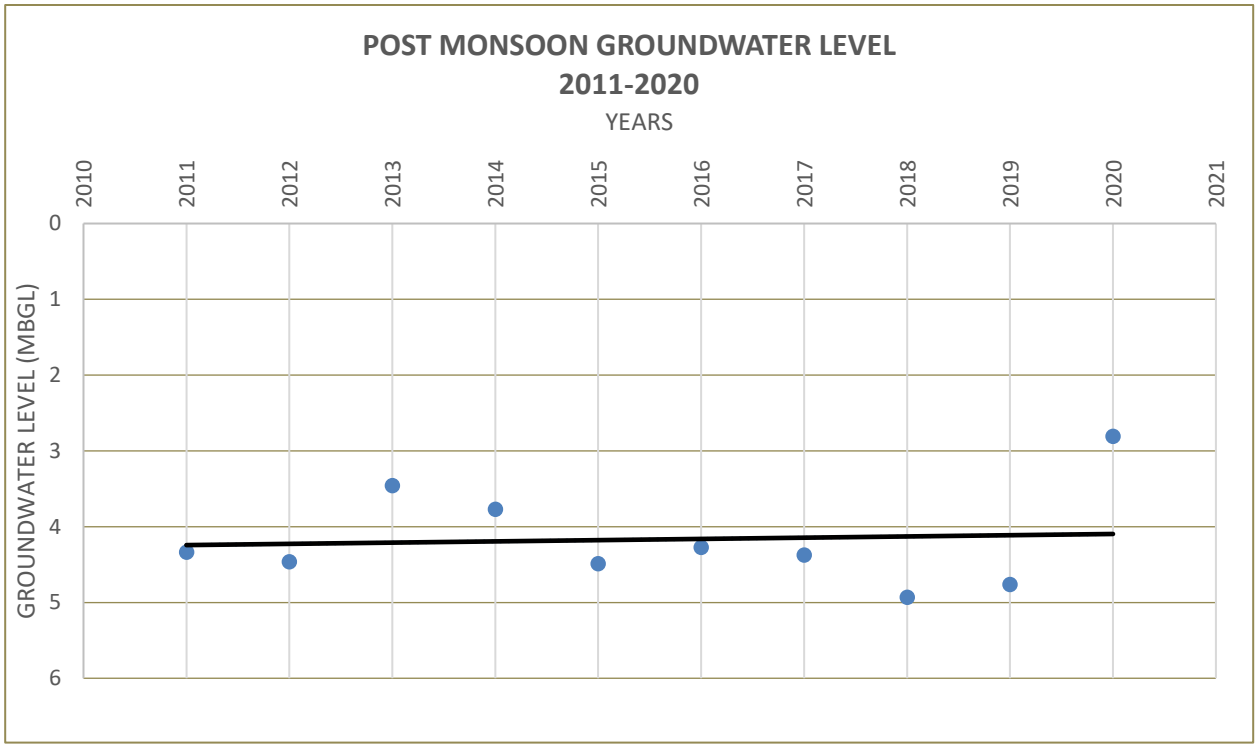


Fig 2.7b: Long term postmonsoon groundwater level tends in Balagaht district (Source: CGWB)

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 Rainfal l-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.

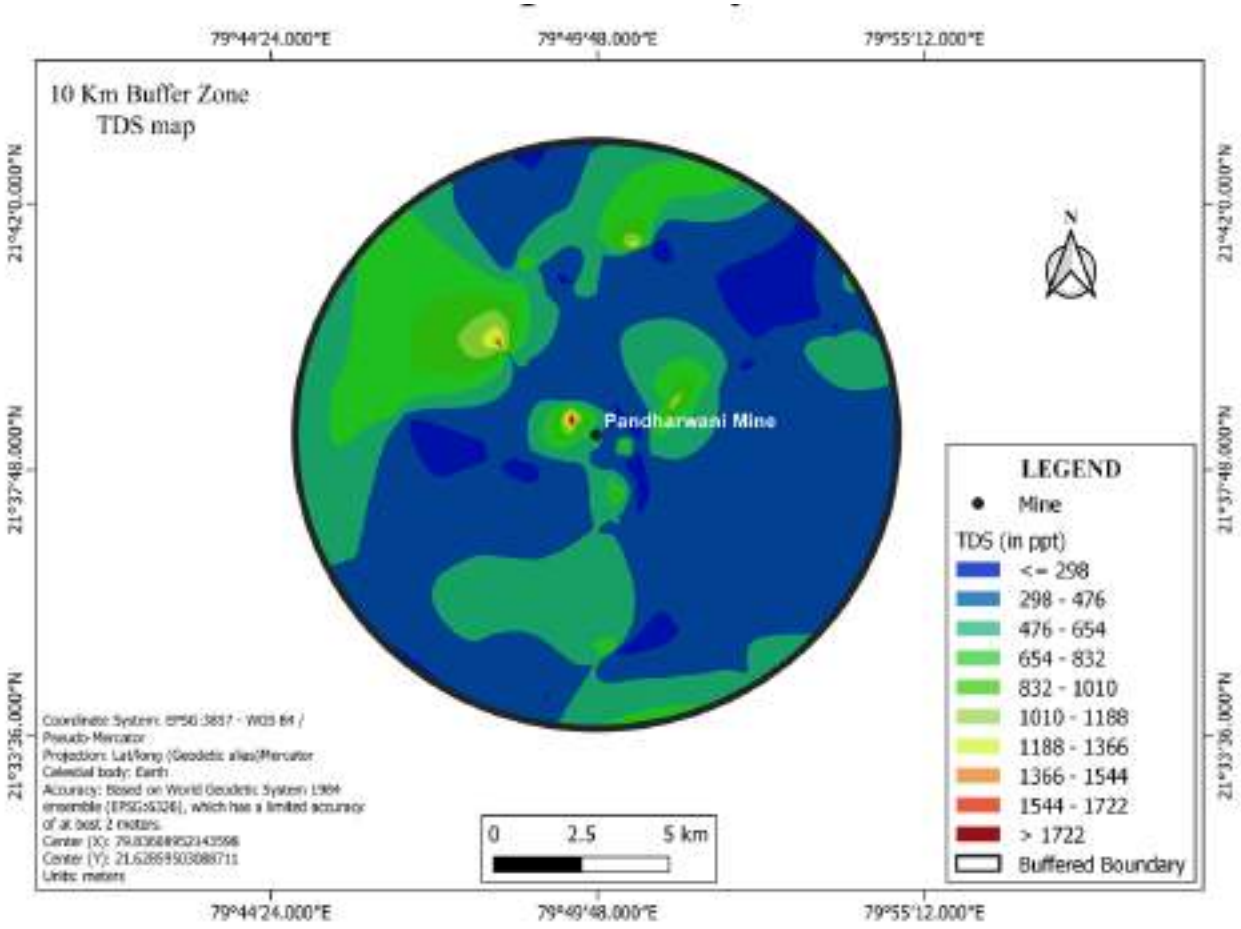


Fig 2.8: TDS map of study area

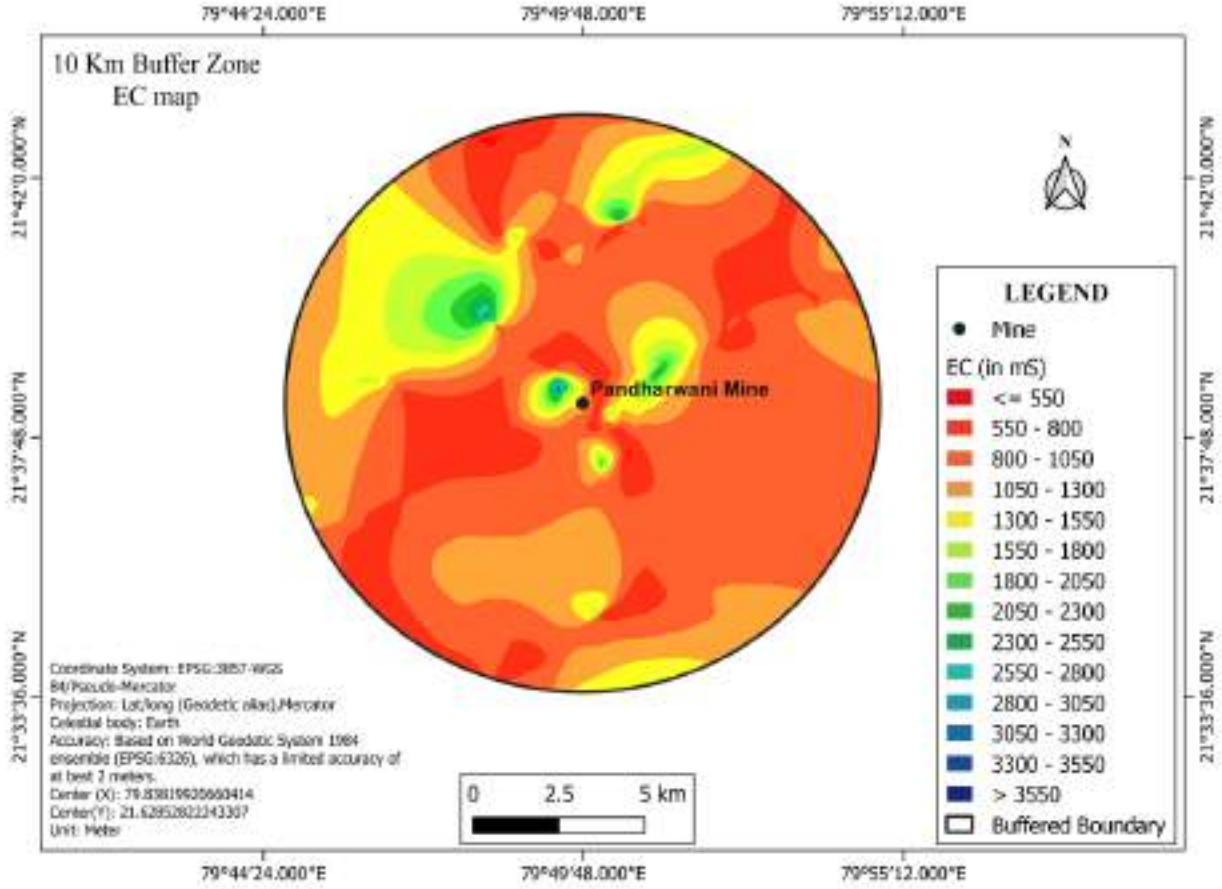


Fig 2.9: EC map of Study area Pandharwani mine

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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: 2 *2 3 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	181.96
15	Iron as Fe	mg/lit	3500- Fe E	<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^{6+} 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-462039(M.P.)
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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** 20-73 **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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Telephone : 0755-4299319, Fax : 0755-4243510, Mobile : 9425009319
Email: creativelab.bpl@gmail.com, creative.bpl@gmail.com, Website : www.creativeenviroservices.com

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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**)

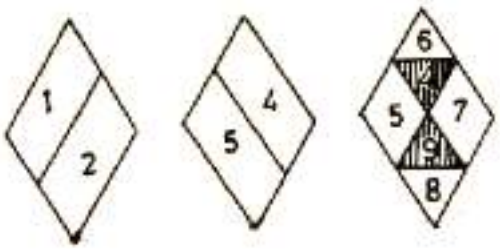


Fig 2.10: Sub-divisions of the diamond field

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).

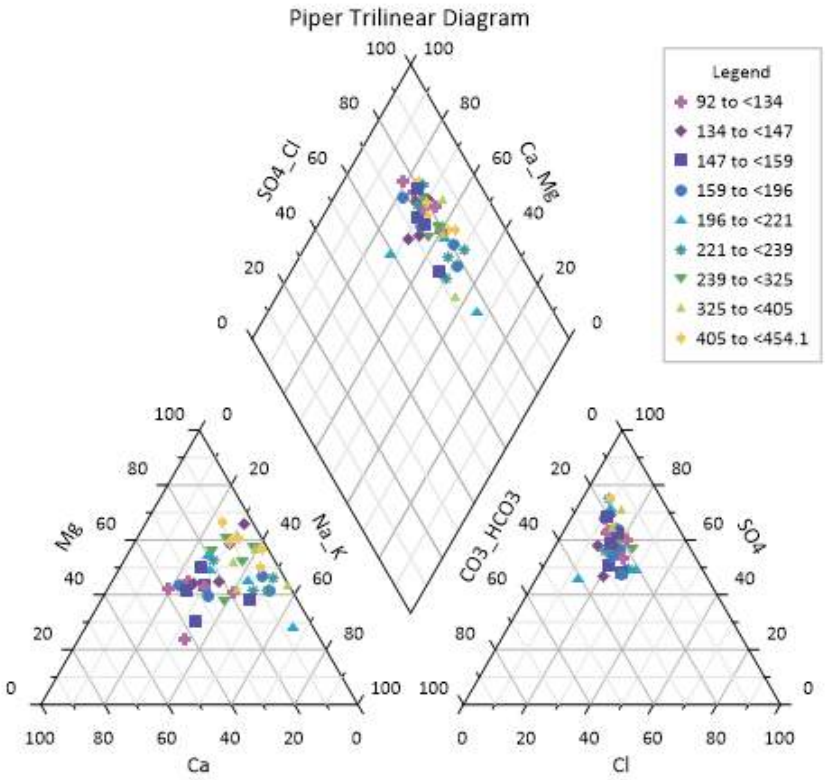


Fig: 2.11 Distribution of water samples in Piper Trilinear Diagram

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.

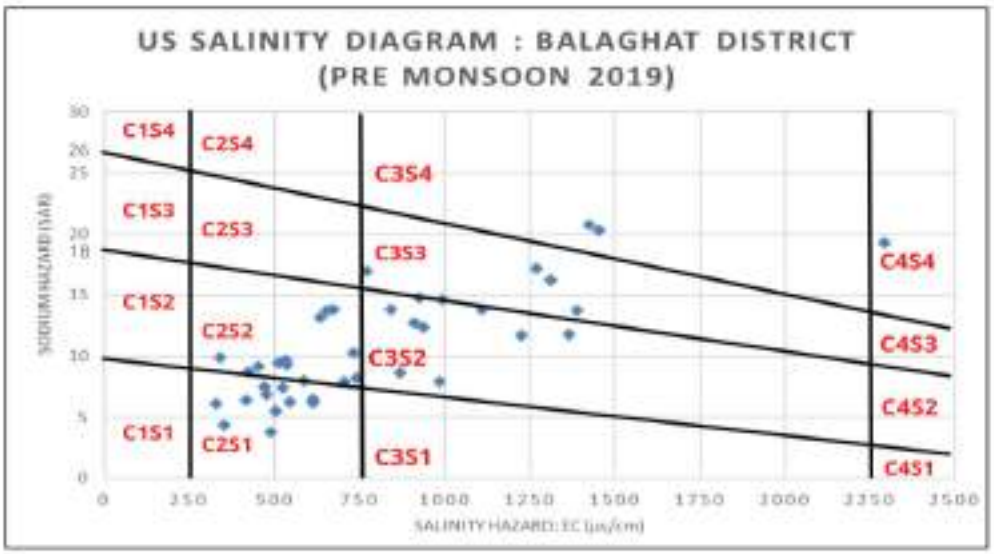
Sodium Adsorption Ratio: High sodium in irrigation water reduces the permeability of soil.The USSL diagram based on SAR divided to four categories included:

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

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).**



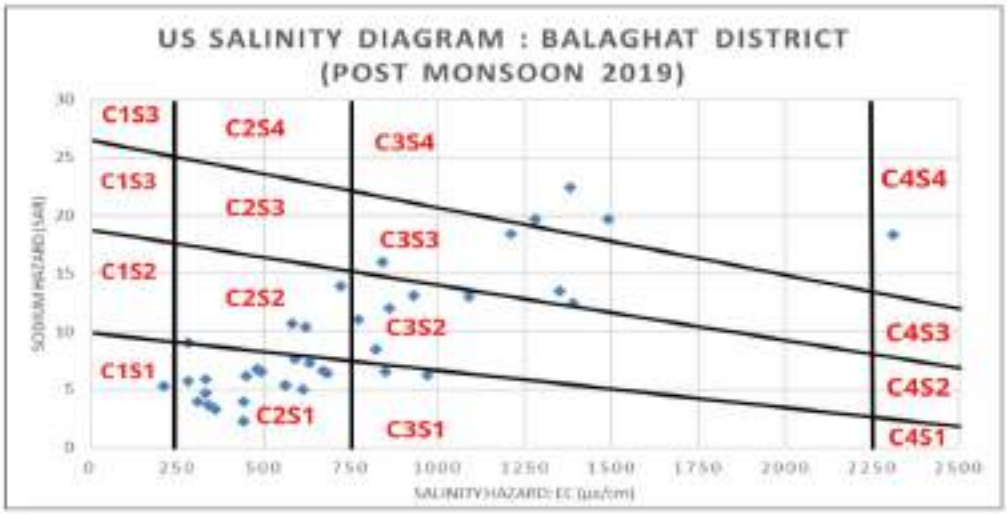


Fig:2.12 US Salinity diagram of Pre Monsoon 2019 and Post Monsoon 2019, Balaghat

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

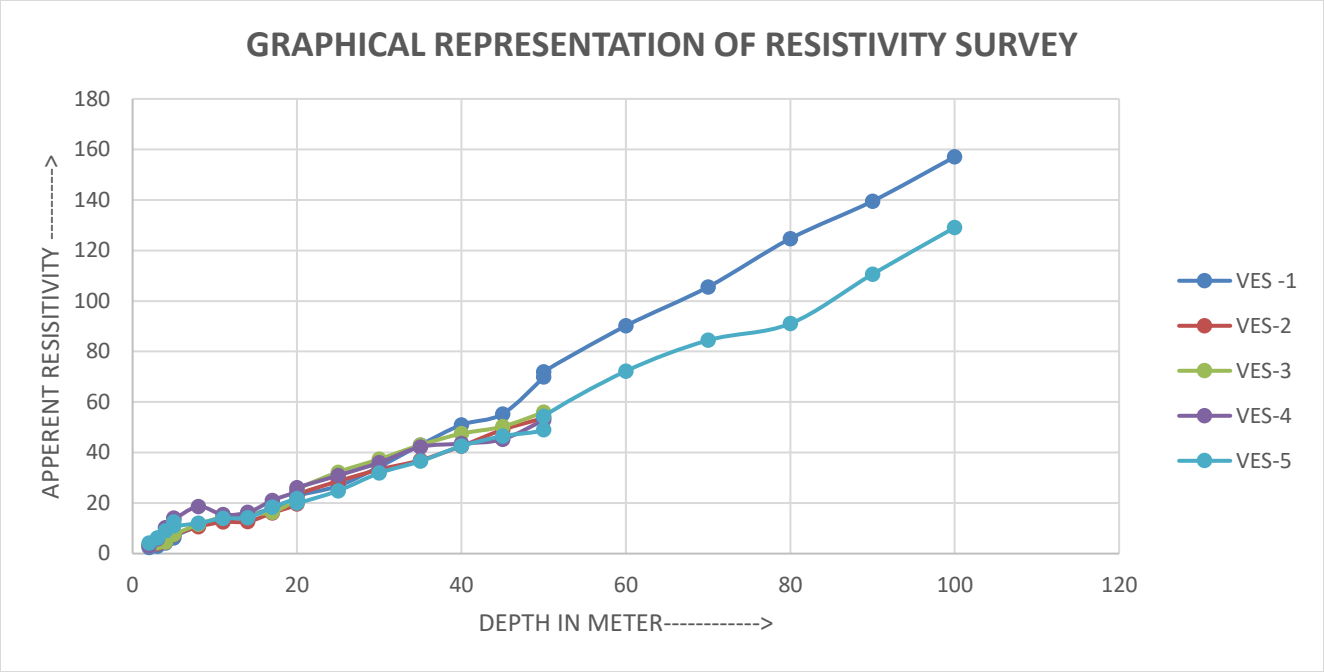
GROUND WATER INVESTIGATION

DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

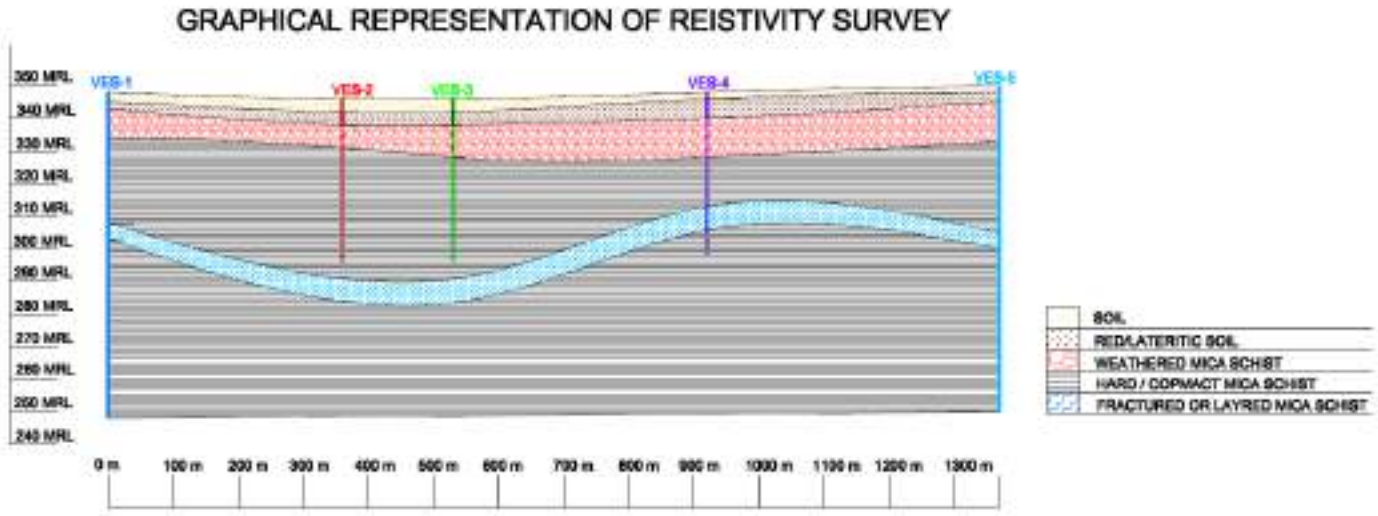
- FROM VES-1 TO VES-5

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 ---------->
180
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
120
DEPTH IN METER---------->
VES -1
VES-2
VES-3
VES-4
VES-5


VES 1
VES 2
VES 3
VES 4
VES 5



VES -1

RESISTIVITY SURVEY

GROUND WATER INVESTIGATION

DATA SHEET DEPTH PROBE SCHLUBERGER ELECTRODE CONFIGURATION

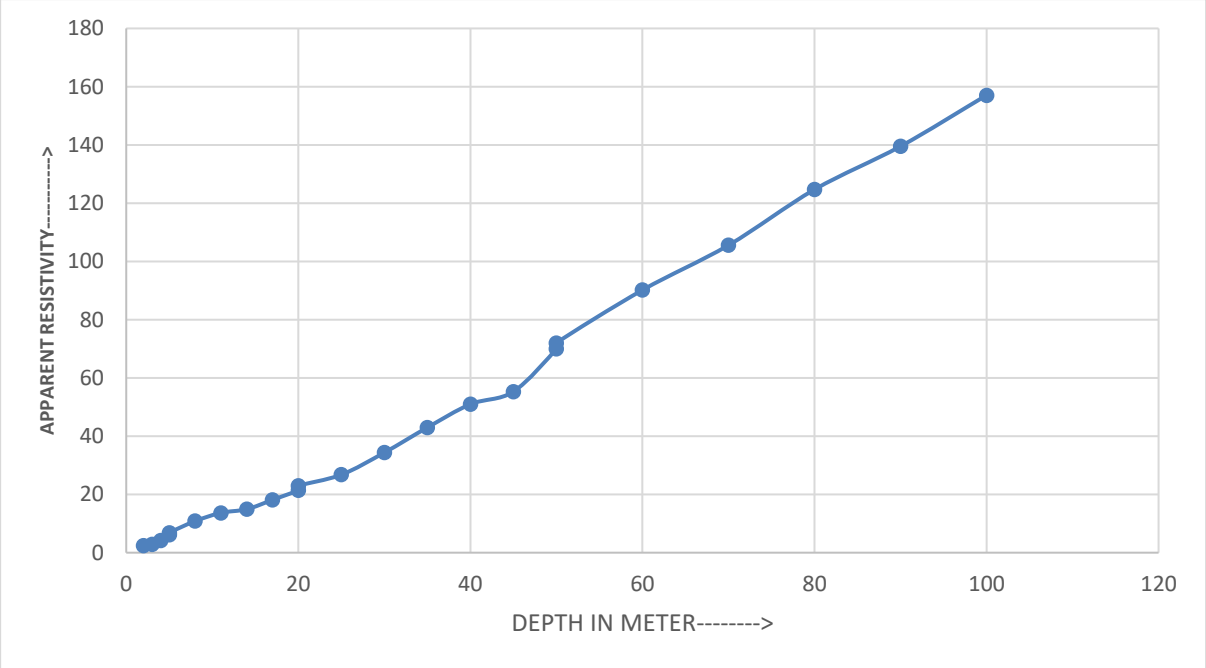
- LOCATION – IN MIRAGPUR MINE (24 HACT)
- LAT - 21°37'55.78"N LONG - 79°49'54.35"E

S.N	AB/2 (in Mtr)	MN/ 2 (in Mtr)	SPACIN G FACTOR K	MEASURED RESISTANCE (R- OHMS) 1	APPARENT RESISTIVI TY (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

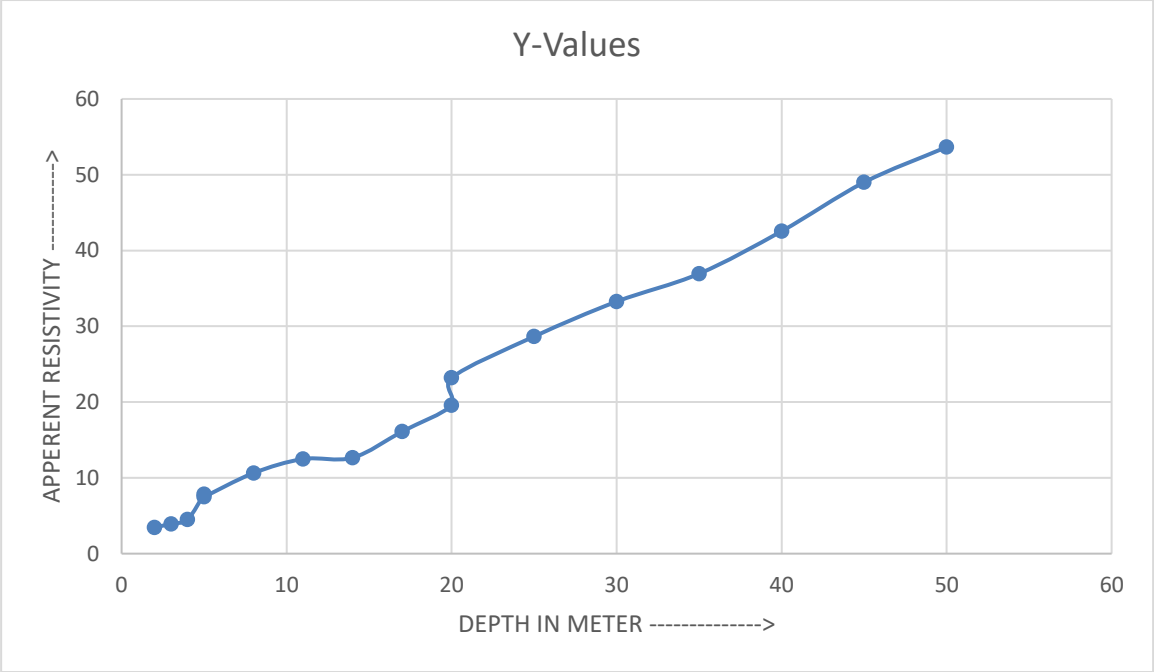
- LOCATION – NEAR KALA GADDA (OLD PIT)
- LAT - 21°37'52.40"N LONG - 79°50'6.30"E

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

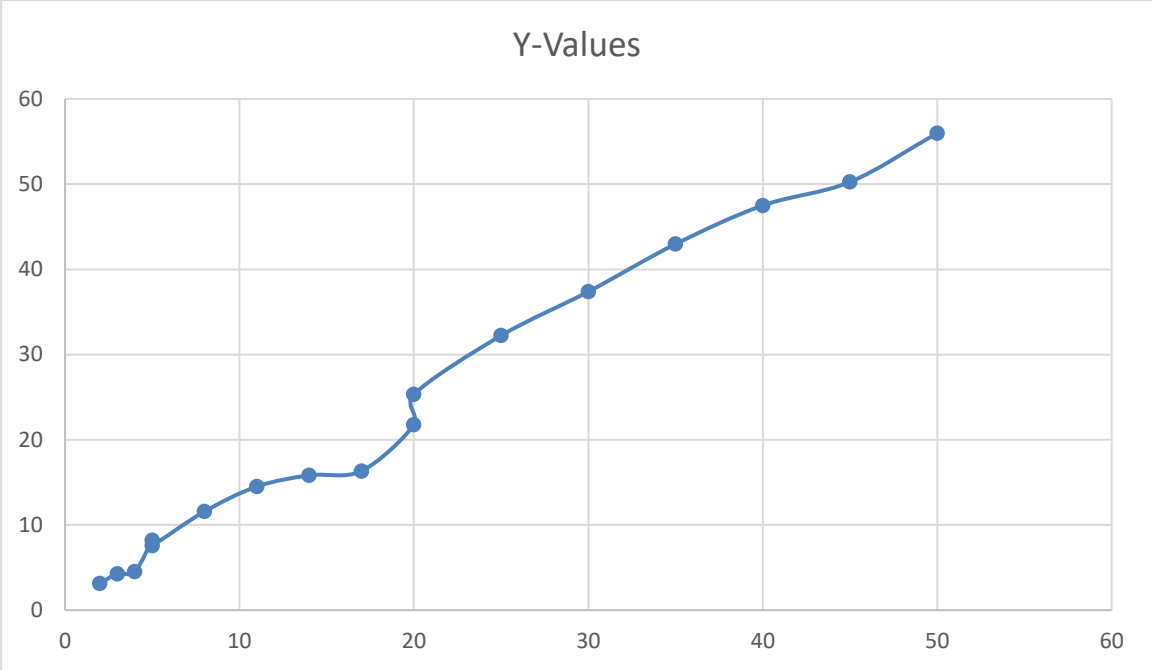
DATA SHEET DEPTH PROBE SCHLUMBERGER ELECTRODE CONFIGURATION

- 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

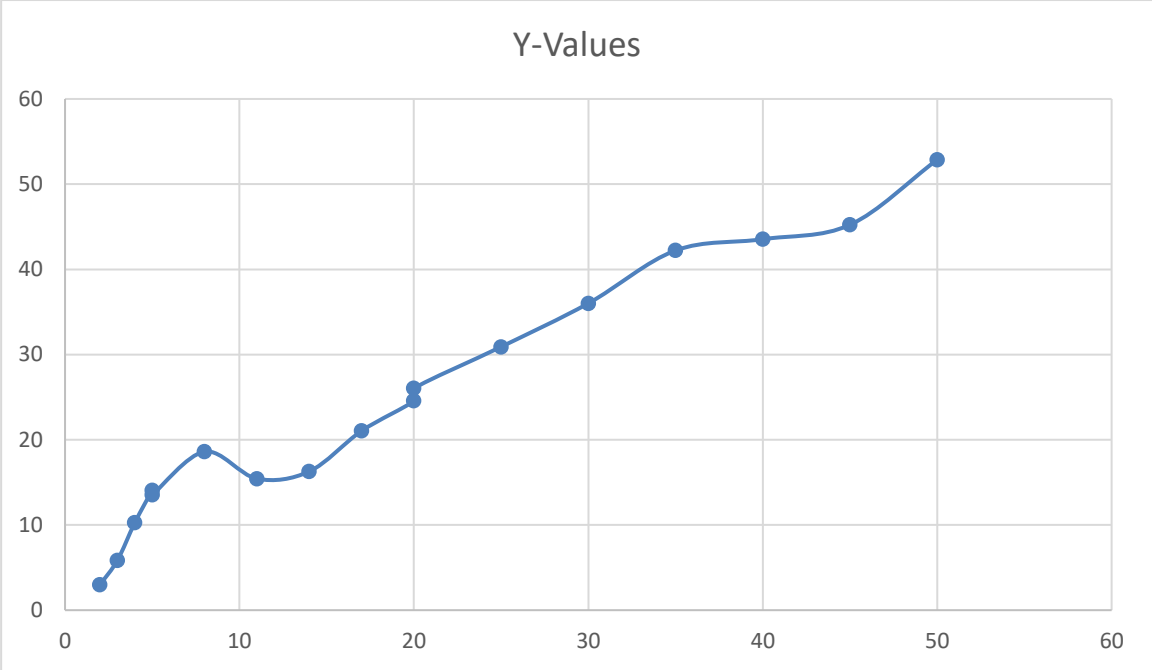
DATA SHEET DEPTH PROBE SCHLUMBERGER ELECTRODE CONFIGURATION

- 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

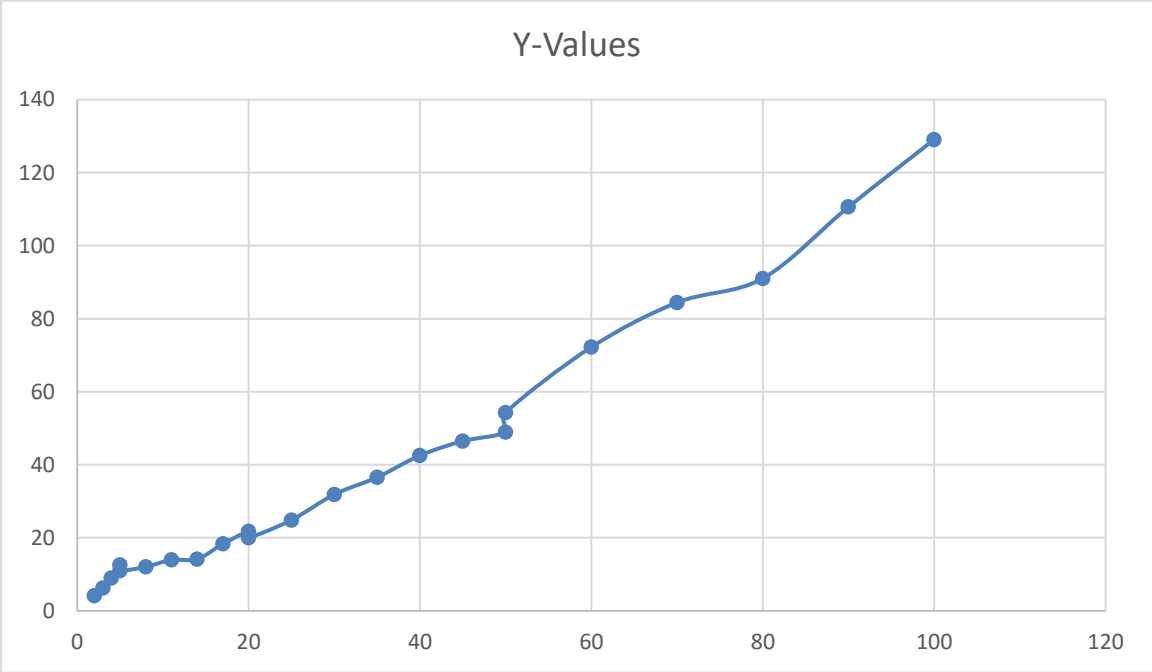
- LOCATION – IN FRONT OF PANDHARWANI MINE GATE
- LAT - 21°37'42.45"N LONG - 79°50'40.75"E

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.

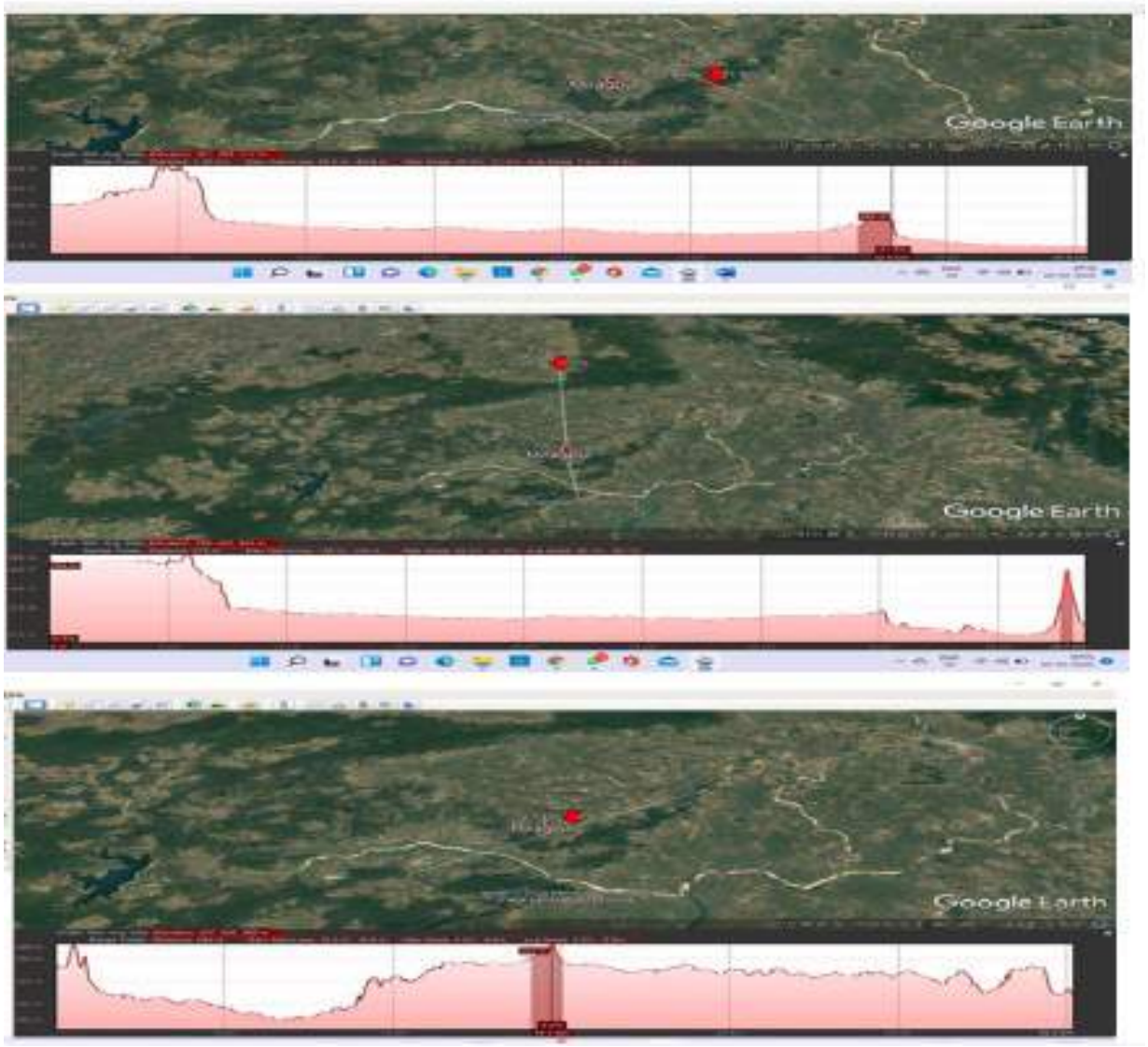


Fig 7.2 Google elevation profile of study area around Pandharwani Mine from three directions

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.

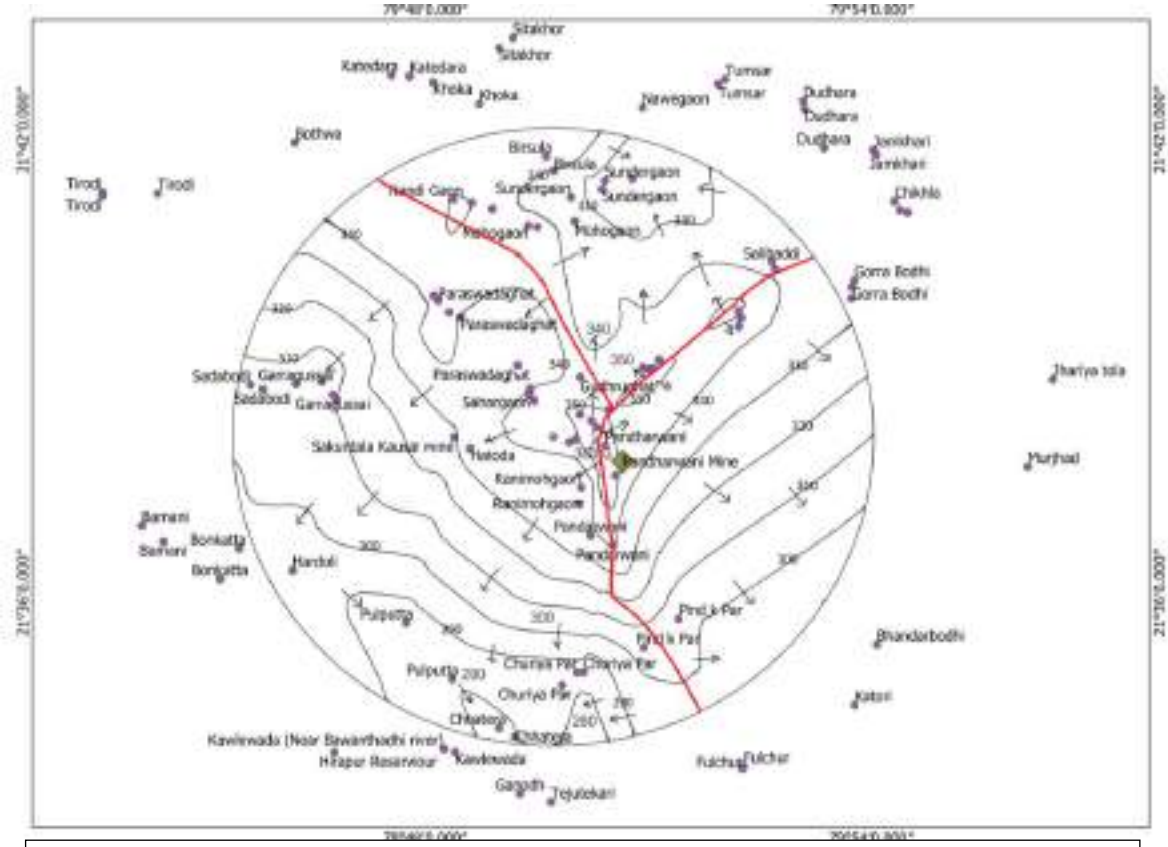
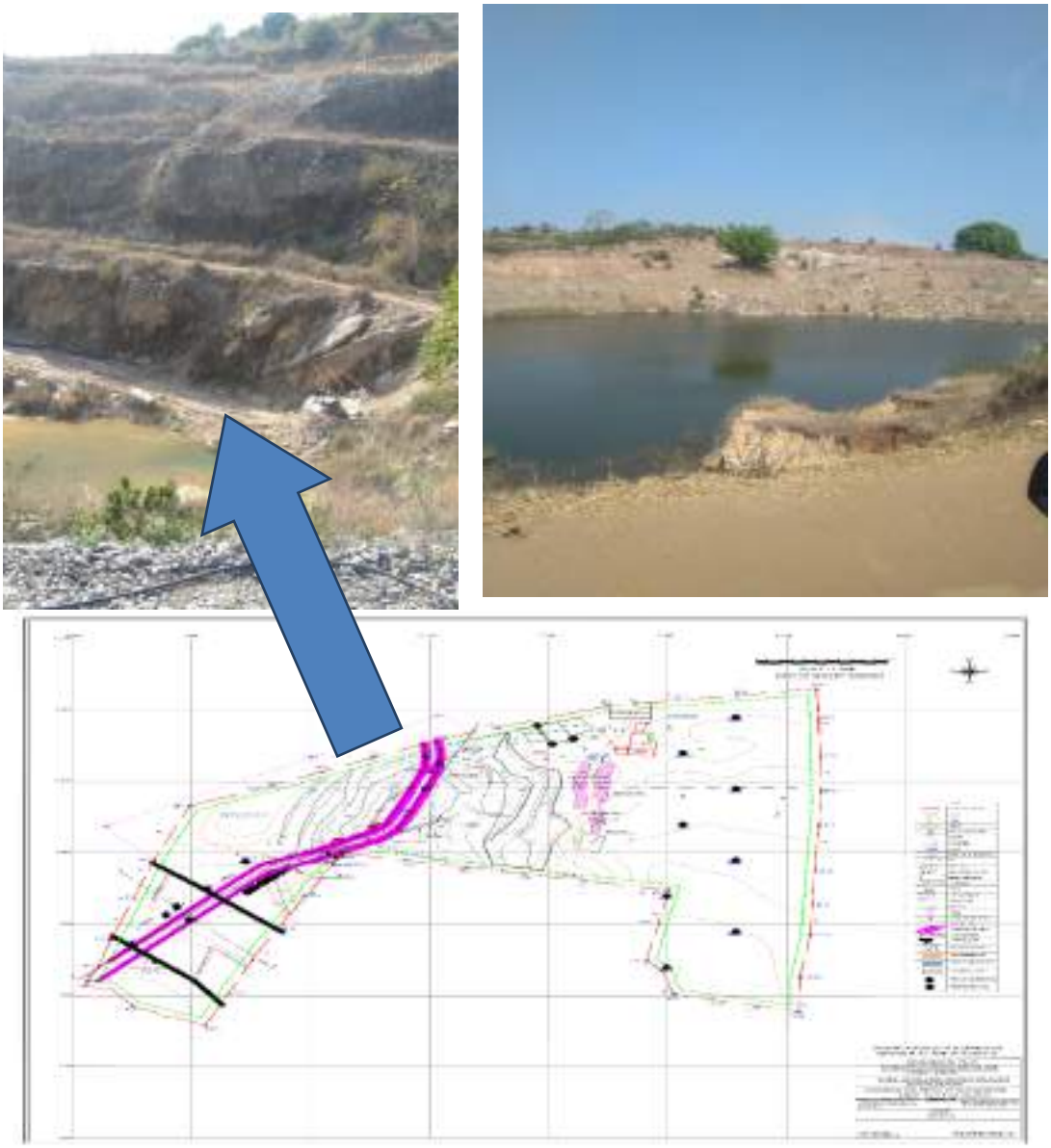


Fig 7.3 Groundwater contour map of Pandharwani mine area.

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 m^2having 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	HirapurReservioour	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).

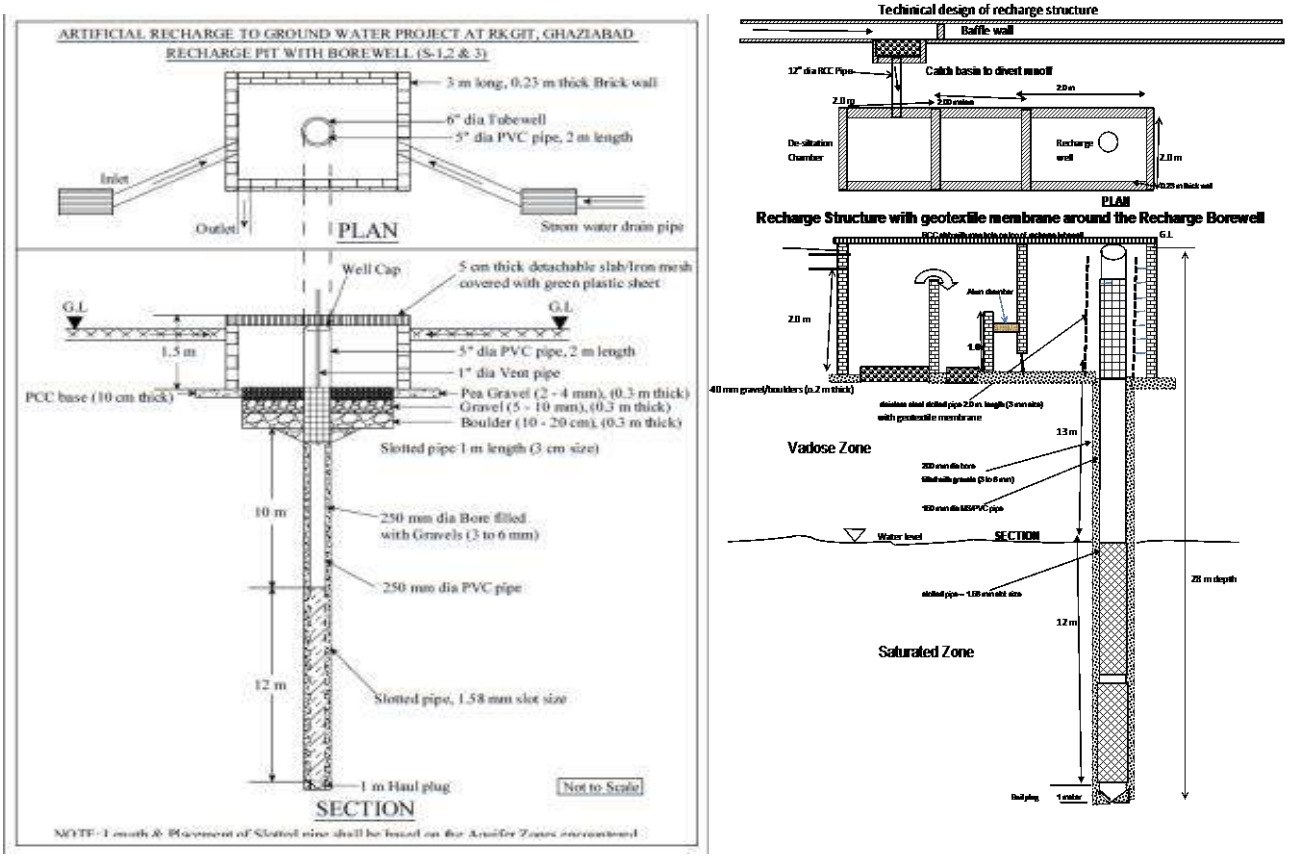


Fig 9.5 Design of proposed rooftop rain water harvesting structure

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

Buffer Zone										
S. N.	Location	Latitude	Longitude	Elevation	EC (mS)	pH	TDS (ppt)	Water Level (m)	DO (mg/l)	Type of water body
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