



Ref No: NINL/KJR/2024/87

Date: 29.05.2024

To,
The Additional Director,
Ministry of Environment and Forest & Climate Change,
Eastern Region Office,
A/3, Chandrasekharapur,
Bhubaneswar-751023

Subject: Submission of half-yearly compliance report on the stipulated environmental clearance terms and conditions in respect of Iron Ore Mine of M/s Neelachal Ispat Nigam Ltd. with proposed production capacity of 2.0 MTPA, located at District(s) Keonjhar and Sundergarh, Odisha [MLA: 874.290 ha] for the period from **October'2023 to March'2024**.

Reference:

- 1) MoEFCC's Letter Ref No: J-11015/55/2010-IA.II (M) dated 15th June 2018.
- 2) MoEFCC's notification vide S.O-5845 (E), dated 28th November 2018.

Respected Sir,

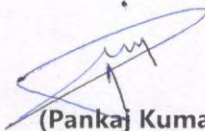
We are herewith submitting the six-monthly compliance report on the status of the implementation of the conditions stipulated in environmental clearance awarded to us vide MoEFCC's Letter Ref No: J-11015/55/2010-IA.II (M) dated 15th June 2018 in respect of Iron Ore Mine of M/s Neelachal Ispat Nigam Ltd. with proposed production capacity of 2.0 MTPA, located at District(s) Keonjhar and Sundergarh, Odisha [MLA: 874.290 ha] for the period from October'2023 to March'2024 for your kind perusal.

This is in reference to the above referred MoEFCC's notification, the six-monthly compliance report is being submitted only in soft copy mode, shared with your good office at e-mail @ roez.bsr-mef@nic.in.

We believe the above submission is in order.

Thanking You,

Yours Faithfully,
For Neelachal Ispat Nigam Limited


(Pankaj Kumar)
Head Mines, NINL
Tata Steel Limited,
Joda I Odisha

Encl: As above.

Copy To:

- 1) Zonal Office Kolkata, Central Pollution Control Board, South end Conclave, Block 502, 5th and 6th Floors, 1582 Rajdanga Main Road, Kolkata, West Bengal 700107.
- 2) The Member Secretary, State Pollution Control Board, A/118, Nilakantha Nagar, Bhubaneswar, Odisha-751012.
- 3) The Regional Officer, State Pollution Control Board, Baniapat, DD College Road, Keonjhar, Odisha-758001.

NEELACHAL ISPAT NIGAM LIMITED

Kalinga Nagar Industrial Complex Duburi 755026 Odisha India Phone 06726 264001
Corporate Identification Number U27109OR1982PLC001050

Your (**Environment Clearance**) application has been **Submitted** with following details

Proposal No	IA/OR/MIN/9259/2012
Compliance ID	59743948
Compliance Number(For Tracking)	EC/M/COMPLIANCE/59743948/2024
Reporting Year	2024
Reporting Period	01 Jun(01 Oct - 31 Mar)
Submission Date	30-05-2024
IRO Name	ARTATRANA MISHRA
IRO Email	jhk109@ifs.nic.in
State	ODISHA
IRO Office Address	Integrated Regional Offices, Bhubaneswar

Note:- SMS and E-Mail has been sent to ARTATRANA MISHRA, ODISHA with Notification to Project Proponent.

Half Yearly Compliance Report**2024****01 Jun(01 Oct - 31 Mar)****Acknowledgment**

Proposal Name	Iron Ore Mine of M/s Neelachal Ispat Nigam Ltd. with proposed production capacity of 2.0 MTPA, located at District(s) Keonjhar and Sundergarh, Odisha [MLA: 874.290 ha]				
Name of Entity / Corporate Office	Neelachal Ispat Nigam Ltd				
Village(s)	BASADA				
District	SUNDARGARH				
Proposal No.	IA/OR/MIN/9259/2012		Category	Non-Coal Mining	
Plot / Survey / Khasra No.	30,31		Sub-District	Koida	
State	ODISHA		Entity's PAN	NA	
MoEF File No.	J-11015/55/2010-IA.II (M)		Entity name as per PAN	NA	

Compliance Reporting Details

Reporting Year 2024

Remarks (if any)

Reporting Period 01 Jun(01 Oct - 31 Mar)

Details of Production and Project Area

Name of Entity / Corporate Office	Neelachal Ispat Nigam Ltd				
	Project Area as per EC Granted	Annual Project Area in Possession			
Private	6.3	8.911			
Revenue Land	0	59.226			
Forest	806.153	806.153			
Others	61.837	0			
Total	874.29	874.29			

Production Capacity

Sr. no	Product Name	units	Valid Upto	Capacity	Production last year	Capacity as per CTO
1	Iron Ore	Tons per Annum (TPA)	31/03/2025	2000000	1796886.78	2000000

Conditions

Specific Conditions

Sr.No.	Condition Type	Condition Details
1	Statutory compliance	No mining activities will be allowed in forest area for which the Forest Clearance is not available.
PPs Submission: Complied The Stage II Forest clearance obtained for total forest area of 806.153 ha within the ML area issued vide ref F. No. 8-68/2013-FC dated 22.07.2019. Mining & other ancillary activities are confined within above 806.153 ha. Copy of the Forest Clearance enclosed herewith.		Date: 29/05/2024
2	Statutory compliance	Environmental clearance is granted subject to final outcome of Hon'ble Supreme Court of India, Hon'ble High Court of Pune, Hon'ble NGT and any other Court of Law, if any, as may be applicable to this project.
PPs Submission: Complied All the judgements applicable for this project are strictly followed. The project started operation after obtaining requisite regulatory clearances i.e Forest Clearance vide ref F. No. 8-68/2013-FC dated 22.07.2019, Env't. Clearance vide no: J-11015/55/2010-IA. II(M) dated 15/06/2018, CTO vide no: 4436/IND-I-CON-6674 dtd.23.03.23 and CGWA clearance vide no: CGWA/NOC/MIN/ORIG/2023/17541, dated 12/01/2023 etc.		Date: 29/05/2024
3	AIR QUALITY MONITORING AND PRESERVATION	The Proponent shall install online Ambient Air Quality Monitoring System and there should be system for display of digital AAQ data within 03 months at least at three locations as per wind direction. Online provisions of pH and turbidity meters at discharge points of STP and ETP and also at water storage ponds in the mining area may be made. Project Proponent should display the result digitally in front of the main Gate of the mine site.
PPs Submission: Complied Three number of online AAQ monitoring system have been planned to be installed. One station has been installed near Mine Gate (Core Zone) and is operational. Out of the balance two CAAQMS, one will be installed in the core zone and one online system will be installed in the buffer zone as per the predominant wind direction in consultation with RO, OSPCB. Regular manual monitoring of environmental parameters is also being carried out through an external agency having NABL accreditation. Copy of the monitoring report is enclosed herewith. Mining operation commenced during Oct 2021 & the mine is in its initial development phase. Thus, no ETP and STP is installed at site at present. However, provision of installation of the same is planned & under progress. Treated water from STP and ETP will be reused for water sprinkling purpose as well as horticulture purpose. Zero effluent discharge shall be maintained. Provisions for online monitoring of pH and turbidity at discharge points of STP and ETP and at water storage ponds in the mining area has been made and shall be implemented. The monitoring results are being displayed on the digital display board installed in front of main gate of the Mine site. Photographs of the existing Online AAQ monitoring station and display board enclosed herewith.		Date: 29/05/2024
4	Statutory compliance	The Department of Mines and Geology. Govt. of Odisha shall ensure the implementation of the recommendations of the Carrying Capacity Study Report submitted by CSIR-NEERI.
PPs Submission: Complied Regular visit & direction from DDM, Mines, OSPCB & District Administration is being followed.		Date: 29/05/2024
5	WATER QUALITY MONITORING AND PRESERVATION	Project Proponent shall obtain the necessary prior permission from the Central Ground Water Authority (CGWA) in case of intersecting the Ground water table. The intersecting ground water table can only be commenced after conducting detailed hydro geological study and necessary permission from the CGWA/ MoEF & CC. The Report on

		six monthly basis on changes in Ground water level and quality shall be submitted to the Regional Office of the Ministry, CGWA and State Pollution Control Board.
PPs Submission: Complied Detailed Hydro Geological study has been carried out by accredited consultant (M/s Anacon Labs Pvt Ltd). Since the mine is presently being operated in a hilly terrain, the chances of intersecting ground water table are rare. However, if the mining operation will intersect the ground water table in the later stage of mining operation, prior permission of CGWA will be obtained. The Ground water level and quality monitoring reports will be submitted to the RO-MoEFCC, CGWA and OSPCB on six monthly basis. Copy of the monitoring report is enclosed herewith.		Date: 29/05/2024
6	GREENBELT	Project Proponent should plant only native species for green belt development. Plantation of local species should be carried out during the Monsoon Season.
PPs Submission: Complied 6080 saplings of native species have already been planted till date. An area of 1.88Ha. has also been developed as greenbelt within ML boundary safety zone. Species planted include Karanja, Sisoo, Baula, Mahaneem, Guava etc. Brief glimpses of Greenbelt and associated afforestation activities undertaken at mine level are enclosed herewith.		Date: 30/05/2024
7	Corporate Environmental Responsibility	The project should also implement community Development and Welfare programme in the area of Health, Education and Environmental Protection.
PPs Submission: Complied Community development & welfare programme in health, drinking water, Education, Solar light, communication and Environmental Protection are being taken up within peripheral villages through Tata Steel Foundation. Tata Steel Foundation take care of the social welfare activities and for the well-being and upliftment of the people residing near the project. They interact regularly with the local communities to identify their needs and requirement and accordingly plan the yearly activities in all the listed themes. Photographs of recent CSR Activities are enclosed herewith.		Date: 30/05/2024
8	Human Health Environment	Proponent shall appoint an Occupational Health Specialist for Regular and Periodical medical examination of the workers engaged in the Project and maintain records accordingly; also, Occupational health check-ups for workers having some ailments like BP, diabetes, habitual smoking, etc. shall be undertaken once in six months and necessary remedial/ preventive measure taken accordingly. The Recommendations of National Institute for ensuring good occupational environment for mine workers shall be implemented; the prevention measure for burns, malaria and provision of anti-snake venom including all other paramedical safeguards may be ensured before initiating the mining activities.
PPs Submission: Complied Periodical Medical Examination of employees (departmental & contractual) are conducted as per prescribed norms of Mines Rule, 1955. Initial & Periodical Occupational Health check-ups/ medical examination of the workers engaged in the Mines are conducted by Occupational Health Specialist at Tata Steel hospital, Joda and records are being maintained. In addition to the above, free medical check-up camps with free medicines are being organised in all the peripheral villages. One full time Doctor assisted by Pharmacist & Nurse are regularly attending the patients in peripheral villages. One Ambulance has been deployed 24x7 days of the year for shifting serious patients to referral hospitals.		Date: 29/05/2024
9	Corporate Environmental Responsibility	Transport of minerals shall be done either by dedicated road or it should be ensured that the trucks/dumpers carrying the mineral should not be allowed to pass through the villages. The Project Proponent shall ensure that the road may not be damaged due to transportation of the mineral; and transport of minerals will be as per

		IRC Guidelines with respect to complying with traffic congestion and density.
PPs Submission: Complied The existing transport road is well connected to the railway siding & State highways. This road bypasses adjacent villages. These haul roads are being repaired regularly. However, construction of concrete road from Mandajoda to Sargigad for a distance of about 10 km under CSR scheme with an estimated cost of Rs 30 crore is under progress as per the direction of Local administration.		Date: 29/05/2024
10	PUBLIC HEARING	Implementation of Action Plan on the issues raised during the Public Hearing. The Proponent shall complete all the tasks as per the Action Plan submitted with the budgetary provisions during the Public Hearing.
PPs Submission: Complied Action Plan on the issues raised during the Public Hearing is under implementation through Tata Steel Foundation in phased manner in consultation with the District Administration. Around 35 nos of locals are directly employed and an additional 540 nos are employed indirectly through local vendors for Transportation of Ore. Provision has been kept for installation of 157 nos of Solar lights and for 18 nos deep borewells with solar pump for drinking water. One doctor, one Pharmacist & One nurse are available for mobile treatment with Ambulance & free medicines. One 35-seater school bus has been provided for attending schools at Koira. Afforestation activities have been started, regular water sprinkling is being carried out over haul roads, toe wall & garland drain/ settling pit construction is started, and environment monitoring is being carried out at site.		Date: 29/05/2024
11	Corporate Environmental Responsibility	Project Proponent shall ensure the safeguard and wellbeing of villagers and school, regular health Monitoring of all residents in the area and the compliance Report shall be submitted to the regional office of the Ministry.
PPs Submission: Complied As per the direction of Local administration, Construction of concrete road from Mandajoda to Sargigad (~10 km) has been started under CSR scheme. Free medical check up camps are conducted along with free medicines for the villagers on regular basis accompanied by Doctors, Pharmacists & Nurses. In addition to this one ambulance (24x7) is stationed at Mines for emergencies.		Date: 29/05/2024
12	Statutory compliance	Project Proponent shall comply all the Recommendations of CSIR-NEERI study Report on "Carrying Capacity Study for Environmentally Sustainable Iron and Manganese Ore Mining Activity in Keonjhar, Sundargarh and Mayurbhanj districts of Odisha State.
PPs Submission: Complied All the Recommendations of CSIR-NEERI study Report on "Carrying Capacity Study for Environmentally Sustainable Iron and Manganese Ore Mining Activity in Keonjhar, Sundargarh districts of Odisha are being implemented under the guidance of Govt. Administration.		Date: 29/05/2024
13	Statutory compliance	The Environmental Clearance is subject to obtaining requisite NBWL Clearance, if any, from the Standing Committee of National Board for Wildlife for Mining project.
PPs Submission: Complied There are no Protected Areas such as National Park, Wildlife Sanctuary etc. within 10 kms of the lease area. However, funds towards Regional Wildlife Conservation plan & Site-Specific Wildlife Conservation plan have been deposited with CAMPA as demanded. Copy of the Demand notice and payment details are enclosed herewith.		Date: 29/05/2024
14	Statutory compliance	The Project Proponent shall obtain Consent to Operate from the State Pollution Control Board, Odisha and effectively implement all the conditions stipulated therein.

PPs Submission: Complied
Consent to Operate from the State Pollution Control Board, Odisha obtained vide letter no. 3953/IND-I-CON-6674 dtd.20.03.24 valid till 31.03.2025. The conditions stipulated therein are being implemented. Copy of CTO enclosed herewith.

Date:
29/05/2024

General Conditions

Sr.No.	Condition Type	Condition Details
1	AIR QUALITY MONITORING AND PRESERVATION	Project Proponent shall follow the mitigation measures provided in Office Memorandum No. Z-11013/57/2014-IA. II(M), dated 29th October, 2014, titled "Impact of mining activities on Habitations-Issues related to the mining Projects wherein Habitations and villages are the part of mine lease areas or Habitations and villages are surrounded by the mine lease area".
PPs Submission: Complied Adopted requisite mitigation measures like Afforestation, Water sprinkling over the haul roads, provision of dry fog system in Crushing & Screening plants, Construction of retaining wall, toe wall, garland drain, provision of employment, drinking water, solar light, medical facility & educational support, so that there will be no adverse impact on the habitations & villages located within or around the ML area due to Mining activities.		Date: 29/05/2024
2	LAND RECLAMATION	The top soil, if any, shall temporarily be stored at earmarked site(s) only and it should not be kept unutilized for long. The topsoil shall be used for land reclamation and plantation. The over burden (OB) generated during the mining operations shall be stacked at earmarked dump site(s) only and it should not be kept active for a long period of time. The maximum height of the dumps shall not exceed 8m and width 20 m and overall slope of the dumps shall be maintained to 45°. The OB dumps should be scientifically vegetated with suitable native species to prevent erosion and surface run off. In critical areas, use of geo textiles shall be undertaken for stabilization of the dump. The entire excavated area shall be backfilled and afforested. Monitoring and management of rehabilitated areas should continue until the vegetation becomes self-sustaining. Compliance status shall be submitted to the Ministry of Environment, Forest and Climate Change and its Regional Office on six monthly basis.
PPs Submission: Complied About 3000 CuM of topsoil which was recovered during mining operation, is stored at earmarked site and same is being utilized for plantation work. There is no prominent OB dump existing in the mine. OB generated shall be stored only at earmarked site in accordance with approved mining plan as per guidelines laid by DGMS & IBM. Reclamation activities shall be done as per Progressive Mine Closure Plan. Backfilling & afforestation shall be done in accordance with Approved Mining plan & PMCP.		Date: 29/05/2024
3	MISCELLANEOUS	Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.
PPs Submission: Complied Majority of the labourers working in this Mine belong to nearby villages only and are staying in their own houses at present. Provision has been kept for providing housing with necessary infrastructure like fuel for cooking, mobile toilets, safe drinking water, medical health care, creche for kids etc. in future.		Date: 29/05/2024

4	Noise Monitoring & Prevention	Measures should be taken for control of noise levels below 85 dBA in the work environment. Workers engaged in operations of HEMM, etc. should be provided with ear plugs /muffs.
PPs Submission: Complied All the workers are provided with earmuffs & ear plugs & other PPE w.r.t to the location and type of work. Adequate training & awareness are provided for health & safety. Monitoring Report for Noise level in core & buffer zones is attached herewith.		Date: 29/05/2024
5	WATER QUALITY MONITORING AND PRESERVATION	Industrial waste water (workshop and waste water from the mine) should be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19th May, 1993 and 31st December, 1993 or as amended from time to time. Oil and grease trap should be installed before discharge of workshop effluents.
PPs Submission: Complied The mine is in its initial development phase. Thus, at present no ETP is installed at site. However, provision of installation of the same is kept. An ETP will be established to treat the industrial wastewater. The inlet & outlet properties of effluent will be monitored as per the standards issued by SPCB.		Date: 29/05/2024
6	Human Health Environment	Personnel working in dusty areas should wear protective respiratory devices and they should also be provided with adequate training and information on safety and health aspects.
PPs Submission: Complied Personnel working in dusty areas are provided with proper respiratory masks, eyewear protection, hand gloves, earmuffs, leg guard & other PPEs. Proper training and information on safety and health aspects at Group VT Centre of M/s Tata Steel Ltd, Joda to the employees as stipulated.		Date: 29/05/2024
7	MINING PLAN	Digital processing of the entire lease area using remote sensing technique shall be carried out regularly once in three years for monitoring land use pattern and report submitted to Ministry of Environment, Forest and Climate Change its Regional Office.
PPs Submission: Complied Land Use Land Cover Map of the lease area is attached herewith. The same has been countersigned & verified by forest department.		Date: 30/05/2024
8	MINING PLAN	No change in mining technology and scope of working should be made without prior approval of the Ministry of Environment, Forest and Climate Change.
PPs Submission: Complied No change in mining technology shall be made without prior approval of the Ministry of Environment, Forests & Climate Change.		Date: 29/05/2024
9	MISCELLANEOUS	The project authorities should inform to the Regional Office regarding date of financial closures and final approval of the project by the concerned authorities and the date of start of land development work.
PPs Submission: Complied Commencement of mining operation was intimated to the Member Secretary, OSPCB, Bhubaneswar vide our letter NINL/KJR/2020/09 dated 01.02.2020.		Date: 23/04/2024
10	WATER QUALITY MONITORING AND PRESERVATION	Sufficient number of Gullies to be provided for better management of water. Regular Monitoring of pH shall be included in the monitoring plan and report shall be submitted to the Ministry of Environment, Forest and Climate Change and its Regional Office on

		six monthly basis.
PPs Submission: Complied Mining operation commenced during Oct 2021 & the mine is in its initial development phase. Therefore, no prominent OB dumps are present at site as per current situation. However, as mining advances, proper channelization of water shall be provided to avoid siltation from OB dumps. Water quality monitoring of surface source of water present outside the mine lease area is done regularly and the reports are submitted to concerned regulatory bodies.		Date: 29/05/2024
11	WATER QUALITY MONITORING AND PRESERVATION	There shall be planning, developing and implementing facility of rainwater harvesting measures on long term basis and implementation of conservation measures to augment ground water resources in the area in consultation with Central Ground Water Board.
PPs Submission: Complied A site-specific rainwater harvesting scheme has been prepared by M/s KRG Rainwater foundation. The recommendations provided will be implemented during life of mine for rainwater harvesting. Copy of the report is enclosed herewith.		Date: 29/05/2024
12	MISCELLANEOUS	The project proponent shall take all precautionary measures during mining operation for conservation and protection of endangered fauna, if any, spotted in the study area. Action plan for conservation of flora and fauna shall be prepared and implemented in consultation with the State Forest and Wildlife Department. A copy of action plan shall be submitted to the Ministry of Environment, Forest and Climate Change and its Regional Office.
PPs Submission: Complied No endangered fauna is found in the project area. However, for better conservation of flora & Fauna the project proponent has deposited a sum of Rs.7.17 Cr towards Regional Wildlife conservation plan of this area. Moreover, a site-specific Wildlife conservation plan duly approved by PCCF (Wildlife), Odisha with an estimated cost of Rs.4.03 crore is under implementation as per the advice of DFO, Bonai.		Date: 29/05/2024
13	Corporate Environmental Responsibility	At least 1.5% of the total cost of the project shall be earmarked towards the Corporate Environment Responsibility (CER) based on Ministry's OM issued vide No. F.No.22-65/2017 -IA.III dated 1st May, 2018. The action plan with financial and physical breakup/ details shall be prepared and submitted to the Ministry's Regional Office. Implementation of such program shall be ensured accordingly in a time bound manner.
PPs Submission: Complied In accordance with the provisions of the MoEF&CC Office Memorandum No.22-65/2017-IA.11I dated 30 September 2020, an Action Plan on the issues raised during the Public Hearing is under implementation through Tata Steel Foundation in phased manner in consultation with the District Administration.		Date: 29/05/2024
14	WATER QUALITY MONITORING AND PRESERVATION	Catch drains and siltation ponds of appropriate size shall be constructed around the mine working, mineral and OB dumps to prevent run off of water and flow of sediments directly into the river and other water bodies. The water so collected should be utilized for watering the mine area, roads, green belt development etc. The drains shall be regularly desilted particularly after monsoon and maintained properly. The drains, settling tanks and check dams of appropriate size, gradient and length shall be constructed both around the mine pit and over burden dumps to prevent run off of water and flow of sediments directly into the river and other water bodies and sump capacity should be designed keeping 50% safety margin over and above peak sudden rainfall (based on 50 years data) and maximum discharge in the area adjoining the mine site. Sump capacity should

		also provide adequate retention period to allow proper settling of silt material. Sedimentation pits shall be constructed at the corners of the garland drains and desilted at regular intervals.
PPs Submission: Complied As per the Approved Mining Plan & PMCP, Garland drains, Check dams and settling pits of adequate capacity is being provided at appropriate places to arrest silt and sediment flows to ensure that only clear water will leave from lease boundary. The water collected shall be used for dust suppression and green belt development. All the structures shall be regularly de-silted and maintained properly. Photographs of the retaining walls, garland drains along with settling pit near the stack yard is attached herewith.		Date: 29/05/2024
15	GREENBELT	Plantation shall be raised in a 7.5m wide green belt in the safety zone around the mining lease, backfilled and reclaimed area, around water body, along the roads etc. by planting the native species in consultation with the local DFO/ Agriculture Department and as per CPCB Guidelines. The density of the trees should be around 2500 plants per ha. Greenbelt shall be developed all along the mine lease area in a phased manner and shall be completed within first five years.
PPs Submission: Complied Total safety zone has been fenced & planted with native species like Karanj, Neem, Sisoo, Guava etc. Total 6080 no. of saplings have been planted in the safety zone since commencement of mining operation. Remaining are is being planted with native species as stipulated. The scheme for fencing, protection & regeneration of Safety zone area has been prepared & approved by State Forest Dept. which is under implementation. Plantation along roads, water bodies, over back filled area & dumps will be taken up in due course.		Date: 29/05/2024
16	MISCELLANEOUS	The Project Proponent shall make necessary alternative arrangements, where required, in consultation with the State Government to provide alternate areas for livestock grazing, if any. In this context, Project Proponent should implement the directions of the Hon'ble Supreme Court with regard to acquiring grazing land. The sparse trees on such grazing ground, which provide mid-day shelter from the scorching sun, should be scrupulously guarded against felling and plantation of such trees should be promoted.
PPs Submission: Complied Arrangements for livestock feed will be developed in the nearby areas.		Date: 29/05/2024
17	Statutory compliance	As per the Company Act, the CSR cost should be 2 % of average net profit of last three years. Hence CSR expenses should be as per the Company Act/Rule for the Economic Development of the neighbourhood Habitats which could be planned and executed by the Project Proponent more systematically based on the 'Need based door to door survey' by established Social Institutes/Workers. The report shall be submitted to the Ministry of Environment, Forest and Climate Change and its Regional Office on six monthly basis.
PPs Submission: Complied As per the provision of the Companies Act 2013, an amount equivalent to 2 % of average net profit of last three years is being spent towards CSR activities in the field of Health, Drinking water, Solar light, educational support, repairing of village roads, Environment protection & employment etc through Tata Steel Foundation.		Date: 29/05/2024
18	MISCELLANEOUS	A separate environmental management cell with suitable qualified personnel should be set-up under the control of a Senior Executive, who will report directly to the Head of the Organization.

PPs Submission: Complied The company has made a robust arrangement for reviewing and monitoring the implementation of Environment management plan by Centralized Environmental Management Department, headed by the Chief, Environment and supporting staff. The operation and legal sections include Head, Mine & Production Planning, Head, Environment, Senior Manager - Mine Planning, Senior Manager - Environment, Environment Engineer, Chemists, etc.		Date: 29/05/2024
19	MISCELLANEOUS	The funds earmarked for environmental protection measures should be kept in separate account and should not be diverted for other purpose. Year wise expenditure should be reported to the Ministry and its Regional Office.
PPs Submission: Complied A dedicated cost Centre for maintaining all environmental expenditure is maintained in a separate GL account having a unique cost center mapped in the SAP system. All sorts of environmental protection related expenditures are booked in the said cost center for accounting purpose. The year wise expenditure will be reported to the Regional Office as stipulated. Details of the expenditure incurred during last six months period (Oct-2023 to March 2024) towards environment protection enclosed herewith.		Date: 29/05/2024
20	Statutory compliance	The project proponent shall submit six monthly reports on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment, Forest and Climate Change, its Regional Office, Central Pollution Control Board and State Pollution Control Board.
PPs Submission: Complied Being complied		Date: 23/04/2024
21	MINING PLAN	No change in the calendar plan including excavation, quantum of mineral and waste should be made.
PPs Submission: Complied Complied and shall always follow the directive.		Date: 29/05/2024
22	Statutory compliance	The lands which are not owned by Proponent, mining will be carried out only after obtaining the consents from all the concerned landowners as per the provisions of the Mineral Concession Rules, 1960 and MMDR Act, 1957.
PPs Submission: Complied At present mining is being carried out over diverted forest land & non-forest govt land. However proper procedure will be followed under the provision of MCR 1960 & MMDR Act 1957 during mining over private land if need to be acquired in course of mining operation.		Date: 29/05/2024
23	WATER QUALITY MONITORING AND PRESERVATION	Regular monitoring of the flow rate of the springs and perennial nallahs flowing in and around the mine lease shall be carried out and records maintain. The natural water bodies and or streams which are flowing in an around the village, should not be disturbed, The Water Table should be nurtured so as not to go down below the pre- mining period. In case of any water scarcity in the area, the Project Proponent has to provide water to the villagers for their use. A provision for regular monitoring of water table in open dug wall located in village should be incorporated to ascertain the impact of mining over ground water table.
PPs Submission: Complied Regular monitoring of flow rate of springs & perennial nallahs flowing in the buffer zone of ML		Date: 29/05/2024

area is being done.		
24	WASTE MANAGEMENT	The reclamation at waste dump sites shall be ecologically sustainable. Scientific reclamation shall be followed. The local species may be encouraged and species are so chosen that the slope, bottom of the dumps and top of the dumps are able to sustain these species. The aspect of the dump is also a factor which regulates some climatic parameters and allows only species adapted to that microclimate.
PPs Submission: Complied Prescribed methodologies will be adhered to maintain the slope stability, prevent erosion and surface run off.		Date: 29/05/2024
25	AIR QUALITY MONITORING AND PRESERVATION	The critical parameters as per the Notification 2009 such as PM10, PM2.5, NO2, and SO2 etc. in the ambient air within the impact zone, peak particle velocity at 300m distance or within the nearest habitation, whichever is closer shall be monitored periodically. Further, quality of discharged water shall also be monitored [(TDS, DO, PH and Total Suspended Solids (TSS))]. The monitored data shall be uploaded on the website of the company as well as displayed on a display board at the project site at a suitable location near the main gate of the Company in public domain. The circular No. J-20012/1/2006-IA.II(M) dated 27.05.2009 issued by Ministry of Environment, Forest and Climate Change shall also be referred in this regard for its compliance.
PPs Submission: Complied Monitoring of critical parameters in ambient air is being done regularly. At present, no wastewater is being discharged from mine. However, quality of Surface water is being monitored regularly [(TDS, DO, PH and Total Suspended Solids (TSS))]. The digital display board has been installed in front of mines gate showing reports on various environmental parameters. Copy of the latest monitoring report is enclosed herewith.		Date: 29/05/2024
26	WATER QUALITY MONITORING AND PRESERVATION	Regular monitoring of water quality upstream and downstream of water bodies shall be carried out and record of monitoring data should be maintained and submitted to the Ministry of Environment, Forest and Climate Change and its Regional Office, Central Ground Water Authority, Regional Director, Central Ground Water Board, State Pollution Control Board and Central Pollution Control Board.
PPs Submission: Complied Regular monitoring is being done through M/s Anacon Laboratories (a NABL accredited lab) and the data is being submitted to all concerned govt. bodies. Monitoring report is enclosed herewith.		Date: 29/05/2024
27	AIR QUALITY MONITORING AND PRESERVATION	The pollution due to transportation load on the environment will be effectively controlled and water sprinkling will also be done regularly. Vehicular emissions shall be kept under control and regularly monitored. Project should obtain 'PUC' certificate for all the vehicles from authorized pollution testing centres.
PPs Submission: Complied Water sprinkling is done regularly. Two nos. of water tankers (12 kl capacity each) are deployed for sprinkling over the haul road, loading & unloading points and other dust prone areas on regular basis. Pollution Under Control (PUC) certificate for all the vehicles are being maintained.		Date: 29/05/2024
28	Human Health Environment	The illumination and sound at night at project sites disturb the villages in respect of both human and animal population. Consequent sleeping disorders and stress may affect the health in the villages located close to mining operations. Habitations have a right for

		darkness and minimal noise levels at night. PPs must ensure that the biological clock of the villages is not disturbed; by orienting the floodlights/ masks away from the villagers and keeping the noise levels well within the prescribed limits for day light/night hours.
PPs Submission: Complied All precautionary measures are being taken not to disturb habitation around the site. The illumination & sound has been done in such a way that the villagers are not disturbed.		Date: 29/05/2024
29	AIR QUALITY MONITORING AND PRESERVATION	Main haulage road in the mine should be provided with permanent water sprinklers and other roads should be regularly wetted with water tankers fitted with sprinklers. Crusher and material transfer points should invariably be provided with Bag filters and or dry fogging system. Belt-conveyors should be fully covered to avoid air borne dust.
PPs Submission: Complied Mining operation commenced during Oct 2021 & the mine is in its initial development phase. Thus, no permanent haul roads are developed at present. With the progression of mining activities, permanent haul roads shall be developed in accordance with the approved mining plan & shall be equipped with Fixed Water Sprinklers for dust control. Two water tankers of 12KL capacity are presently engaged in dust suppression. The Crushing & Screening plants are equipped with dust suppression system i.e. dry fog & water sprinklers. Wet drilling is being carried out to prevent dust emission.		Date: 29/05/2024
30	AIR QUALITY MONITORING AND PRESERVATION	Main haulage road in the mine should be provided with permanent water sprinklers and other roads should be regularly wetted with water tankers fitted with sprinklers. The material transfer points should invariably be provided with Bag filters and or dry fogging system. In case of Belt-conveyors facilities the system should be fully covered to avoid air borne dust; Use of effective sprinkler system to suppress fugitive dust on haul roads and other transport roads shall be ensured.
PPs Submission: Complied Mining operation commenced during Oct 2021 & the mine is in its initial development phase. Thus, no permanent haul roads are developed at present. With the progression of mining activities, permanent haul roads shall be developed in accordance with the approved mining plan & shall be equipped with Fixed Water Sprinklers for dust control. Two water tankers of 12KL capacity are presently engaged in dust suppression. All feed hoppers where ore is unloaded, and all transfer chutes shall be provided with dry-fog dust suppression system. Mist cannons shall be placed at strategic points to prevent and control fugitive dust emissions. Ambient air quality conforms to the CPCB norms.		Date: 29/05/2024
31	MISCELLANEOUS	The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data / information / monitoring reports.
PPs Submission: Complied The company has been extending full co-operation to the officers of the Regional Office and other statutory agencies by furnishing the requisite data / information / monitoring reports as and when required. The same shall be continued in future as well.		Date: 23/04/2024
32	MISCELLANEOUS	A copy of clearance letter will be marked to concerned Panchayat / local NGO, if any, from whom suggestion / representation has been received while processing the proposal.
PPs Submission: Complied Complied as stipulated		Date: 23/04/2024

33	MISCELLANEOUS	State Pollution Control Board should display a copy of the clearance letter at the Regional office, District Industry Centre and Collector's office/ Tehsildar's Office for 30 days.
PPs Submission: Complied Noted. The action is to be ensured by the State Pollution Control Board.		Date: 23/04/2024
34	MISCELLANEOUS	The project authorities should advertise at least in two local newspapers widely circulated, one of which shall be in the vernacular language of the locality concerned, within 7 days of the issue of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance letter is available with the State Pollution Control Board and also at web site of the Ministry of Environment, Forest and Climate Change at www.environmentclearance.nic.in and a copy of the same should be forwarded to the Regional Office.
PPs Submission: Complied Complied as stipulated.		Date: 23/04/2024
35	WASTE MANAGEMENT	The Project Proponent has to take care of gullies formed on slopes. Dump mass should be consolidated with proper filling/levelling with the help of dozer/compactors
PPs Submission: Complied Mining operation commenced during Oct 2021 & the mine is in its initial development phase. Thus, there is no prominent OB dump existing in the mine. However, proper precautions will be taken to address gullies formation as per progression of mining activities. Slope of the dumps will be stabilized by coir matting, vetiver grassing etc., Toe wall with wire net shall be constructed on the bottom side of OB dump/Ore fines dump & ROM stack pile to arrest silt during rain.		Date: 29/05/2024
36	MINING PLAN	A Final Mine Closure Plan along with details of Corpus Fund shall be submitted to the Ministry of Environment, Forest and Climate Change 5 years in advance of final mine closure for approval.
PPs Submission: Complied A progressive mine closure plan approved by IBM is in place. The final mine closure plan along with details of Corpus fund will be submitted to the Ministry of Environment & Forests 5 years in advance.		Date: 29/05/2024
37	MINING PLAN	Mining shall be carried out as per the provisions outlined in mining plan approved by Indian Bureau of Mines (IBM)/State Mines and Geology Department as well as by abiding to the guidelines of Directorate General Mines Safety (DGMS).
PPs Submission: Complied Mine plan is approved by IBM, Bhubaneswar vide letter no RMP/A/02-RI/BHU/2021-22 dtd.04.05.2021. Permission under Regulation 106(2)(b) of MMR 1961 has been obtained from DGMS, BBSR Region vide no.330896/SEZ/Bhubaneswar Region II/Perm/2023/255502 dated 26.06.2023 to carry out deep hole blasting & deployment of HEMM. Mining is being carried out as per the provisions of approved Mining plan & also as per the guidelines of DGMS. Copy of the approval of Mining Plan is enclosed herewith.		Date: 29/05/2024
38	Corporate Environmental Responsibility	Transportation of the minerals by road passing through the village shall not be allowed. A 'bypass' road should be constructed (say, leaving a gap of at least 200 meters) for the purpose of transportation of the minerals so that the impact of sound, dust and accidents could be mitigated. The project proponent shall bear the cost towards the widening and strengthening of existing public road network in case

		the same is proposed to be used for the Project. No road movement should be allowed on existing village road network without appropriately increasing the carrying capacity of such roads.
PPs Submission: Complied The existing transport road is away from villages & well connected to the railway siding & State highways. This transport road is being maintained regularly & water sprinkling also done regularly. The concreting of transport road is under progress with an estimated cost of Rs 30 Crores to minimize the dust emission during ore transportation.		Date: 29/05/2024
39	AIR QUALITY MONITORING AND PRESERVATION	Effective safeguard measures such as regular water sprinkling shall be carried out in critical areas prone to air pollution and having high levels of PM10 and PM2.5 such as haul road, loading and unloading point and transfer points. Fugitive dust emissions from all the sources shall be controlled regularly. It shall be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central Pollution Control Board in this regard. Monitoring of Ambient Air Quality to be carried out based on the Notification 2009, as amended from time to time by the Central Pollution Control Board.
PPs Submission: Complied Two nos. of water tankers (12 kl capacity each) are deployed for sprinkling over haul road, loading & unloading points and other dust prone areas on regular basis. Regular monitoring of AAQ parameters being done and it is within prescribed norm of CPCB.		Date: 29/05/2024
40	WATER QUALITY MONITORING AND PRESERVATION	Regular monitoring of ground water level and quality shall be carried out in and around the mine lease by establishing a network of existing wells and constructing new piezometers during the mining operation. The project proponent shall ensure that no natural water course and/or water resources shall be obstructed due to any mining operations. The monitoring shall be carried out four times in a year pre-monsoon (April-May), monsoon (August), post-monsoon (November) and winter (January) and the data thus collected may be sent regularly to Ministry of Environment, Forest and Climate Change and its Regional Office, Central Ground Water Authority and Regional Director, Central Ground Water Board.
PPs Submission: Complied Network of wells & piezometers to monitor the ground water level is being constructed. Monitoring of the ground water quality will be done on monthly basis. Regular monitoring of water quality is being done as per provision. Copy of the reports is enclosed herewith. No natural water course is being obstructed due to mining activities as there are no natural water streams inside the ML area.		Date: 29/05/2024
Visit Remarks		
Last Site Visit Report Date:		N/A
Additional Remarks:		

F. No. 8-68/2013-FC
Government of India
Ministry of Environment, Forests & Climate Change
(Forest Conservation Division)

Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj
New Delhi-1100 03
Dated: 22 July, 2019

To

The Principal Secretary (Forests),
Government of Odisha,
Bhubaneswar

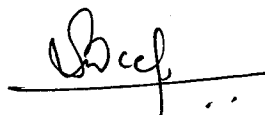
Sub: Diversion of 806.153 hectares of forest land including 16.601 ha for safety zone over the total Mining Lease area of 874.290 ha for iron ore mining in Sundergarh and Keonjhar districts of Odisha by M/s Neelachal Ispat Nigam Ltd.

Sir,

I am directed to refer to the State Government's letter no. 10F (Cons) 99/2013/17199/F&E dated 19th August 2013 on the above mentioned subject seeking prior approval of the Central Government under Section-2 of the Forest (Conservation) Act, 1980. After careful consideration of the proposal by the Forest Advisory Committee constituted under Section-3 of the said Act, In-principle/ Stage-I approval for above subject proposal was granted vide this Ministry's letter of even number dated 08.01.2018 subject to fulfilment of certain conditions. The State Government has furnished compliance report in respect of the conditions stipulated in the approval and has requested the Central Government to grant final approval.

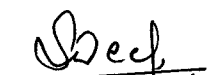
In this connection, I am directed to say that on the basis of the compliance report furnished by the Government of Odisha vide their Letters No. 8021/9F(MG)-167/2006 dated 24.04.2019, No. 12222/9F(MG)-167/2006 dated 10.07.2019 and No.10F(Cons)28/19/13855/F&E dated 20.07.2019, Stage-II/ Final approval of the Central Government is hereby granted under Section 2 of the Forest (Conservation) Act, 1980 for diversion of 806.153 hectares of forest land including 16.601 ha for safety zone over the total Mining Lease area of 874.290 ha for iron ore mining in Sundergarh and Keonjhar districts of Odisha by M/s Neelachal Ispat Nigam Ltd. subject to the following conditions:-

1. Legal status of the forest land shall remain unchanged.
2. Forest land will be handed over only after required non-forest land for the project is handed over to the user agency.
3. **Compensatory afforestation:**
 - a) Compensatory afforestation and soil & moisture conservation activities shall be taken up as per approved plan/scheme by the Forest Department over 789.52 non-forest and 45 ha. degraded forest land at the cost of the user agency. As far as possible, a mixture of local indigenous species shall be planted and monoculture of any species may be avoided.
 - b) The non-forest land which has been transferred and mutated in favour of the State Forest Department for the purpose of compensatory afforestation shall be declared as Reserved Forest under Section-4 or Protected Forest under Section-29 of the Indian Forest Act, 1927 or under the relevant Section(s) of the State Forest Act. The Nodal Officer, Forest (Conservation) Act, 1980 may report compliance within a period of six (6) months from the date of grant of final approval and send a copy of the original notification declaring the


22.7.19

non-forest land under Section 4 or Section 29 of the Indian Forest Act, 1927, or under the relevant section of the State Forest Act as the case may be, to this Office for information and record;

4. The State Govt. shall ensure that 2.86 Ha area of forest land in the lease falling in adjoining Keonjhar Forest Division shall be maintained as green zone and no mining will be done in this area. The forestry activities as approved for green zone shall be carried out by State Forest Department from the funds deposited by the user agency in the account of CAMPA.
5. The State Govt. ensure that the approved Regional Wildlife Management Plan and Site Specific Wildlife Conservation Plan shall be implemented by State Forest Department from the funds deposited by the user agency in the account of CAMPA.
6. The State Govt. ensure that the approved R & R Plan for this project shall be implemented at project cost. A copy of the duly approved R&R Plan shall be uploaded on the website of the Ministry and a copy of the same be submitted to concern Regional Office.
7. The State Govt. ensure that the user agency shall comply with all the conditions imposed on the basis of the NEERI report by this Ministry.
8. The complete compliance of the FRA, 2006 shall be ensured by way of prescribed certificate from the concerned District Collector.
9. The User Agency shall pay the additional amount of NPV, if so determined, as per the final decision of the Hon'ble Supreme Court of India.
10. The State Govt. ensure that State Forest Department shall implement the approved plan for fencing, protection and afforestation of the safety zone area (7.5 meter strip shall be kept within the mining lease or mining cluster, as applicable and such other areas as specified in the approved mining plan) from the funds provided and deposited in CAMP account. Area of safety zone of a mining lease shall be a part of the total area of the mining lease.
11. The State Govt. ensure that the State Forest Department shall carry out afforestation on identified degraded forest land against one and half time in extent to the area used for safety zone from the funds provided and deposited in CAMP account.
12. No labour camp shall be established on the forest land and No damage to the flora and fauna of the adjoining area shall be caused;
13. The User Agency shall provide firewood preferably alternate fuels to the labourers and the staff working at the site so as to avoid any damage and pressure on forest areas.
14. The boundary of the diverted forest land, mining lease area and safety zone shall be suitably demarcated on ground at the project cost as per the directions of concerned Divisional Forest Officer.
15. User Agency shall obtain the Environmental Clearance as per the provisions of the Environmental (Protection) Act, 1986.
16. The change in the layout plan of the mining lease, if required, shall be done as prescribed in the Handbook of comprehensive guidelines of Forest (Conservation) Act, 1980 as issued by this Ministry's letter No. 5-2/2017-FC dated 28.03.2019.
17. The forest land shall not be used for any purpose other than that specified in the project proposal.
18. The period of diversion of the said forest land shall be co-terminus with the period of the mining lease granted under the Mines and Minerals (Development & Regulating) Act, 1957 or Rules framed thereunder.
19. User Agency shall restrict the felling of trees to minimum numbers in the diverted forest land and trees shall be felled under strict supervision of the State Forest Department.
20. The State Govt. ensure that the State Forest Department shall implement approved plan/scheme for gap planting and soil & moisture conservation activities to restock and rejuvenate the degraded open forests (having crown density less than 0.40), if any, located in the area within 100 m. from outer perimeter of the mining lease;


22.7.19

21. The State Govt. ensure that the State Forest Department shall implement approved plan/scheme for regularly desilting of identified village tanks and other water bodies so as to mitigate the impact of siltation of such tanks/water bodies.
22. The user agency shall undertake mining and reclamation of the mined out area as per the approved mining plan and the directions of the concerned Divisional Forest Officer.
23. The forest land proposed to be diverted shall under no circumstances be transferred to any other agencies, department or person without prior approval of Central Government.
24. The concerned Divisional Forest Officer, will monitor and take necessary mitigative measures to ensure that there is no adverse impact on the forests in the surrounding area.
25. The User Agency and the State Government shall ensure compliance of all the Court orders, provisions, rules, regulations and guidelines for the time being in force as applicable to the project.
26. Violation of any of these conditions will amount to violation of Forest (Conservation) Act, 1980 and action would be taken as prescribed in para 1.21 of Chapter 1 of the Handbook of comprehensive guidelines of Forest (Conservation) Act, 1980 as issued by this Ministry's letter No. 5-2/2017-FC dated 28.03.2019.
27. Any other condition that the Ministry of Environment, Forests & Climate Change may stipulate from time to time in the interest of conservation, protection and development of forests & wildlife. The State Government shall ensure compliance of all the above conditions.

Yours faithfully,


(Sandeep Sharma) 22.7.19

Assistant Inspector General of Forests (FC)

Copy to:

1. The Principal Chief Conservator of Forests, Government of Orissa, Bhubaneswar.
2. The Nodal Officer (FCA), O/o PCCF, Government of Orissa, Bhubaneswar.
3. The Dy. Director General(Central), Regional Office, Bhubaneswar.
4. User Agency.
5. Monitoring Cell of FC Division, MoEF&CC, New Delhi.
6. Guard File.



OFFICE OF THE DIVISIONAL FOREST OFFICER, KEONJHAR DIVISION

Ph. No.06766-254315, email: dfokjr.od@gov.in

No. 9877 /6F-Mining-20/2010

Dated, Keonjhar the 16 / 04 / 2019

To

The Neelachal Ispat Nigam Ltd.,
IPICOL House, 1st Floor, Annex Building
Bhubaneswar-751022.

Sub: Diversion of 806.153ha of forest land (including 16.601 ha. for Safety Zone) over the total Mining Lease area of 874.290 ha for Iron Ore Mining in Sundargarh and Keonjhar district of Odisha by M/s Neelachal Ispat Nigam Ltd.

X-Sub: Demand of differential funds towards Schemes to maintain 2.86 ha of forest land as green zone in the mining lease.

Ref: Memo. 896 dated 11.04.2019 of Regional Chief Conservator of Forests, Rourkela Circle, Rourkela.

Sir,

With reference to the aforementioned memo on the captioned subject, you are requested to deposit the differential amount of Rs. 11,90,936/- (Rupees eleven lakh ninety thousand nine hundred thirty-six) only towards maintain 2.86 ha of forest land as green zone in the mining lease falling in Keonjhar Forest Division as per revised wage rate 280/- per man-day approved by the Regional Chief Conservator of Forests, Rourkela Circle, Rourkela in compliance with the stipulation- iv of the Stage- I approval order of the MoEF&CC, GoI through e-portal of MoEF&CC as provided in the <https://parivesh.nic.in/> and the proof/evidence of the deposit of fund be submitted to this office for further necessary action at this end.

Particulars	Area (ha)	Amount due as per revised wage rate of Rs. 280/- per Manday (Rs)	Amount deposited as per wage rate of Rs. 224.30/- per Manday (Rs)	Balance to be deposited.
Scheme for maintaining 2.86 ha forest land in compliance with the stipulation- iv of the Stage- I approval	2.86	70,86,750/-	58,95,814/-	11,90,936/-
Total				11,90,936/-

Yours faithfully,

Sd/-
Divisional Forest Officer,
Keonjhar Division.

Memo No. _____ / Dated.

Copy forwarded to the Divisional Forest Officer, Bonai Division for information and necessary action with reference to memo No. 898 dated 11.04.2019 of Regional Chief Conservator of Forests, Rourkela Circle, Rourkela.

Y
Divisional Forest Officer,
Keonjhar Division.

2/7/2019

NEFT RTGS CHALLAN

1462

AGENCY COPY	
NEFT / RTGS CHALLAN for Ad-HOC CAMPA	
Date : 07-02-2019	
Agency Name.	NEELACHAL ISPAT NIGAM LIMITED
Application No.	5822457576
MoEF/SG File No.	8-59/2016-FC
Location.	ORRISA
Address.	IPICOL HOUSE, 1ST FLOOR, ANNEXE BUILDING, BHUBANESKHordha
Amount(In Rs)	5895814/-
Amount In Words : Fifty-Eight Lakh Ninety-Five Thousand Eight Hundred and Fourteen Rupees Only	
NEFT/RTGS to be made as per following details;	
Beneficiary Name:	ORRISA CAMPA
IFSC Code:	CORP0000371
Pay to Account No.	150825822457576 Valid only for this challan amount.
Bank Name & Address:	Corporation Bank Lodhi Complex Branch, Block 11, CGO Complex, Phase I, Lodhi Road, New Delhi -110003
<ul style="list-style-type: none"> This Challan is strictly to be used for making payment to CAMPA by NEFT/RTGS only This challan is valid only for seven days. 	

BANK COPY	
NEFT / RTGS CHALLAN for Ad-HOC CAMPA	
Date : 07-02-2019	
Agency Name.	NEELACHAL ISPAT NIGAM LIMITED
Application No.	5822457576
MoEF/SG File No.	8-59/2016-FC
Location.	ORRISA
Address:	IPICOL HOUSE, 1ST FLOOR, ANNEXE BUILDING, BHUBANES Khordha
Amount(In Rs)	5895814/- + 29.5 = 5895843.5
Amount In Words : Fifty-Eight Lakh Ninety-Five Thousand Eight Hundred and Fourteen Rupees Only	
NEFT/RTGS to be made as per following details;	
Beneficiary Name:	ORRISA CAMPA
IFSC Code:	CORP0000371
Pay to Account No.	150825822457576 Valid only for this challan amount.
Bank Name & Address:	Corporation Bank Lodhi Complex Branch, Block 11, CGO Complex, Phase I, Lodhi Road, New Delhi -110003
<ul style="list-style-type: none"> This Challan is strictly to be used for making payment to CAMPA by NEFT/RTGS only This challan is valid only for seven days. 	

After making successful payment, User Agencies may send a line of confirmation through
Email: helpdeskampa@corpbank.co.in

9437306473



67/412

UTR SOIN 419038441528

http://forestclearance.nic.in/User/Account/Neft_ChallanCorp.aspx?pid=MIN224572018578



4/18/2019

UTR: SBINR 5201 9041 8001 25309.

461

AGENCY COPY	
NEFT / RTGS CHALLAN for Ad-HOC CAMPA	
Date : 18-04-2019	
Agency Name.	NEELACHAL ISPAT NIGAM LIMITED
Application No.	5822457140
MoEF/SG File No.	8-59/2016-FC
Location.	ORRISA
Address.	IPICOL HOUSE, 1ST FLOOR, ANNEXE BUILDING, BHUBANESKhardha
Amount(In Rs)	1190936/-

Amount in Words :Eleven Lakh Ninety Thousand Nine Hundred and Thirty-Six Rupees Only

NEFT/RTGS to be made as per following details;

Beneficiary Name:	ORRISA CAMPA
IFSC Code:	CORP000371
Pay to Account No.	150825822457140 Valid only for this challan amount.
Bank Name & Address:	Corporation Bank Lodhi Complex Branch, Block 11,CGO Complex, Phase I, Lodhi Road, New Delhi -110003

- This Challan is strictly to be used for making payment to CAMPA by NEFT/RTGS only
- This challan is valid only for seven days.

After making successful payment, User Agencies m
Email: helpdeskcompa@corpbank.co.in

5664500	S.S.PARIJA
भा.स.व.क. व मा.स.प. COMMERCIAL BR., BBSR	
Code 6657	18 APR 2019 Sign.
जर्नल सं./Journal No.	
क.आ.सं./Cheque ID No.	



4474171	S.MURMU
भा.स.व.क. व मा.स.प. COMMERCIAL BR., BBSR	
Code 6657	18 APR 2019 Sign.
जर्नल सं./Journal No.	
क.आ.सं./Cheque ID No.	

for:sc:barance:nic:in:User:Account/Neft_ChallanCorp.aspx?pid=MIN2245

4/10/2019

1459

AGENCY COPY	
NEFT / RTGS CHALLAN for Ad-HOC CAMPA	
Date : 10-04-2019	
Agency Name.	NEELACHAL ISPAT NIGAM LIMITED
Application No.	5822457648
MoEF/SG File No.	8-59/2016-FC
Location.	ORRISA
Address.	IPICOL HOUSE, 1ST FLOOR, ANNEXE BUILDING, BHUBANESKHORDHA
Amount(in Rs)	20982860/-
Amount in Words :Two Crore Nine Lakh Eighty-Two Thousand Nine Hundred and Sixty Rupees Only	
NEFT/RTGS to be made as per following details;	
Beneficiary Name:	ORRISA CAMPA
IFSC Code:	CORP0000371
Pay to Account No.	150825822457648 Valid only for this challan amount.
Bank Name & Address:	Corporation Bank Lodhi Complex Branch, Block 11,CGO Complex, Phase I, Lodhi Road, New Delhi -110003
<ul style="list-style-type: none">This Challan is strictly to be used for making payment to CAMPA by NEFT/RTGS onlyThis challan is valid only for seven days.	

After making successful payment, User Agencies may
Email: helpdeskcompa@corpbank.co.in

5664500	S.S.PARIJA
भा.स्ट.बैंक,व.शा./S.B.I. COMMERCIAL BR.,BBSR	
Code 6657	10 APR 2019 Sign.
जर्नल सं./Journal No.	
चेक आई.सं./Checker ID No.	

UTR No-BBSNR59019041000657609.

4474171	S.MURMU
भा.स्ट.बैंक,व.शा./S.B.I. COMMERCIAL BR.,BBSR	
Code 6657	10 APR 2019 Sign.
जर्नल सं./Journal No.	
चेक आई.सं./Checker ID No.	

for clearing the User Account Sign: ChallanCorp.aspx?pid=MIN22457201



By E-mail

ବନଖଣ୍ଡ ଅଧୀକାରୀଙ୍କ କାର୍ଯ୍ୟାଳୟ: ବଣାଇ ବନଖଣ୍ଡ I
OFFICE OF THE DIVISIONAL FOREST OFFICER: BONAI DIVISION.

Phone / Fax – 06626-244434: E-mail

At- dfobonai@rediffmail.com

No. 2281 /6F-(Mg.)Dt: 27.03.2019

To

M/s Neelachal Ispat Nigam Ltd.,
IPICOL House, 1st Floor, Annex Building
Bhubaneswar-751022.

Sub:-

Diversion of 806.153 ha. of forest land (including 16.601 ha. for Safety Zone) over the total Mining Lease area of 874.290 ha. for Iron Ore Mining in Sundargarh and Keonjhar district of Odisha by M/s Neelachal Ispat Nigam Ltd.

X-Sub: -

Regarding deposit of approved cost of Compensatory Afforestation.

Ref:-

1. Letter No.8-68/2013-FC dt.8.1.2018 of the MoEF & CC.
2. Letter No.1446/F&E dt.18.1.2018 of the F&E Deptt., Govt. of Odisha, addressed to the PCCF, Odisha, and copy endorsed to all concerned.
3. Memo No.6172 dt.26.3.2019 of the Addl. PCCF (Nodal), Bhubaneswar.

Sir,

With reference to above, this is to inform you that the Compensatory Afforestation Scheme over 834.552 ha. (448.552 ha. of non-forest land in Block model, 341.0 ha. of non-forest land in ANR mode without gap plantation) in Thuamul Rampur Tehsil and 45.0 ha. of Bald hill plantation in degraded forest land indentified in Sahajkhola RF in Dharamgarh Range of Kalahandi South Division along with SMC cost @ 25% of the above revised C.A. cost as per Condition No.2 (vi) of the Stage-I Order against Iron Ore Mining Lease of M/s Neelachal Ispat Nigam Ltd. has been technically approved for Rs.16,62,09,300/- (Amount to be deposited Rs.16,49,64,300/- + Infrastructure to be provided in kinds Rs.12,45,000/-) by the Addl. Principal Chief Conservator of Forests, Forest Diversion & Nodal Officer, F.C. Act' O/O the P.C.C.F., Odisha, Bhubaneswar at the wage rate of Rs.280.00 per MD vide his Memo No. cited above.

Further, you have already deposited Rs.12,89,89,700/- towards cost of Compensatory Afforestation through e-portal on 8.5.2018.

Now, you are requested to deposit the differential amount of Rs.3,59,74,600/- (Rs.16,49,64,300/- (-) Rs.12,89,89,700/-) (Rupees three crore fifty nine lakhs seventy four thousand six hundred) only through e-portal of MoEF & CC as provided in the <http://parivesh.nic.in>, and submit the original proof with seal and signature of the issuing Bank to this office for needful.

Yours faithfully,

Divisional Forest Officer,
Bonai Division.

Contd.2...

Memo No. 2282 /6F-Dt: 27.03.2019

Copy forwarded to the Addl. Principal Chief Conservator of Forests, Forest Diversion & Nodal Officer, F.C. Act' O/O the P.C.C.F., Odisha, Bhubaneswar for favour of kind information and necessary action with reference to his office Memo No.6172 dt.26.3.2019.

27/3/19
Divisional Forest Officer,
Bonai Division.

Memo No. 2283 /6F-Dt: 27.03.2019

Copy forwarded to the Regional Chief Conservator of Forests, Rourkela Circle for favour of kind information and necessary action with reference to Memo No.6173 dt.26.3.2019 of the Addl. PCCF (Nodal), Bhubaneswar.

27/3/19
Divisional Forest Officer,
Bonai Division.

Memo No. 2284 /6F-Dt: 27.03.2019

Copy forwarded to the Divisional Forest Officer, Kalahandi (South) Division, for information and necessary action with reference to Memo No.6175 dt.26.3.2019 of the Addl. PCCF (Nodal), Bhubaneswar.

27/3/19
Divisional Forest Officer,
Bonai Division.

Memo No. 2285 /6F-Dt: 27.03.2019

Copy forwarded to the Divisional Forest Officer, Keonjhar Division for information and necessary action.

27/3/19
Divisional Forest Officer,
Bonai Division.

AGENCY COPY

NEFT / RTGS CHALLAN for Ad-HOC CAMPA

Date : 29-03-2019

Agency Name.	NEELACHAL ISPAT NIGAM LIMITED
Application No.	5822457701
MoEF/SG File No.	8-59/2016-FC
Location.	ORRISA
Address.	IPICOL HOUSE, 1ST FLOOR, ANNEXE BUILDING, BHUBANESKhardha
Amount(in Rs)	35974600/-

Amount in Words :Three Crore Fifty-Nine Lakh Seventy-Four Thousand Six Hundred Rupees Only

NEFT/RTGS to be made as per following details;

Beneficiary Name:	ORRISA CAMPA
IFSC Code:	CORP0000371
Pay to Account No.	150825822457701 Valid only for this challan amount.
Bank Name & Address:	Corporation Bank Lodhi Complex Branch, Block 11,CGO Complex, Phase I, Lodhi Road, New Delhi -110003

- This Challan is strictly to be used for making payment to CAMPA by NEFT/RTGS only
- This challan is valid only for seven days.

BANK COPY

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- This challan is valid only for seven days.

After making successful payment, User Agencies may send a line of confirmation through
Email: helpdeskcampa@corpbank.co.in



BY REGD. POST WITH AD

STATE POLLUTION CONTROL BOARD, ODISHA

[DEPARTMENT OF FOREST, ENVIRONMENT & CLIMATE CHANGE, GOVERNMENT OF ODISHA]

A/118, Nilakantha Nagar, Unit-VIII, Bhubaneswar-751012

Phone-2561909, Fax: 2562822, 2560955 E-mail: paribesh1@ospcboard.org, Website: www.ospcboard.org

CONSENT ORDER

No. 3953 /

IND-I-CON-6674

Dt. 20-03-2024 /

CONSENT ORDER NO. 2884.

Sub : Consent for discharge of sewage and trade effluent under section 25/26 of Water (PCP) Act, 1974 and for existing / new operation of the plant under section 21 of Air (PCP) Act, 1981.

Ref: Your online application No. 5292200, dated 29.12.2023.

Consent to operate is hereby granted under section 25/26 of Water (Prevention & Control of Pollution) Act, 1974 and under section 21 of Air (Prevention & Control of Pollution) Act, 1981 and rules framed thereunder to

Name of the Industry: MITHIRDA IRON ORE MINES OF M/S NEELACHAL ISPAT NIGAM LTD.

Name of the Occupier & Designation: SRI SAROJ KUMAR MISHRA, DGM (GEOLOGY)

Address: AT: KADALIA, PO: PATMUNDA, VIA: KOIRA, DIST: SUNDARGARH, PIN-770048

This consent order is valid for the period from 01.04.2024 to 31.03.2025.

Details of Products Manufactured

Sl. No	Product	Quantity
01.	Iron Ore	2 MTPA

Details of Mineral Handling Plants /Units

01.	Mobile Crushing & Screening Plant of capacity 1 X 450 TPH and 1 X 300 TPH
-----	---

This consent order is valid for the specified outlets, discharge quantity and quality, specified chimney/stack, emission quantity and quality of emissions as specified below. This consent is granted subject to the general and special conditions stipulated therein.



A. Discharge permitted through the following outlet subject to the standard

Outlet No.	Description of outlet	Point of discharge	Quantity of discharge KL/Hr	Prescribed Standard				
				pH	TSS (mg/l)	BOD (mg/l)	COD (mg/l)	Oil & Grease (mg/l)
01	Mine drainage water/ surface runoff/ other wastewater	On land/ Inland surface water body.	--	5.5-9.0	100 (Rainy day)	-	250	10
					50 (Non-Rainy day)			

B. Fugitive Emission Standards

Particulate Matter	1200 µg/m³
Note : Fugitive emission shall be monitored in the predominant downwind direction at a distance 25.0 ± 2.0 metres from the source of fugitive emission as per following :	
Area	Monitoring Location
Mine face / Benches	Drilling, excavation and loading applicable for operating benches above water table
Haul Roads/ Service Roads	Haul roads to ore processing plant, waste dumps and loading areas and service road.
Crushing plant	Run-off mine unloading at hopper, crushing areas, screens and transfer points.
Screening plant	Screens, conveying and transportation of ore discharge points.
Ore storage and loading	Intermediate stock bin / pile areas, ore stock bin / pile areas, wagon / truck loading areas.
Waste dump	Active waste / reject dumps

C. Disposal of solid waste permitted in the following manner

Sl. No.	Type of Solid waste	Quantity generated (TPD)	Quantity to be reused on site(TPD)	Quantity to be reused off site(TPD)	Quantity disposed off (TPD)	Description of disposal site.
01	Top soil & over burden	As per approved mining plan	--	--	--	As per approved mining plan



D. GENERAL CONDITIONS FOR ALL UNITS

1. The consent is given by the Board in consideration of the particulars given in the application. Any change or alternation or deviation made in actual practice from the particulars furnished in the application will also be the ground for liable to review/variation/revocation of the consent order under section 27 of the Water (Prevention & Control of Pollution) Act, 1974 and section 21 of Air (Prevention & Control of Pollution) Act, 1981 and to make such variations as deemed fit for the purpose of the Acts.
2. The occupier would immediately submit revised application for consent to operate to this Board in the event of any change in the quantity and quality of raw material / products / manufacturing process or quantity /quality of the effluent rate of emission / air pollution control equipment / system etc.
3. The applicant shall not change or alter either the quality or quantity or the rate of discharge or temperature or the route of discharge without the previous written permission of the Board.
4. The application shall comply with and carry out the directives/orders issued by the Board in this consent order without any negligence on his/her part. In case of non-compliance of any order/directives issued at any time and/or violation of the terms and conditions of this consent order, the applicant shall be liable for legal action as per the provisions of the Law.
5. The applicant shall make an application for grant of fresh consent at least 90 days before the date of expiry of this consent order.
6. The issuance of this consent does not convey any property right in either real or personal property or any exclusive privileges nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Central, State laws or regulation.
7. This consent does not authorize or approve the construction of any physical structure or facilities or the undertaking of any work in any natural water course.
8. The applicant shall display this consent granted to him in a prominent place for perusal of the public and inspecting officers of this Board.
9. An inspection book shall be opened and made available to Board's Officers during the visit to the factory.
10. The applicant shall furnish to the visiting officer of the Board any information regarding the construction, installation or operation of the plant or of effluent treatment system / air pollution control system / stack monitoring system any other particulars as may be pertinent to preventing and controlling pollution of Water / Air.
11. The applicant shall display suitable caution board at the place where the effluent is entering into any water-body or any other place to be indicated by the Board, indicating therein that the area into which the effluents are being discharged is not fit for the domestic use/bathing.
12. Storm water shall not be allowed to mix with the trade and/or domestic effluent on the upstream of the terminal manholes where the flow measuring devices will be installed.
13. The applicant shall maintain good house-keeping both within the factory and the premises. All pipes, valves, sewers and drains shall be leak-proof. Floor washing shall be admitted into the effluent collection system only and shall not be allowed to find their way in storm drains or open areas.
14. The applicant shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems install or used by him to achieve with the term(s) and conditions of the consent.
15. Care should be taken to keep the anaerobic lagoons, if any, biologically active and not utilized as mere stagnation ponds. The anaerobic lagoons should be fed with the required nutrients for effective digestion. Lagoons should be constructed impervious.
16. The utilization of treated effluent on factory's own land, if any, should be completed and there should be no possibility of the effluent gaining access into any drainage channel or other water courses either directly or by overflow.
17. The effluent disposal on land, if any, should be done without creating any nuisance to the surroundings or inundation of the lands at any time.
18. If at any time the disposal of treated effluent on land becomes incomplete or unsatisfactory or create any problem or becomes a matter of dispute, the occupier must adopt alternate satisfactory treatment and disposal measures.
19. The sludge from treatment units shall be dried in sludge drying beds and the drained liquid shall be taken to equalization tank.
20. The effluent treatment units and disposal measures shall become operative at the time of commencement of production.
21. The applicant shall provide port holes for sampling the emissions and access platform for carrying out stack sampling and provide electrical outlet points and other arrangements for chimneys/stacks and other sources of emissions so as to collect samples of emission by the Board or the applicant at any time in accordance with the provision of the Acts or Rules made therein.



CONSENT ORDER

MITHURDA IRON ORE MINE OF M/S. NEELACHAL ISPAT NIGAM LTD.

22. The applicant shall provide all facilities and render required assistance to the Board staff for collection of samples / stack monitoring / inspection.
23. The applicant shall not change or alter either the quality or quantity or rate of emission or install, replace or alter the air pollution control equipment or change the raw material or manufacturing process resulting in any change in quality and/or quantity of emissions, without the previous written permission of the Board.
24. No control equipments or chimney shall be altered or replaced or as the case may be erected or re-erected except with the previous approval of the Board.
25. The liquid effluent arising out of the operation of the air pollution control equipment shall be treated in the manner so as to meet the standards prescribed by the Board in accordance with the provisions of Water (Prevention and Control of Pollution) Act, 1974 (as amended).
26. The stack monitoring system employed by the applicant shall be opened for inspection to this Board at any time.
27. There shall not be any fugitive or episodal discharge from the premises.
28. In case of such episodal discharge/emissions the occupier shall take immediate action to bring down the emission within the limits prescribed by the Board and stop the operation of the plant if required. Report of such accidental discharge /emission shall be brought to the notice of the Board within 24 hours of occurrence.
29. The applicant shall keep the premises and air pollution control equipments clean and make all hoods, pipes, valves, stacks/chimneys leak proof. The air pollution control equipments, location, inspection chambers, sampling port holes shall be made easily accessible at all times.
30. Any upset condition in any of the plant/plants of the factory which is likely to result in increased effluent discharge/emission of air pollutants and / or result in violation of the standards mentioned shall be reported to the Headquarters and Regional Office of the Board by E-mail within 2 hours of its occurrence.
31. The occupier has to ensure that minimum three varieties of trees are planted at the density of not less than 1000 trees per acre. The trees may be planted along boundaries of the premises. This plantation is stipulated over and above the bulk plantation of trees in that area.
32. The solid waste such as sweeping, wastage packages, empty containers residues, sludge including that from air pollution control equipments collected within the premises of the shall be disposed off scientifically to the satisfaction of the Board.
33. All solid wastes arising in the premises shall be properly classified and disposed off to the satisfaction of the Board by :
 - i) Land fill in case of inert material, care being taken to ensure that the material does not give rise to leachate which may percolate into ground water or carried away with storm run-off
 - ii) Controlled incineration, wherever possible in case of combustible organic material.
 - iii) Composting, in case of bio-degradable material.
34. Any toxic material shall be detoxicated if possible, otherwise be sealed in steel drums and buried in protected areas after obtaining approval of this Board in writing. The detoxication or sealing and burying shall be carried out in the presence of Board's authorized persons only. Letter of authorization shall be obtained for handling and disposal of hazardous wastes.
35. If due to any technological improvement or otherwise this Board is of opinion that all or any of the conditions referred to above requires variation (including the change of any control equipment either in whole or in part) this Board shall after giving the applicant an opportunity of being heard, vary all or any of such condition and thereupon the applicant shall be bound to comply with the conditions so varied.
36. The applicant, his/heirs/legal representatives or assignees shall have no claim whatsoever to the condition or renewal of this consent after the expiry period of this consent.
37. The Board reserves the right to review, impose additional conditions or condition, revoke change or alter the terms and conditions of this consent.
38. Notwithstanding anything contained in this conditional letter of consent, the Board hereby reserves to it the right and power under section 27(2) of the Water (Prevention & Control of Pollution) Act, 1974 to review any and/or all the conditions imposed herein above and to make such variations as deemed fit for the purpose of the Act by the Board.
39. The conditions imposed as above shall continue to be in force until revoked under section 27(2) of the Water (Prevention & Control of Pollution) Act, 1974 and section 21 A of Air (Prevention & Control of Pollution) Act, 1981.
40. The occupier shall comply to the conditions stipulated in CTE order issued by Odisha State Pollution Control Board and conditions stipulated in Environmental Clearances issued by MoEF&CC, Govt. of India.
41. The occupier shall abide by E(P) Act, 1986 and Rules framed there-under.



CONSENT ORDER

MITHIRDA IRON ORE MINE OF M/S. NEELACHAL ISPAT NIGAM LTD.

Page 5 of 13

GENERAL CONDITIONS FOR UNITS WITH INVESTMENT OF MORE THAN Rs 50 CRORES, AND 17 CATEGORIES OF HIGHLY POLLUTING INDUSTRIES (RED A).

1. The applicant shall analyse the emissions every month for the parameters indicated in TABLE B & C as mentioned in the order and shall furnish the report thereof to the Board by the 10th of the succeeding month.
2. The applicant shall provide and maintain at his own cost three ambient air quality monitoring stations for monitoring Suspended Particulate Matter, Sulphur Dioxide, Oxides of Nitrogen, Hydro-Carbon, Carbon-Monoxide and monitor the same once in a day/week/fortnight/month. The data collected shall be maintained in a register and a monthly extract be furnished to the Board.
3. The applicant shall provide and maintain at his own cost a meteorological station to collect the data on wind velocity, direction, temperature, humidity, rainfall, etc. and the daily reading shall be recorded and the extract sent to the Board once in a month.
4. The applicant shall forward the following information to the Member Secretary, State Pollution Control Board, Odisha, Bhubaneswar regularly:
 - a) Report of analysis of stack monitoring, ambient air quality monitoring meteorological data as required every month.
 - b) Progress on planting of trees quarterly.
5. The applicant shall install mechanical composite sampling equipment and continuous flow measuring / recording devices on the effluent drains of trade as well as domestic effluent. A record of daily discharge shall be maintained.
6. The following information shall be forwarded to the Member Secretary on or before 10th of every month:
 - a) Performance / progress of the treatment plant.
 - b) Monthly statement of daily discharge of domestic and/or trade effluent.
7. Non-compliance with effluent limitations
 - a) If for any reason the applicant does not comply with or is unable to comply with any effluent limitations specified in this consent, the applicant shall immediately notify the consent issuing authority by telephone and provide the consent issuing authority with the following information in writing within 5 days of such notification:
 - i) Causes of non-compliance
 - ii) A description of the non-compliance discharge including its impact on the receiving waters
 - iii) Anticipated time of continuance of non-compliance if expected to continue or if such condition has been corrected the duration or period of non-compliance
 - iv) Steps taken by the applicant to reduce and eliminate the non-complying discharge and
 - v) Steps to be taken by the applicant too prevent the condition of non-compliance.
 - b) The applicant shall take all reasonable steps to minimize any adverse impact to natural waters resulting from non-compliance with any effluent limitation specified in this consent including such accelerated or additional monitoring as necessary to determine the nature and impact of the non-complying discharge.
 - c) Nothing in this consent shall be construed to relieve the applicant from civil or criminal penalties for non-compliance whether or not such non-compliance is due to factors beyond his control, such as break-down, electric failure, accident or natural disaster.
8. The applicant shall at his own cost get the effluent samples collected both before and after treatment and get them analysed at an approval laboratory every month for the parameters indicated in Part-D and shall submit in duplicate the report thereof to the Board.
9. The addition of various treatment chemicals should be done only with mechanical dosers and proper equipment for regulation of correct dosages determined daily and for proper uniform feeding. Crude practices such as dumping of chemicals in drains or sumps or trickling of acids or alkalis arbitrarily and utilizing poles for stirring etc. should not be resorted to.
10. In the disposal of treated effluent on land for irrigation, the industry shall keep in view of the need for:
 - a) Rotation of crops
 - b) Change of point of application of effluent on land
 - c) A portion of land kept fallow
11. The adoption of these would avoid soil becoming sick or stale, the industry may ensure this in consultation with the Agriculture Department.
12. It is the sole responsibility of the industry to ensure that there are no complaints at any time from the ryots in the surrounding areas as a result of discharge of sewage or trade effluent if any.
13. Proper housekeeping shall be maintained by a dedicated team.
14. The industry must constitute a team of responsible and technically qualified personnel who will ensure continuous operation of all pollution control devices round the clock (including night hours) and should be in a position to explain the status of operation of the pollution control measures to the inspecting officers of the Board at any point of time. The name of these persons with their contact telephone numbers shall be intimated to the concerned Regional Officer and Head Office of the Board and in case of any change in the team it shall be intimated to the Board immediately.

**E. SPECIAL CONDITIONS:**

1. Mining operation is subject to availability of all other statutory clearances.
 2. Drills shall either be operated with dust extractors or equipped with water injection system to minimize dust generation in the work environment.
 3. Controlled blasting shall be practiced to minimize generation of dust and fly rocks.
 4. Regular water sprinkling shall be carried out in areas prone to air pollution. Water sprinkling shall also be carried out on haul roads at frequent interval so that it should always remain in wet condition. Haulage roads shall be devoid of ruts and potholes and shall be maintained properly to avoid generation of dust during movement of vehicles.
 5. Dust suppression measures (preferably dry fog system) shall be provided at all appropriate places of mineral handling plants (crusher & screening plant). Loading and unloading areas including all the transfer points shall also have efficient dust suppression arrangements (dry fog system). These shall be properly maintained and operated.
 6. Dust extraction system (bag filter) shall be provided at all dust generating source such as crushing, screening and metal transfer points etc. The particulate matter emission from the stack shall not exceed 100mg/Nm³ as per MoEF & CC, Govt. of India Notification No.G.S.R.-809 (E) dated 4.10.2010.
 7. The primary crusher, screen and secondary crusher shall be placed in covered shed. All the conveyors shall be covered with corrugated GI Sheets.
 8. Mechanized wheel washing facility for the ore transport vehicles shall be provided at the exit point of the mine. The wheel washing facility shall be integrated with complete recirculation system.
 9. The vehicles carrying ore for transportation from the mine shall be covered with tarpaulin (both bottom & top).
 10. Regular water sprinkling on mineral transportation roads passing through the habitation area as well as other strategic point on the National Highway shall be done jointly by the mining lessees in consultation with the Regional Officer.
 11. Four Ambient Air Quality Monitoring Stations shall be established in core zone and buffer zone for monitoring of ambient air quality and location of the stations shall be decided in consultation with the Regional Officer, State Pollution Control Board based on the metrological data, topographical features and environmentally and ecologically sensitive targets.
 12. Fugitive Dust Emission Monitoring shall be carried out at the places as stated in Part-B of this order. The monitoring of ambient air quality and fugitive dust shall be carried out twice in a week (24 hourly) at a particular site and the consolidated data shall be submitted to the State Pollution Control Board, once in a year.
 13. The topsoil generated shall be stored at earmarked site (s) only and stabilized with plantation or shall be used for land reclamation and plantation.
-



14. The over burden generated during the course of mining shall be stacked at earmarked dump site (s) and stabilized with plantation or used for reclamation of excavated land followed by plantation.
15. The project proponent shall ensure that no natural watercourse and / or water resources are obstructed due to any mining operations. In case of diversion of natural watercourse, this shall be done with prior permission of the competent authority.
16. Quantification of surface runoff and other wastewater generated in the mine shall be done. Report on runoff management practice as well as wastewater management practices along with time bound action plan for its implementation shall be furnished to the Board commencement of mining operation. The report of runoff management practices shall be submitted along with a map indicating the flow direction of runoff and management systems.
17. Check dams and check weirs shall be constructed at appropriate places of the mine lease area to prevent direct flow of runoff to nearby water bodies. The surface runoff water from the existing runoff management system shall meet the prescribed standards as stated in Part A of the consent order.
18. Retention wall shall be constructed at the toe of topsoil dump and OB dump. Garland drain shall be constructed around topsoil dumps, over burden dumps and mineral stack yards terminating at settling pit to prevent direct disposal of runoff to nearby water bodies.
19. Garland drain and sedimentation pit shall be de-silted after monsoon or as and when required. The runoff discharge quality from runoff management system shall meet the prescribed standards as stated in Part-A of the consent order.
20. Domestic effluents shall be treated in a sewage treatment plant (STP) and or shall be discharged to soak pit via septic tank constructed as BIS specification. The treated wastewater quality of STP shall remain within the following standards and shall be used for plantation:

pH	-	6.5 -9.0
TSS	-	<100 mg/l
BOD	-	30 mg/l
Fecal Coliform	-	<1000 MPN/100 ml.

21. ETP comprising of oil and grease trap with sedimentation pit shall be provided for treatment of workshop effluent and treated effluent shall remain within the following prescribed standards and shall be re-used for washing of vehicles:

pH	-	6.5 -8.5
TSS	-	50 mg/l
Oil & grease	-	10 mg/l
COD	-	150 mg/l
22. Regular monitoring of water quality of upstream and downstream of surface water bodies existed if any within 5 Km shall be carried out once in every month and record shall be maintained and submitted to the State Pollution Control Board once in every year. Monitoring shall be carried out through MoEF& CC accredited laboratory.



CONSENT ORDER

MITHURDA IRON ORE MINE OF M/S. NEELACHAL ISPAT NIGAM LTD.

Page 8 of 13

23. Regular monitoring of ground water level and quality should be carried out by establishing a network of existing wells. The monitoring should be done four times a year in pre-monsoon (April/May), monsoon (August), post-monsoon (November) and winter (January) seasons. Data thus collected should be submitted to the Board quarterly.
 24. The mine shall take necessary action for compliance with the air and water quality standards as stipulated in Part-A and Part-B of this order.
 25. Adequate measures shall be taken for control of noise levels in the work environment of mine area so that noise levels at the boundary line of mining lease area shall not exceed 75 dB(A) during daytime (6.00 AM to 9.00 PM) and 70 dB(A) during nighttime (9.00 PM to 6 AM).
 26. Adequate noise barriers shall be provided surrounding the crushing and screening plants to control noise pollution and avoid impact on wildlife due to operation of crushing and screening plants during night hours.
 27. Online noise monitoring system shall be installed to monitor noise level during night hours.
 28. Protective barriers shall be provided for the lights to prevent illumination towards the forest area during night hours.
 29. The following actions shall be taken in time bound manner to complete by 31.12.2024 for better environmental management.
 - i) Check dams and check weirs shall be provided at strategic places of mine to prevent runoff to discharge outside.
 - ii) Surface runoff study shall be done and runoff management facilities shall be provided as per the recommendation of the study report.
 - iii) Mineral processing units and conveyor belts shall be covered up with GCI sheets.
 - iv) ETP at workshop shall be constructed to treat wastewater generated from vehicle washing activity.A progress report in this regard shall be submitted by 31.10.2024 at the Regional Office as well at Head Office of SPCB, Odisha.
 30. Ambient air quality monitoring data, noise monitoring data and water / wastewater quality monitoring data shall be electronically displayed at the entry point of the mine or at a suitable location of the mine.
 31. The height of the stack connected to DG sets of capacity more than 800 KVA shall conform to the following:
 - i) $14Q^{0.3}$, Q = Total SO₂ emission from the plant in kg/hr.
 - ii) Minimum 6m. above the building where generator set is installed.
 - iii) 30 m.
 32. The height of the stack connected to DG set of capacity less than and upto 800 KVA shall conform to the following:
 - i) $H = h + 0.2\sqrt{KVA}$
 - ii) h = Height of the building where it is installed in meter
 - iii) KVA = Capacity of DG set
 - iv) H = Height of the stack in meter above ground level.
-



CONSENT ORDER

Page 9 of 13

MITHIRDA IRON ORE MINE OF M/S. NEELACHAL ISPAT NIGAM LTD

33. All DG sets installed before 1.7.2004 shall be scrapped. DG sets complying with either State-I or Stage-II emission norms shall reduce Particulate Matter Emission by 70% by installing RECD without affecting any other emission parameters as per the CPCB guidelines and Board's letter vide No.17927, dated 14.11.2023, in this regard.
34. Plantation of trees shall be undertaken in the colony/ township, over top soil dumps, OB dumps, along the side of haul road and in other areas of the mines not being utilized for mining activities. The mine shall take up avenue plantation and plantation in nearby village areas in consultation with DFO/Horticulture Department. The plantation details shall be submitted to the Board before end of April every year.
35. A copy of the annual return (annual return submitted to IBM, Govt. of India/ Directorate of Mines, Govt. of Odisha) shall be submitted to this Board every year.
36. The environmental statement report for the financial year ending 31st March shall be submitted to the Board in Form -V on or before 30th September every year.

MEMBER SECRETARY
STATE POLLUTION CONTROL BOARD, ODISHA

TO,

SRI SAROJ KUMAR MISHRA, DGM (GEOLOGY)
MITHIRDA IRON ORE MINES OF M/S. NEELACHAL ISPAT NIGAM LTD
AT: PARK LINE, NEAR MUNICIPALITY KALYAN MANDAP
PO: KEONJHARGARH, DIST: KEONJHAR, PIN-758001.

Memo No. _____/Dt. _____/

Copy forwarded to :

- i) Regional Officer, State Pollution Control Board, **Rourkela.**
- ii) District Collector, **Sundargarh/Keonjhar**
- iii) Director of Mines, Govt. of Odisha, Bhubaneswar
- iv) Director, Environment-cum-Special Secretary, F & E. Dept. Govt. of Odisha, Bhubaneswar.
- v) **D.F.O, Bonal/Keonjhar**
- vi) Dy. Director of Mines, **Koira/Joda**
- vii) Chief Env. Scientist, Central Lab, SPCB, Bhubaneswar
- viii) Addl. Chief Env. Engineer (Hazardous Waste Management Cell)
- ix) Consent Register

CHIEF ENV. ENGINEER(M)
STATE POLLUTION CONTROL BOARD, ODISHA



CONSENT ORDER

MITHIRDA IRON ORE MINE OF M/S. NEELACHAL ISPAT NIGAM LTD.

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GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENT POLLUTANTS



**GENERAL STANDARDS FOR DISCHARGE OF
ENVIRONMENTAL POLLUTANTS PART – A : EFFLUENTS**

Sl. No.	Parameters	Standards			
		Inland surface	Public sewers	Land for irrigation	Marine Costal Areas
		(a)	(b)	(c)	(d)
1.	Colour & odour	Colourless/ Odourless as far as practicable	--	See 6 of Annex-1	See 6 of Annex-1
2.	Suspended Solids (mg/l)	100	600	200	a. For process wastewater – 100 b. For cooling water effluent 10% above total suspended matter of influent.
3.	Particular size of SS	Shall pass 850	--	--	--
5.	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
6.	Temperature	Shall not exceed 5°C above the receiving water temperature	--	--	Shall not exceed 5°C above the receiving water temperature
7.	Oil & Grease mg/l max.	10	20	10	20
8.	Total residual chlorine	1.0	--	--	1.0
9.	Ammonical nitrogen (as N) mg/l max.	50	50	--	50
10.	Total Kjeldahl nitrogen (as NH ₃) mg/l max.	100	--	--	100
11.	Free ammonia (as NH ₃) mg/l max.	5.0	--	--	5.0
12.	Biochemical Oxygen Demand (5 days at 20°C) mg/l max.	30	350	100	100
13.	Chemical Oxygen Demand, mg/l max.	250	--	--	250
14.	Arsenic (as As) mg/l max.	0.2	0.2	0.2	0.2
15.	Mercury (as Hg) mg/l max.	0.01	0.01	--	0.001
16.	Lead (as Pb) mg/l max.	01.	1.0	--	2.0
17.	Cadmium (as Cd) mg/l max.	2.0	1.0	--	2.0



CONSENT ORDER

MITHIRDA IRON ORE MINE OF M/S. NEELACHAL ISPAT NIGAM LTD.

Page 12 of 13

Sl. No.	Parameters	Standards			
		Inland surface	Public sewers	Land for irrigation	Marine Coastal Areas
		(a)	(b)	(c)	(d)
18.	Hexavalent Chromium (as Cr + 6) mg/l max.	0.1	2.0	--	1.0
19.	Total Chromium (as Cr) mg/l max.	2.0	2.0	--	2.0
20.	Copper (as Cu) mg/l max.	3.0	3.0	--	3.0
21.	Zinc (as Zn) mg/l max.	5.0	15	--	15
22.	Selenium (as Se) mg/l max.	0.05	0.05	--	0.05
23.	Nickel (as Ni) mg/l max.	3.0	3.0	--	5.0
24.	Cyanide (as CN) mg/l max.	0.2	2.0	0.2	0.02
25.	Fluoride (as F) mg/l max.	2.0	15	--	15
26.	Dissolved Phosphates (as P) mg/l max.	5.0	--	--	--
27.	Sulphide (as S) mg/l max.	2.0	--	--	5.0
28.	Phenolic compounds as (C ₆ H ₅ OH) mg/l max.	1.0	5.0	--	5.0
29.	Radioactive materials				
	a. Alpha emitter micro curie/ml.	10 ⁷	10 ⁷	10 ⁸	10 ⁷
	b. Beta emitter micro curie/ml.	10 ⁸	10 ⁸	10 ⁷	10 ⁸
30.	Bio-assay test	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
31.	Manganese (as Mn)	2 mg/l	2 mg/l	--	2 mg/l
32.	Iron (Fe)	3 mg/l	3 mg/l	--	3 mg/l
33.	Vanadium (as V)	0.2 mg/l	0.2 mg/l	--	0.2 mg/l
34.	Nitrate Nitrogen	10 mg/l	--	--	20 mg/l



NATIONAL AMBIENT AIR QUALITY STANDARDS

Sl. No.	Pollutants	Time Weighed Average	Concentrate of Ambient Air		
			Industrial Residential, Rural and other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1.	Sulphur Dioxide (SO ₂), µg/m ³	Annual * 24 Hours **	50 80	20 80	-Improved west and Gaeke - Ultraviolet fluorescence
2.	Nitrogen Dioxide (NO ₂), µg/m ³	Annual * 24 Hours **	40 80	30 80	- Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
3.	Particulate Matter (size less than 10µm) or PM ₁₀ µg/m ³	Annual * 24 Hours **	60 100	60 100	-Gravimetric - TOEM - Beta Attenuation
4.	Particulate Matter (size less than 2.5µm) or PM _{2.5} µg/m ³	Annual * 24 Hours **	40 60	40 60	-Gravimetric - TOEM - Beta Attenuation
5.	Ozone (O ₃) µg/m ³	8 Hours ** 1 Hours **	100 180	100 180	- UV Photometric - Chemiluminescence - Chemical Method
6.	Lead (Pb) µg/m ³	Annual * 24 Hours **	0.50 1.0	0.50 1.0	-AAS/ICP method after sampling on EMP 2000 or equivalent filter paper. - ED-XRF using Teflon filter
7.	Carbon Monoxide (CO) mg/m ³	8 Hours ** 1 Hours **	02 04	02 04	- Non Dispersive Infra Red (NDIR) Spectroscopy
8.	Ammonia (NH ₃) µg/m ³	Annual* 24 Hours**	100 400	100 400	-Chemiluminescence - Indophenol Blue Method
9.	Benzene (C ₆ H ₆) µg/m ³	Annual *	05	05	-Gas Chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10.	Benzo (a) Pyrene (BaP)-Particulate phase only, ng/m ³	Annual*	01	01	-Solvent extraction followed by HPLC/GC analysis
11.	Arsenic (As), ng/m ³	Annual*	06	06	-As ₂ S ₃ method after sampling on EMP 2000 or equivalent filter paper
12.	Nickel (Ni),ng/m ³	Annual*	20	20	-Sampling on EMP 2000 or equivalent filter paper

Signature Not Verified

Digitally Signed by : SARITA PATNAIK

Date: 2024.03.21 13:07:11 IST

- * Annual arithmetic mean of minimum 104 measurements in a year, 24 hourly at uniform intervals.
- ** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be compared with 98% of the time in a year, 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

NILACHAL ISPAT NIGAM LIMITED
AVERAGE AIR QUALITY REPORT (CORE & BUFFER ZONE)

Month	Nr. Dump-1					Near Stock Yard					Near Main Gate					Office Area Near Canteen				
	PM ₁₀	PM _{2.5}	SO ₂	NOX	CO	PM ₁₀	PM _{2.5}	SO ₂	NOX	CO	PM ₁₀	PM _{2.5}	SO ₂	NOX	CO	PM ₁₀	PM _{2.5}	SO ₂	NOX	CO
Oct 23	65.0	26.9	11.0	21.5	BDL	62.6	24.3	11.1	23.3	BDL	65.2	28.8	12.1	23.2	BDL	59.4	20.9	10.5	19.9	BDL
Nov 23	62.2	24.0	11.2	22.0	BDL	63.6	24.0	10.7	19.9	BDL	60.3	23.3	11.0	20.5	BDL	54.9	20.4	9.5	18.4	BDL
Dec 23	60.7	22.2	11.2	21.4	BDL	62.3	22.0	10.1	21.6	BDL	58.8	22.7	10.9	21.9	BDL	55.2	19.7	9.8	20.1	BDL
Jan 24	60.2	25.7	10.9	22.1	BDL	63.5	25.5	11.7	23.1	BDL	61.4	24.5	10.9	21.6	BDL	57.4	20.3	10.1	21.4	BDL
Feb 24	63.1	26.0	11.6	20.8	BDL	64.9	23.1	11.4	21.6	BDL	66.9	25.9	11.6	22.6	BDL	58.7	20.4	10.6	18.8	BDL
Mar 24	60.9	24.8	10.8	21.7	BDL	65.6	23.5	10.9	20.8	BDL	66.4	24.1	11.6	23.8	BDL	60.7	21.2	10.6	20.5	BDL

BDL - BDL (DL-0.5)

Month	Mithirda					Kadalia					Kriyakudar					Basada				
	PM ₁₀	PM _{2.5}	SO ₂	NOX	CO	PM ₁₀	PM _{2.5}	SO ₂	NOX	CO	PM ₁₀	PM _{2.5}	SO ₂	NOX	CO	PM ₁₀	PM _{2.5}	SO ₂	NOX	CO
Oct 23	50.0	17.3	7.9	16.1	BDL	50.0	16.3	7.7	16.9	BDL	52.1	20.0	8.0	16.9	BDL	49.5	17.5	10.0	19.1	BDL
Nov 23	50.6	20.0	8.8	16.9	BDL	51.6	20.0	7.9	17.0	BDL	52.7	20.8	8.8	17.3	BDL	51.1	19.0	7.9	16.9	BDL
Dec 23	49.0	17.8	8.0	16.0	BDL	52.2	21.4	8.8	16.2	BDL	55.5	22.7	8.8	17.0	BDL	50.0	17.0	7.0	16.1	BDL
Jan 24	53.3	20.0	8.9	17.0	BDL	55.6	22.0	10.3	17.1	BDL	50.0	17.0	8.0	16.1	BDL	50.6	17.0	7.0	16.1	BDL
Feb 24	52.1	18.7	7.2	17.6	BDL	55.9	20.3	12.3	17.7	BDL	49.5	16.2	7.1	17.0	BDL	49.7	17.2	7.3	16.1	BDL
Mar 24	54.5	20.5	7.8	17.3	BDL	59.0	20.2	11.9	22.7	BDL	52.8	19.9	7.9	17.1	BDL	58.9	22.5	10.3	20.3	BDL

Unit of measurement for all parameters except CO is µg/m³. Co is in mg/m³

NILACHAL ISPAT NIGAM LIMITED
FUGITIVE DUST MONITORING REPORT
(Oct23- Mar-24)

Fugitive Dust Monitoring Locations	M/s NEELACHAL ISPAT NIGAM LIMITED						
	Monthly Average Results, µg/m3						
	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Norms µg/m3
Weigh Bridge	499	483	471	546	561	638	1200
Near Quarry	355	307	295	356	481	530	
Haul Road	661	657	582	653	663	738	

Photo of CAAQMS - 1



Photo of Display Board



GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
October 2023

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1. Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1. Water					
2	Total Alkalinity (as CaCO ₃)	191.46	181.64	187.94	168.19	176.38
3	Anionic surface active agents (as MBAS)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	34.76	36.19	23.58	23.57	27.46
7	Calcium (as Ca)	46.29	51.37	53.64	48.61	52.68
8	Free residual chlorine	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
9	Fluoride (as F)	0.27	0.31	0.18	0.27	0.38
10	Magnesium (as Mg)	13.68	11.64	12.63	12.51	12.97
11	Nitrate (as NO ₃)	7.46	7.57	9.57	6.18	8.31
12	Oduor	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	7.14 at 25°C	8.14 at 25°C	6.84 at 25°C	7.93 at 25°C	6.84 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	18.21	18.32	16.43	17.42	19.24
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	452	462	461	452	439
18	Turbidity	0.6	0.4	0.3	0.6	0.3
19	Total hardness (as CaCO ₃)	171.91	176.23	185.97	172.90	184.96
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminum (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.42	0.21	0.21	0.28	0.36
26	Lead (as Pb)	BDL(DL - 0.001)	BDL(DL - 0.001)	BDL(DL - 0.001)	BDL(DL - 0.001)	BDL(DL - 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'.

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)

KALAMANG WEST IRON MINE

October 2023

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL- 0.001)	BDL (DL- 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
November 2023

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1.Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1.Water					
2	Total Alkalinity (as CaCO ₃)	182.54	194.28	164.76	186.29	172.36
3	Anionic surface active agents (as MBAS)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	36.91	31.97	26.52	26.53	28.43
7	Calcium (as Ca)	52.84	52.81	48.93	52.81	47.26
8	Free residual chlorine	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
9	Fluoride (as F)	0.31	0.26	0.26	0.34	0.31
10	Magnesium (as Mg)	14.17	11.94	11.52	13.58	11.68
11	Nitrate (as NO ₃)	9.36	8.51	8.76	7.81	7.93
12	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	6.92 at 25°C	7.93 at 25°C	6.87 at 25°C	8.21 at 25°C	7.21 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	16.43	16.43	14.53	21.94	32.68
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	472	457	459	473	462
18	Turbidity	0.4	0.3	0.2	0.7	0.4
19	Total hardness (as CaCO ₃)	190.29	181.06	169.64	187.80	166.12
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminium (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.37	0.34	0.46	0.41	0.37
26	Lead (as Pb)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
November 2023

	Parameter	Ganua Village (Mr. Keshar Patra)	Guruda Village (Nr. Club)	Guruda Village	Khondbond Village (Mr. Mothua Munda)	OMC Colony
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL - 0.001)	BDL (DL - 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
December 2023

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1. Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1. Water					
2	Total Alkalinity (as CaCO ₃)	164.72	182.97	191.68	176.47	184.37
3	Anionic surface active agents (as MBAS)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	41.96	28.76	31.76	28.93	31.93
7	Calcium (as Ca)	53.28	48.29	52.38	51.68	47.36
8	Free residual chlorine	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
9	Fluoride (as F)	0.28	0.24	0.16	0.36	0.24
10	Magnesium (as Mg)	13.52	12.81	12.73	12.74	12.41
11	Nitrate (as NO ₃)	8.76	7.93	7.18	6.52	6.71
12	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	7.18 at 25°C	8.16 at 25°C	7.17 at 25°C	7.94 at 25°C	8.16 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	15.42	18.24	16.24	23.81	26.43
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	463	462	462	481	453
18	Turbidity	0.6	0.4	0.3	0.6	0.3
19	Total hardness (as CaCO ₃)	188.70	173.31	183.21	181.50	169.34
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminium (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.26	0.27	0.37	0.37	0.52
26	Lead (as Pb)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
December 2023

	Parameter	Ganua Village (Mr. Keshar Patra)	Guruda Village (Nr. Club)	Guruda Village	Khondbond Village (Mr. Mothua Munda)	OMC Colony
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL - 0.001)	BDL (DL - 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
January 2024

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1.Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1.Water					
2	Total Alkalinity (as CaCO ₃)	172.94	194.28	184.51	164.28	193.81
3	Anionic surface active agents (as MBAS)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	43.68	26.51	32.81	26.41	36.57
7	Calcium (as Ca)	51.57	47.67	53.16	52.87	51.29
8	Free residual chlorine	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
9	Fluoride (as F)	0.26	0.26	0.21	0.34	0.17
10	Magnesium (as Mg)	12.58	13.94	11.57	12.87	11.52
11	Nitrate (as NO ₃)	7.64	8.27	6.31	7.39	7.36
12	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	6.72 at 25°C	7.94 at 25°C	6.92 at 25°C	8.14 at 25°C	8.21 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	13.92	16.28	18.53	21.57	21.94
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	471	443	471	462	472
18	Turbidity	0.4	0.3	0.2	0.3	0.4
19	Total hardness (as CaCO ₃)	180.59	176.42	180.42	185.03	175.54
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminium (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.34	0.24	0.27	0.26	0.31
26	Lead (as Pb)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
January 2024

	Parameter	Ganua Village (Mr. Keshar Patra)	Guruda Village (Nr. Club)	Guruda Village	Khondbond Village (Mr. Mothua Munda)	OMC Colony
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL - 0.001)	BDL (DL - 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
February 2024

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1.Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1.Water					
2	Total Alkalinity (as CaCO ₃)	141.23	164.76	182.57	192.81	164.53
3	Anionic surface active agents (as MBAS)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	36.52	28.46	18.39	34.56	27.93
7	Calcium (as Ca)	54.27	48.29	47.26	52.39	49.76
8	Free residual chlorine	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
9	Fluoride (as F)	0.16	0.18	0.21	0.47	BDL (DL – 0.1)
10	Magnesium (as Mg)	13.68	13.57	12.97	11.94	14.28
11	Nitrate (as NO ₃)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)
12	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	7.16 at 25°C	6.97 at 25°C	6.91 at 25°C	7.87 at 25°C	7.16 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	14.78	16.24	16.52	21.46	14.73
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	472	472	471	461	463
18	Turbidity	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
19	Total hardness (as CaCO ₃)	191.86	176.45	171.41	180.01	183.04
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminium (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.36	0.36	0.28	0.26	0.31
26	Lead (as Pb)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
February 2024

	Parameter	Ganua Village (Mr. Keshar Patra)	Guruda Village (Nr. Club)	Guruda Village	Khondbond Village (Mr. Mothua Munda)	OMC Colony
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL - 0.001)	BDL (DL - 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
March 2024

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1.Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1.Water					
2	Total Alkalinity (as CaCO ₃)	153.64	172.64	176.94	164.29	147.39
3	Anionic surface active agents (as MBAS)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	32.58	32.58	23.58	32.57	28.16
7	Calcium (as Ca)	48.72	52.46	51.39	51.93	52.64
8	Free residual chlorine	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
9	Fluoride (as F)	0.21	0.24	0.27	0.42	BDL (DL – 0.1)
10	Magnesium (as Mg)	12.58	9.76	11.64	13.58	13.91
11	Nitrate (as NO ₃)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)
12	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	6.92 at 25°C	7.21 at 25°C	6.87 at 25°C	7.91 at 25°C	7.21 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	13.81	18.43	17.32	23.57	16.52
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	461	439	482	472	467
18	Turbidity	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
19	Total hardness (as CaCO ₃)	173.46	171.23	176.28	185.60	188.73
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminium (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.27	0.31	0.31	0.31	0.27
26	Lead (as Pb)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
March 2024

	Parameter	Ganua Village (Mr. Keshar Patra)	Guruda Village (Nr. Club)	Guruda Village	Khondbond Village (Mr. Mothua Munda)	OMC Colony
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL - 0.001)	BDL (DL - 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

Photo- Glimpses of Plantation done in Safety Zone



Corporate Social Responsibility – TATA Steel Foundation Photos – FY 2023-24

CIVIL



Ring Well Bispani



Football Gallery at Ganua



**96 nos of Solar Street Lights
installed at NINL area**



Solar High Mast at Kadalía and Mithirda village



**PCC Road Construction at
Pindpokhri and Basarda**

CIVIL



Installation of Solar Powered Drinking water projects in NINL area



Construction of 20 nos livelihood pond

LIVELIHOOD



Duck Rearing at Mithirda and Ganua



Mushroom Cultivation at Kadaliala and Sanputli



Distribution of Raw material for construction of goatery Shed



Poultry farming at Kadaliala, Pindpokhri and Ganua

Women Empowerment



Digital Literacy at Kriyakudar



Awareness Session on Safety at Sanpatli



Gender Sensitisation Program at Amliam



DISHA training at Amblian

Skill Development



3 candidates completed HMV Training at Chhatia, Jajpur

Agriculture



Intercropping Practices at Mithirda



Polyhouse structure at kadalia



Agriculture Exposure visit

Education



Jyoti Fellowship Scholarship

Health



Saas Bahu Pati Sammelan at Kalimati

Sports



Hockey Tournament Support at Patmunda

Tribal Identity



Cultural Program organized on Birsa Munda jayanti



भारत सरकार GOVERNMENT OF INDIA
खान मंत्रालय MINISTRY OF MINES
भारतीय खान ब्यूरो INDIAN BUREAU OF MINES
क्षेत्रीय खान नियंत्रक के कार्यालय
OFFICE OF THE REGIONAL CONTROLLER OF MINES



BY REGD PARCEL
Phone: 0674-2352463
Tele Fax: 0674-2352490
E-mail: ro.bhubaneswar@ibm.gov.in
Plot No.149, Pokhariput
BHUBANESWAR-751020

No. RMP/A/02-ORI/BHU/2021-22

Date: 04.05.2021

सेवामे

✓ Shri M R Jha, Managing Director & Nominated Owner,
M/s Neelachal Ispat Nigam Ltd,
IPICOL House (1st Floor Annexe Building),
Bhubaneswar-751022

विषय: Approval of Review of Mining Plan of Neelachal Iron Ore Mine along with Progressive Mine Closure Plan (PMCP), over an area of 874.290 ha in Sundargarh & Keonjhar district of Odisha State, submitted by M/s Neelachal Ispat Nigam Ltd under Rule 17 of Mineral Concession Rules, 2016.

- Ref: - i) Your letter No. Nil dated 25.03.2021 received on 31.03.2021.
ii) This office letter of even no. dated 31.03.2021.
iii) This office letter of even no. dated 31.03.2021 addressed to the Director of Mines, Govt. of Odisha, copy endorsed to you.
iv) This office letter of even no. dated 09.04.2021.
v) Your letter No. NINL/KJR/2021/27 dated 22.04.2021.

Sir,

In exercise of the power delegated to me vide Gazette Notification No. S.O. 1857(E) dated 18.05.2016, I hereby **Approve** the Review of Mining Plan including Progressive Mine Closure Plan of Neelachal Iron Ore Mine over an area of 874.290 ha of M/s Neelachal Ispat Nigam Ltd in Sundargarh & Keonjhar district of Odisha State submitted under Rule 17 of Mineral Concession Rules, 2016. This approval is subject to the following conditions:

- I. The Review of Mining Plan is approved without prejudice to any other law applicable to the mine area from time to time whether made by the Central Government, State Government or any other authority and without prejudice to any order or direction from any court of competent jurisdiction.
- II. The proposals shown on the plates and/or given in the document is based on the lease map /sketch submitted by the applicant/ lessee and is applicable from the date of approval.
- III. It is clarified that the approval of aforesaid Review of Mining Plan does not in any way imply the approval of the Government in terms of any other provision of Mines & Minerals (Development & Regulation) Act, 1957, or the Mineral Concession Rules, 2016 and any other laws including Forest (Conservation) Act, 1980, Environment (Protection) Act, 1986 or the rules made there under, the Occupational Safety, Health and Working Conditions Code, 2020 and Rule & Regulations made there under.
- IV. Indian Bureau of Mines has not undertaken verification of the mining lease boundary on the ground and does not undertake any responsibility regarding correctness of the

- boundaries of the leasehold shown on the ground with reference to lease map & other plans furnished by the applicant / lessee.
- V. At any stage, if it is observed that the information furnished, data incorporated in the document are incorrect or misrepresent facts, the approval of the document shall be revoked with immediate effect.
- VI. If this approval conflicts with any other law or court order/ Direction under any statute, it shall be revoked immediately.
- VII. Validity of this document shall expire on 31.03.2026.

Encl: - One copy of Review
of Mining Plan

भवदीय / yours faithfully,


(HARKESH MEENA)

क्षेत्रीय खान नियंत्रक / Regional Controller of Mines

Copy for kind information to:-

1. The Director of Mines, Directorate of Mines, Government of Odisha, Heads of the Department Building, Bhubaneswar- 751001, Odisha along with one copy of Review of Mining Plan by REGISTERED PARCEL.
2. Shri Sanjib Kumar Swain & Shri Nihar Ranjan Nayak, M/s The Techno Chamber, Plot No.16/5, Cuttack Road, Bhubaneswar-751006.

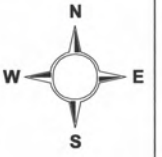
(HARKESH MEENA)

क्षेत्रीय खान नियंत्रक / Regional Controller of Mines

MAP SHOWING EXISTING LANDUSE OF M/s NEELACHAL ISPAT NIGAM LIMITED
AT - SUNDARGARH & KEONJHAR DISTRICT

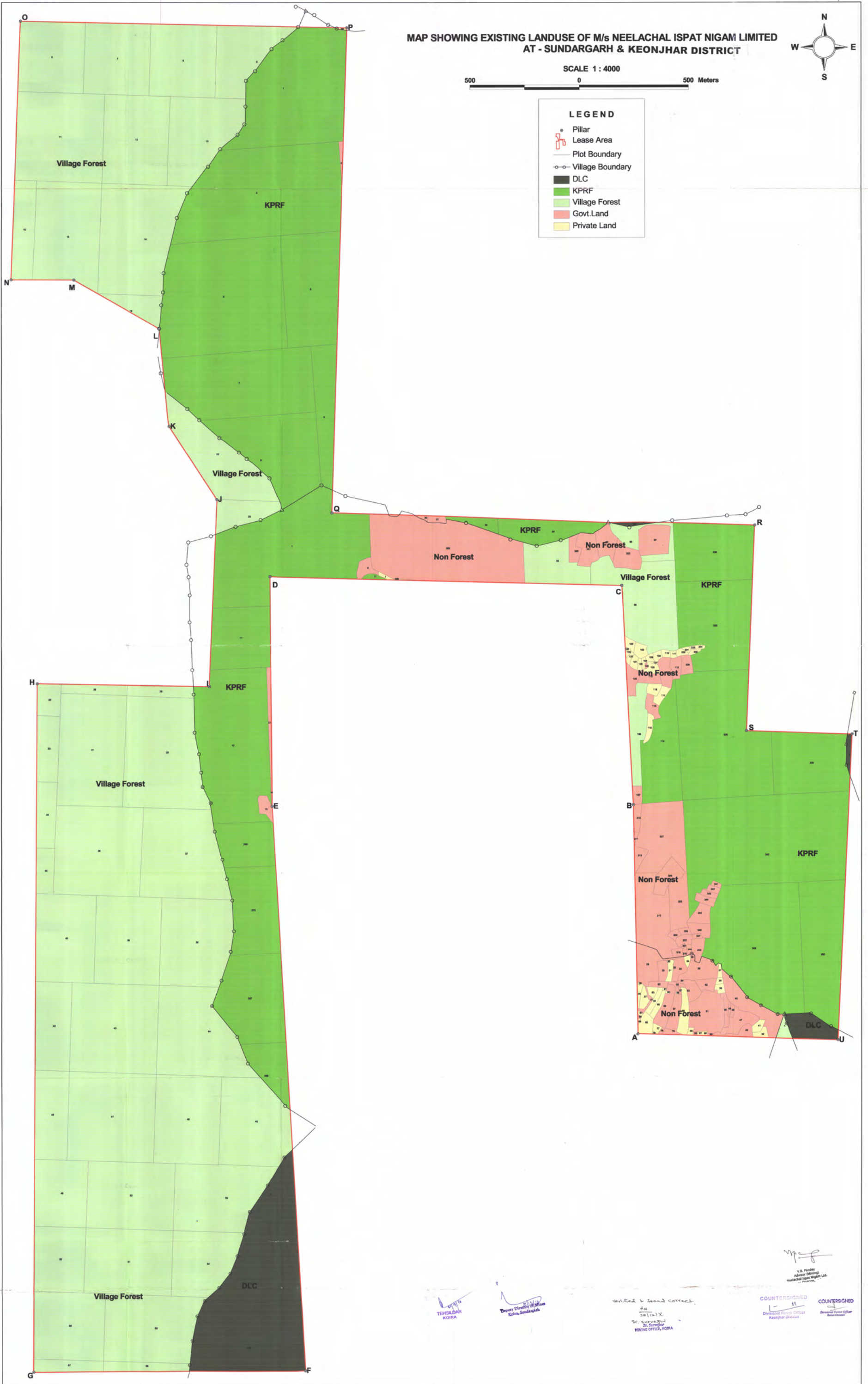
SCALE 1 : 4000

500 0 500 Meters



LEGEND

- Pillar
- ▭ Lease Area
- Plot Boundary
- Village Boundary
- DLC
- KPRF
- Village Forest
- Govt. Land
- Private Land



V.S. Pandey
Deputy Divisional Forest Officer
Keonjhar Division

COUNTERSIGNED
District Forest Officer
Keonjhar Division

COUNTERSIGNED
District Forest Officer
Keonjhar Division

Verified & Issued correct.
Sd/-
Sr. Surveyor
Keonjhar Division, Keonjhar

Deputy Divisional Forest Officer
Keonjhar Division

TEHSILDAAR
KEONJHAR

Surface Water Quality Monitoring Report
Neelachal Ispat Nigam Limited of M/s Tata Steel Limited
Period: October-23 to March-24

		Oct 23		Nov 23	
Parameters		Sona River (Upstream)	Sona River (Downstream)	Sona River (Upstream)	Sona River (Downstream)
I	Biological Testing 1.Water				
1	Total Colifom	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)
II	Chemical Testing 1.Water				
2	pH value	8.31 at 250C	8.14 at 250C	8.17 at 250C	7.93 at 250C
3	Colour	24	16	36	28
4	Dissolved Oxygen	6.8	6.4	6.7	6.5
5	Total Suspended Solid (as TSS)	BDL(DL-10)	BDL(DL-10)	BDL(DL-10)	BDL(DL-10)
6	BOD (3 days at 27°C)	2.87	2.53	2.53	2.47
7	Chemical oxygen demand	8.53	7.19	6.91	6.28
8	Total Dissolved Solids (TDS)	1432	1381	1394	1251
9	Copper (as Cu)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
10	Chloride (as Cl)	58.26	49.31	52.94	47.36
11	Sulphate (as SO ₄)	164.27	148.37	216.51	194.73
12	Nitrate (as NO ₃)	16.94	13.58	13.58	11.64
13	Fluoride (as F)	0.54	0.47	0.48	0.39
14	Cyanide (as CN)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)
15	Phenolic compounds (as C ₆ H ₅ OH)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
16	Anionic Detergent	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
	Chemical Testing 2. Residues In Water				
17	Iron (as Fe)	0.42	0.37	0.46	0.42
18	Cadmium (as Cd)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)
19	Selenium (as Se)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
20	Arsenic (as As)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
21	Lead (as Pb)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
22	Zinc (as Zn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)
23	Hexa Chromium (as Cr ⁺⁶)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
24	Mercury (as Hg)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
25	Manganese (as Mn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)

Summarised Surface Water Quality Monitoring Report					
Neelachal Ispat Nigam Limited of M/s Tata Steel Limited					
Period: October-23 to March-24					
		Dec 23		Jan 24	
Parameters		Sona River (Upstream)	Sona River (Downstream)	Sona River (Upstream)	Sona River (Downstream)
I	Biological Testing 1.Water				
1	Total Colifom	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)
II	Chemical Testing 1.Water				
2	pH value	7.97 at 250C	7.81 at 250C	7.81 at 250C	7.68 at 250C
3	Colour	42	38	26	21
4	Dissolved Oxygen	6.5	6.3	6.1	5.8
5	Total Suspended Solid (as TSS)	BDL(DL-10)	BDL(DL-10)	BDL(DL-10)	BDL(DL-10)
6	BOD (3 days at 27°C)	2.76	2.59	2.46	2.39
7	Chemical oxygen demand	8.14	7.36	7.84	6.21
8	Total Dissolved Solids (TDS)	1491	1387	1347	1192
9	Copper (as Cu)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
10	Chloride (as Cl)	46.29	38.76	37.56	32.91
11	Sulphate (as SO ₄)	204.82	183.91	182.57	164.82
12	Nitrate (as NO ₃)	14.76	12.87	13.94	11.61
13	Fluoride (as F)	0.41	0.38	0.42	0.38
14	Cyanide (as CN)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)
15	Phenolic compounds (as C ₆ H ₅ OH)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
16	Anionic Detergent	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
	Chemical Testing 2. Residues In Water				
17	Iron (as Fe)	0.42	0.37	0.43	0.39
18	Cadmium (as Cd)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)
19	Selenium (as Se)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
20	Arsenic (as As)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
21	Lead (as Pb)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
22	Zinc (as Zn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)
23	Hexa Chromium (as Cr ⁺⁶)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
24	Mercury (as Hg)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
25	Manganese (as Mn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)

Summarised Surface Water Quality Monitoring Report					
Neelachal Ispat Nigam Limited of M/s Tata Steel Limited					
Period: October-23 to March-24					
		Feb 24		Mar 24	
Parameters		Sona River (Upstream)	Sona River (Downstream)	Sona River (Upstream)	Sona River (Downstream)
I	Biological Testing 1.Water				
1	Total Colifom	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)
II	Chemical Testing 1.Water				
2	pH value	6.72 at 250C	6.68 at 250C	6.53 at 250C	6.72 at 250C
3	Colour	16	12	21	16
4	Dissolved Oxygen	6.7	6.3	6.5	6.2
5	Total Suspended Solid (as TSS)	16	12	12	BDL(DL-10)
6	BOD (3 days at 27°C)	2.41	2.37	2.17	2.13
7	Chemical oxygen demand	6.39	5.76	6.48	5.92
8	Total Dissolved Solids (TDS)	1294	1174	1394	1258
9	Copper (as Cu)	0.04	0.03	0.06	0.04
10	Chloride (as Cl)	87.36	76.29	92.87	86.34
11	Sulphate (as SO ₄)	103.94	87.36	112.57	101.72
12	Nitrate (as NO ₃)	13.82	9.72	13.94	11.64
13	Fluoride (as F)	0.37	0.26	0.46	0.37
14	Cyanide (as CN)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)
15	Phenolic compounds (as C ₆ H ₅ OH)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
16	Anionic Detergent	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
	Chemical Testing 2. Residues In Water				
17	Iron (as Fe)	0.34	0.27	0.41	0.38
18	Cadmium (as Cd)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)
19	Selenium (as Se)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
20	Arsenic (as As)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
21	Lead (as Pb)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
22	Zinc (as Zn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)
23	Hexa Chromium (as Cr ⁺⁶)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
24	Mercury (as Hg)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
25	Manganese (as Mn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
October 2023

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1. Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1. Water					
2	Total Alkalinity (as CaCO ₃)	191.46	181.64	187.94	168.19	176.38
3	Anionic surface active agents (as MBAS)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	34.76	36.19	23.58	23.57	27.46
7	Calcium (as Ca)	46.29	51.37	53.64	48.61	52.68
8	Free residual chlorine	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
9	Fluoride (as F)	0.27	0.31	0.18	0.27	0.38
10	Magnesium (as Mg)	13.68	11.64	12.63	12.51	12.97
11	Nitrate (as NO ₃)	7.46	7.57	9.57	6.18	8.31
12	Oduor	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	7.14 at 25°C	8.14 at 25°C	6.84 at 25°C	7.93 at 25°C	6.84 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	18.21	18.32	16.43	17.42	19.24
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	452	462	461	452	439
18	Turbidity	0.6	0.4	0.3	0.6	0.3
19	Total hardness (as CaCO ₃)	171.91	176.23	185.97	172.90	184.96
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminum (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.42	0.21	0.21	0.28	0.36
26	Lead (as Pb)	BDL(DL - 0.001)	BDL(DL - 0.001)	BDL(DL - 0.001)	BDL(DL - 0.001)	BDL(DL - 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'.

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)

KALAMANG WEST IRON MINE

October 2023

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL- 0.001)	BDL (DL- 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
November 2023

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1.Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1.Water					
2	Total Alkalinity (as CaCO ₃)	182.54	194.28	164.76	186.29	172.36
3	Anionic surface active agents (as MBAS)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	36.91	31.97	26.52	26.53	28.43
7	Calcium (as Ca)	52.84	52.81	48.93	52.81	47.26
8	Free residual chlorine	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
9	Fluoride (as F)	0.31	0.26	0.26	0.34	0.31
10	Magnesium (as Mg)	14.17	11.94	11.52	13.58	11.68
11	Nitrate (as NO ₃)	9.36	8.51	8.76	7.81	7.93
12	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	6.92 at 25°C	7.93 at 25°C	6.87 at 25°C	8.21 at 25°C	7.21 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	16.43	16.43	14.53	21.94	32.68
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	472	457	459	473	462
18	Turbidity	0.4	0.3	0.2	0.7	0.4
19	Total hardness (as CaCO ₃)	190.29	181.06	169.64	187.80	166.12
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminium (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.37	0.34	0.46	0.41	0.37
26	Lead (as Pb)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
November 2023

	Parameter	Ganua Village (Mr. Keshar Patra)	Guruda Village (Nr. Club)	Guruda Village	Khondbond Village (Mr. Mothua Munda)	OMC Colony
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL - 0.001)	BDL (DL - 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
December 2023

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1.Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1.Water					
2	Total Alkalinity (as CaCO ₃)	164.72	182.97	191.68	176.47	184.37
3	Anionic surface active agents (as MBAS)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	41.96	28.76	31.76	28.93	31.93
7	Calcium (as Ca)	53.28	48.29	52.38	51.68	47.36
8	Free residual chlorine	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
9	Fluoride (as F)	0.28	0.24	0.16	0.36	0.24
10	Magnesium (as Mg)	13.52	12.81	12.73	12.74	12.41
11	Nitrate (as NO ₃)	8.76	7.93	7.18	6.52	6.71
12	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	7.18 at 25°C	8.16 at 25°C	7.17 at 25°C	7.94 at 25°C	8.16 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	15.42	18.24	16.24	23.81	26.43
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	463	462	462	481	453
18	Turbidity	0.6	0.4	0.3	0.6	0.3
19	Total hardness (as CaCO ₃)	188.70	173.31	183.21	181.50	169.34
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminium (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.26	0.27	0.37	0.37	0.52
26	Lead (as Pb)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
December 2023

	Parameter	Ganua Village (Mr. Keshar Patra)	Guruda Village (Nr. Club)	Guruda Village	Khondbond Village (Mr. Mothua Munda)	OMC Colony
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL - 0.001)	BDL (DL - 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
January 2024

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1.Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1.Water					
2	Total Alkalinity (as CaCO ₃)	172.94	194.28	184.51	164.28	193.81
3	Anionic surface active agents (as MBAS)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)	BDL (DL – 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	43.68	26.51	32.81	26.41	36.57
7	Calcium (as Ca)	51.57	47.67	53.16	52.87	51.29
8	Free residual chlorine	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
9	Fluoride (as F)	0.26	0.26	0.21	0.34	0.17
10	Magnesium (as Mg)	12.58	13.94	11.57	12.87	11.52
11	Nitrate (as NO ₃)	7.64	8.27	6.31	7.39	7.36
12	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	6.72 at 25°C	7.94 at 25°C	6.92 at 25°C	8.14 at 25°C	8.21 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	13.92	16.28	18.53	21.57	21.94
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	471	443	471	462	472
18	Turbidity	0.4	0.3	0.2	0.3	0.4
19	Total hardness (as CaCO ₃)	180.59	176.42	180.42	185.03	175.54
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminium (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.34	0.24	0.27	0.26	0.31
26	Lead (as Pb)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
January 2024

	Parameter	Ganua Village (Mr. Keshar Patra)	Guruda Village (Nr. Club)	Guruda Village	Khondbond Village (Mr. Mothua Munda)	OMC Colony
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL - 0.001)	BDL (DL - 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
February 2024

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1.Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1.Water					
2	Total Alkalinity (as CaCO ₃)	141.23	164.76	182.57	192.81	164.53
3	Anionic surface active agents (as MBAS)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	36.52	28.46	18.39	34.56	27.93
7	Calcium (as Ca)	54.27	48.29	47.26	52.39	49.76
8	Free residual chlorine	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
9	Fluoride (as F)	0.16	0.18	0.21	0.47	BDL (DL – 0.1)
10	Magnesium (as Mg)	13.68	13.57	12.97	11.94	14.28
11	Nitrate (as NO ₃)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)
12	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	7.16 at 25°C	6.97 at 25°C	6.91 at 25°C	7.87 at 25°C	7.16 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	14.78	16.24	16.52	21.46	14.73
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	472	472	471	461	463
18	Turbidity	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
19	Total hardness (as CaCO ₃)	191.86	176.45	171.41	180.01	183.04
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminium (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.36	0.36	0.28	0.26	0.31
26	Lead (as Pb)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
February 2024

	Parameter	Ganua Village (Mr. Keshar Patra)	Guruda Village (Nr. Club)	Guruda Village	Khondbond Village (Mr. Mothua Munda)	OMC Colony
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL - 0.001)	BDL (DL - 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
March 2024

	Parameter	Guali Village	Kalamang Village	Sagasahi Village	Gandalpada Village	Sunindpur Village
I	Biological Testing 1.Water					
1	<i>Escherichia coli</i>	Absent	Absent	Absent	Absent	Absent
II	Chemical Testing 1.Water					
2	Total Alkalinity (as CaCO ₃)	153.64	172.64	176.94	164.29	147.39
3	Anionic surface active agents (as MBAS)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
4	Colour	1	1	1	1	1
5	Cyanide (as CN)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)	BDL (DL – 0.005)
6	Chloride (as Cl)	32.58	32.58	23.58	32.57	28.16
7	Calcium (as Ca)	48.72	52.46	51.39	51.93	52.64
8	Free residual chlorine	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
9	Fluoride (as F)	0.21	0.24	0.27	0.42	BDL (DL – 0.1)
10	Magnesium (as Mg)	12.58	9.76	11.64	13.58	13.91
11	Nitrate (as NO ₃)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)
12	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
13	pH	6.92 at 25°C	7.21 at 25°C	6.87 at 25°C	7.91 at 25°C	7.21 at 25°C
14	Phenolic compounds (as C ₆ H ₅ OH)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)	BDL (DL – 0.001)
15	Sulphate (as SO ₄)	13.81	18.43	17.32	23.57	16.52
16	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
17	Total dissolved solids	461	439	482	472	467
18	Turbidity	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)	BDL (DL – 0.1)
19	Total hardness (as CaCO ₃)	173.46	171.23	176.28	185.60	188.73
II	Chemical Testing 2. Residues In Water					
20	Arsenic (as As)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
21	Aluminium (as Al)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
22	Boron (as B)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
23	Copper (as Cu)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
24	Cadmium (as Cd)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)
25	Iron (as Fe)	0.27	0.31	0.31	0.31	0.27
26	Lead (as Pb)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)	BDL(DL- 0.001)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

GROUND WATER QUALITY REPORT (OCTOBER 2023 TO MARCH 2024)
KALAMANG WEST IRON MINE
March 2024

	Parameter	Ganua Village (Mr. Keshar Patra)	Guruda Village (Nr. Club)	Guruda Village	Khondbond Village (Mr. Mothua Munda)	OMC Colony
27	Manganese (as Mn)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)	BDL(DL-0.0005)
28	Mercury (as Hg)	BDL (DL - 0.001)	BDL (DL - 0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
29	Selenium (as Se)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
30	Total Chromium (as Cr)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)	BDL (DL - 0.1)
31	Zinc (as Zn)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
32	Polynuclear aromatic hydrocarbon (PAH)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
33	Mineral Oil	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)	BDL (DL - 0.01)
II	Pesticide Residues Organochlorine					
i	Alpha-HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ii	Beta HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iii	Gamma - HCH (Lindane)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
iv	Delta- HCH	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
v	Alachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vi	Aldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
vii	Dieldrin	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
viii	Butachlor	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
ix	p,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
x	o,p'-DDE	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xi	p,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xii	o,p'-DDD	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiii	o,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xiv	p,p'- DDT	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xv	Monocrotophos	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvi	Atrazine	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xvii	Parathion Methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xviii	Paraoxon methyl	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xix	Malathion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xx	Malaoxon	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)
xxi	Ethion	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)	BDL (DL - 0.03)

BDL- Below detection limit DL-Indicates detection limit of instrument /method shall be considered as 'absent'

Surface Water Quality Monitoring Report
Neelachal Ispat Nigam Limited of M/s Tata Steel Limited
Period: October-23 to March-24

		Oct 23		Nov 23	
Parameters		Sona River (Upstream)	Sona River (Downstream)	Sona River (Upstream)	Sona River (Downstream)
I	Biological Testing 1.Water				
1	Total Colifom	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)
II	Chemical Testing 1.Water				
2	pH value	8.31 at 250C	8.14 at 250C	8.17 at 250C	7.93 at 250C
3	Colour	24	16	36	28
4	Dissolved Oxygen	6.8	6.4	6.7	6.5
5	Total Suspended Solid (as TSS)	BDL(DL-10)	BDL(DL-10)	BDL(DL-10)	BDL(DL-10)
6	BOD (3 days at 27°C)	2.87	2.53	2.53	2.47
7	Chemical oxygen demand	8.53	7.19	6.91	6.28
8	Total Dissolved Solids (TDS)	1432	1381	1394	1251
9	Copper (as Cu)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
10	Chloride (as Cl)	58.26	49.31	52.94	47.36
11	Sulphate (as SO ₄)	164.27	148.37	216.51	194.73
12	Nitrate (as NO ₃)	16.94	13.58	13.58	11.64
13	Fluoride (as F)	0.54	0.47	0.48	0.39
14	Cyanide (as CN)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)
15	Phenolic compounds (as C ₆ H ₅ OH)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
16	Anionic Detergent	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
	Chemical Testing 2. Residues In Water				
17	Iron (as Fe)	0.42	0.37	0.46	0.42
18	Cadmium (as Cd)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)
19	Selenium (as Se)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
20	Arsenic (as As)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
21	Lead (as Pb)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
22	Zinc (as Zn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)
23	Hexa Chromium (as Cr ⁺⁶)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
24	Mercury (as Hg)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
25	Manganese (as Mn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)

Summarised Surface Water Quality Monitoring Report					
Neelachal Ispat Nigam Limited of M/s Tata Steel Limited					
Period: October-23 to March-24					
		Dec 23		Jan 24	
Parameters		Sona River (Upstream)	Sona River (Downstream)	Sona River (Upstream)	Sona River (Downstream)
I	Biological Testing 1.Water				
1	Total Colifom	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)
II	Chemical Testing 1.Water				
2	pH value	7.97 at 250C	7.81 at 250C	7.81 at 250C	7.68 at 250C
3	Colour	42	38	26	21
4	Dissolved Oxygen	6.5	6.3	6.1	5.8
5	Total Suspended Solid (as TSS)	BDL(DL-10)	BDL(DL-10)	BDL(DL-10)	BDL(DL-10)
6	BOD (3 days at 27°C)	2.76	2.59	2.46	2.39
7	Chemical oxygen demand	8.14	7.36	7.84	6.21
8	Total Dissolved Solids (TDS)	1491	1387	1347	1192
9	Copper (as Cu)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)	BDL(DL-0.03)
10	Chloride (as Cl)	46.29	38.76	37.56	32.91
11	Sulphate (as SO ₄)	204.82	183.91	182.57	164.82
12	Nitrate (as NO ₃)	14.76	12.87	13.94	11.61
13	Fluoride (as F)	0.41	0.38	0.42	0.38
14	Cyanide (as CN)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)
15	Phenolic compounds (as C ₆ H ₅ OH)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
16	Anionic Detergent	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
	Chemical Testing 2. Residues In Water				
17	Iron (as Fe)	0.42	0.37	0.43	0.39
18	Cadmium (as Cd)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)
19	Selenium (as Se)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
20	Arsenic (as As)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
21	Lead (as Pb)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
22	Zinc (as Zn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)
23	Hexa Chromium (as Cr ⁺⁶)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
24	Mercury (as Hg)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
25	Manganese (as Mn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)

Summarised Surface Water Quality Monitoring Report					
Neelachal Ispat Nigam Limited of M/s Tata Steel Limited					
Period: October-23 to March-24					
		Feb 24		Mar 24	
Parameters		Sona River (Upstream)	Sona River (Downstream)	Sona River (Upstream)	Sona River (Downstream)
I	Biological Testing 1.Water				
1	Total Colifom	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)	BDL(DL-2)
II	Chemical Testing 1.Water				
2	pH value	6.72 at 250C	6.68 at 250C	6.53 at 250C	6.72 at 250C
3	Colour	16	12	21	16
4	Dissolved Oxygen	6.7	6.3	6.5	6.2
5	Total Suspended Solid (as TSS)	16	12	12	BDL(DL-10)
6	BOD (3 days at 27°C)	2.41	2.37	2.17	2.13
7	Chemical oxygen demand	6.39	5.76	6.48	5.92
8	Total Dissolved Solids (TDS)	1294	1174	1394	1258
9	Copper (as Cu)	0.04	0.03	0.06	0.04
10	Chloride (as Cl)	87.36	76.29	92.87	86.34
11	Sulphate (as SO ₄)	103.94	87.36	112.57	101.72
12	Nitrate (as NO ₃)	13.82	9.72	13.94	11.64
13	Fluoride (as F)	0.37	0.26	0.46	0.37
14	Cyanide (as CN)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)	BDL(DL-0.005)
15	Phenolic compounds (as C ₆ H ₅ OH)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
16	Anionic Detergent	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
	Chemical Testing 2. Residues In Water				
17	Iron (as Fe)	0.34	0.27	0.41	0.38
18	Cadmium (as Cd)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)	BDL(DL-0.002)
19	Selenium (as Se)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
20	Arsenic (as As)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
21	Lead (as Pb)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
22	Zinc (as Zn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)
23	Hexa Chromium (as Cr ⁺⁶)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
24	Mercury (as Hg)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)
25	Manganese (as Mn)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)	BDL(DL-0.02)

TECHNICAL FEASIBILITY REPORT AND MASTER PLAN FOR THE IMPLEMENTATION OF RAINWATER HARVESTING STRUCTURES AT NEELACHAL ISPAT NIGAM LTD. (NINL), SUNDARGARH/KEONJHAR DISTRICTS, ODISHA

“A 1–2-degree Celsius warming along with a 10-percent decrease in precipitation - well within the realm of possibility in some areas - could reduce annual runoff by 40–70 percent. Such a drop would have staggering economic and environmental consequences on regions already short of water forcing land out of irrigation, reducing hydroelectric power production, wiping out many species, and greatly constraining urban growth and the quality of life.”

- Intergovernmental Panel on Climate Change in the U.N. Environment Programme, held in Geneva, organized by the World Meteorological Organization.

PREFACE

“Water is a strange natural resource.

It can unite a community as easily as it can divide it.”

Water is life! It plays a vital role in the proper functioning of the earth's ecosystems and the climate regulation cycle. With the growth of economy and subsequent upgradation of the very pattern of life, there is a corresponding increase in demand for water from different sectors.

Rain is the main source of fresh water. Though India gets a high amount of rainfall, with an annual average of about 1100 mm, it is not evenly spread across the year. Most of the time, even in a year of normal rainfall, many parts of the country face drought. It is unfortunate that we have to face the fury of floods and the vagaries of drought year after year, in spite of the fact that India is a water rich country as per records.

“Eminent meteorologist, Shri P.R. PISHAROTY, points out that in most parts of the country, there is a precipitation during not more than 50 days.” Even on days when rainfall does occur, it does not fall over the entire period of four hours. Heavy showers of short duration are not uncommon. Most of the places of the country therefore receive rainfall for just 100 hours in a year. The remaining 8660 hours in a year, there is no rain. Therefore, if the rain is not harvested in those few hours, in a year, when the rivers and streams swell up, then there is only little water to capture to meet human needs.

Every time it rains, only about 5-20% of the total rain is recharged into the ground and even that depends upon the terrain, topsoil condition, subsurface formation, rainfall pattern, etc. The topsoil can hold only a fraction of water that falls on it and the rest gradually percolates down, depending on the type of the soil and joins the aquifers.

The term “aquifer” may be defined as a formation that contains sufficient saturated permeable material to yield significant quantities of water-to-water extraction structures like open wells, bore wells etc.

The quantity of water that is recharged is much lesser than the water, which goes as run off. As huge quantity of rainwater finds its way ultimately to sea especially, through canals and rivers, the only choice is to harvest and conserve this precious gift of nature through appropriate Rainwater Harvesting methods.

Use of rainwater, the major resource of water supply, probably the only source, will gain more and more importance in the coming years. The conjunctive use of available surface water, ground water and rainwater is the need of the hour.

For companies, lack of water poses significant risks, including limiting their ability to use water for manufacturing and operations, or impinging on the quality of life of customers, employees, and others. Leading companies make water crisis a strategic issue, creating water management plans that include efficiency and conservation as well as contingency plans.

CHAPTER I

A. INTRODUCTION TO THE STUDY

NEELACHAL ISPAT NIGAM LIMITED (NINL), originally a joint venture public sector company having its steel plant at Duburi, Jajpur District, Odisha, was promoted by Mineral Metals Trading Corporation Ltd. (MMTC), Govt. of India undertaking and Industrial Promotion & Investment Corporation Ltd. (IPICOL), a Govt. of Odisha Enterprise. Subsequently, NINL was taken over by Tata Steel Long Products Ltd., a subsidiary of Tata Steel Ltd., during July 2022. It is reported that NINL, with all its units, produces 492,000 MT of pig iron, 300,000 MT of wire rods and 276,000 MT of billets per annum.

NINL has its iron ore mines, spreading across a sprawling area of **874.29 hectares** (ha) and covering 9 villages, located in Keonjhar and Sundergarh districts. The details of environmental setting of the NINL Iron Ore Mine are given below in the Table-1.

TABLE – 1: ENVIRONMENTAL SETTING

Sl. No	Particulars	Details	
1	Latitude	21° 50′ 37″ to 21° 54′ 16″ N	
2	Longitude	85° 19′ 34″ to 85° 22′ 09″ E	
3	Elevation above MSL	619.5 m – 941.5 m	
4	Climatic conditions	IMD – Keonjhar Post Monsoon	Site Specific Post Monsoon
	Temperature	Mean Max–32.2 °C Mean Min–8.7 °C	Mean Max–31.2 °C Mean Min–8.2 °C
	Relative Humidity	Mean Max–80 % Mean Min–56 %	Mean Max–79 % Mean Min–57 %

	Rainfall	109.7 cm	16.3 cm
5	Land Use of Mine Lease Area	Forest, agricultural fields and barren lands	
6	Nearest Highway	National Highway – 215, connecting Rourkela with Keonjhar	
7	Nearest Railway Station	Nayagarh on Jakhapura-Banspani Railway line, which is 17 km away from the mine site	
8	Nearest Helipad	Malangtoli	
9	Nearest Air port	Rourkela – 128 km on the NW side	
10	Nearest village	Kadalia (within ML area)	
11	Nearest town	Koira – 8 km on the Western side	
12	Nearest major city	Rourkela – 118 km	
13	Hills/valleys	The ML area itself is on a hilly terrain	
14	Ecologically sensitive zone	Nil within 25 km radial distance from the ML boundary	
15	Historical places	Nil within 15 km radial distance from the ML boundary	
16	Defence Installations	Nil within 10 km radial distance from the ML boundary	
17	Wildlife sanctuary, National Parks and Biospheres	Nil within 15 km radial distance from the ML boundary	
18	Seismic zone	Zone–III as per IS-1893 (Part–I) 2002	

The mine site is located in 3 mining blocks, namely, **Mithirda, Basada and Kriyakudar**. The Mining plan details for the 3 Blocks in the Mine lease area are given in Table – 2.

TABLE – 2: DETAILS OF MINING PLAN

Year	Mithirda	Basada	Kriyakudar	Total
I	404560	838110	469218.8	1711888.8
II	336960	917280	600600	1854840
III	374400	931840	600600	1906840
IV	395200	891800	625625	1912625
V	416000	910000	688187.5	2014187.5
Total	1927120	4489030	2984231.3	9400381.3

Water Demand and Supply

The mine lease area admeasures about **874.29 ha, which includes 806.153 ha of forest land and 68.137 ha** of non-forest land. During the initial stages of development, the water requirement for construction purposes will be met through ground water drawn from the 4 proposed bore wells. After construction, these bore wells will be used for meeting the drinking water requirements. During operational stage, a total of 550 KL of water per day (peak requirement is estimated at 600 KL per day) is required, which includes the requirements for township, domestic and mining purposes (dust suppression etc.). This water will be met from Suna Nadi which is about 2.5 km from the mine lease area.

The available data as well as the field data indicate that the area is represented by **low to moderate water bearing aquifers** which are favourable for limited extraction of ground water. The topography of the terrain with steep gradient facilitates easy drainage of major portion of the runoff water and retards the recharge to ground water.

Therefore, the limited aquifers need to be protected from depleting water levels by impounding the runoff water generated in the study site at appropriate locations. The rain water harvesting will improve the ground water storage and also the sustainability of open wells and bore wells in the area. Further, developing dependable domestic surface sources of water to meet the mine water requirements has to be explored.

Justification of the Technical Feasibility Study

It is indeed shocking to understand from reliable scientific reports that a shocking *freshwater crisis* awaits various parts of our country in the next two decades including states like *Odisha*. This critical situation need not be due to lack of water as such, but definitely due to lack of availability of adequate quantity of water at the required place at the required time.

The vagaries of monsoon with erratic rainfall in most parts of the country and over exploitation of water sources have created a water crisis especially during peak summer. The consistent decrease in rainfall and consequent depletion of recharge to ground water aquifer shall lower the ground water table conditions and seriously affect the yield of the bore wells and open wells.

One of the recent publications of the Meteorological Department gives a shock, as it says, “not only the amount of rains has been less, but change is also visible in the rainfall pattern. Earlier “monsoon rains” were spread out over a number of days, but since the last few years, it has been reported that the rains occur in bulk, that is, heavy downpour in a short span of time”.

The effective and judicious management of water resources is increasingly becoming an essential component for any project in the last few years due to severe water crisis in many parts of our country. It has become an imperative necessity to resort to suitable measures for increasing the recharge activities and improve water table conditions of the study area.

It is observed that enormous quantity of runoff water is generated from mine lease area during monsoon period. Major portion of the runoff water follows the natural gradient and flows through gullies towards the valley and nallahs on the downstream side without much contribution to the aquifer of the study site.

It is appreciable that **Rainwater harvesting has become the most successful scientific and cost-effective technology** in getting a lasting solution in order to overcome the water shortage throughout the world.

The Management has taken a swift and right decision to look into the possibilities of introducing the innovative techniques and systems of Rainwater harvesting in the leasehold area. The recharge to the deeper aquifers needs suitable site-specific techniques and sufficient quantity of surplus fresh water resources.

The primary objective of the Management is to adopt suitable rain water harvesting systems and meet the EC conditions. The implementation of rainwater harvesting structures will be appropriate, if done after necessary survey and investigation. Hence, this important study has been entrusted to **M/s. KRG Rainwater Foundation, Chennai** with a view to carry out a detailed Technical Feasibility Study on the ground water conditions and the Rainwater Harvesting systems applicable for the site and devise a master plan to implement the systems scientifically and effectively.

It is planned to evaluate the total rain water harvesting potential and the proper storage of the same in surface and sub-surface for its beneficial use. KRG Rainwater Foundation has taken up a detailed examination of the surface and ground water scenario of NINL Iron mines and surrounding area along with the possibilities and feasibilities of introducing the simple and scientific systems of rain water harvesting. The present study is aimed at improving the recharge activities at favourable locations with the available rainwater which may gradually improve the ground water table conditions. The details of the various studies conducted and assessment of the ground water potential is given in this report.

The technical team consisting of the following members

- i. Dr. R. Raghuraman, Chief Executive & Hydrogeologist
- ii. Dr. N.Varadaraj, Resource Person (Formerly Member, CGWB, Govt. of India and CGWA Accredited Ground Water Consultant)

visited the site and carried out an intensive reconnoiter and a detailed field survey in the premise involving hydro-geological, geophysical, remote sensing methods between **17th to 19th October 2022**.

B. OBJECTIVES OF THE STUDY

- *The primary objective of the Feasibility Study is to find out suitable rainwater harvesting systems applicable for the study site and to prepare a Master Plan for implementation of the scheme with its economic considerations in totality for better water resource planning.*
- *To reduce the increased dependence on external water sources (Suna Nadi) and to develop dependable local surface water sources.*
- *To identify suitable locations for the storage of runoff water in cost- effective storage cum recharge ponds for direct use of harvested water in rainy season and emergency situation as well as recharge purposes.*
- *To identify the sub surface formations occurring at the study site by hydrogeological surveys to design suitable Rainwater harvesting structures.*
- *To minimize the entry of silt from the mine cut areas, approach roads, gullies etc. into the downstream nallahs by constructing barriers, garland drains, retaining walls, settling pits etc.*
- *To design suitable Rainwater Harvesting Structures like Recharge Trenches and Pits, Contour drains, bunds etc. based on the site conditions and subsurface formations.*
- *To impound adequate quantity of the runoff water in proposed desilting / percolation ponds and site specific recharge structures to improve the recharge to ground water and stem the decline of water table.*

C. GENERAL FEATURES OF THE STUDY AREA

(i) Location

The mine site is having 3 Blocks which are located in Sundergarh and Keonjhar districts. The location map of the ML area is shown in Figure – 1. The ML area is approachable from Koira town. NH – 520, which is around 10 KM away from the site, connects the main towns in the district with Barbil.

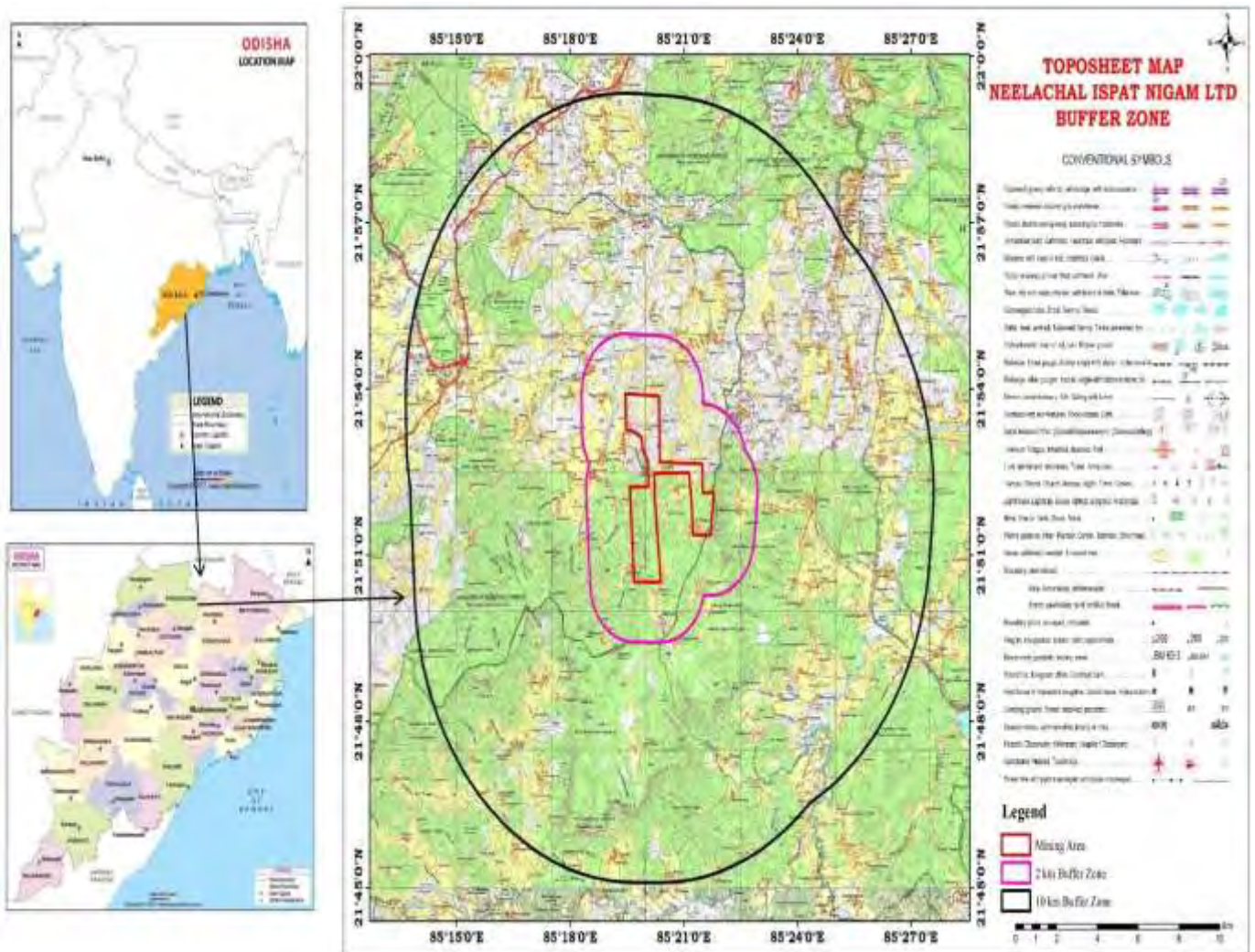
The google map showing the Mine lease boundary, 2 km radius Core zone and 10 km radius Buffer zone is given in Figure – 2. There are number of mining projects belonging to various mining industries located in the buffer zone. A few prominent mines being Joda East, Khondbond and Ganua mines on the Northern side, Siljoda and Unchabali mines on the Eastern side and many other mines in the buffer zone.

The project area is part of reserve forest with number of hillocks. Satellite Imagery is used to prepare the Digital elevation model (DEM) of the buffer zone which is given in Figure – 3.

(ii) Areal Extent

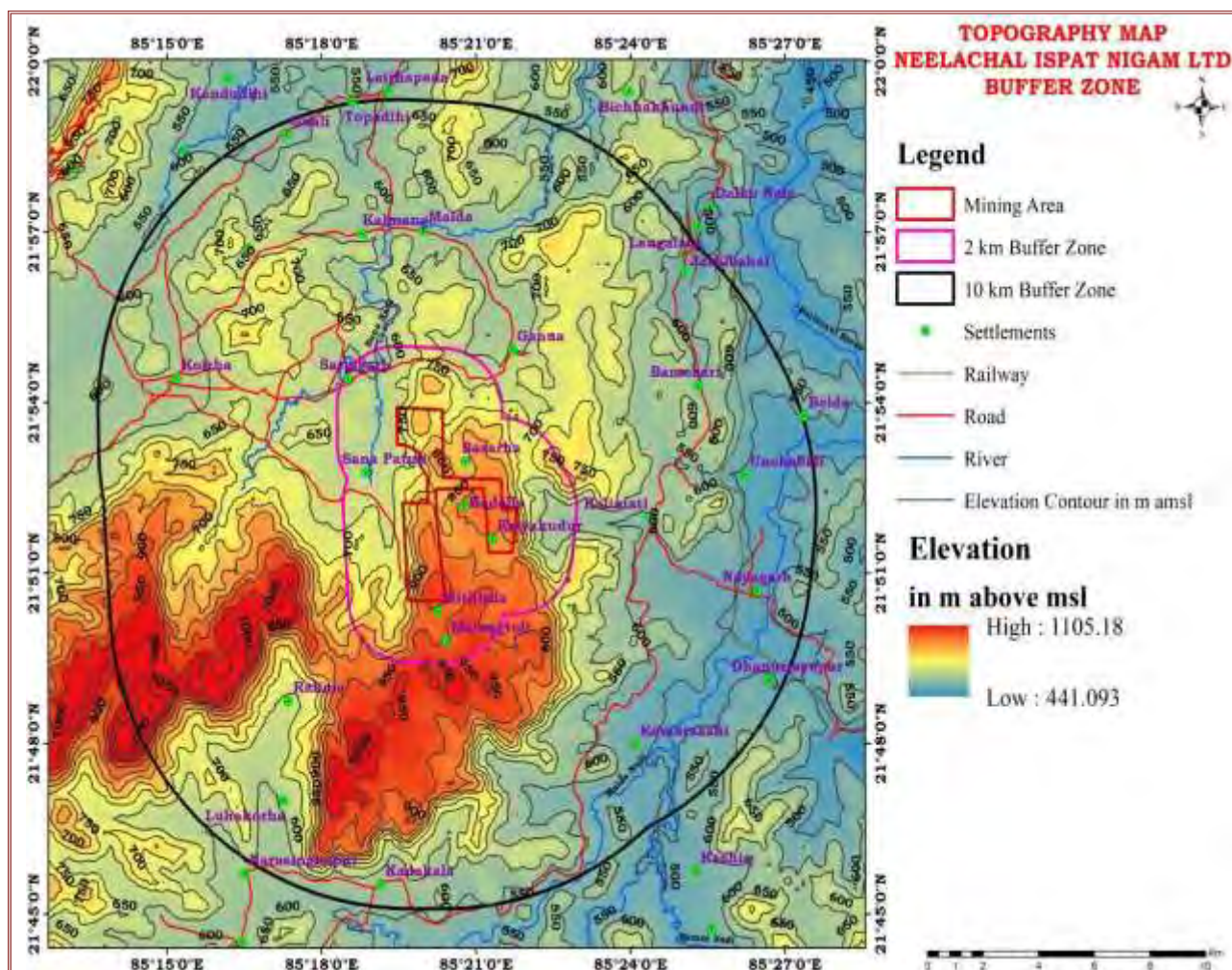
The total areal extent of the leased area of the mines is reported to be **874.29 hectares (8742900 square meters)**, out of which, **806.153 ha** is under forest land and **68.137 ha** is covered under non forest land.

FIGURE – 1: LOCATION MAP OF THE SITE



**FIGURE – 2: GOOGLE MAP SHOWING ML AREA,
CORE ZONE AND BUFFER ZONE**



FIGURE – 3: DIGITAL ELEVATION MODEL (DEM) OF STUDY AREA

(iii) Land Use and Land Use classification

The land use and land use classification map is prepared from the Bhuvan Portal of NRSA which is depicted in Figure – 4. The study area is covered mainly by forest and agricultural lands. The rural and urban built-up area is also present. Mining area is one of the main land use category in the area. The land use table with pictorial representation of different areas covered under various land use is shown in Figure – 5. It is noted that Mining is the fourth dominant land use in the study area.

FIGURE – 4: LAND USE AND LAND CLASSIFICATION MAP OF SITE

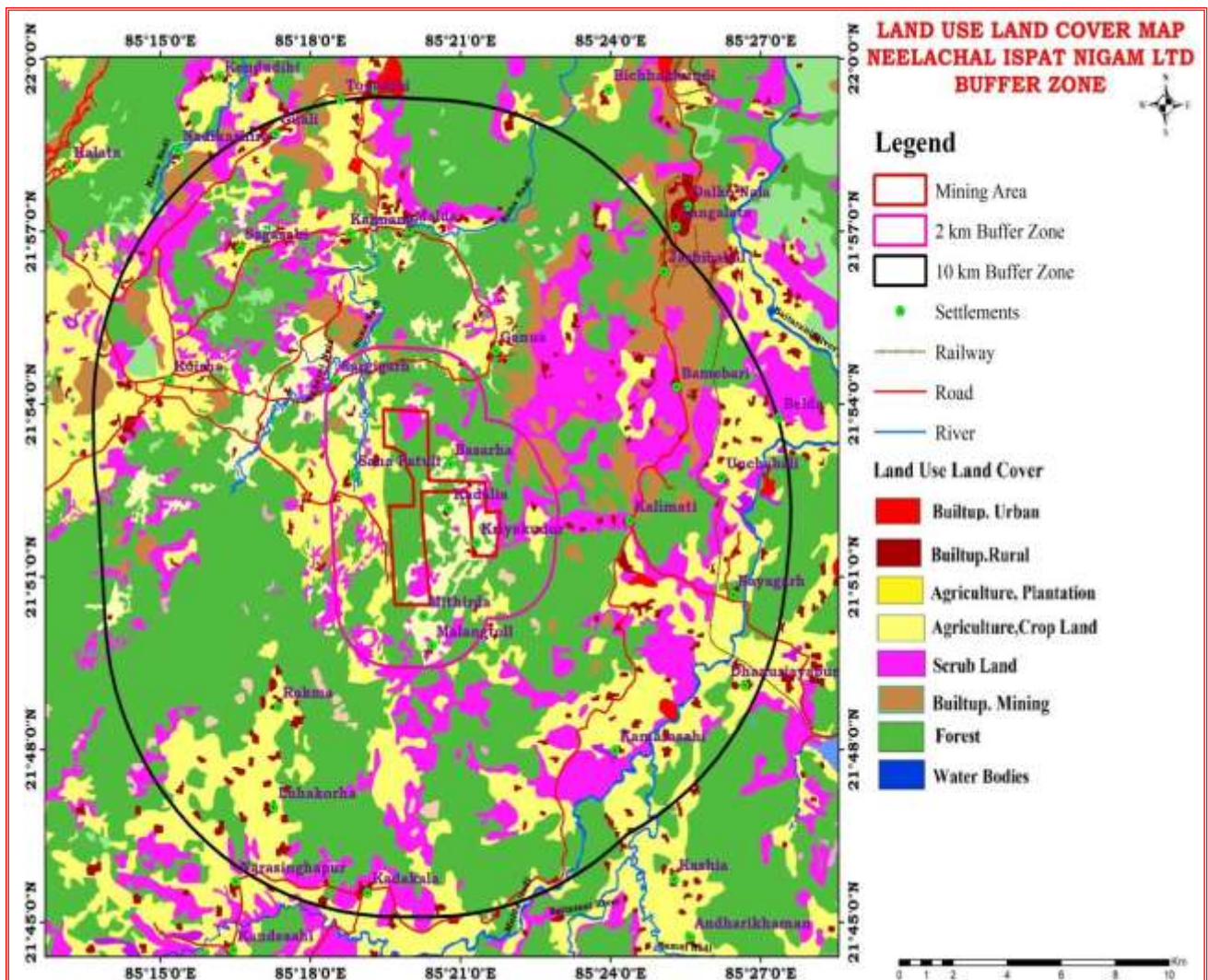
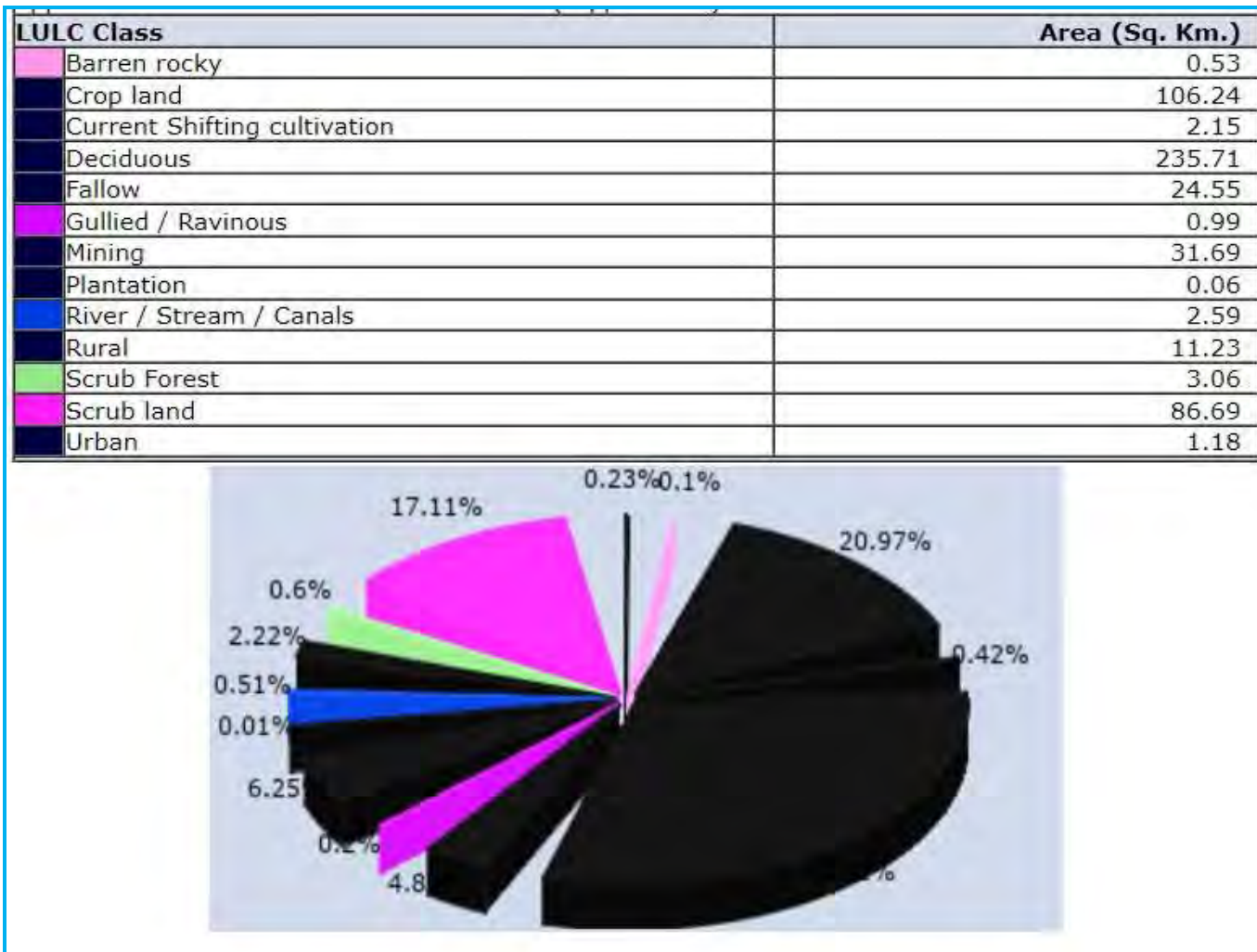


FIGURE – 5: LAND USE PATTERN OF THE STUDY AREA



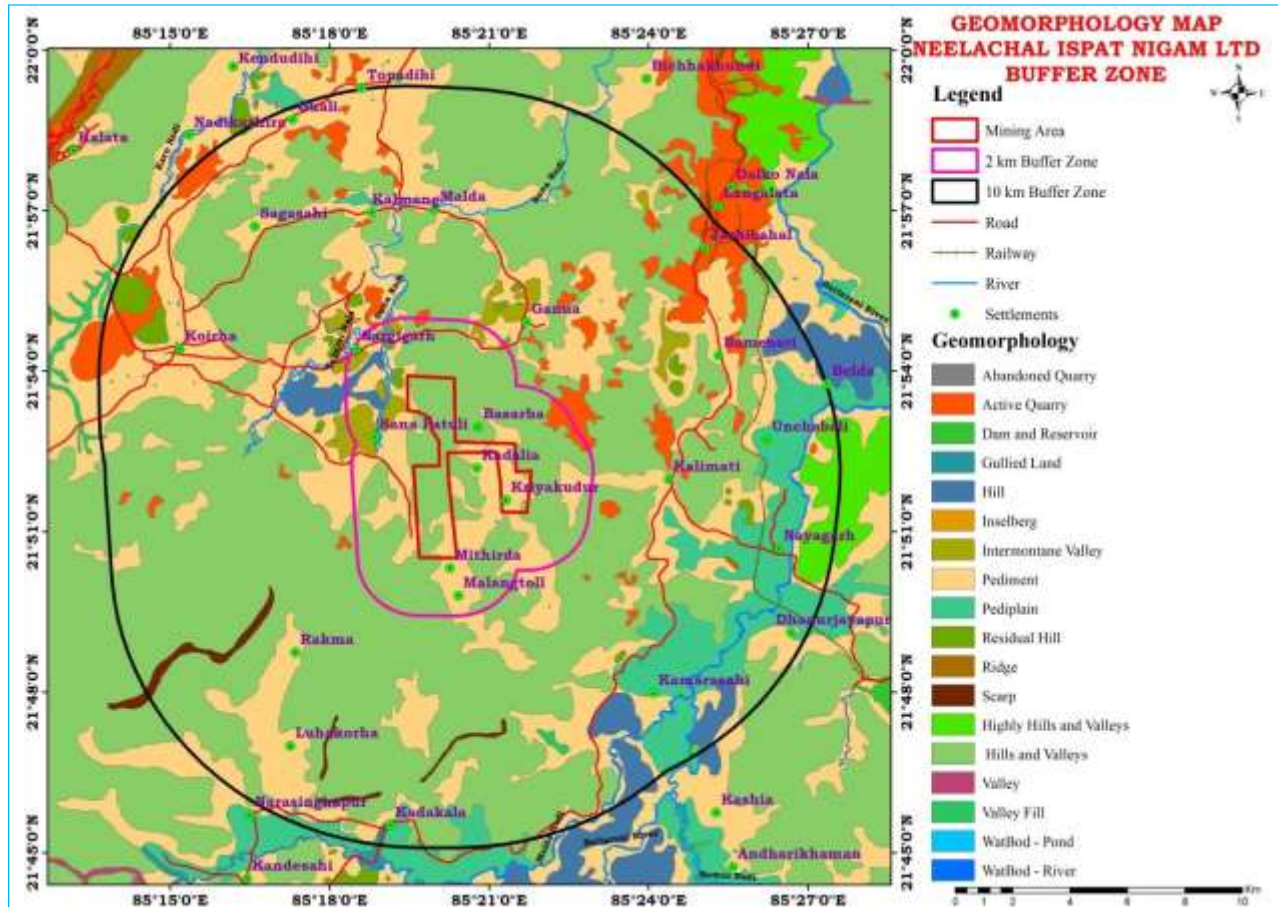
(iv) Physiography, Geomorphology and Drainage Pattern

The study site is an undulating terrain having rugged terrain features. The hydrogeological studies of the leasehold area are carried out with terrain analysis and it is noted that the physiographic features control the surface runoff. The sub surface formations and rainfall influences the drainage pattern. The presence of loose sedimentary formation gives low drainage density while hard rocks give high drainage density.

The presence of geological structures results in parallel, trellis drainage and the study area is showing dendritic drainage pattern which is indicative of poor structural features. The study site acts as a distinct runoff zone due to the morphological set up with steep gradient on all sides. The steep gradient allows major portion of the runoff water to follow natural gullies and small order streams and finally reach the downstream nallahs.

The various landforms present in the area are shown in the Geomorphological map of the area (Figure – 6). Hills, valleys, valley fills, pediments, pedi plains, inselberg, water bodies are the main natural land forms. The active and old quarry and manmade roads and built-up area are also shown in the map.

FIGURE – 6: GEOMORPHOLOGY OF THE STUDY AREA



Topography

The pattern of rainfall runoff is important to plan the site-specific rain water harvesting structures. The rainfall intensity, ground slope and elevation play an important role in the surface runoff availability and duration of flow.

The leasehold area depicts an undulated hilly topography. Altitudes of the mine site vary between RL 619.5 m to RL 941.5 m (highest) at the hill top. It is noted that there will be minimal significant adverse changes in the topography of the buffer zone as the excavation will be confined to the top of the hill. There will be a marginal decrease in the height (18 m to 24 m) of the hill. At the foot of the hill, there will not be any topographical changes. The mining activity is proposed for first five years with small change in the land use pattern and the changes in surface runoff will be very much localized.

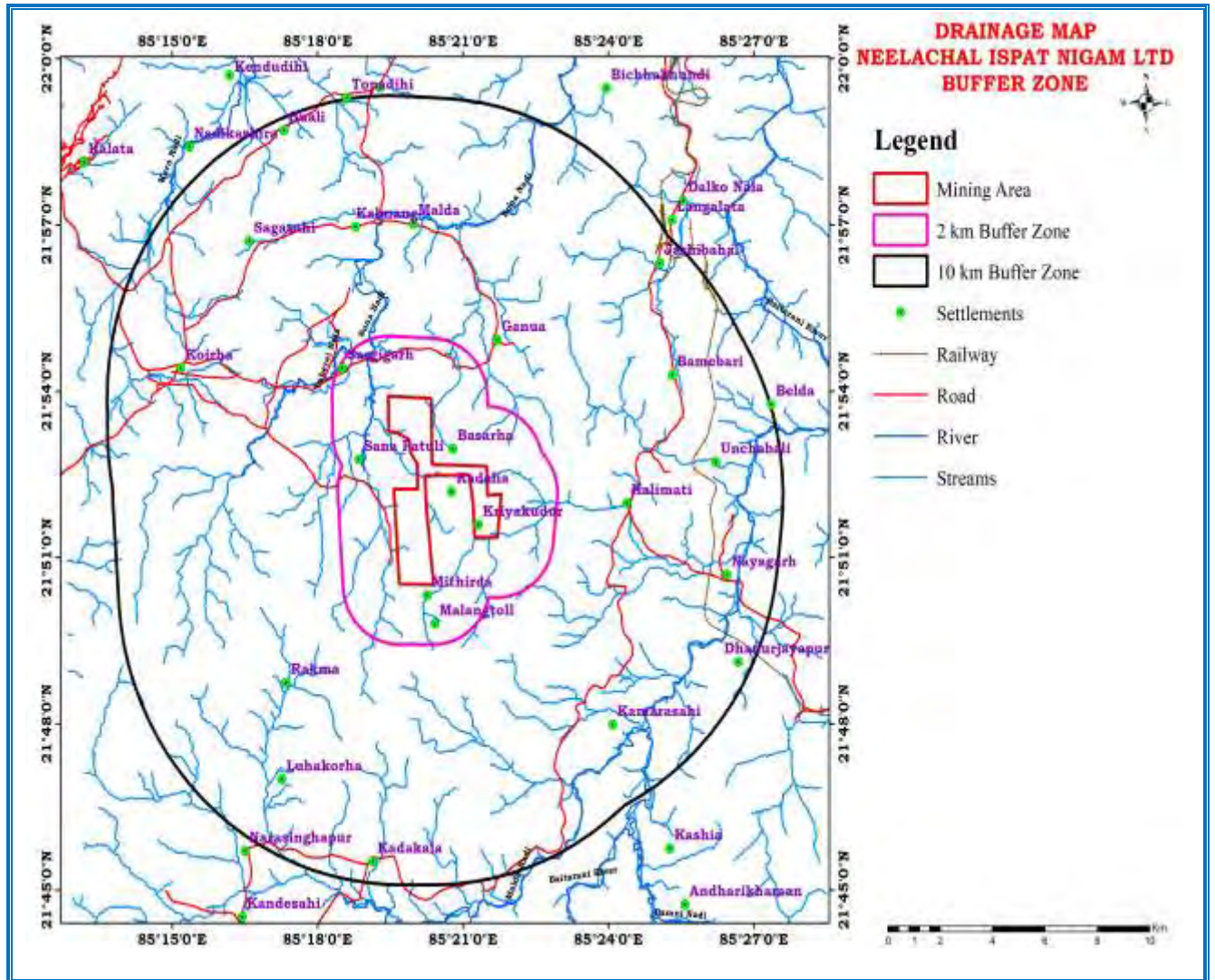
Drainage Pattern

The runoff water generated during monsoon along with prevailing drainage is considered for better planning of rainwater harvesting structures in the project area. The mine site is characterized by dendritic type of drainage system. The Mine Lease area is a high ground with the origin of number of gullies and nallahs. These gullies and nallahs reach the Suna Nadi, which flows at a distance of 1.5 km and parallel to the Western lease boundary.

Kakarpani Nallah, a perennial source, starting near village Basada, drains the Northern part of the applied ML area due North to meet Suna Nadi at Chormalda which is at a linear distance of 10 km from the starting point. Similarly, the Southern part of the ML area is drained by Archanda and Gahirajala nallahs which flow North West to meet the Suna Nadi.

Baitarani River is flowing on the Eastern side of buffer zone and Karo River is flowing on the Western side of the buffer zone. The drainage map of the 10 km buffer zone with main nallahs / river is given in Figure – 7.

FIGURE – 7: DRAINAGE MAP OF PROJECT AREA



(v) Soil

The study site is occupied by various types of soils which are formed due to the natural weathering of the diverse types of rock formations. The topsoil occurring in the study area is red coloured lateritic soil derived from the insitu weathering of Iron Ore formations and its associated rocks. The soils derive the reddish tint due to leaching of iron from the host rocks.

The upper reaches of the hillocks have light red coloured soils which are gravelly and sandy in texture, whereas deep darker varieties are found in the valleys and plains. Some areas, especially in the valley portions and lower grounds, are occupied by brown coloured clay associated with silt. Top Soil, Laterite, Red soil, alluvial soil and black soil are seen in the study area.

Gravelly soil with admixtures of Quartz pebbles and floats of Quartz and rock fragments are seen in many places. The presence of massive rock outcrops in selective pockets and variation in the thickness of weathering results in very uneven thickness of the soil cover.

(vi) Vegetation

The hilltop is covered with isolated laterite capping and is devoid of forest growth. The slopes and base of the ML area has natural vegetation, which mainly consists of Sal, Banyan, Mahua, Bel, Kendu, Char, Asan etc. with lot of shrubs and wild bushes. The plains and the open areas around the mining area are covered with shrubby vegetation.

(vii) Climate and Rainfall

The hydro-meteorological features of the area are very important to evaluate the ground water scenario and understanding the weather situation. The area experiences sub-tropical climate with abundant rainfall during monsoon months. The summers are not very hot due to the thick forest cover in the area. April and May are the hottest months while December and January are the coolest months. The summer maximum temperature ranges between 35°C and 40°C and the low temperatures are usually between 12°C to 14°C.

The area may be divided into four seasons. Hot season lasts from March to May, Period from June to September is the post monsoon season and the cold season is from December to February.

Seasons of the Study Site

Season	Months
Hot weather Period	March to May
South West Monsoon	June to September
North East Monsoon	October to December
Winter (Post Monsoon)	January to February

Details of the different parameters studied through the data recorded at the nearest IMD station, Keonjhar are given below.

Temperature: Month wise average maximum and average minimum temperatures recorded between years 1993-2014 are given in **Table – 3** below.

TABLE – 3 : MONTHLY VARIATION IN TEMPERATURE

Months	Temperature (°C)	
	Minimum	Maximum
January	11.4	26.0
February	14.3	29.0
March	17.83	33.02
April	21.02	36.04
May	23.84	36.64
June	23.36	32.49
July	23.15	30.16
August	22.75	29.68
September	22.07	29.22
October	19.94	29.87
November	15.42	27.88
December	11.8	25.7
Average	18.75	30.52

The table – 3 indicates that the minimum temperature is in December at 11.8°C with maximum of 36.64 °C in the month of May.

Relative Humidity: The monthly average relative humidity (%) recorded at Keonjhar is summarized in **Table – 4** below.

The data indicates that High relative humidity occurs between the months of June to October. The average values at 8.30 hrs and 17.30 hrs are 66% and 56%, respectively.

TABLE – 4: MONTHLY DATA OF RELATIVE HUMIDITY

Months	Relative Humidity (%)	
	Maximum	Minimum
January	66.0	53.0
February	61.0	46.0
March	49.3	26.5
April	49.7	26.7
May	55.4	34.4
June	73.8	63.9
July	80.8	75.5
August	84.2	72.8
September	76.3	72.9
October	76.8	62.0
November	68.7	47.6
December	66.0	56.0

RAINFALL

The rainfall data does not show any cyclic occurrences but shows erratic variations. The monsoon season spreads over the months from June to September. The annual total rainfall from nearby station is given in the following **Table – 5** and that of Koira station is given in **Table – 6**.

The monthly rainfall from 2016-17 to 2020-2021 from nearby station shows that the monsoon rainfall occurs from June to September and also the occurrence of summer rains in April and May months. The analysis of annual rainfall for the period from 2007-08 to 2020-21 recorded an average of 1697.32 mm. The lowest rainfall of 545 mm was recorded in 2010-11. The highest rainfall was recorded during the year 2018-19 in the order of 2451.4mm.

Table – 5: Annual Rainfall data from Nearby Station

Rainfall in mm Year 2016-17		Rainfall in mm Year 2019-20		Rainfall in mm Year 2020-21		Annual Rainfall	
Month	Total Rain	Month	Total Rain	Month	Total Rain		
April	0.60	April	48.00	Apr	172.6	2007-08	1676.10
May	188.90	May	129.5	May	219.0	2008-09	1332.20
June	203.90	June	147.8	Jun	403.4	2009-10	1000.40
July	380.60	July	422.2	Jul	324.8	2010-11	545.00
Aug	521.90	Aug	516.3	Aug	963.3	2011-12	1786.00
Sep	429.80	Sep	370.2	Sep	227.6	2012-13	1591.10
Oct	97.70	Oct	386.7	Oct	39.90	2013-14	1786.30
Nov	0.00	Nov	3.00	Nov	0.00	2014-15	1655.90
Dec	0.00	Dec	8.30	Dec	0.00	2015-16	1672.60
Jan	0.00	Jan	46.90	Jan	3.40	2016-17	1848.20
Feb	0.00	Feb	69.40	Feb	15.80	2017-18	1803.60
Mar	24.80	Mar	95.60	Mar	0.00	2018-19	2451.40
Ave.	154.02	Ave.	187.0	Ave.	197.5	2019-20	2243.90
Total Rainfall	1848.20	Total Rainfall	2244	April	2370	2020-21	2369.80
						AVG	1697.32

TABLE – 6: Rainfall at Koira Rain Gauge Station

Sl.No.	YEAR	JUN	JUL	AUG	SEPT	OCT	M.TOTAL	NOV	DEC	JAN	FEB	MAR	APR	MAY	MEAN TOTAL	ANNUAL
1	1977	156.70	360.00	446.75	157.25	0	1120.70	43.75	0.00	0.00	27.50	52.50	8.75	12.50	145.00	1265.70
2	1978	222.75	254.25	272.50	307.50	46	1103.25	0.00	27.50	0.00	26.25	0.00	23.75	2.50	80.00	1183.25
3	1979	282.00	189.00	347.00	187.00	36	1041.25	20.00	5.00	7.50	0.00	113.50	25.00	113.75	284.75	1326.00
4	1980	447.50	391.50	161.25	156.25	172	1329.00	0.00	20.00	10.00	20.00	0.00	32.50	56.40	138.90	1467.90
5	1981	155.80	195.00	201.80	166.00	19	737.60	0.00	0.00	12.80	16.00	49.60	5.00	31.00	114.40	852.00
6	1982	196.00	114.00	374.00	70.60	10	765.40	3.60	0.00	0.00	53.80	0.00	33.00	68.00	158.40	923.80
7	1983	108.80	150.60	211.00	441.50	132	1044.10	0.00	16.00	26.80	7.00	0.00	0.00	0.00	49.80	1093.90
8	1984	325.00	226.20	536.70	92.20	87	1267.70	0.00	0.00	29.00	20.00	0.00	7.00	45.00	101.00	1368.70
9	1985	127.50	351.90	492.90	223.80	208	1404.10	0.00	0.00	27.00	61.40	15.00	1.40	65.70	170.50	1574.60
10	1986	321.40	457.40	261.80	123.00	60	1223.70	80.00	40.00	10.00	16.00	7.00	27.00	69.00	249.00	1472.70
11	1987	53.00	426.00	225.50	271.00	25	1000.50	60.00	0.00	0.00	91.00	20.50	48.00	23.00	242.50	1243.00
12	1988	203.00	346.00	295.00	254.50	96	1194.50	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	1197.50
13	1989	443.00	148.00	343.00	126.00	19	1079.00	0.00	0.00	0.00	21.00	57.00	26.00	76.00	180.00	1259.00
14	1990	257.00	360.00	174.00	343.00	192	1326.00	16.00	0.00	5.00	9.00	2.00	0.00	8.00	40.00	1366.00
15	1991	163.00	538.00	504.00	155.00	117	1477.00	19.00	24.00	0.00	0.00	0.00	33.00	163.00	239.00	1716.00
16	1992	149.00	236.00	320.00	72.00	29	806.00	7.00	0.00	0.00	0.00	0.00	11.00	15.00	33.00	839.00
17	1993	325.00	315.00	231.00	334.00	81	1286.00	0.00	0.00	5.00	31.00	0.00	35.00	75.20	146.20	1432.20
18	1994	388.30	719.40	565.10	179.40	82	1934.70	7.20	0.00	100.60	11.00	4.20	9.20	178.00	310.20	2244.90
19	1995	84.00	368.20	376.00	314.40	132	1274.60	96.20	0.00	7.00	12.00	7.00	9.00	61.00	192.20	1466.80
20	1996	343.70	215.20	305.00	99.30	27	990.20	0.00	0.00	2.00	0.00	0.00	65.10	24.00	91.10	1081.30
21	1997	441.00	247.00	506.50	156.20	55	1406.20	26.00	70.00	98.00	6.50	39.50	3.00	30.00	273.00	1679.20
22	1998	145.00	55.00	109.00	94.00	85	488.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	490.00
23	1999	204.00	204.00	302.00	276.50	23	1009.50	0.00	0.00	0.00	42.00	0.00	12.00	82.00	136.00	1145.50
24	2000	185.00	425.70	245.00	305.00	36	1197.20	0.00	0.00	0.00	0.00	103.50	5.00	12.00	120.50	1317.70
25	2001	431.50	753.00	413.50	145.00	102	1845.00	2.00	0.00	24.00	0.00	15.00	43.00	186.00	270.00	2115.00
26	2002	226.00	155.00	308.00	169.50	84	942.50	0.00	0.00	0.00	17.00	0.00	10.00	0.00	27.00	969.50
27	2003	236.00	180.00	277.00	372.00	142	1207.00	0.00	10.00	0.00	0.00	0.00	0.00	23.00	33.00	1240.00
28	2004	73.00	143.00	245.30	45.00	13	519.30	0.00	0.00	24.40	4.00	9.00	0.00	41.00	78.40	597.70
29	2005	286.00	280.00	95.00	106.00	88	855.00	0.00	14.80	0.00	0.00	13.80	0.00	54.60	83.20	938.20
30	2006	93.10	453.40	355.50	123.00	9	1034.00	0.00	0.00	0.00	65.00	0.00	0.00	0.00	65.00	1099.00
31	2007	111.10	419.90	450.10	217.00	11	1209.10	24.00	0.00	7.00	0.00	2.00	2.00	5.00	40.00	1249.10
32	2008	348.20	225.53	138.03	178.00	24	913.76	0.00	0.00	0.00	0.00	0.00	0.00	84.00	84.00	997.76
33	2009	75.00	317.20	100.80	103.00	41	637.30	40.00	0.00	11.00	3.00	0.00	0.00	3.30	57.30	694.60
34	2010	95.00	134.50	159.50	111.50	18	518.80	0.00	25.50	47.00	11.00	17.00	113.50	0.00	214.00	732.80
Avg Rainfall		226.54	304.56	304.40	190.45	67.	1093.76	13.23	7.44	13.36	16.81	15.53	17.30	47.29	130.95	1224.72

CHAPTER II

GEOHYDROLOGY

(i) Geological Conditions

This iron ore deposit forms part of the Eastern limb of the famous horse-shoe shaped Iron ore synclinorium of Singhbhum – Keonjhar – Bonai belt. This Precambrian horse-shoe shaped belt is well known for its vast reserves of iron and manganese ore. The litho units of the Jamda-Koira valley form a part of the Singhbhum Craton.

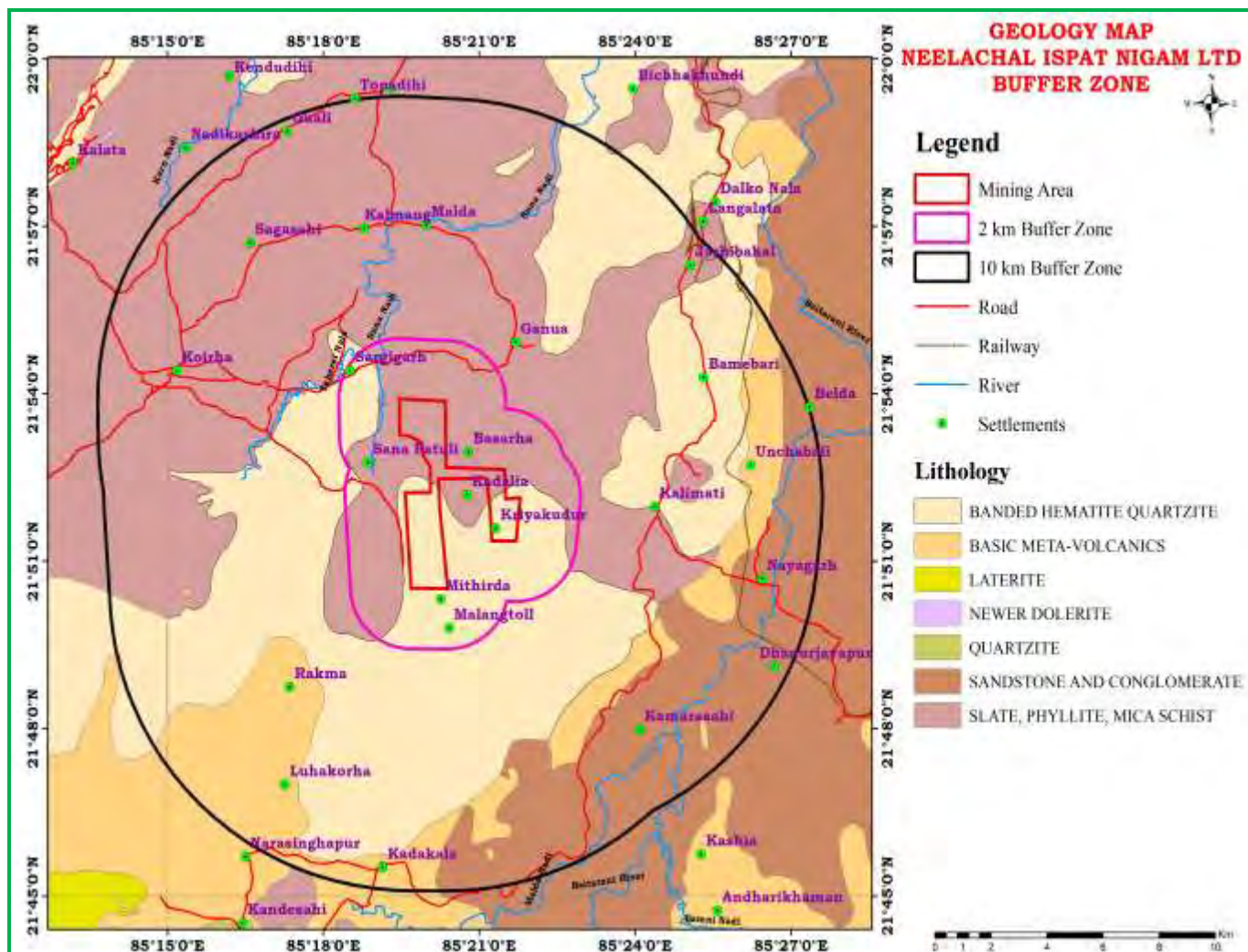
The basal unit of Jamda – Koira valley is metamorphosed sandstone, lithic wacke to arkose and volcanic tuffs altered to shale. Along the Eastern and Western margins of the basin, BIF and Iron ore i.e., hematite is common. Shale, Lavas, Volcanics, altered Pyroclastic Tuffs, impure Dolomite rock constitute the Iron Ore group. Banerjee (1974, 1977 and 1984), Sarangi and Acharya (1975) favour the basal unit of IOG as the lower shale formation which unconformably overlies the lower volcanic unit. After Chakraborty and Majumdar (1986) and Saha (1988), the generalized Stratigraphic succession of IOG in Jamda – Koira valley is presented in **Table – 7** as given below.

**TABLE – 7: REGIONAL STRATIGRAPHIC SUCCESSION
OF THE AREA**

	Alluvium
	Laterite (Mn bearing)
	Newer dolerites
~~~~~ Unconformity ~~~~~	
Iron Ore Group	Singhbhum Granite
	Epidiorites (intrusive)
	Upper tuffs and Volcanics
	Manganese Bearing shale
	Banded Iron formation (BIF) with Iron Ores
	Lower tuffs and greywackes
	Chert ankerite dolomite
	Quartzite
	Singhbhum Granite

The rock formations present in the study area is prepared from Geological Survey of India (GSI) map and given in Figure – 8. Slate, Phyllite, Mica Schist and Banded Hematite Quartzite (BHQ) are the major rock types in the ML area. There are laterite cappings in parts of the Buffer zone.

Basic Meta Volcanics, Sandstone and Conglomerates and Quartzites are also seen in the study area.

**FIGURE – 8: GEOLOGICAL MAP OF THE STUDY AREA**

The parent rock of the iron ore deposits is Banded Iron Formation (BIF), which includes BHJ, BHQ and Ferruginous Shales. The BHJ and BHQ occur as ridges forming a configuration of U open to North. The elongated horse-shoe shaped synclinorium is trending NNE – SSW and spread over an area of approximately 100 KM x 30 KM in Jamda –Koira valley synclinorium. The Western limb of the fold has been overturned.



The iron ore deposit of the Eastern limb contains + 64% Fe. The ores are hard, massive and the thickness of ore varies between 20 m and 50 m. The overburden (laterite) is absent occasionally and thin cap of laterite is observed at places.

The deposits on the Western limb of the synclinorium are invariably poor in grade (Fe content between 58 percent and 62 percent). The ores are mostly friable and laminated. The incidence of massive and hard ores is low. The thickness of the ore body is as high as 200 m. A thick profile of laterite overlies the iron ore formation. The Western limb features Kiruburu, Bolani, Kaita, Barsuan and Khandadhar group of deposits.

### **Local Geology**

The massive ore zone, which occurs at the higher levels on the North Western part of the quarry, has progressively graded into laminated / blue dust at lower levels. The laminated ores are very prominent. These are relatively softer and are fine grained with earthy look. They are also comprised of Hematite, Goethite and occasionally martitized Magnetite.

The iron ore contents are almost same as that of massive ore. Powdery ore / blue dust occur as irregular pockets at deeper levels with the laminated ore zones. These ores have been encountered in number of bore holes at various depths within the laminated ore zone. The ores are blue to dark brown in colour having iron content of 63%. Lateritic/limonitic ores occur as capping on the laminated ore horizon having Fe content less than 60% and contain both hematite and goethite.

Float ore zone scattered on the hill slopes is of massive type. Conga ore in surficial and near surficial condition occurs in a few places where boulders, gravels, pebbles of various shapes and sizes are cemented by iron solution.

## Structure

The sequence, in spite of the high degree of folding, attains only a low grade of metamorphism. The structural features are more prominent in BHJ and Iron ore than in the Shale formation due to its comparatively hard nature. The structural features are as follows:

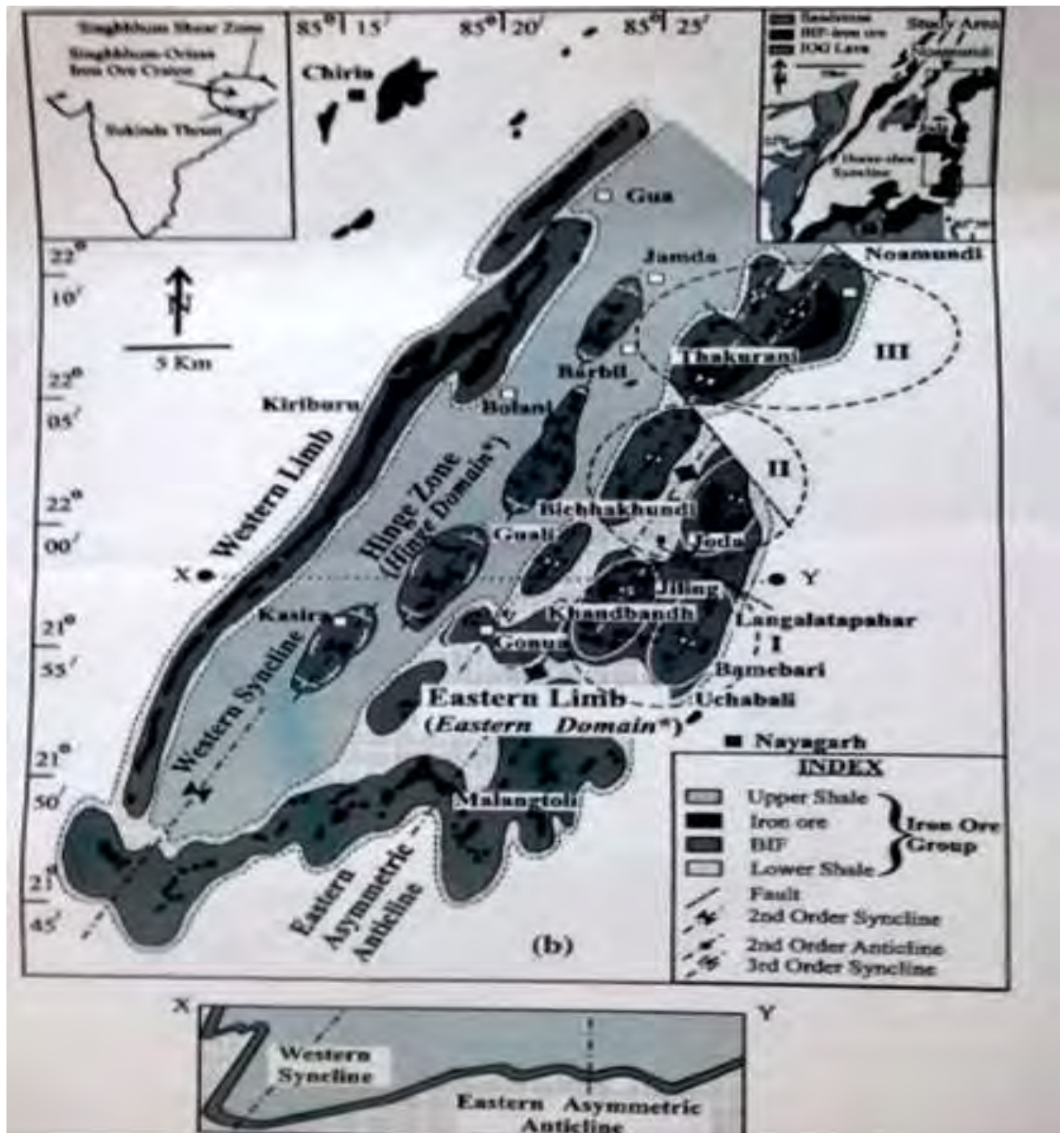
Beddings are represented by the compositional banding in Shale, BHJ and laminated in iron ore due to the rock suffering intense folding movements. The amount and direction of dip vary significantly. However, the general strike of the ore bodies is found to be  $N30^{\circ} E - S30^{\circ} W$  to  $N60^{\circ} E - S60^{\circ} W$  with a dip of  $25^{\circ}$  to  $50^{\circ}$  towards North West.

The folds in BHJ and associated ore include both symmetrical and asymmetrical folds with doubly plunging phenomena. The regional plunge is  $20^{\circ}$  to  $30^{\circ}$  in  $N25^{\circ}E$  whereas the refolded character gives another plunge direction in  $S 20^{\circ} W$  with  $25^{\circ}$  to  $40^{\circ}$  dips. Although the BIF and associated sediments have been affected by more than one generation of folding, they do not record incidence of significant metamorphism.

All the litho-units within BIF and Shale are affected by multiple sets of joints. The strike of the joints usually follows the regional plunge direction i.e.,  $N30^{\circ}W - S30^{\circ}E$  to  $N60^{\circ}W - S60^{\circ}E$ . The dip of the joints is mainly sub-vertical to vertical. Oblique joints are also marked in some exposures.

The geological map with iron ore disposition of the Singhbhum belt is given in Figure – 9.

**FIGURE – 9: IRON ORE DEPOSITION & REGIONAL GEOLOGICAL MAP**



## Hydrogeological Conditions

The widely varying water bearing properties of the different litho-units usually play an important role in the occurrence and movement of groundwater. The hydrogeological framework of the study area is mainly controlled by geological setup, rainfall distribution and degree of secondary and primary porosity of the geological formation for storage and movement of ground water. The area has undergone several phases of intense tectonic deformations for development of deep-seated intersecting fracture system. The thickness of the weathered and jointed rocks decides the total ground water storage while the openness in the fractures controls the movement of water in the sub-surface.

A major part of Sundergarh district is underlain by hard, crystalline rocks belonging to Pre-Cambrian age Iron Ore Group and Proterozoic Meta volcanics of Kolhan group.

The detailed hydrogeological survey indicates that the potential of ground water is low to moderate and depends on the thickness of weathered rocks and granular meta-sediments. The shallow aquifer, represented by the [highly weathered portion of the rocks](#), and the deeper aquifer, consisting of [fractures and joints](#), acts as water bearing formations.

Ground water primarily occurs under shallow unconfined conditions in the weathered mantle and under semi-confined conditions within the secondary porosity developed due to weathering and fracturing of the hard rock formations. The study site is mainly a runoff zone and the steep gradient allows the immediate drainage of runoff water resulting in poor recharge. Ground water in surrounding area is tapped through bore wells and handpumps.



### Iron Ore Group

In this formation, ground water occurs in weathered and fractured horizons in unconfined, semi-confined and confined conditions. Yield of the dug wells is about 3 liters per second (lps) and that of bore wells ranges from 3.0 to 7.0 lps.

### Kolhan Group

Quartzites occur mainly as bands and are resistant to weathering. These rocks have very thin weathered mantle and are generally devoid of joints and other fissile plains. These rocks have very poor potential for ground water development, except when the rocks are fractured and fissured. The yield of wells is generally less than 2 lps.

The hydrogeological properties of these formations are summarized in the following Table – 8.

**TABLE – 8: HYDROGEOLOGICAL PROPERTIES  
OF IRON ORE GROUP**

<b>Properties</b>	<b>Iron Ore Group</b>	<b>Proterozoic Volcanic</b>
Lithology	BHQ, BHJ, Shales	Lava Meta-basic
Depth of weathering (Regolith)	25 to 40 m	15 to 50 m
Transmissivity of saprolite zone (up to 20 mbgl)	Moderate to high	Low
Specific capacity	Moderate to high	Low
Transmissivity (up to 60 m bgl)	0.5 to 3.0 m ² /day	0.1 to 1.0 m ² /day
Yield (up to 60 m bgl)	18 to 200 lpm	7 to 30 lpm
Deep aquifer		
Transmissivity (up to 200 m )	11.76 to 21.56 m ² /day	0.4 to 80.66 m ² /day
Yield (up to 200 m)	3.4 to 8.6 lps	0.24 to 10 lps

**Source: NINL**

## **(ii) Demand and Supply of Water**

### **(a) Water Requirement**

The total demand of water for the mining requirements and colony area including the green belt improvement is reported to be around **550 m³ per day**.

### **(b) Source of Supply**

For construction purposes, the water drawn from the **proposed 4** bore wells will be used. After construction, the bore wells will be used to meet the drinking requirements. During operational stage, a total of 550 KL of water per day (with peak requirement 600 KLD) is required for the township, domestic and mining needs. This water will be met through the supply from Suna Nadi, which is about 2.5 km from the ML area.

In order to get sustainable local water supply, the possibility of ground water development with bore wells and Rain water harvesting to create storage cum percolation pond is also considered. Furthermore, the rain water harvesting in any project is mandatory for protection of the environment. In order to meet the statutory conditions, rain water harvesting and recharge to ground water is given priority and this report has been prepared to prepare a master plan for rain water harvesting and construction of cost effective and scientifically designed RWH structures in the project area.

### **(iii) Depth of Water Table in the Buffer Zone**

Base level well inventory and water sampling have been carried out during 2010 during the pre-monsoon period. The present hydrogeological surveys in September 2022 were mainly to assess the rain water harvesting potential. The area is devoid of any open wells and only bore wells fitted with hand pump exist in villages. As per the studies conducted by CGWB & GWS, the stage of ground water development in Koira block is only 3%. But the buffer zone development is 41.26% and there is no long-term decline of pre and post monsoon water level and the area is categorized as „safe“.

The mining is planned to be worked up to 30 m from the general surface level. Likely depth of water table is expected to be around 45 m. Thus, there is no possibility of contamination of ground water at water table.

### **(iv) Water Quality**

The historical water quality data of the buffer zone is available for the year 2010 (EIA – NINL report prepared by Vimta labs., Hyderabad). Ground water in and around the study site is found to be of good quality. The total dissolved solids and most of the chemical parameters of ground water including chlorides and sulphates are within the limits prescribed for potable water. To assess the physical and chemical properties of water in the region, water samples from 4 surface sampling locations and eight ground water locations are analyzed from various water sources around the project site.

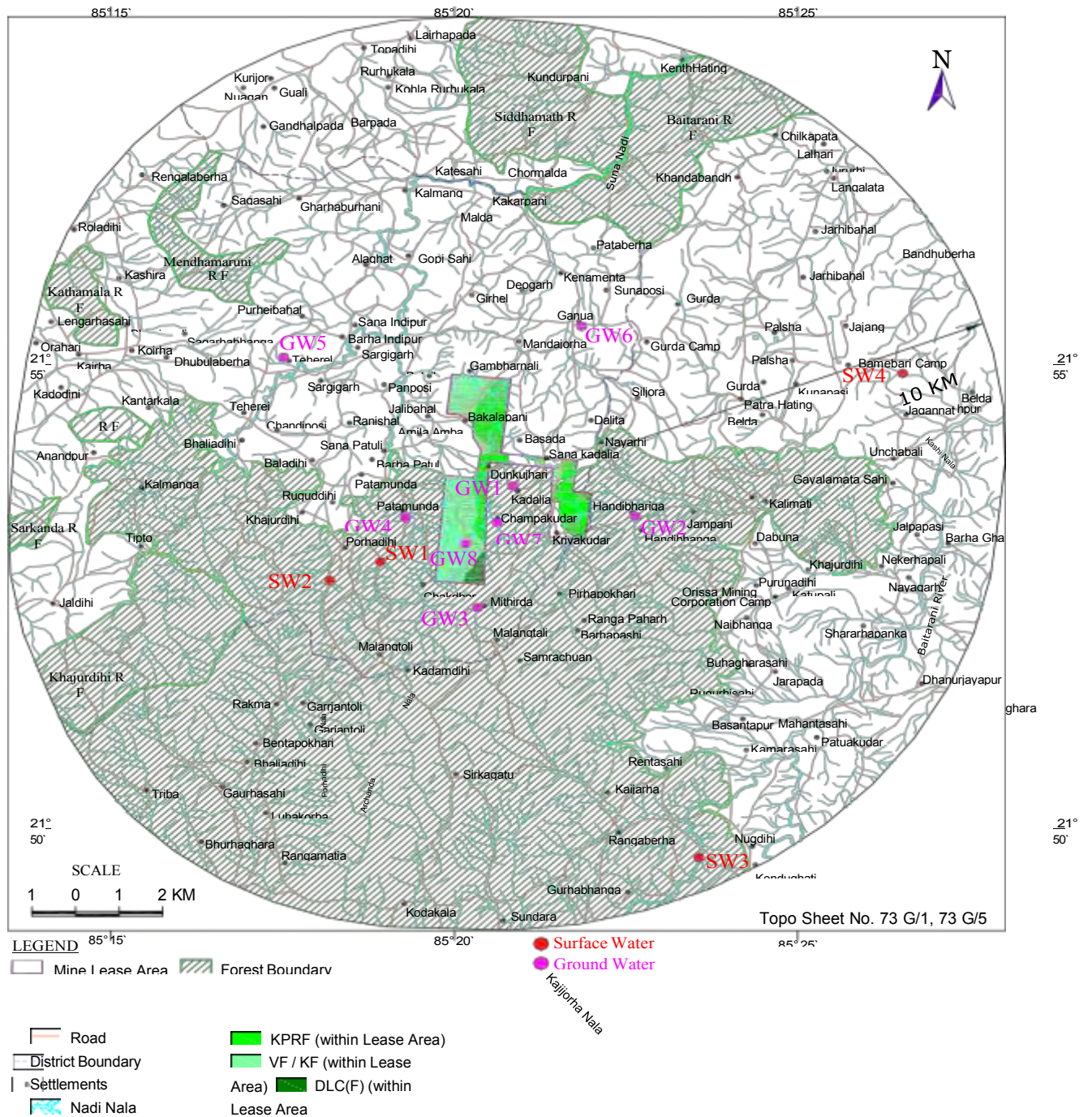


All the water quality parameters are well within the limits as per the water quality standards IS – 10500. The sampling location details are given in Table – 9 and Figure – 10. The results are given in Tables – 10 and 11. The water quality is good and suitable for drinking purposes.

**TABLE – 9: WATER SAMPLING LOCATIONS  
POST MONSOON 2010**

Code	Location	Direction	Distance (km)	Remarks
		w.r.t. Proposed Mine Leas Boundary		
Surface Water				
SW-1	Porhadihi-Archanda Nala	SW	1.0	Surface water
SW-2	Ballapahar –Pornadihi Nallah	SW	2.2	Surface water
SW-3	Nalda Nadi	SE	8.6	Surface water
SW-4	Bamebari Camp	ENE	7.2	Surface water
Ground Water				
GW-1	Kadalia village	S	0.6	Hand pump
GW-2	Handibhanga village	ESE	1.1	Hand pump
GW-3	Mithirda village	S	0.6	Hand pump
GW-4	Patmunda village	W	0.9	Hand pump
GW-5	Teherel village	NW	3.8	Hand pump
GW-6	Ganua village	NNE	2.1	Hand pump
GW-7	Champakudar village	S	1.1	Hand pump
GW-8	Mithirda block	Within ML area		Hand pump

**FIGURE – 10: WATER SAMPLING LOCATIONS**



**TABLE – 10: SURFACE WATER QUALITY**

Sl. No.	Parameter	Unit	Limits as per IS10500	SW1	SW2	SW3	SW4
1	pH	-	6.5-8.5 (NR)	7.0	7.2	7.1	6.8
2	Conductivity	µS/cm	\$	92	83	128	85
3	TDS	mg/l	500(2000)	60	54	84	56
4	DO	mg/l	\$	4.4	4.3	4.6	4.8
5	BOD	mg/l	\$	<3	<3	<3	<3
6	COD	mg/l	\$	<5	<5	<5	<5
7	Total Hardness as CaCO ₃	mg/l	300(600)	36	34	56	38
8	Total Alkalinity as CaCO ₃	mg/l	200(600)	35	30	50	30
9	Calcium as Ca	mg/l	75(200)	8.8	9.6	12.8	9.6
10	Magnesium as Mg	mg/l	30(100)	3.4	2.4	5.8	3.4
11	Chlorides as Cl	mg/l	250(1000)	3.2	2.5	4.5	3.5
12	Residual Free Chlorine	mg/l	0.2 Min	<0.2	<0.2	<0.2	<0.2
13	Phosphates as PO ₄	mg/l	\$	0.02	0.01	0.04	0.08
14	Sulphates as SO ₄	mg/l	200(400)	3.6	5.5	5.2	3.4
15	Fluorides as F	mg/l	1.0(1.5)	0.3	0.2	0.3	0.1
16	Nitrates as NO ₃	mg/l	45(NR)	0.9	1.2	0.8	3.4
17	Sodium as Na	mg/l	\$	2.6	2.4	2.8	1.6
18	Potassium as K	mg/l	\$	0.2	0.8	0.6	0.6
19	Total Boron as B	mg/l	1	0.13	0.10	0.08	0.16
20	Cyanides	mg/l	0.05(NR)	<0.0	<0.02	<0.02	<0.02
21	Phenolic compounds	mg/l	0.001(0.002)	<0.01	<0.001	<0.001	<0.001
22	Oil and grease	mg/l	0.01(0.03)	<1.0	<1.0	<1.0	<1.0
23	Cadmium as Cd	mg/l	0.01(NR)	<0.0	<0.01	<0.01	<0.01
24	Arsenic as As	mg/l	0.01(NR)	<0.0	<0.01	<0.01	<0.01
25	Copper as Cu	mg/l	0.05(1.5)	0.01	<0.01	<0.01	<0.01
26	Lead as Pb	mg/l	0.05(NR)	<0.0	<0.01	<0.01	<0.01
27	Iron as Fe	mg/l	0.3(1.0)	0.07	0.12	0.06	0.24
28	Chromium as Cr ^{VI}	mg/l	0.05(NR)	<0.0	<0.05	<0.05	<0.05
29	Selenium as Se	mg/l	0.01(NR)	<0.0	<0.01	<0.01	<0.01
30	Zinc as Zn	mg/l	5(15)	0.16	0.12	0.58	0.63
31	Aluminium as Al	mg/l	0.03(0.2)	0.10	0.06	0.12	0.08
32	Mercury as Hg	mg/l	0.001(NR)	<0.01	<0.001	<0.001	<0.001
33	SAR	mg/l	-	0.19	0.18	0.16	0.11
34	Insecticides	mg/l	Absent	Absent	Absent	Absent	Absent
35	Anionic detergents as MBAS	mg/l	1	<0.2	<0.2	<0.2	<0.2
36	Total Coliforms	MPN/100 ml	10	2	3	5	2

**TABLE – 11: GROUND WATER QUALITY POST MONSOON SEASON 2010**

Sr. No	Parameter	Unit	Limits as per IS10500	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8
1	pH	-	6.5-8.5 (NR)	6.8	7.2	7.3	7.1	7.2	7.1	7.0	7.0
2	Colour	Hazen	5(25)	2	1	2	2	1	3	2	2
3	Taste	-	Agreeable	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag
4	Odor	-	UO	UO	UO	UO	UO	UO	UO	UO	UO
5	Conductivity	μS/cm	\$	136	164	192	203	175	212	194	233
6	TDS	mg/l	500(2000)	92	112	132	138	114	146	132	152
7	Turbidity	NTU	5(10)	2	1	1	2	2	1	2	1
8	Total Hardness as CaCO ₃	mg/l	300(600)	60	72	84	92	80	98	86	100
9	Total Alkalinity	mg/l	200(600)	50	60	70	80	70	80	70	80
10	Calcium as Ca	mg/l	75(200)	16.8	16.0	18.4	20.0	16.8	20.8	17.6	21.6
11	Magnesium as Mg	mg/l	30(100)	4.4	7.8	9.2	10.2	9.2	11.2	10.2	11.2
12	Residual Chlorine	mg/l	0.2 Min	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
13	Boron	mg/l	1	0.22	0.16	0.28	0.20	0.18	0.18	0.14	0.16
14	Chlorides as Cl	mg/l	250(1000)	7.5	8.7	8.5	10.2	7.6	13.5	14.2	16.5
15	Sulphates as SO ₄	mg/l	200(400)	4.5	5.8	3.6	4.2	3.5	4.5	3.6	6.5
16	Fluorides as F	mg/l	1.0(1.5)	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1
17	Nitrates as NO ₃	mg/l	45(NR)	1.4	1.2	11.2	4.3	3.2	2.6	1.4	3.2
18	Sodium as Na	mg/l	\$	3.2	3.8	4.4	3.6	2.6	3.2	4.2	4.6
19	Potassium as K	mg/l	\$	1.2	1.0	0.8	1.2	0.8	1.2	0.6	1.4
20	Phenolic Compounds	mg/l	0.001(0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
21	Cyanides	mg/l	0.05(NR)	<0.001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
22	Anionic Detergents	mg/l	0.2(0.1)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
23	Mineral Oil	mg/l	0.01(0.03)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
24	Cadmium as Cd	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Arsenic as As	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Copper as Cu	mg/l	0.05(1.5)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01



	<b>Parameter</b>	<b>Unit</b>	<b>Limits as per IS10500</b>	<b>GW1</b>	<b>GW2</b>	<b>GW3</b>	<b>GW4</b>	<b>GW5</b>	<b>GW6</b>	<b>GW7</b>	<b>GW8</b>
27	Lead as Pb	mg/l	0.05(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Manganese as Mn	mg/l	0.1(0.3)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
29	Iron as Fe	mg/l	0.3(1.0)	0.10	0.04	0.05	0.01	0.03	0.02	0.01	0.02
30	Chromium as Cr+6	mg/l	0.05(NR)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
31	Selenium as Se	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Zinc as Zn	mg/l	5(15)	0.38	0.52	0.01	0.12	0.08	0.01	0.02	0.01
33	Aluminium as Al	mg/l	0.03(0.2)	0.06	0.05	0.12	0.08	0.06	0.12	0.10	0.08
34	Mercury as Hg	mg/l	0.001(NR)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
35	Pesticides	mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
36	E.Coli	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
37	Total Coliforms	MPN/10 ml	10	<2	<2	<2	<2	<2	<2	<2	<2

## **(v) Water Quality Management**

As per the project planning, about 96 m³/day of wastewater will be generated from the township which will be routed to STP and will be reused for greenbelt development purposes. The measures to be taken for water quality management are given below:

- Working benches will be kept free from loose overburden soil/waste material
- Garland drains around the mine will be constructed to arrest silt from the water flowing out of mining area
- Periodical clearing of silt accumulation in drains
- Monitoring of water in the garland drains
- Direct precipitation of rain water in the mine during the rainy season will be channelized to the garland drains via settling tanks. The same will be used for horticulture after desilting.
- Check dams will be constructed around the dumps to prevent washing off loose sediments.

### **(vi) Water Divining with Copper Wire**

Study of the ground water flow direction and identifying the ground water flow lines is very essential and significant to demarcate the potential zones of ground water occurrence. Besides, the information is very much useful for planning the location of recharge zones and design of rain water harvesting structures in order to augment and facilitate easy recharge of the aquifer system in totality.

Conventional Water Diving survey with Copper Wire (Water Dowsing) was carried out in all the 3 blocks and the outside catchment area to identify the ground water flow directions. Based on the water divining survey, **ground water flow lines** have been traced at a few potential locations. The ground water always tends to move along these flow lines and follows the regional topography.

**Photo – 1: Tracing of Ground Water Flow Line at Mithirda Block**



**Photos 2 A & 2 B: Tracing of Ground Water Flow Lines  
At Kriyakudar and Basada Blocks**





## **(vii) Geophysical Investigations**

Application of Geophysics in selection of sites for artificial recharge is additional tool for better site selection and design of structure. As far as artificial recharge is concerned, the main considerations are the availability of larger infiltration surface to get enough water to the aquifer through the vadose zone. The recharge water flows through the aquifer, building a ground water mound and therefore it requires a sufficient permeable surface soil and suitable vadose zone.

Role of geophysics has been mostly helpful in assessing the hidden subsurface hydro geological conditions economically. It can model the stratification and spatial variability of hydraulic conductivity for the characterization of zone and area suitable for artificial recharge. It is helpful to locate negative or protective horizontal layer of low hydraulic conductivity in unsaturated and saturated zones.

### **Electrical Resistivity Survey**

The electrical resistivity or specific resistance of a medium is the resistance offered by a unit cube of it, when a unit current passes normal to the surface of the cross-sectional Area „A“. It is given by Ohm's law:

$$\rho = RA/L$$

where

$\rho$  = Resistivity

R = Resistance offered by the medium of length L A = cross-sectional area

In Schlumberger arrangement of electrodes method, the electrical resistance determined by applying an electric current (I) to the ground through a pair of current electrodes A and B and the potential difference ( $\Delta v$ ) created in the medium between another pair of potential electrodes M and N is measured. The resistivity of the formation is given by:

$$\rho = K \frac{\Delta v}{I}$$

K is termed the geometric factor of the electrode arrangement, and is computed as

$$K = \frac{(AB/2)^2 - (MN/2)^2}{MN} \times \pi$$

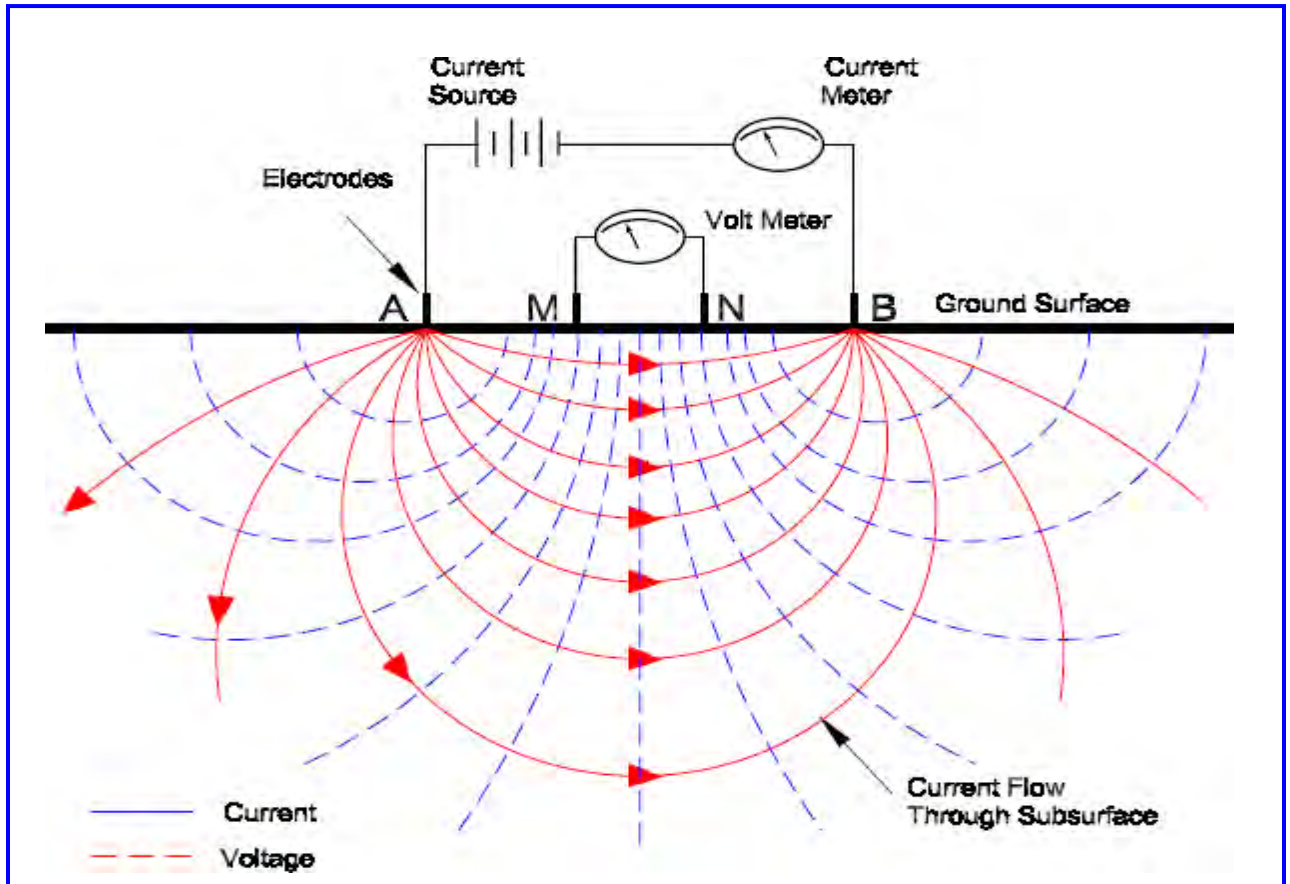
Where AB and MN are distances between the designated electrodes.

The apparent resistivity ( $\rho_a$ ) is given by

$$\rho_a = R \times K$$

where  $R = V/I$  therefore „V“ is the potential difference created between the pair of potential electrodes P1 and P2 and „I“ is the current sent into the ground through the current electrodes C1 and C2.

**Figure – 11: Schematic View of Electrode Array in Schlumberger Method**

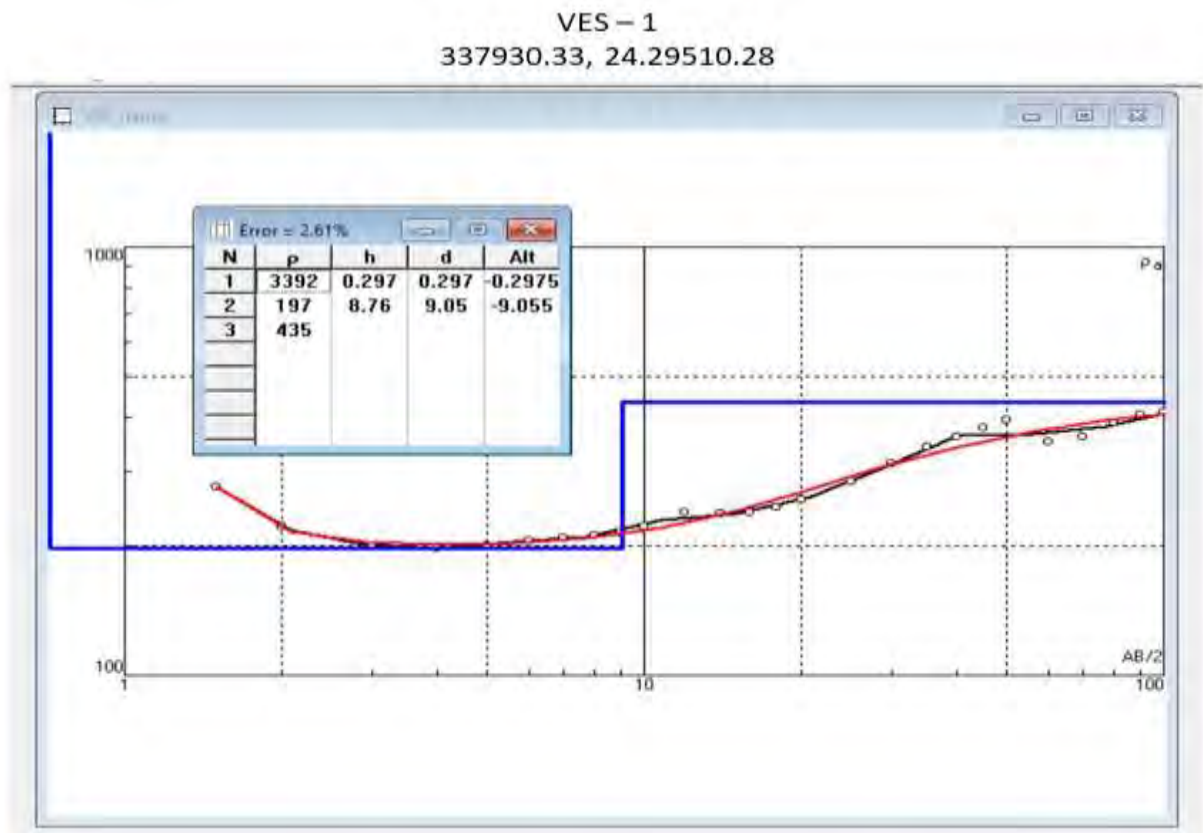


The consultants have carried out number of hydrogeological and geophysical surveys in the study area over years and the information on sub surface geology is important to understand the ground water potential and also the suitability of the site for specific rain water harvesting structures. The information on the geoelectrical characteristics of the study area is given below.

## Vertical Electrical Sounding

Vertical Electrical Sounding (VES) using digital resistivity meter is carried out by using Schlumberger configuration to know the sub surface geology in detail. The Vertical Electrical Sounding was carried out in the open ground and Forest area. The data is interpreted by using IPI2WIN software and multi layers are identified with top low resistivity soil zone followed by moderate resistivity layer of weathered and jointed rock and bottom high resistivity massive rock. The apparent resistivity, thickness of the layer, depth to layer and the depth from ground surface is shown as table within **Figures –11 &12.**

**Figure – 12: Resistivity Curve at VES – 1**

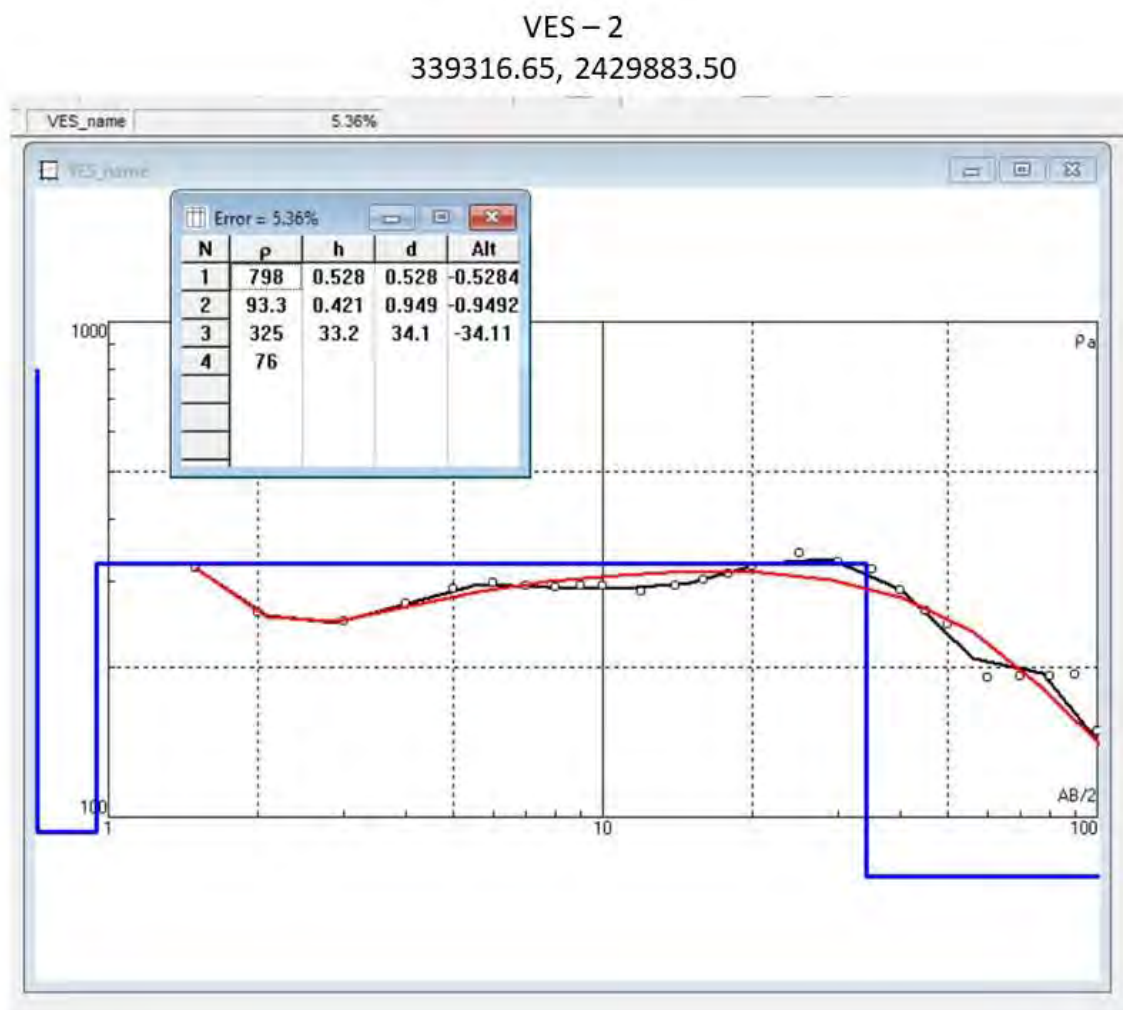




## Inferred Lithology

Depth in m	Lithology
0 m – 0.3 m	Top Soil with Resistivity value of 3392 Ohm.m
0.3 m – 9.05 m	Weathered and fractured rocks with Resistivity value of 197 Ohm.m
Above 9.05 m	Jointed rock with Resistivity of 435 Ohm.m

**Figure – 13: Resistivity Curve at VES-2**



## Inferred Lithology

Depth in m	Lithology
0 m – 0.6 m	Top Soil with Resistivity value of 798 Ohm.m
0.6 m – 0.95 m	Weathered rocks with Resistivity value of 93.3 Ohm.m
0.95 - 34.1	Jointed and fractured rock with Resistivity of 325 Ohm.m
Above 34.1 m	Fractured rock with Resistivity of 76 Ohm.m

The available geophysical survey data is indicative of variable thickness of weathered rocks in the area which is site specific and the massive rocks with limited fractures is suitable for the construction of percolation ponds.

## CHAPTER III

### WATER HARVESTING POTENTIAL

#### QUANTITY OF WATER THAT COULD BE GENERATED IN THE PREMISES

#### FORMULA

$$\text{Area} \times \text{Runoff Coefficient} \times \text{Annual Rainfall in m}$$

**Average rainfall** = 1697.32 mm

**Project Area:** 874.29 ha = 8742900 m²

The CGWA recommended run off co-efficient for various land use type is given below;

Type of Area	Runoff Co-efficient
Roof Area	0.85
Paved and Concrete Area	0.65
Open Area	0.2
Green belt Area	0.15

The study area is mostly covered by open area with vegetation and other land use type is very less.

#### Runoff Water Generated from the study site per annum

$$= 8742900 \text{ m}^2 \times 0.20 \times 1.697 \text{ m}$$

$$= 2967899.8 \text{ m}^3 \text{ per year or } 8131.2 \text{ m}^3 \text{ per day}$$

**The Mine lease area is located in high ground and is mainly a runoff zone. Hence, due to the prevailing ground conditions, the runoff water generated during monsoon will be much more than the above quantity. Furthermore, the cross-boundary flow will be also significant at many places and the flow direction with respect to the project area is important.**

The storage place available within the active mine area is not considered on account of mine safety and practical difficulties in sustaining the storage pond. The recharge to ground water is feasible at selective places. In order to get a proper idea of the rain water harvesting methods suitable for the study area, the guide lines and manuals prepared by Central Ground Water Board (CGWB) is referred.



## **CHAPTER V**

### **ARTIFICIAL RECHARGE**

The demand of water for the community and industries increases day by day, resulting in extraction of more and more ground water. It is observed that the extraction is in far excess of the net average recharge from natural resources. Hence, it has become an imperative necessity to artificially recharge the drying aquifers to balance the output.

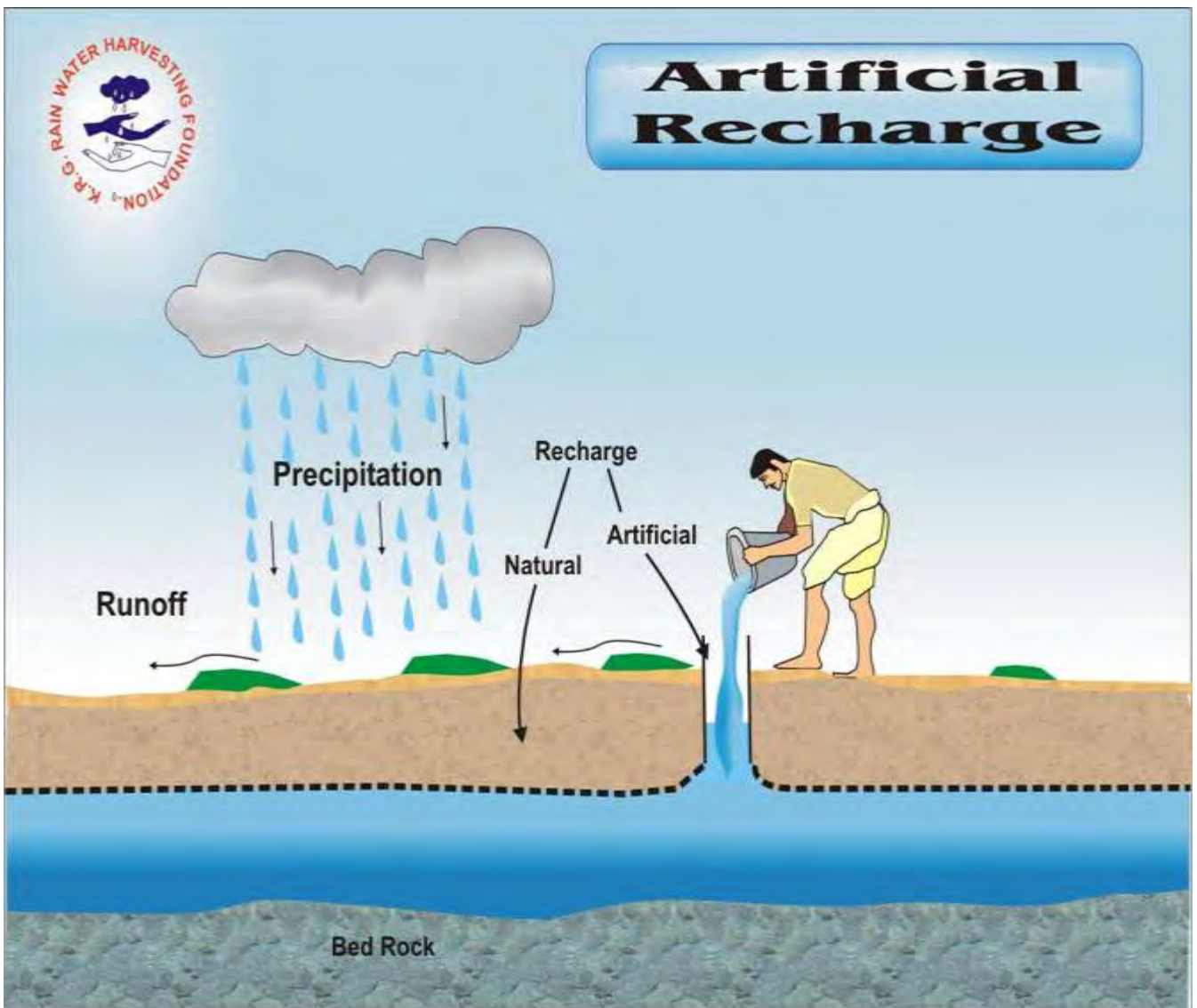
“Artificial recharge” may be defined as the practice of increasing by artificial means, the amount of water that enters the ground water reservoir. This is accomplished by unique systems and techniques, depending on the site specifications.

The natural process of recharging the aquifers is accelerated through percolation of stored or flowing surface water, which otherwise does not percolate into the aquifers. Artificial recharge aims at augmenting the natural replenishment of ground water storage by some method of construction, spreading of water or by artificially changing natural conditions.

#### **Concept of Recharge**

Flow below the land surface takes place due to the process of infiltration. The soil will not be completely saturated with water unless water supply is maintained for prolonged periods. If water is applied only intermittently, there may be no recharge during the first infiltration or even between two subsequent infiltrations. The evolution of water in the soil during the period between two instances of infiltration is referred to as redistribution.

**Figure – 14: Image Showing the Increase in Water Table Due to Recharge**



The hydraulic effects generated by artificial recharge are basically of two types, viz. **Piezometric effect in confined aquifers and volumetric effect in unconfined aquifers.**

The **Piezometric effect** results in a rise of the Piezometric surface, the magnitude of which depends on the geologic and hydraulic boundaries of the aquifer being recharged and the type, location, yield and duration of the recharge mechanism. It is also related to the ratio of Transmissivity (T) of the aquifer and the replenishment coefficient (C), which is equal to the storage coefficient. The recharged water moves in a sliding effect, with a speed related to ground water flow.

The **volumetric effect** is related to the specific yield, replenishment coefficient, Transmissivity and the geologic and hydraulic boundaries of the aquifer. This result in a spreading-out effect with a speed related to the recharge flow.

### **Significant Components of Artificial Recharge Structures**

In order to implement the artificial recharge scheme in scientific and cost-effective way, the following major components are to be understood.

- Assessment of source water
- Planning of recharge structures
- Finalization of specific techniques and designs
- Monitoring and impact assessment
- Financial and economic evaluation
- Operation and maintenance

## Source Water

The source water available for artificial recharge could be of the following types:

- i) *In situ* precipitation
- ii) Nearby stream / aquifer system
- iii) Surface water (canal) supplies located within the watershed
- iv) Surface water supplies through trans-basin water transfer
- v) Treated industrial wastewaters
- vi) Any other specific sources (s)

The availability of water for artificial recharge from all these sources may vary considerably from place to place. The study area is having insitu precipitation and run off water from leased area and adjoining catchment areas for artificial recharge.

The following information may be required for a realistic assessment of the source water available for recharge.

- i) The quantum of non-committed water available for recharge
- ii) Time for which the source water will be available
- iii) Quality of source water and the pre-treatment required.
- iv) Conveyance system required to bring the water to the proposed recharge site.

Based on the field observations and secondary data collected from various agencies, it is found that the rainfall is the main source of recharge. The quality of rain water will be suitable for direct storage and recharge.



## **Planning of Artificial Recharge Schemes**

Detailed consideration of the following aspects is made for evolving artificial recharge scheme.

- Establishment of ground facts, which includes
- Need for Artificial Recharge
- Estimation of sub-surface storage capacity of the aquifers and quantification of water required for recharge
- Prioritization of areas for artificial recharge
- Source water availability
- Assessment of source water
- Source water quality
- Suitability of the area for recharge in terms of climate, topography, soil and land use characteristics and hydrogeologic set-up
- Appraisal of economic viability
- Finalization of rain water harvesting Plan.

## **Artificial Recharge Techniques and Designs**

The selection of a suitable technique for artificial recharge of ground water depends on various factors. CGWB manual has indicated the following designs:

- Quantum of non-committed surface run-off available.
- Rainfall pattern
- Land use and vegetation
- Topography and terrain profile
- Soil type and soil depth
- Thickness of weathered / granular zones
- Hydrological and hydrogeological characteristics
- Socio-economic conditions and infrastructural facilities available
- Environmental and ecological impacts of artificial recharge scheme proposed.

## **Artificial Recharge Techniques**

Techniques used for artificial recharge to ground water broadly fall under the following categories

### **(I) Direct Methods**

#### **A) Surface Spreading Techniques**

- a) Flooding
- b) Ditch and Furrows
- c) Recharge Basins
- d) Runoff Conservation Structures
- i) Bench Terracing
- ii) Contour Bunds and Contour Trenches
- iii) Gully Plugs, *Nallah* Bunds, Check Dams
- iv) Percolation Ponds
- e) Stream Modification / Augmentation

#### **B) Sub-surface Techniques**

- a) Injection Wells (Recharge Wells)
- b) Gravity Head Recharge Wells
- c) Recharge Pits and Shafts

## **(II) Indirect Methods**

- A) Induced Recharge from Surface Water Sources;
- B) Aquifer Modification
  - i) Bore Blasting.
  - ii) Hydro-fracturing.

### **Recharge Options at the Study Site**

The total rainfall falling over the study site and its catchment areas can be effectively harvested and stored in the storage cum percolation ponds which will increase the ground water table conditions and improve the ground water status in terms of both quantity and quality. This will also satisfy the norms given by Ministry of Environment and Forests and Climate Change (MoEF & CC) for Rainwater Harvesting.



## **CHAPTER VI**

### **RECOMMENDATIONS**

#### **Observations**

A brief summary on the outcome of the present studies carried out will be purposeful and necessary for planning the rainwater harvesting scheme.

- The hydrogeological set up of NINL Iron Mines indicates that the potential of ground water is poor to moderate.
- The study site is represented by an undulating terrain with hillocks and dissected valleys and characterized by dentritic type of drainage pattern.
- Major portion of the runoff water from the study site flows through the waterways and gullies towards the downstream nallahs without much contribution to the aquifer system of the study site.
- Favourable locations for recharge have been identified at a few selective locations within the lease area with the study of google maps and surface plan, conventional water divining with copper wire, electrical resistivity surveys etc.
- These hydrogeologically potential open areas can be utilized for impounding the surplus rainwater in percolation ponds and other site-specific rainwater harvesting structures.
- The continuous impounding of rainwater in the artificial recharge structures will gradually augment the ground water potential and check the decline in water level with time. This will also improve the water quality in long run.

- The calculation of rainwater harvesting potential indicates that app. **2967899.8 m³ of runoff water** is generated per annum (Refer Page 49 for Calculations).
- Conventional Water Divining with Copper Wire (Dowsing Survey) has indicated that a few potential ground water flow lines at selective locations.
- The best options available for the study site are ground water recharge and surface water storage. Ground water recharge is controlled by the sub soil strata characteristics and water table conditions.
- The recharge to ground water may certainly protect the aquifer from lowering water levels.

The objective of the present study is to find out the feasibility of developing dependable domestic ground water sources and surface water sources and reduce the increased dependence on river sources. Therefore, the Management has given a serious thought to adopt various measures so that the precious rainwater can be effectively harnessed in rainy days and stored for its use in entire monsoon and non-monsoon seasons. The general EC conditions like providing garland drains, settling ponds and check dams to arrest the suspended solids flow towards the downstream from mining area is also considered and recommended at appropriate locations.

## **Surface Plan of the project area**

In order to understand the terrain conditions in and around the project area, the ground elevation contour map is studied. There are 3 Blocks within the leasehold area of NINL mines, namely,

- Mithirda Block
- Basada Block
- Kriyakudar Block

The surface plan of the project area with ground contours is shown in Figure – 15 and detailed terrain information of the project area is downloaded from Survey of India (SOI) topo sheet and given in Figure – 16.

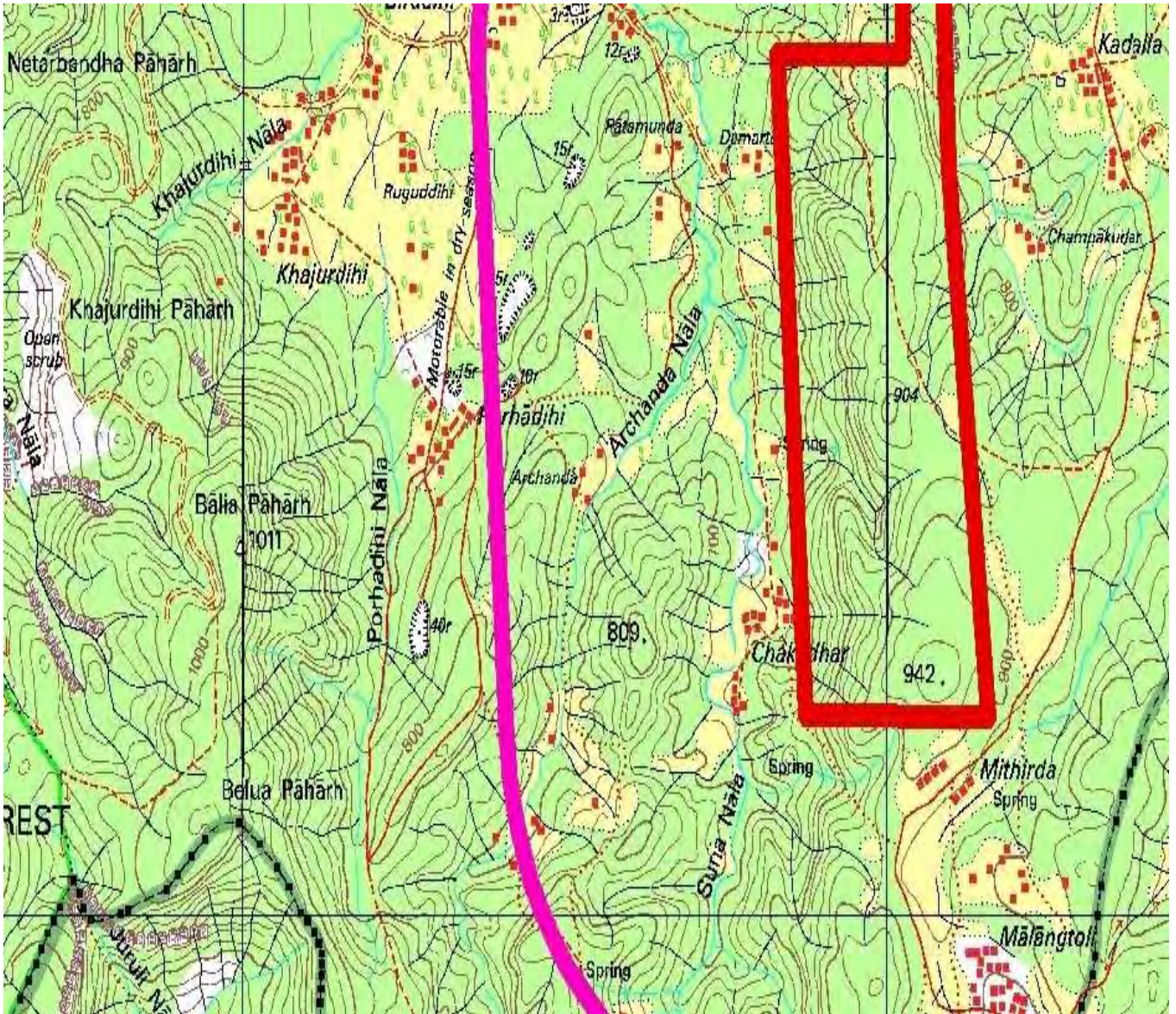








**FIGURE – 17: MITHIRDA BLOCK TOPOGRAPHY**



## **RECOMMENDATIONS FOR MITHIRDA BLOCK**

### **Mithirda Block**

It is observed that the proposed mining area of Mithirda block is having a North – South trending surface water divide with the ground slope mainly towards the Western side. The hillock with a peak of 942 RL is located on the South Eastern part of the Mithirda block. The terrain analysis and study of contour map indicates that the movement of runoff water to any centralized location is absent. In order to get more information on the local mini catchment and identification of suitable sites for rain water harvesting, the contour levels, mining plan and mini catchment area are compiled and discussed below.

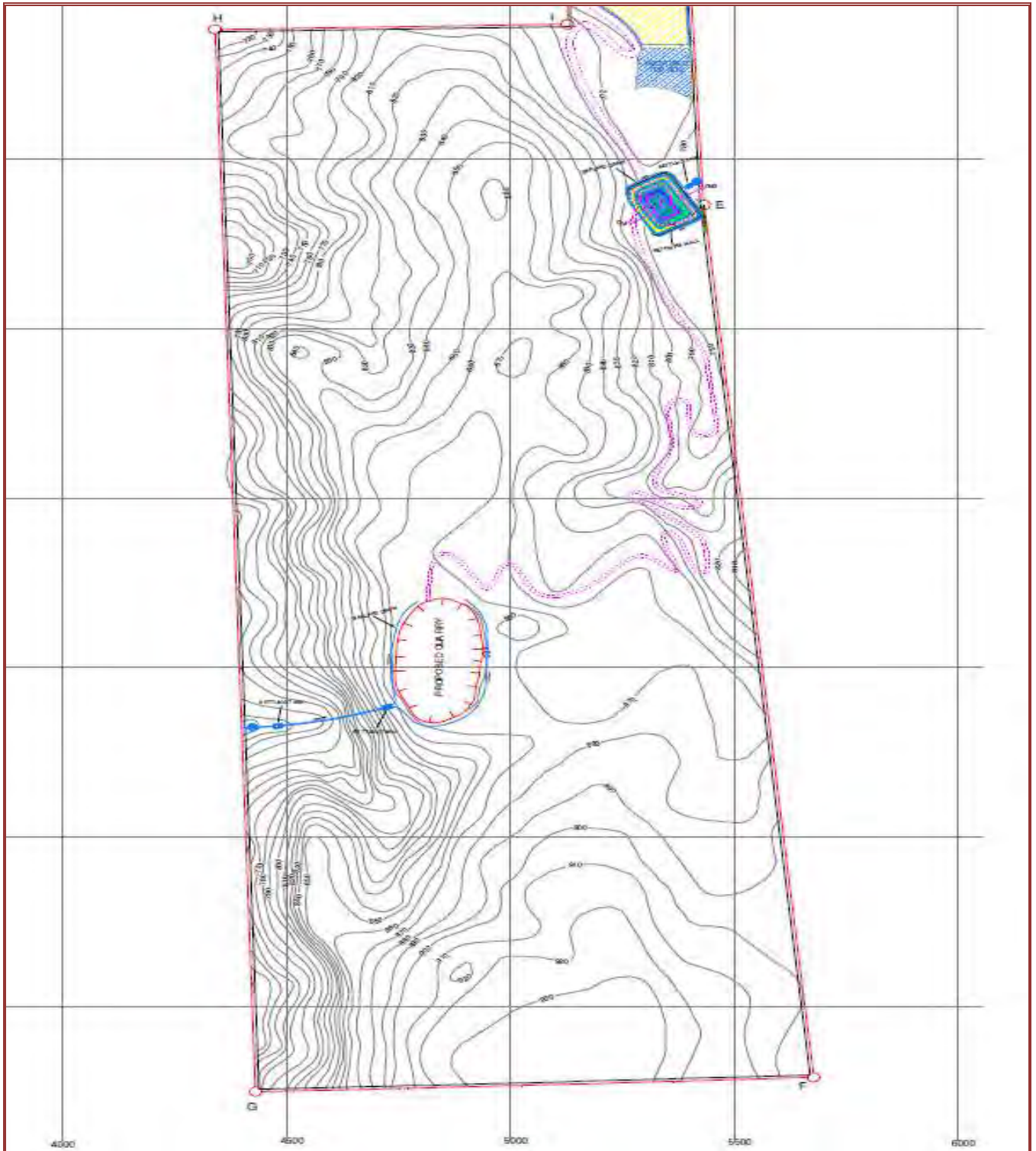
Mithirda Block is the largest area among the three blocks in the entire leasehold area. The area is divided into 6 segments (viz., Mithirda – I, II, III, IV, V and VI). Of all these segments, Mithirda I and II cover maximum area and the other segments are of smaller dimensions. The mineralization is mostly restricted to the Western portion in the Central part of the block, Part of the Eastern portion and in the Southern part of the block. The proposed mining activity at year 5 is important to locate the RWH structures and mining plan of the Block is reproduced in Figure – 18.

Based on the proposed mining activity in the next five years, the garland drain around the mine pit and settling pits on the Westward drain is planned which is shown in the surface plan (Refer Figure – 19).





**FIGURE – 19: SURFACE PLAN SHOWING MINING AREA WITH GARLAND DRAIN AND SETTLING PITS AT MITHIRDA BLOCK**





Based on the contour pattern and the terrain setting, important catchment area for runoff collection is demarcated in the Google map and three sites are identified for the construction of storage cum percolation ponds. The details are shown in Figure – 20 as depicted below. Three storage cum percolation ponds and two check weirs with desilting pits are recommended.

**FIGURE – 20: MINI CATCHMENTS WITH PROPOSED RWH  
– MITHIRDA BLOCK**





## **RECOMMENDATION – 1**

### **CONSTRUCTION OF STORAGE CUM PERCOLATION PONDS**

#### **Significance of Surface Water Bodies and Impounding Water at Hydrogeologically Potential Areas**

Following are the benefits of maintaining natural flow of water or artificially keeping or impounding maximum quantity of water in ponds or other surface water bodies at scientifically appropriate, strategic and hydrogeologically potential areas:

- Infiltration of water takes place gradually
- Creates the required hydrostatic head
- Provides suitable conditions for ground water movement
- Recharges the shallow aquifers
- Recharges the unsaturated aquifers
- Arrests the decline of ground water levels
- Results in satisfactory yield of water extraction structures like tube wells
- Reduces flow of run off

The role played by surface water bodies like ponds, drains, canals and nallahs is undoubtedly significant to recharge the shallow aquifers. Maintaining natural flow of water in the rivers or artificially keeping water in valleys, riverbeds, ponds, lakes, etc. at similar scientifically appropriate locations will create the required hydrostatic head and provide conditions for ground water movement. This will also be very useful to recharge the unsaturated aquifers and thus stabilize the ground water, resulting in satisfactory yield of dug wells, bore wells, etc.

By various ground water studies, it has been scientifically estimated that ground water runs parallel to the topography and finds termination point in a drainage line such as rivers, deep lakes, thalabs, etc., which cut across its movement path.

As a matter of awareness, for this unique subject, it is advisable to understand certain scientific facts such as, base flow, surface run off, ground water flow, etc.

<b>Runoff = Surface run off + Ground water inflow (i.e. Base flow)</b>
------------------------------------------------------------------------

If there is insufficient base flow, due to inadequate recharge activities, the ground water flow towards lakes, thalabs and rivers will be very much less and accordingly, these surface water bodies become dry, except when fed by direct surface flow immediately after high intensity rainfall. From this it can be easily inferred that *the yield of water extraction structures and surface water bodies are complementary to each other*. Therefore, it is essential to store maximum quantity of rainwater in surface water bodies like ponds, large lakes, nallahs and rivers.

### **Percolation Ponds**

A percolation Pond / Tank can be defined as an artificially created surface water body submerging a highly permeable land area so that the surface runoff is made to percolate and recharge the ground water storage. They are not provided with sluices or outlets for discharging water from the tank for irrigation or other purposes.

The hydrogeology of the area should be such that the Litho-units occurring in the area of submergence of the tank should have high permeability. The availability of non-committed surplus monsoon runoff should be sufficient to ensure filling of the tank every year.

Selection of the size of a percolation tank should be governed by the percolation capacity of the strata rather than the yield of the catchment. In order to avoid wastage of water through evaporation, larger capacity tanks should be constructed only if percolation capacity is proven to be good. If percolation rates are low to moderate, tanks of smaller capacity may be constructed.

The depth of water impounded in the tank provides the recharge head and hence it is necessary to design the tank to provide a minimum height of ponded water column of 3 to 4.5 m and rarely 6 m above the bed level.

## RECOMMENDATION – 1A

### (I) CONSTRUCTION OF STORAGE CUM PERCOLATION POND 1 (SCP - 1)

**Location: On the South Western side of Mithirda Block (Refer Fig. – 20)**

The concept of **Storage cum Percolation Pond (SCP)** is slowly and steadily gaining popularity among the corporate sectors of our country. This unique and innovative structure can not only store adequate quantity of rainwater, but also permit gradual percolation and consequent charging of the limited aquifers in and around the area. Construction of scientifically designed storage cum percolation ponds is invariably essential to raise the ground water table of the study area.

#### **Benefits of SCP**

By executing number of Storage cum Percolation Ponds at different terrains of our country, it is observed that by storing rainwater in this water body can saturate the downstream and upstream side of the pond to a considerable extent. It is proved that maximum benefits occur to the downstream side where the Hand pumps, Open wells and Bore wells will start giving satisfactory yield of water even during summer period.

It is also appropriate to record here that ground water flow and surface water flow are parallel and the velocity of surface water is measured in terms of cm/hour whereas the velocity of ground water is measured in terms of cm/day. From this, it is very clear that by injecting rainwater at appropriate recharge zones, subject to *hydraulic conductivity*, the water may flow to the discharge area.



The catchment area for the favourable location on the South Western of the block, as calculated from the Google map is around 4,90,010 Square meters (Sq.m) (Refer Figure – 20).

### Water Harvesting Potential for the Storage cum Percolation Pond

$$\begin{aligned}\text{Area} &= 490010 \text{ m}^2 \\ \text{Runoff Co-efficient} &= 0.2 \\ \text{Annual Rainfall} &= 1.697 \text{ m} \\ &= 490010 \times 0.2 \times 1.697 \\ &= \mathbf{166310 \text{ m}^3 \text{ per annum (455 m}^3 \text{ per day)}}\end{aligned}$$

### It is recommended to

- Construct **Storage cum Percolation Pond (SCP – 1)** at the identified favourable location on the South Western portion of the block.
- Use the excavated soil to **prepare strong bunds** surrounding the SCP – 1 for safety purposes.
- Construct **contour trenches / storm water canal** for the diversion of runoff water from the catchment area to the pond.
- Construct **RCC Check Weir** at the tail end of the contour trench / canal.
- Divert the water from the upstream side of check weir to a settling pond and subsequently to the SCP through 2 no.s of 0.9 m dia RCC hume pipes (**inlet arrangement**).
- Divert the **overflow water** from the pond through 2 no.s of 0.9 m dia RCC hume pipes to follow the original drainage pattern.

## Dimensions of the Storage cum Percolation Pond (SCP)

Length of the Pond – 200 m

Width of the Pond – 150 m

Depth of the Pond – 4 m

Surface Area – 30000 Sq.m

Free Board – 0.9 m

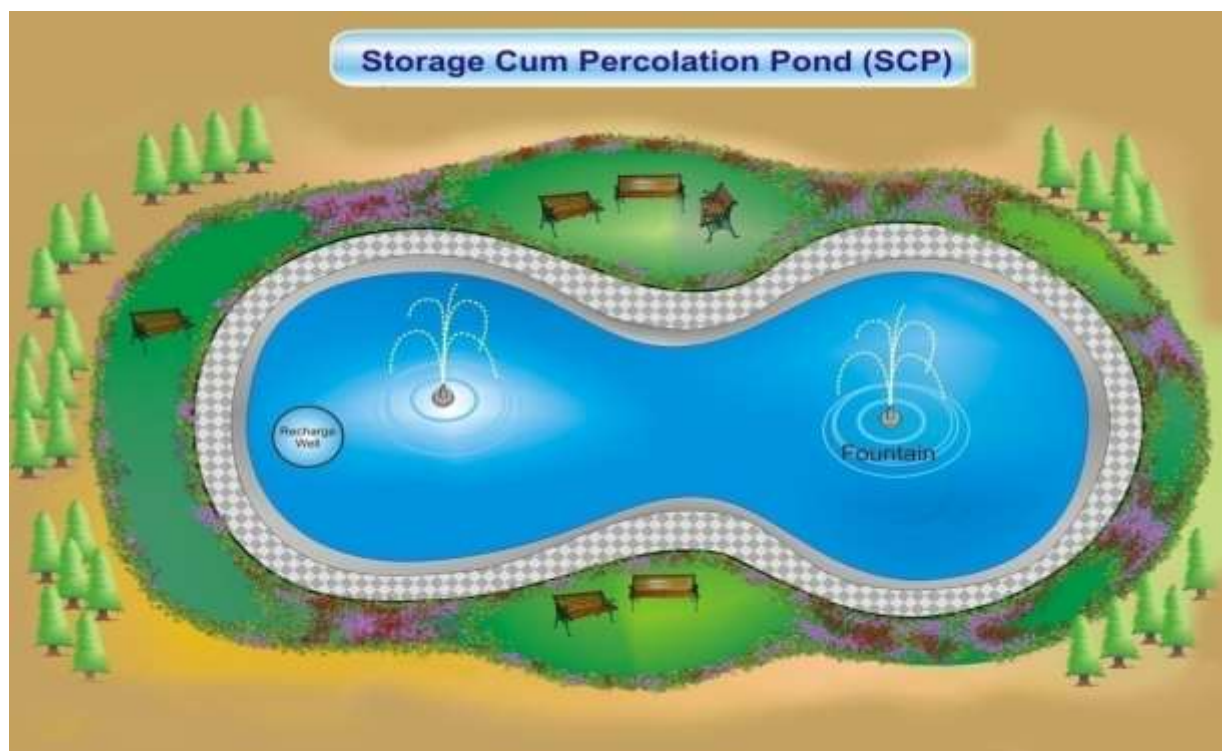
Storage Capacity – 93000 m³

**Note: The shape and size of the pond can be altered depending on the site conditions.**

## Construction Details

- *Excavate the top soil up to a depth of 4 m below ground level. Use the excavated soil to prepare short bunds surrounding the SCP – 1.*
- *Provide suitable slope to the sidewalls of SCP in the ratio 1:1 (Horizontal: Vertical) to avoid soil erosion.*
- *In case pitching of the side walls is not carried due to budgetary constraints, provide slope to the side walls in the ration 1.5:1 (Horizontal : Vertical).*
- *Level and consolidate the bottom and side walls of the SCP. Remove all sharp edges and protrusions.*
- *Provide necessary berm of width 1.2 m on all sides of the SCP.*
- *Provide slope for the base of the SCP towards the outlet side so that accumulated silt, if any, can be removed after monsoon (Figure – 22).*

**Figure – 21: Images of Storage cum Percolation Pond**

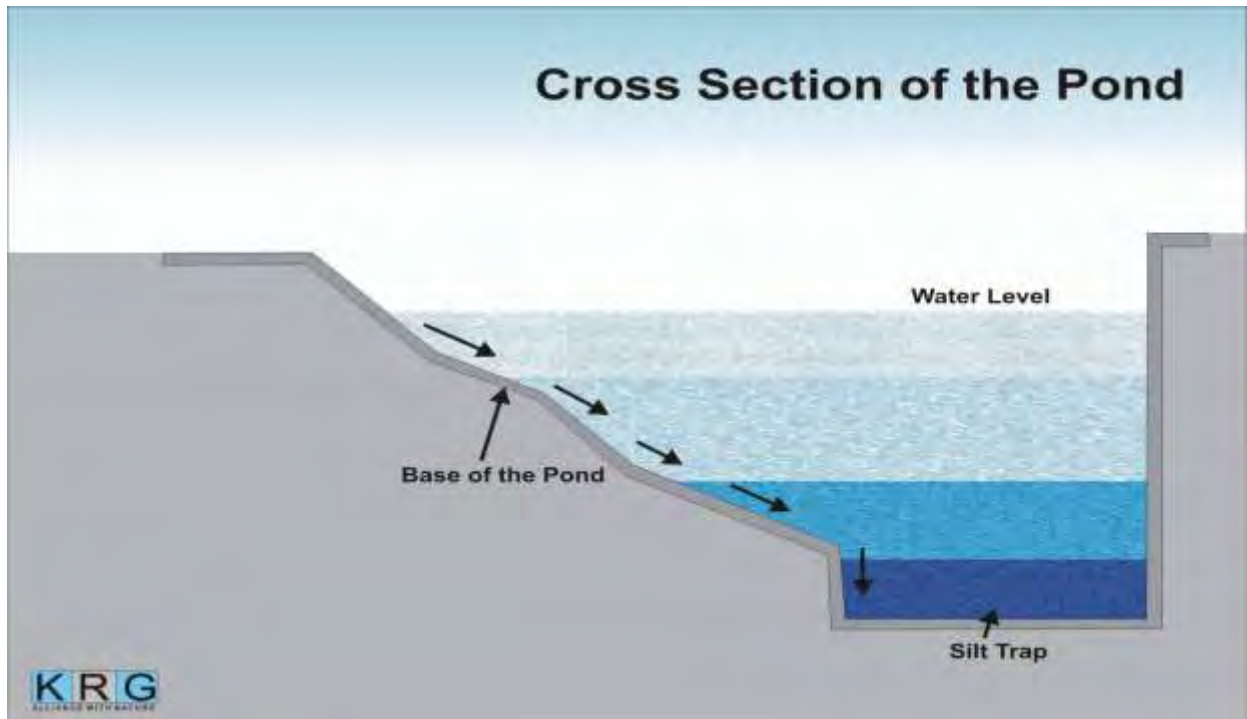


### **Pitching of Side walls to avoid Soil Erosion (optional)**

- ***Carry out pitching for the side walls of the pond and berm with PCC slabs measuring 0.3 m x 0.45 m x 0.05 m.***
- ***Construct a toe wall at the base of the side walls of SCP to check the slipping of pre-cast slabs provided on the side wall (For Toe wall details, refer the CAD drawing).***
- ***Level and consolidate the sidewalls of the SCP and provide PCC mix of suitable thickness as a binder for fixing the pre-cast slabs.***
- ***Fix pre-cast PCC slabs of size 0.45 m x 0.3 m x 0.05 m on the side walls of the SCP and carryout pointing on the sidewalls.***
- ***Maintain water level for each row of pre-cast slabs for better aesthetic view.***
- ***Lay pre-cast slabs of different design on top of the berms also.***
- ***Provide weep holes with 2 inches PVC pipe, at a rate of 1 m horizontal and 1 m vertical, for the side walls of the pond to facilitate seepage and avoid pressure on the PCC slabs.***
- ***Provide Step arrangements with stainless steel railings for easy access into the SCP for maintenance purposes.***



**Figure – 22: Cross Section of Pond with Slope towards the Outlet Side**



**Photo – 3: Photo Showing the Pitching of Sidewalls of the Pond**



## **(II) Construction of Strong Bunds surrounding the SCP – 1**

- Construct **Bunds** surrounding the SCP – 2 with the excavated soil.
- Provide suitable slope to the side walls of the bund in the ratio 1.5:1 (Horizontal : Vertical)
- Consolidate and level the sloping sides of the bund by watering and ramming.

### **Dimensions of Bund**

Length of Bund	–	Top Perimeter of the pond
Top Width	–	1.5 m
Bottom Width	–	6 m
Height	–	1.5 m

### **Measures to arrest soil erosion of side walls of the Bund (Optional)**

Needless to mention, in spite of maintaining scientifically designed slope of side walls, there may be a possibility of erosion of soil and subsequent caving in of the walls. This can be overcome by resorting to the following.

Planting of Vetiver (*Vetiveria zizanioides*) on bund and also side walls, particularly on the free board side, is a simple and inexpensive method for effective means to check soil erosion.

Being vegetative, it is environment friendly and when planted in single rows can form a hedge, which is very effective in reducing soil erosion, and conserving soil moisture, and trapping sediments. Advance countries like China and Korea have introduced this system for effectively checking the soil erosion.

**Photo – 4: Vetiver Plantation to Avoid Erosion of Sidewalls**



### **(III) Construction of Contour Trench / Storm Water Canal**

#### **Dimensions of the Storm Water Canal**

Length of the Canal	=	App. 1000 m
Top Width of the Canal	=	3 m
Bottom Width of the Canal	=	0.9 m
Depth of the Canal	=	1 m

- *Provide suitable slope to the side walls of the canal in the ratio 1:1*
- *Level and consolidate the side walls of the canal by watering and ramming.*
- *Remove all sharp edges and protrusions*
- *Maintain the drains periodically by removing the weeds, silt accumulation etc. both before and after monsoon.*



**Figure – 23: Image Showing the Storm Water Drain**



#### **(IV) Construction of RCC Barriers / Barriers with Locally Available Boulders Across the Contour Trench / Drain**

- *Provide RCC Barriers or Gully plugs (Crated boulder masonry) with locally available boulders in the storm water drain at suitable intervals.*
- *The barriers will check the velocity of the flowing water and deposit the silt on the upstream side of the barrier.*

**Photo – 5: RCC Barriers across the Drain**



**Figure – 24: Barriers / Gully Plugs with Locally Available Boulders**





**Photo – 6: Barriers with Locally Available Boulders Across the Nallah**





## **Construction of Gabion Structures across the Contour Trench/Drain**

Gabion Structures may also be constructed along the path of the drain, which will act as an effective barrier. Gabion structure consists of wire mesh boxes interconnected by tying the same with steel wire. Each wire mesh box will be filled with locally available rubbles and boulders.

### **Dimensions of Gabion Structures**

Length of Gabion Box – 1 m Width of Gabion Box – 1 m

Height of Gabion Box – 1 m

**Photo – 7: Gabion Structure Prepared with Gabion Boxes**



### **(v) Construction of Silt Traps/Desilting Pits**

- Construct **silt trap** on the upstream side of the barrier.
- Remove the silt from the silt trap periodically for better functioning of the system.

### **Dimensions of Silt Trap/Desilting Pit**

Length of the Silt Trap – Width of the Nallah

Width of the Silt Trap – 3 m

Depth of the Silt Trap – 2 m

- Provide suitable slope to the sidewalls of the pit in the ratio 1.5:1.
- Carry out pitching with Random rubbles to avoid erosion of sidewalls.
- Remove the silt from the pit periodically either manually or with excavators for efficient functioning of the structure.

### **(vi) Construction of RCC Check Weir**

- Construct **RCC Check Weir** of suitable structural design at a favourable location before the inlet point of the settling pond.
- Divert the water from the upstream side of the check weir to the settling pond and subsequently to the SCP through 2 no.s of 0.9 m dia RCC hume pipe.
- Provide **PCC platform** at the downstream side of the check weir to avoid gully erosion.

### **Dimensions of RCC Check Weir**

Length of the Check Weir = Width of the Nallah

Width of the Check Weir = 0.3 m to 0.4 m

Height of the Check Weir = 0.9 to 1.2 m above ground level  
1 m below ground level

**Photo – 8: View of RCC Check Weir with PCC Platform**



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## **(VII) Construction of Settling cum Recharge Pond before the Entry Point to the SCP – 1**

- ***Construct a **Settling cum Recharge Pond** of the following dimensions at a suitable location and allow the runoff water from the storm water canal to pass through this settling tank through 2 no.s of 0.9 m RCC hume pipes.***
- ***Provide proper overflow arrangements to the settling tank with 0.9 m dia RCC hume pipes and divert the water to the SCP – 1.***
- ***Desilt the settling pond periodically.***

### **Dimensions of the Settling cum Recharge Pond**

Length of the Tank – 30 m

Width of the Tank – 30 m

Depth of the Tank – 3 m

- ***Excavate the soil to depth of 3 m below ground level and dispose the soil elsewhere.***
- ***Provide suitable slope to the sidewalls of pond in the ratio 1:1 (Horizontal: Vertical) to avoid soil erosion. Level and consolidate the bottom and side walls of the pond. Remove all sharp edges and protrusions.***
- ***Provide necessary berm of width 1.2 m on all sides of the pond.***
- ***Provide slope for the base of the pond towards the outlet side so that accumulated silt, if any, can be removed after monsoon.***



### **Pitching of Side walls to avoid Soil Erosion**

- ***Carry out pitching for the side walls of the pond and berm with PCC slabs measuring 0.3 m x 0.45 m x 0.05 m or designer tiles of suitable size.***
- ***Construct a toe wall at the base of the side walls of pond to check the slipping of pre-cast slabs provided on the side wall.***
- ***Level and consolidate the sidewalls of the pond and provide PCC mix of suitable thickness as a binder for fixing the pre-cast slabs.***
- ***Fix pre-cast PCC slabs of size 0.45 m x 0.3 m x 0.05 m or designer tiles of suitable size on the side walls of the Pond and carryout pointing on the sidewalls.***
- ***Maintain water level for each row of pre-cast slabs for better aesthetic view.***
- ***Lay pre-cast slabs of different design on top of the berms also.***
- ***Provide weep holes with 2 inches PVC pipe, at a rate of 1 m horizontal and 1 m vertical, for the side walls of the pond to facilitate seepage and avoid pressure on the PCC slabs.***
- ***Provide grill fencing surrounding the pond for safety purposes.***
- ***Provide suitable overflow arrangement and allow the comparatively silt free water to the SCP.***

## RECOMMENDATION – 1B

### (I) CONSTRUCTION OF STORAGE CUM PERCOLATION POND 2 (SCP - 2)

**Location: On the Western side of Mithirda Block – Refer Figure – 20**

#### **Water Harvesting Potential for the Storage cum Percolation Pond**

Area = 280896 m²

Runoff Co-efficient = 0.2

Annual Rainfall = 1.697 m

= 280896 x 0.2 x 1.697

**= 95330 m³ per annum (261 m³ per day)**

#### **It is recommended to**

- Construct **Storage cum Percolation Pond (SCP – 2)** at the identified favourable location on the Western portion of the block.
- Use the excavated soil to **prepare strong bunds** surrounding the SCP – 2 for safety purposes.
- Construct **contour trenches / storm water canal** for the diversion of runoff water from the catchment area to the pond.
- Construct **RCC Check Weir** at the tail end of the contour trench / canal.
- Divert the water from the upstream side of check weir to a settling pond and subsequently to the SCP through 2 no.s of 0.9 m dia RCC hume pipes (**inlet arrangement**).
- Divert the **overflow water** from the pond through 2 no.s of 0.9 m dia RCC hume pipes to follow the original drainage pattern.

## Dimensions of the Storage cum Percolation Pond (SCP – 2)

Length of the Pond – 150 m

Width of the Pond – 100 m

Depth of the Pond – 4 m

Surface Area – 15000 Sq.m

Free Board – 0.9 m

Storage Capacity – 46500 m³

**For Construction Details & Pitching of Side walls, Images of Barriers, Gully Plugs, Gabion Structures etc., Refer SCP – 1 in Recommendation – 1 A.**

### (I) Construction of Strong Bunds surrounding the SCP – 2

- Construct **Bunds** surrounding the SCP – 2 with the excavated soil.
- Provide suitable slope to the side walls of the bund in the ratio 1.5:1 (Horizontal : Vertical)
- Consolidate and level the sloping sides of the bund by watering and ramming.

### Dimensions of Bund

Length of Bund – Top Perimeter of the pond

Top Width – 1.5 m

Bottom Width – 6 m

Height – 1.5 m

### **(III) Construction of Contour Trench / Storm Water Canal**

#### **Dimensions of the Storm Water Canal**

Length of the Canal	=	App. 800 m
Top Width of the Canal	=	3 m
Bottom Width of the Canal	=	0.9 m
Depth of the Canal	=	1 m

- *Provide suitable slope to the side walls of the canal in the ratio 1:1*
- *Level and consolidate the side walls of the canal by watering and ramming.*
- *Remove all sharp edges and protrusions*
- *Maintain the drains periodically by removing the weeds, silt accumulation etc. both before and after monsoon.*



#### **(IV) Construction of RCC Barriers / Barriers with Locally Available Boulders Across the Contour Trench / Drain**

- *Provide **RCC Barriers** or **Gully plugs** (Crated boulder masonry) with locally available boulders in the storm water drain at suitable intervals.*
- *The barriers will check the velocity of the flowing water and deposit the silt on the upstream side of the barrier.*

##### **Dimensions of Barrier (Gully Plug) with Random Rubbles**

Length of the Barrier	–	Width of the drain
Top Width	–	0.75 m
Bottom Width	–	2 m
Height of the Barrier	–	0.6 m

#### **Construction of Gabion Structures across the Contour Trench/Drain**

##### **Dimensions of Gabion Structures**

Length of the Gabion Box	–	1 m
Width of the Gabion Box	–	1 m
Height of the Gabion Box	–	1 m

#### **(v) Construction of Silt Traps/Desilting Pits**

- *Construct **silt trap** on the upstream side of the barrier.*
- *Remove the silt from the silt trap periodically for better functioning of the system.*

### **Dimensions of Silt Trap/Desilting Pit**

Length of the Silt Trap – Width of the Nallah

Width of the Silt Trap – 3 m

Depth of the Silt Trap – 2 m

- *Provide suitable slope to the sidewalls of the pit in the ratio 1.5:1.*
- *Carry out pitching with Random rubbles to avoid erosion of sidewalls.*
- *Remove the silt from the pit periodically either manually or with excavators forefficient functioning of the structure.*

### **(vi) Construction of RCC Check Weir**

- *Construct **RCC Check Weir** of suitable structural design at a favourable locationbefore the inlet point of the settling pond.*
- *Divert the water from the upstream side of check weir to a settling pond and subsequently to the SCP through 2 no.s of 0.9 m dia RCC hume pipes (**inlet arrangement**).*
- *Provide **PCC platform** at the downstream side of the check weir to avoid gully erosion.*

### **Dimensions of RCC Check Weir**

Length of the Check Weir = Width of the Nallah

Width of the Check Weir = 0.3 m to 0.4 m

Height of the Check Weir = 0.9 to 1.2 m above ground level

1 m below ground level

## **(VII) Construction of Settling cum Recharge Pond before the Entry Point to the SCP – 2**

- *Construct a **Settling cum Recharge Pond** of the following dimensions at a suitable location and allow the runoff water from the storm water canal to pass through this settling tank through 2 no.s of 0.9 m RCC hume pipes.*
- *Provide proper overflow arrangements to the settling tank with 0.9 m dia RCC hume pipes and divert the water to the SCP – 2.*
- *Desilt the settling pond periodically.*

### **Dimensions of the Settling cum Recharge Pond**

Length of the Tank – 30 m

Width of the Tank – 30 m

Depth of the Tank – 3 m

- *Excavate the soil to depth of 3 m below ground level and dispose the soil elsewhere.*
- *Provide suitable slope to the sidewalls of pond in the ratio 1:1 (Horizontal: Vertical) to avoid soil erosion. Level and consolidate the bottom and side walls of the pond. Remove all sharp edges and protrusions.*
- ***Provide necessary berm** of width 1.2 m on all sides of the pond.*
- ***Provide slope for the base of the pond towards the outlet side so that accumulated silt, if any, can be removed after monsoon.***

## RECOMMENDATION – 1C

### (I) CONSTRUCTION OF STORAGE CUM PERCOLATION POND 3 (SCP - 3)

**Location: On the North Western side of Mithirda Block (Refer Figure – 20**

#### **Water Harvesting Potential for the Storage cum Percolation Pond**

Area = 432976 m²

Runoff Co-efficient = 0.2

Annual Rainfall = 1.697 m

= 432976 x 0.2 x 1.697

= 146950 m³ per annum (402 m³ per day)

#### **Google Map Showing the Catchment area of SCP – 3**





### **It is recommended to**

- Construct **Storage cum Percolation Pond (SCP – 3)** at the identified favourable location on the Western portion of the block.
- Use the excavated soil to **prepare strong bunds** surrounding the SCP – 3 for safety purposes.
- Construct **contour trenches / storm water canal** for the diversion of runoff water from the catchment area to the pond.
- Construct **RCC Check Weir** at the tail end of the contour trench / canal.
- Divert the water from the upstream side of check weir to a settling pond and subsequently to the SCP through 2 no.s of 0.9 m dia RCC hume pipes (**inlet arrangement**).
- Divert the **overflow water** from the pond through 2 no.s of 0.9 m dia RCC hume pipes to follow the original drainage pattern.

### **Dimensions of the Storage cum Percolation Pond (SCP – 3)**

Length of the Pond – 200 m

Width of the Pond – 125 m

Depth of the Pond – 4 m

Surface Area – 25000 Sq.m

Free Board – 0.9 m

Storage Capacity – 77500 m³

**For Construction Details & Pitching of Side walls, Images of Barriers, Gully Plugs etc., Refer SCP – 1 in Recommendation – 1 A.**

### **(II) Construction of Strong Bunds surrounding the SCP – 3**

- Construct **Bunds** surrounding the SCP – 3 with the excavated soil.
- Provide suitable slope to the side walls of the bund in the ratio 1.5:1 (Horizontal : Vertical)
- Consolidate and level the sloping sides of the bund by watering and ramming.

#### **Dimensions of Bund**

Length of Bund – Top Perimeter of the pond

Top Width – 1.5 m

Bottom Width – 6 m

Height – 1.5 m

### **(III) Construction of Contour Trench / Storm Water Canal**

#### **Dimensions of the Storm Water Canal**

Length of the Canal	=	App. 1000 m
Top Width of the Canal	=	3 m
Bottom Width of the Canal	=	0.9 m
Depth of the Canal	=	1 m

- *Provide suitable slope to the side walls of the canal in the ratio 1:1*
- *Level and consolidate the side walls of the canal by watering and ramming.*
- *Remove all sharp edges and protrusions*
- *Maintain the drains periodically by removing the weeds, silt accumulation etc. both before and after monsoon.*

### **(III) Construction of RCC Barriers / Barriers with Locally Available Boulders Across the Contour Trench / Drain**

- *Provide **RCC Barriers** or **Gully plugs** (Crated boulder masonry) with locally available boulders in the storm water drain at suitable intervals.*
- *The barriers will check the velocity of the flowing water and deposit the silt on the upstream side of the barrier.*

#### **Dimensions of Barrier (Gully Plug) with Random Rubbles**

Length of the Barrier – Width of the drain

Top Width – 0.75 m

Bottom Width – 2 m

Height of the Barrier – 0.6 m

### **Construction of Gabion Structures across the Contour Trench/Drain**

#### **Dimensions of Gabion Structures**

Length of Gabion Box – 1m

Width of Gabion Box – 1m      Height of Gabion Box – 1 m

### **(v) Construction of Silt Traps/Desilting Pits**

- *Construct **silt trap** on the upstream side of the barrier.*
- *Remove the silt from the silt trap periodically for better functioning of the system.*



### Dimensions of Silt Trap/Desilting Pit

Length of the Silt Trap – Width of the Nallah

Width of the Silt Trap – 3 m

Depth of the Silt Trap – 2 m

- *Provide suitable slope to the sidewalls of the pit in the ratio 1.5:1.*
- *Carry out pitching with Random rubbles to avoid erosion of sidewalls.*
- *Remove the silt from the pit periodically either manually or with excavators for efficient functioning of the structure.*

### (vi) Construction of RCC Check Weir

- *Construct **RCC Check Weir** of suitable structural design at a favourable location before the inlet point of the settling pond.*
- *Divert the water from the upstream side of check weir to a settling pond and subsequently to the SCP through 2 no.s of 0.9 m dia RCC hume pipes (**inlet arrangement**).*
- *Provide **PCC platform** at the downstream side of the check weir to avoid gully erosion.*

### Dimensions of RCC Check Weir

Length of the Check Weir = Width of the Nallah

Width of the Check Weir = 0.3 m to 0.4 m

Height of the Check Weir = 0.9 to 1.2 m above ground level

1 m below ground level

## **(VII) Construction of Settling cum Recharge Pond before the Entry Point to the SCP – 3**

- *Construct a **Settling cum Recharge Pond** of the following dimensions at a suitable location and allow the runoff water from the storm water canal to pass through this settling tank through 2 no.s of 0.9 m RCC hume pipes.*
- *Provide proper overflow arrangements to the settling tank with 0.9 m dia RCC hume pipes and divert the water to the SCP – 3.*
- *Desilt the settling pond periodically.*

### **Dimensions of the Settling cum Recharge Pond**

Length of the Tank – 30 m

Width of the Tank – 30 m

Depth of the Tank – 3 m

- *Excavate the soil to depth of 3 m below ground level and dispose the soil elsewhere.*
- *Provide suitable slope to the sidewalls of pond in the ratio 1:1 (Horizontal: Vertical) to avoid soil erosion. Level and consolidate the bottom and side walls of the pond. Remove all sharp edges and protrusions.*
- ***Provide necessary berm** of width 1.2 m on all sides of the pond.*
- ***Provide slope for the base of the pond towards the outlet side so that accumulated silt, if any, can be removed after monsoon.***

## RECOMMENDATION – 1D

### CONSTRUCTION OF CHECK WEIRS AND DESILTING PITS

#### Location: On the Eastern Part of Mithirda Block

The analysis of ground conditions and the study of surface plan with contours indicate that the runoff water generated from the mini water shed on the Eastern side of active mine area in Mithirda block is having a harvesting potential of 33220 cu.m/year ( $91 \text{ m}^3/\text{day}$ ), considering a catchment area of 97860 Sq.m with a runoff coefficient of 0.2 and rainfall of 1.697 m per annum.

#### Google Map Showing the Catchment area for Check Weirs & Desilting Pits on the Eastern side



**Photo – 9: Mining Activity in Mithirda Block**





Considering the elevation and steep ground contours, the existing drain on the Eastern side of the present mining area, can be widened and desilting structures may be provided across the path of the nallah.

**Photo – 10: Nallah on the Eastern side of Present Mining Area**



### **Dimensions of the Nallah to be Widened**

Top Width – 4 m

Bottom Width – 1 m

Average Depth – 1 m

- *Provide suitable slope to the side walls of the canal in the ratio 1:1*
- *Level and consolidate the side walls of the canal by watering and ramming. Remove all sharp edges and protrusions*
- *Maintain the drains periodically by removing the weeds, silt accumulation etc. both before and after monsoon.*

### **Construction of Check Weirs and Silt Traps**

Two check weirs, constructed with boulders and tied with wire mesh, may be constructed across the path of the nallah. Silt traps may be provided on the upstream of the nallah which may be periodically cleaned by mechanical means to increase the ground water recharge and prevention of silt flow to down the valley.



### **Photo – 11: Check Weir with Boulders Tied with Wire Mesh Across the Nallah**



### **Dimensions of Silt Trap/Desilting Pit**

Length of the Silt Trap – Width of the Nallah

Width of the Silt Trap – 5 m

Depth of the Silt Trap – 2 m

- *Provide suitable slope to the sidewalls of the pit in the ratio 1.5:1.*
- *Carry out pitching with Random rubbles to avoid erosion of sidewalls.*
- *Remove the silt from the pit periodically either manually or with excavators forefficient functioning of the structure.*

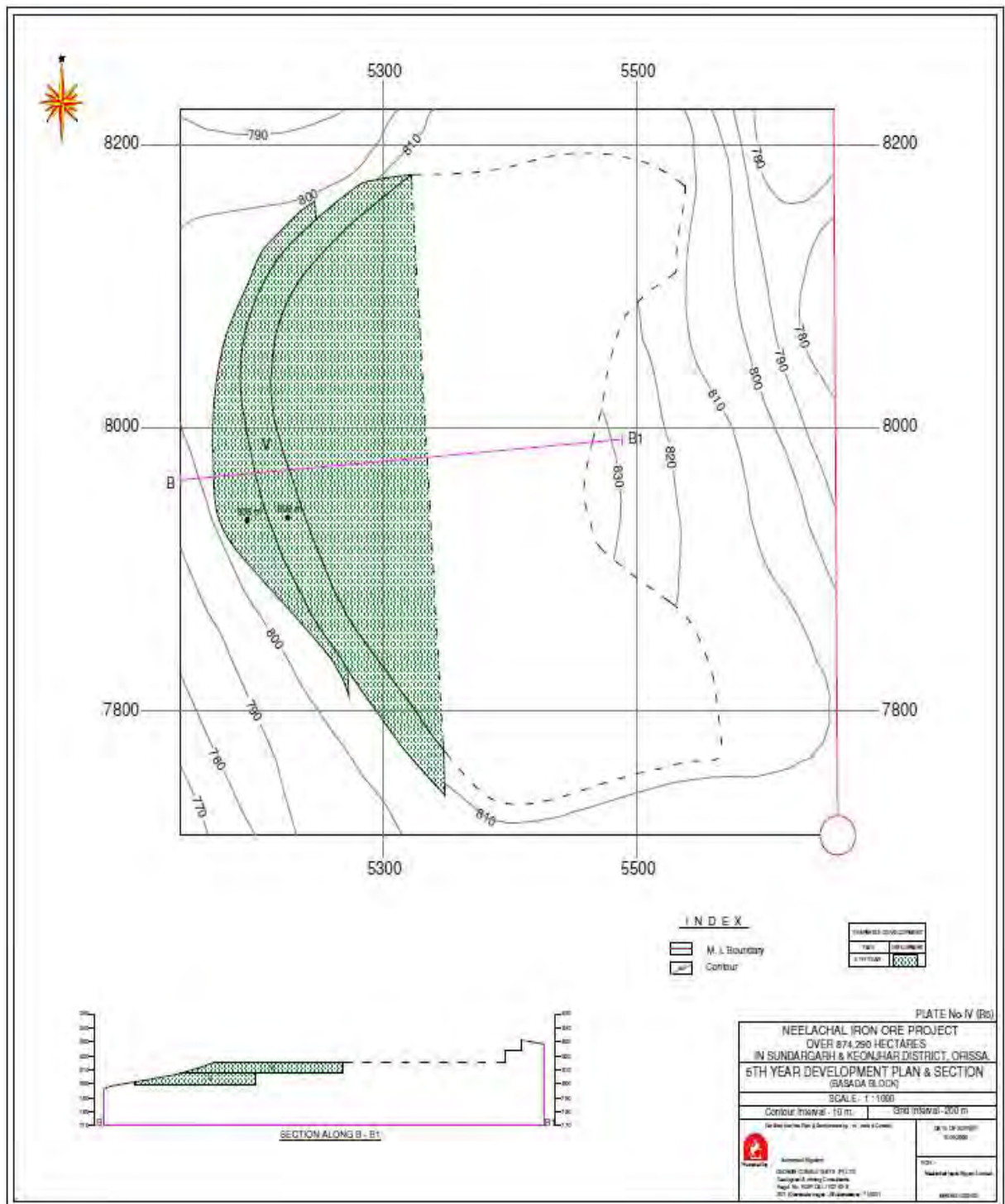
## **RECOMMENDATIONS FOR BASADA BLOCK**

### **BASADA BLOCK**

The Basada block is located on the Northern part of NINL mines. The ore body is in a lateritized zone and occurs as capping on the BHJ. It is presumed to be a blanket type of deposit. In this block, Zone I is prominent and consistent on the Northern side of the Central portion of the block. The proposed mine location and its five year development plan is shown in Figure – 25.

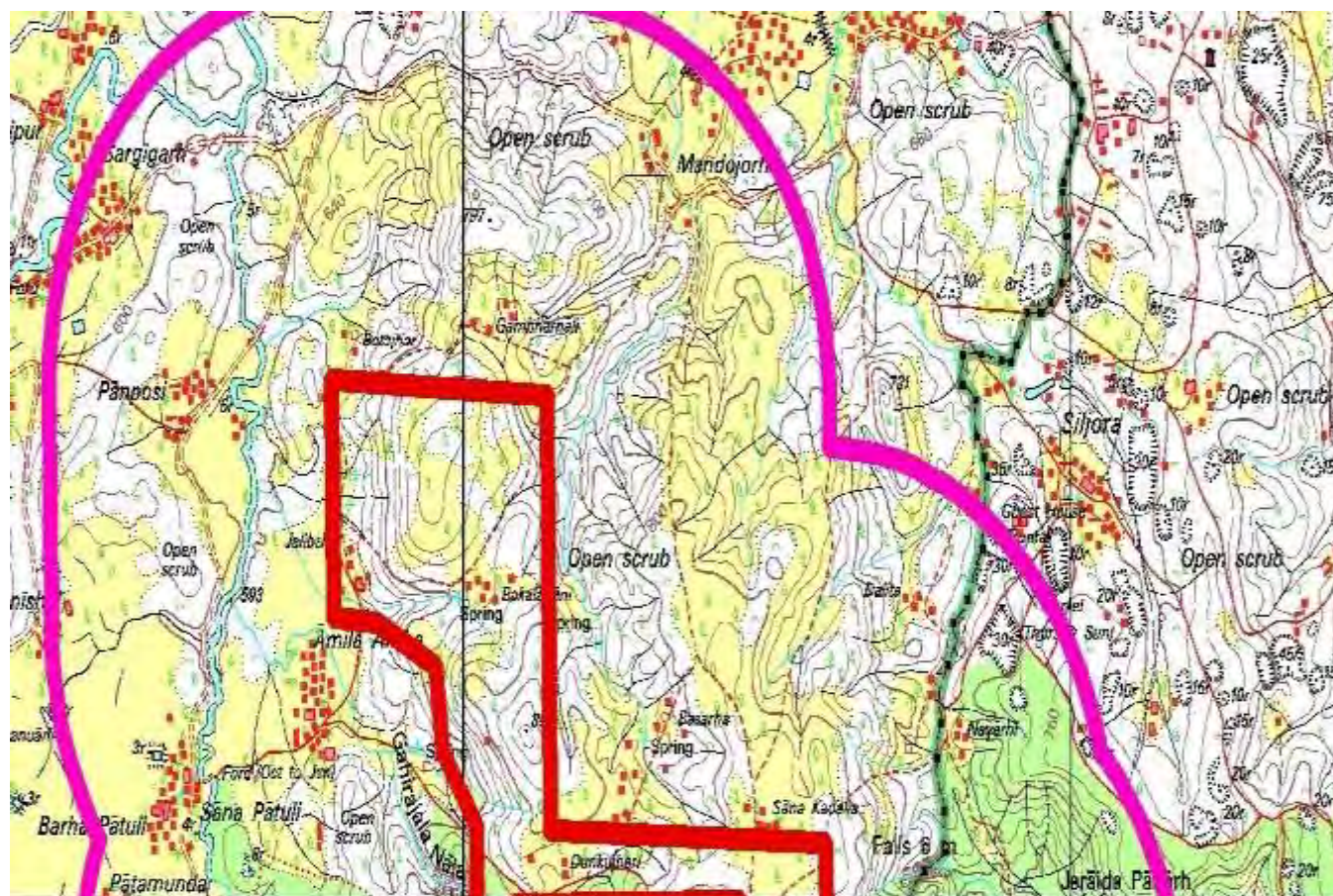
The mining activity is planned on the Southern part of the Block and the topo setting of the core area is depicted in Figure – 26. The surface water divide, trending North – South, results in the terrain sloping towards West and East. The main catchment area is having a well-marked valley and major portion of the runoff water generated from the Block flows towards West and reaches the Suna Nadi. The located of the proposed pond, near the Culvert, is shown in Google map (Figure – 27).

**FIGURE – 25: MINE DEVELOPMENT PLAN FOR BASADA BLOCK**



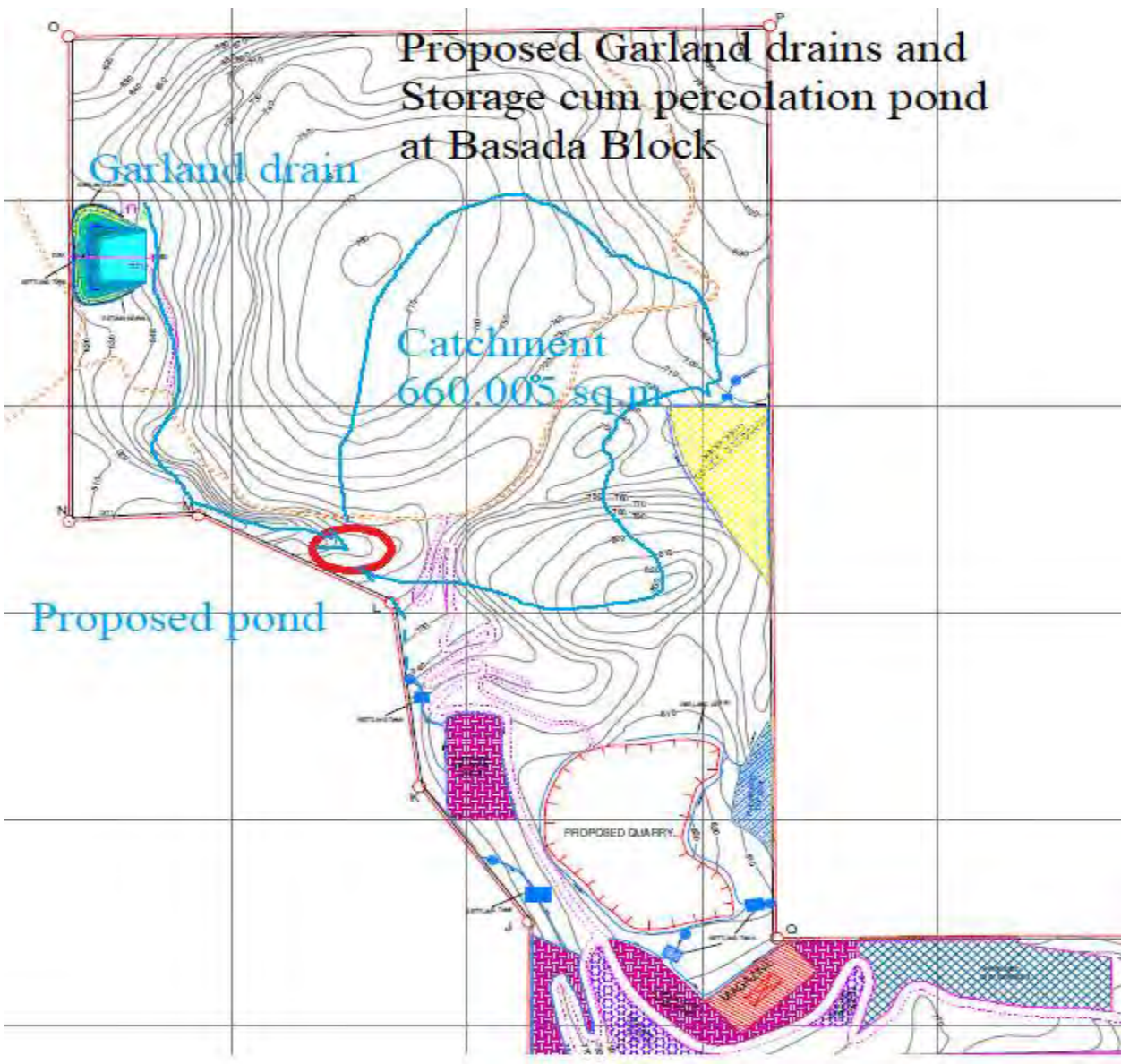


**FIGURE – 26: TOPO MAP OF BASADA BLOCK CORE ZONE**



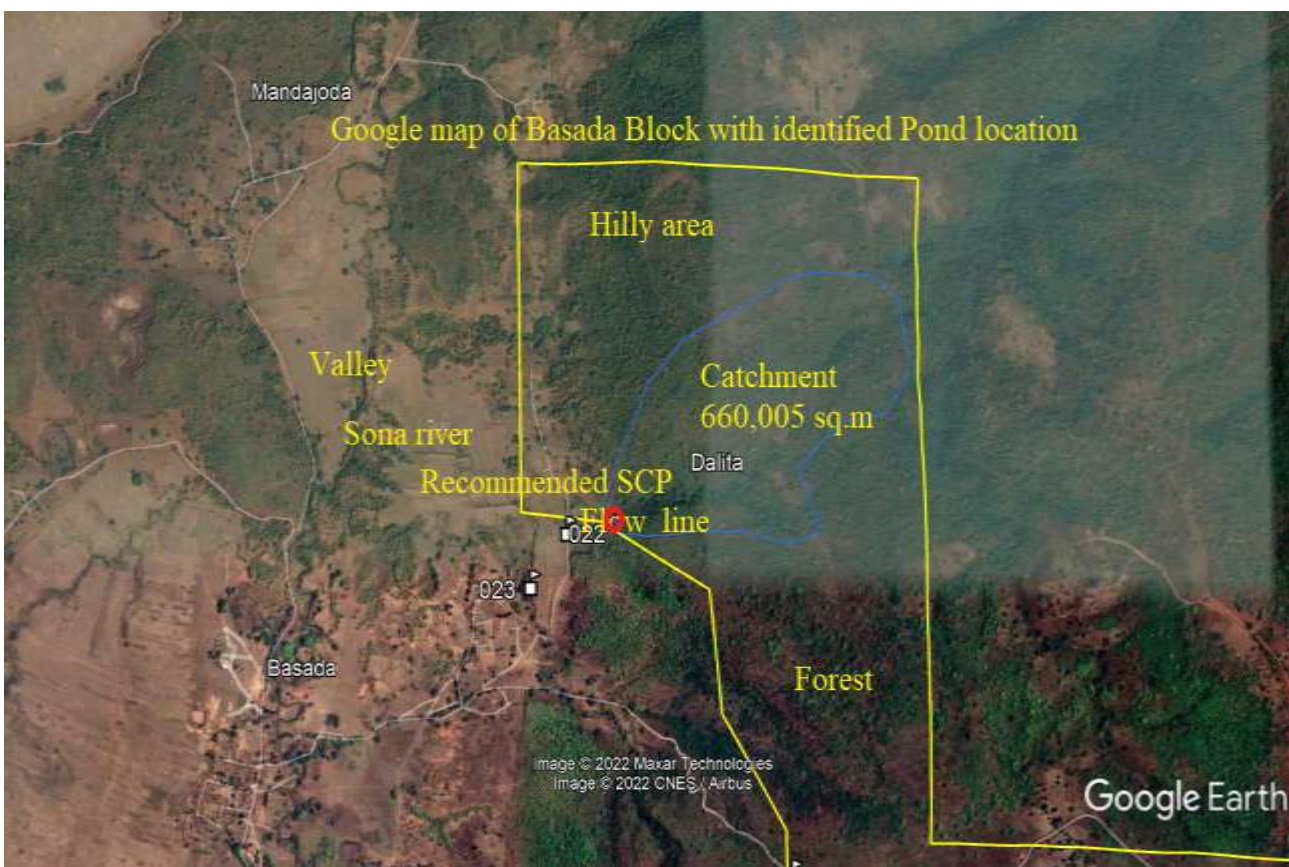
The runoff water generated from the Basada Block is flowing towards the Western side valley and the proposed mine with garland drain and settling pits are shown in Figure – 27. The garland drains can be linked in future to the proposed SCP, which will increase the available water potential in the block.

**FIGURE – 27 : GARLAND DRAINS AND SETTLING PITS**





**FIGURE – 28: GOOGLE MAP OF BASADA BLOCK SHOWING THE MAIN CATCHMENT AND LOCATION OF SCP**



## RECOMMENDATION – 2

### I. CONSTRUCTION OF STORAGE CUM PERCOLATION POND

Based on the detailed hydrogeological survey of the Basada block and the study of topo sheet and surface plan, a favourable location for the construction of Storage cum Percolation Pond has been identified in the low ground on the Western side of the block. Huge quantity of runoff water generated from the upper catchment may be diverted to this SCP through suitable diversion contours.

#### Water Harvesting Potential for the Storage cum Percolation Pond

Area = 660005 m²

Runoff Co-efficient = 0.2

Annual Rainfall = 1.697 m

= 660005 x 0.2 x 1.697 = **224000 m³ per annum (613 m³ per day)**

- Construct **Storage cum Percolation Pond (SCP)** at the identified favourable location on the Western portion of the Basada block.
- Use the excavated soil to **prepare strong bunds** surrounding the SCP.
- Construct **contour trenches / storm water canal** for the diversion of runoff water from the catchment area to the pond.
- Construct **RCC Check Weir** at the tail end of the contour trench / canal.
- Divert the water from the upstream side of check weir to a settling pond and subsequently to the SCP through 2 no.s of 0.9 m dia RCC hume pipes (**inlet arrangement**).
- Divert the **overflow water** from the pond through 2 no.s of 0.9 m dia RCC hume pipes to follow the original drainage pattern.

### **Dimensions of the Storage cum Percolation Pond (SCP)**

Length of the Pond – 200 m

Width of the Pond – 200 m

Depth of the Pond – 4 m

Surface Area – 40000 Sq.m

Free Board – 0.9 m

Storage Capacity – 124000 m³

**Note: The shape and size of the pond can be altered depending on the site conditions.**

### **Construction Details**

- *Excavate the top soil up to a depth of 4 m below ground level. Use the excavated soil to prepare short bunds surrounding the SCP.*
- *Provide suitable slope to the sidewalls of SCP in the ratio 1:1 (Horizontal: Vertical) to avoid soil erosion.*
- *In case pitching of the side walls is not carried due to budgetary constraints, provide slope to the side walls in the ration 1.5:1 (Horizontal : Vertical).*
- *Level and consolidate the bottom and side walls of the SCP. Remove all sharp edges and protrusions.*
- *Provide necessary berm of width 1.2 m on all sides of the SCP.*
- *Provide slope for the base of the SCP towards the outlet side so that accumulated silt, if any, can be removed after monsoon.*



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### **Pitching of Side walls to avoid Soil Erosion (optional)**

- *Carry out pitching for the side walls of the pond and berm with PCC slabs measuring 0.3 m x 0.45 m x 0.05 m.*
- *Construct a toe wall at the base of the side walls of SCP to check the slipping of pre-cast slabs provided on the side wall (For Toe wall details, refer the CAD drawing).*
- *Level and consolidate the sidewalls of the SCP and provide PCC mix of suitable thickness as a binder for fixing the pre-cast slabs.*
- *Fix pre-cast PCC slabs of size 0.45 m x 0.3 m x 0.05 m on the side walls of the SCP and carryout pointing on the sidewalls.*
- *Maintain water level for each row of pre-cast slabs for better aesthetic view.*
- *Lay pre-cast slabs of different design on top of the berms also.*
- *Provide weep holes with 2 inches PVC pipe, at a rate of 1 m horizontal and 1 m vertical, for the side walls of the pond to facilitate seepage and avoid pressure on the PCC slabs.*
- *Provide Step arrangements with stainless steel railings for easy access into the SCP for maintenance purposes.*

## (II) Construction of Strong Bunds surrounding the SCP

- Construct **Bunds** surrounding the SCP with the excavated soil.
- Provide suitable slope to the side walls of the bund in the ratio 1.5:1 (Horizontal : Vertical)
- Consolidate and level the sloping sides of the bund by watering and ramming.

### Dimensions of Bund

Length of Bund	–	Top Perimeter of the pond
Top Width	–	1.5 m
Bottom Width	–	6 m
Height	–	1.5 m

### Measures to arrest soil erosion of side walls of the Bund (Optional)

Needless to mention, in spite of maintaining scientifically designed slope of side walls, there may be a possibility of erosion of soil and subsequent caving in of the walls. This can be overcome by resorting to the following.

Planting of Vetiver (*Vetiveria zizanioides*) on bund and also side walls, particularly on the free board side, is a simple and inexpensive method for effective means to check soil erosion.

### **(III) Construction of Contour Trench / Storm Water Canal**

#### **Dimensions of the Storm Water Canal**

Length of the Canal	=	App. 1200 m
Top Width of the Canal	=	3 m
Bottom Width of the Canal	=	0.9 m
Depth of the Canal	=	1 m

- *Provide suitable slope to the side walls of the canal in the ratio 1:1*
- *Level and consolidate the side walls of the canal by watering and ramming.*
- *Remove all sharp edges and protrusions*
- *Maintain the drains periodically by removing the weeds, silt accumulation etc. both before and after monsoon.*

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#### **(IV) Construction of RCC Barriers / Barriers with Locally Available Boulders Across the Contour Trench / Drain**

- *Provide RCC Barriers or Gully plugs (Crated boulder masonry) with locally available boulders in the storm water drain at suitable intervals.*
- *The barriers will check the velocity of the flowing water and deposit the silt on the upstream side of the barrier.*

#### **Dimensions of Barrier (Gully Plug) with Random Rubbles**

Length of the Barrier – Width of the drain

Top Width – 0.75 m

Bottom Width – 2 m

Height of the Barrier – 0.6 m

#### **Construction of Gabion Structures across the Contour Trench/Drain**

Gabion Structures may also be constructed along the path of the drain, which will act as an effective barrier. Gabion structure consists of wire mesh boxes interconnected by tying the same with steel wire. Each wire mesh box will be filled with locally available rubbles and boulders.

#### **Dimensions of Gabion Structures**

Length of Gabion Box – 1 m

Width of Gabion Box – 1 m

Height of Gabion Box – 1 m

### **(v) Construction of Silt Traps/Desilting Pits**

- Construct **silt trap** on the upstream side of the barrier.
- Remove the silt from the silt trap periodically for better functioning of the system.

### **Dimensions of Silt Trap/Desilting Pit**

Length of the Silt Trap – Width of the Nallah

Width of the Silt Trap – 3 m

Depth of the Silt Trap – 2 m

- Provide suitable slope to the sidewalls of the pit in the ratio 1.5:1.
- Carry out pitching with Random rubbles to avoid erosion of sidewalls.
- Remove the silt from the pit periodically either manually or with excavators for efficient functioning of the structure.

### **(vi) Construction of RCC Check Weir**

- Construct **RCC Check Weir** of suitable structural design at a favourable location before the inlet point of the settling pond.
- Divert the water from the upstream side of check weir to a settling pond and subsequently to the SCP through 2 no.s of 0.9 m dia RCC hume pipes (**inlet arrangement**).
- Provide **PCC platform** at the downstream side of the check weir to avoid gully erosion.



### **Dimensions of RCC Check Weir**

Length of the Check Weir = Width of the Nallah

Width of the Check Weir = 0.3 m to 0.4 m

Height of the Check Weir = 0.9 to 1.2 m above ground level

1 m below ground level

**For Construction Details & Pitching of Side walls, Images of Barriers, Gully Plugs etc., Refer SCP – 1 in Recommendation – 1 A.**

### **(VII) Construction of Settling cum Recharge Pond before the Entry Point to the SCP**

- *Construct a **Settling cum Recharge Pond** of the following dimensions at a suitable location and allow the runoff water from the storm water canal to pass through this settling tank through 2 no.s of 0.9 m RCC hume pipes.*
- *Provide proper overflow arrangements to the settling tank with 0.9 m dia RCC hume pipes and divert the water to the SCP.*
- *Desilt the settling pond periodically.*

### **Dimensions of the Settling cum Recharge Pond**

Length of the Tank – 30 m

Width of the Tank – 30 m

Depth of the Tank – 3 m

- *Excavate the soil to depth of 3 m below ground level and dispose the soil elsewhere.*
- *Provide suitable slope to the sidewalls of pond in the ratio 1:1 (Horizontal: Vertical) to avoid soil erosion. Level and consolidate the bottom and side walls of the pond. Remove all sharp edges and protrusions.*
- *Provide necessary berm of width 1.2 m on all sides of the pond.*
- *Provide slope for the base of the pond towards the outlet side so that accumulated silt, if any, can be removed after monsoon.*

### **Pitching of Side walls to avoid Soil Erosion**

- *Carry out pitching for the side walls of the pond and berm with PCC slabs measuring 0.3 m x 0.45 m x 0.05 m or designer tiles of suitable size.*
- *Construct a toe wall at the base of the side walls of pond to check the slipping of pre-cast slabs provided on the side wall.*
- *Level and consolidate the sidewalls of the pond and provide PCC mix of suitable thickness as a binder for fixing the pre-cast slabs.*
- *Fix pre-cast PCC slabs of size 0.45 m x 0.3 m x 0.05 m or designer tiles of suitable size on the side walls of the Pond and carryout pointing on the sidewalls.*
- *Maintain water level for each row of pre-cast slabs for better aesthetic view.*
- *Lay pre-cast slabs of different design on top of the berms also.*
- *Provide weep holes with 2 inches PVC pipe, at a rate of 1 m horizontal and 1 m vertical, for the side walls of the pond to facilitate seepage and avoid pressure on the PCC slabs.*
- *Provide suitable overflow arrangement and allow the comparatively silt free water to the SCP.*

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## **RECOMMENDATIONS FOR THE KRIYAKUDAR BLOCK**

### **KRIYAKUDAR BLOCK**

Kriyakudar Block is a small block in the leasehold area, located on the South Eastern part of the Lease area. The enrichment of mineralization is reported on the Southern part of the Block and the mining plan is shown in Figure – 29. The topo setting of the block is shown in Figure – 30. It is a plateau area with valley on the Western side and hillock on the Eastern side. There is a perennial nallah, Jalpa nallah, on the Eastern side of the Core area and ground water potential is good.

The presence of springs and perennial runoff in the valley of Kriyakudar block is noted and the topographic setting is indicative of good rainfall runoff in the nallah. The presence of a dyke cutting across the nallah results in subsurface barrier for ground water flow and springs emerge in the contact zone. The mining plan of the Kriyakudar block is given in Figure – 31.

**Photo – 12: Jalpa Nallah, Perennial Source**



**Photo – 13: Spring Source Contributing to the Nallah**





**Photo – 14: Dyke acting as Sub Surface Barrier Resulting in Emergence of Springs**



**Photo – 15: Location of Proposed SCP with Springs**



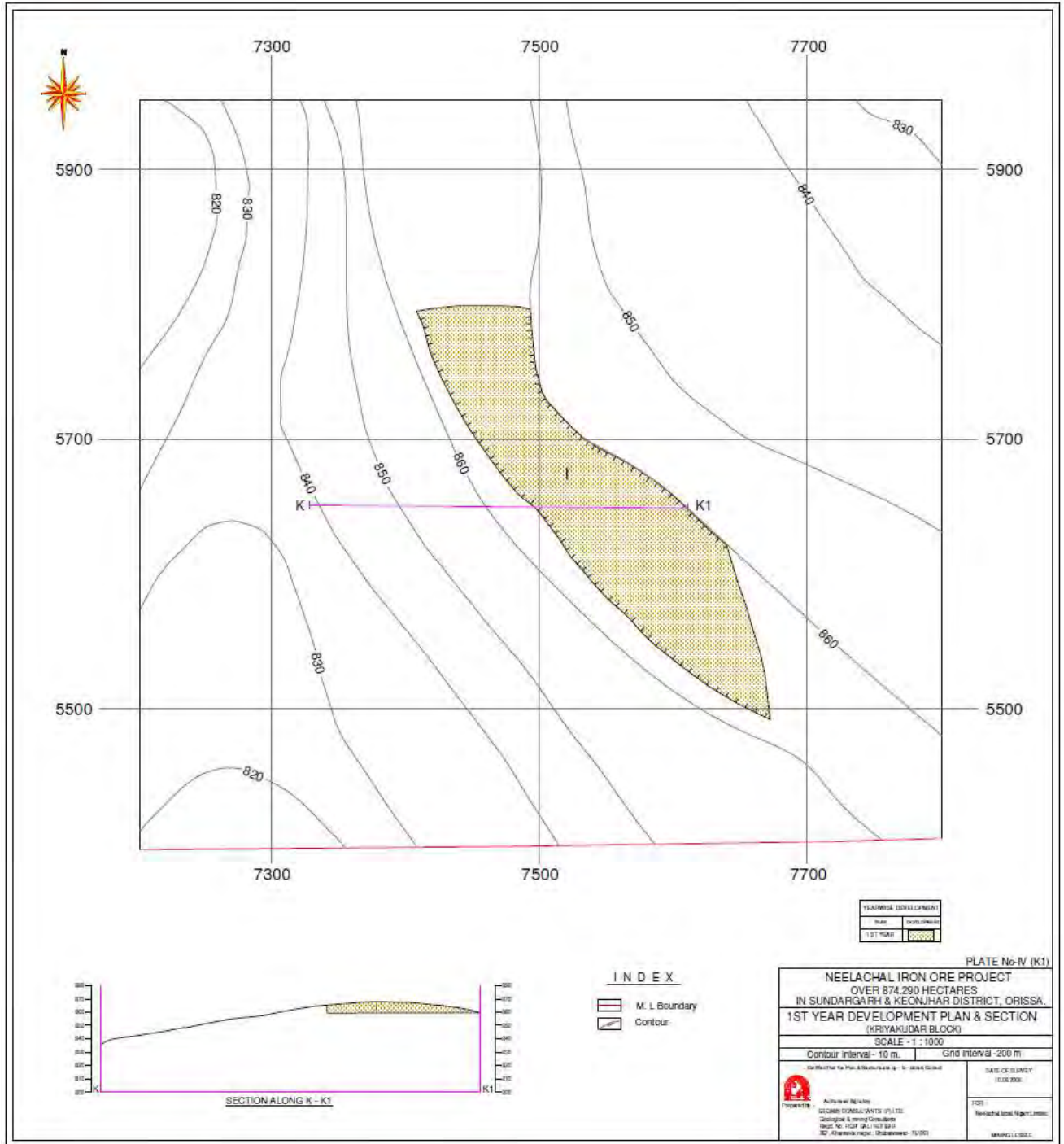


There are a few hand pumps in the Kriyakudar village and reported to have good quality water at shallow depths in summer months also.

**Photo – 16: Hand Pumps in Kriyakudar Village**

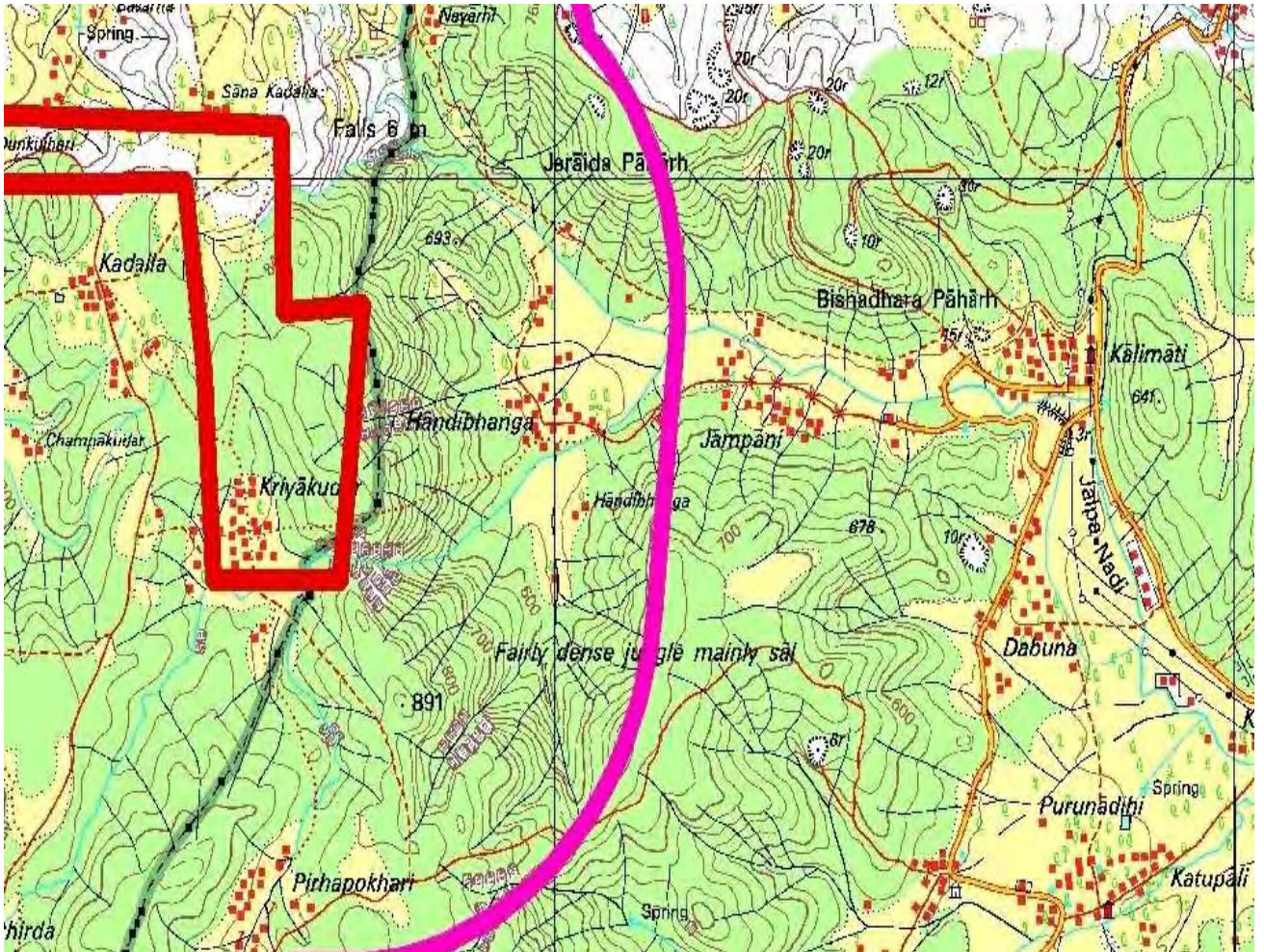


**FIGURE – 29: MINE DEVELOPMENT PLAN OF KRIYAKUDAR BLOCK**

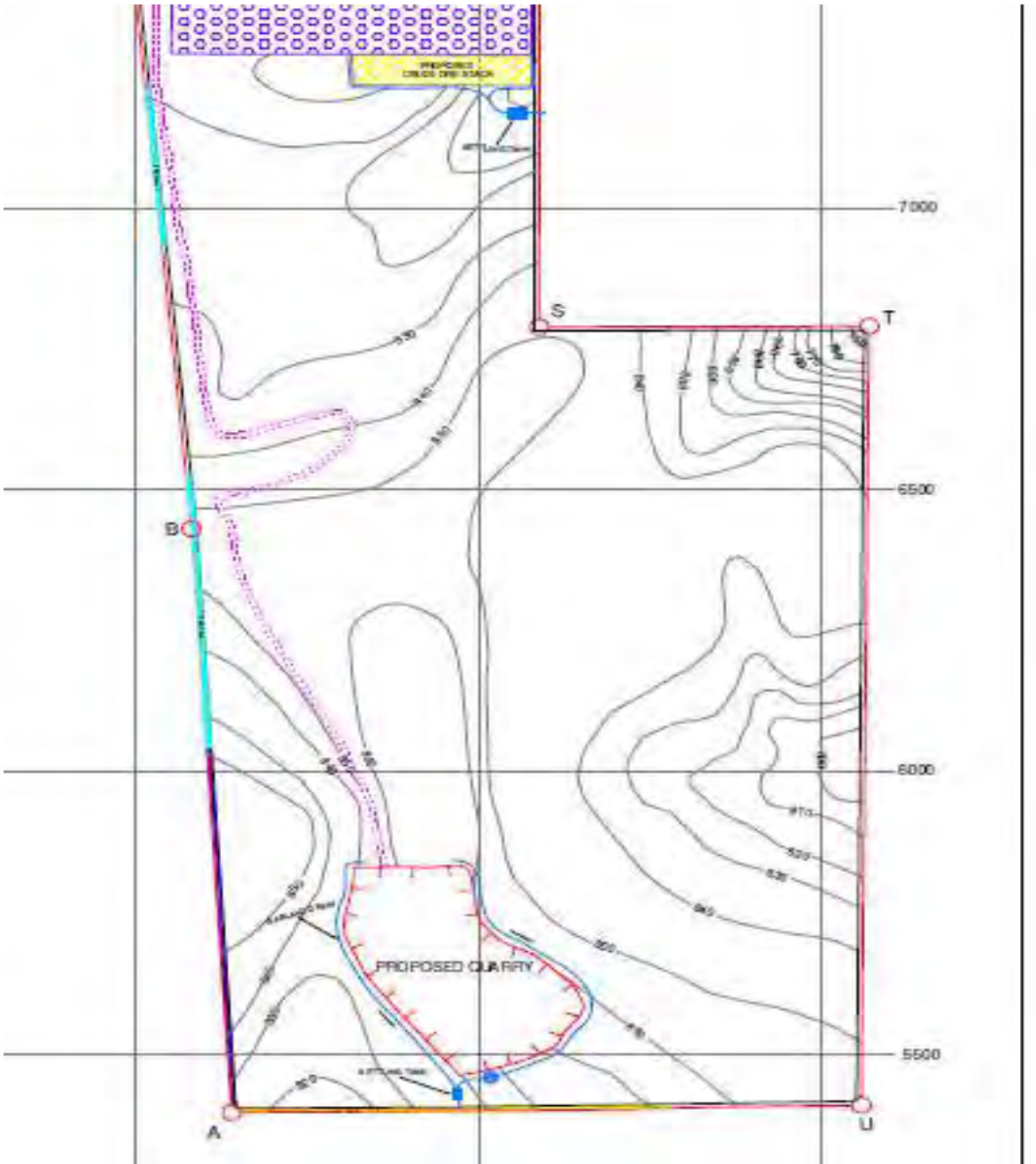




**FIGURE – 30: TOPO SETTING OF KRIYAKUDAR BLOCK**

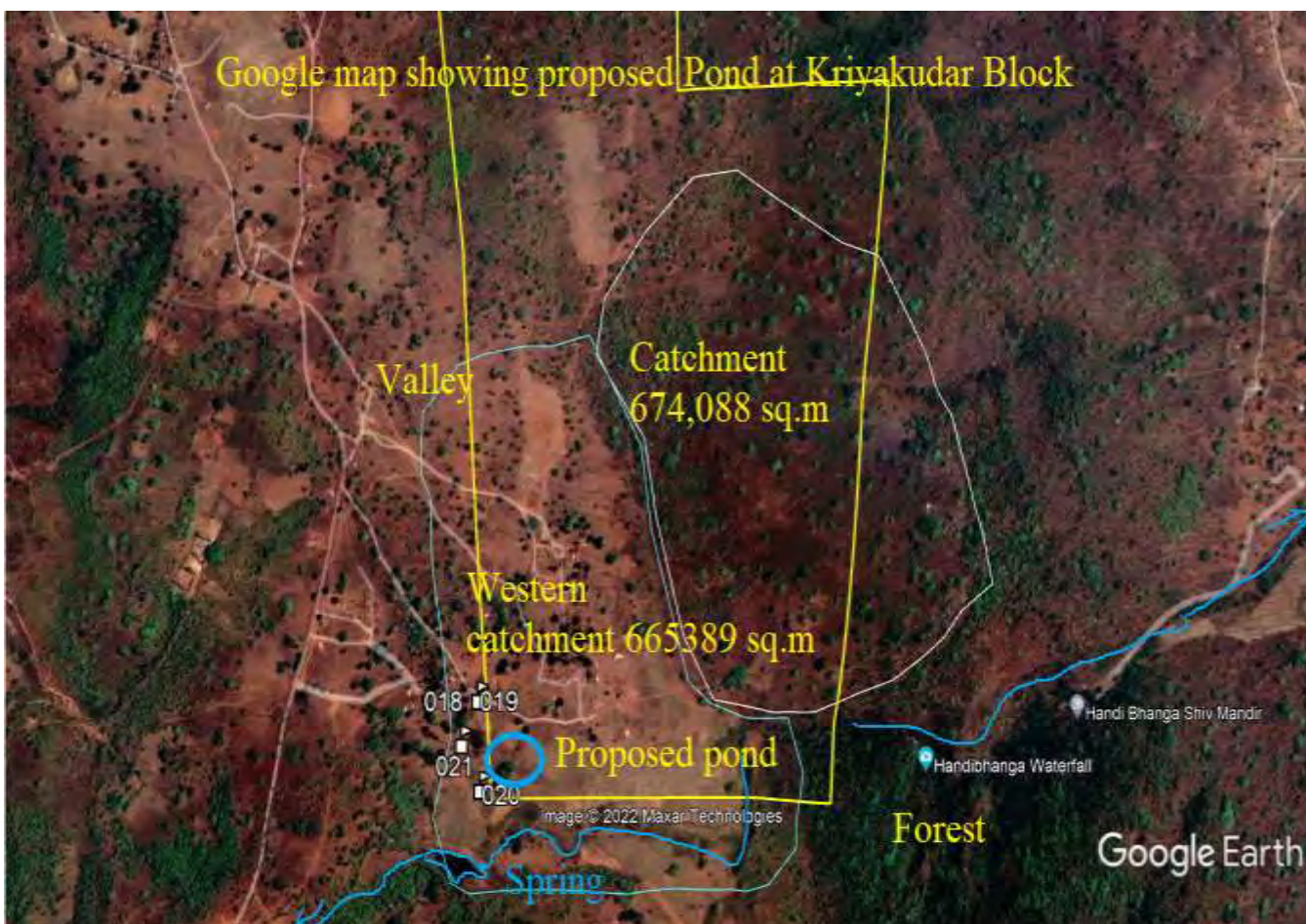


**FIGURE – 31: MINE PLAN SHOWING THE PROPOSED QUARRY  
AND GARLAND DRAIN**





**FIGURE – 32: GOOGLE MAP SHOWING THE EASTERN UPLAND  
AND WESTERN VALLEY**





## RECOMMENDATION – 3

### I. CONSTRUCTION OF STORAGE CUM PERCOLATION POND

#### Location: South Western Portion of the Block

The detailed hydrogeological survey of the Kriyakudar block and the areas in and around the Jalpa Nallah has indicated that the area is occupied by number of ground water flow lines and springs, which contributed to the perennial source. It is recommended to construct storage cum percolation pond and impound the runoff water, which will sustain the shallow water table and yield of the springs. The enormous quantity of runoff water generated from the uplands may be diverted to this SCP through suitable diversion contours.

#### Water Harvesting Potential for the Storage cum Percolation Pond

$$\text{Area} = 665389 \text{ m}^2$$

$$\text{Runoff Co-efficient} = 0.2$$

$$\text{Annual Rainfall} = 1.697 \text{ m}$$

$$= 665389 \times 0.2 \times 1.697 = \mathbf{225833 \text{ m}^3 \text{ per annum (618 m}^3 \text{ per day)}}$$

- Construct **Storage cum Percolation Pond (SCP)** at the identified favourable location on the South Western portion of the Kriyakudar block.
- Use the excavated soil to **prepare strong bunds** surrounding the SCP.
- Construct **contour trenches / storm water canal** for the diversion of runoff water from the catchment area to the pond.
- Construct **RCC Check Weir** at the tail end of the contour trench / canal.

- *Divert the water from the upstream side of check weir to a settling pond and subsequently to the SCP through 2 no.s of 0.9 m dia RCC hume pipes (**inlet arrangement**).*
- *Divert the **overflow water** from the pond through 2 no.s of 0.9 m dia RCC hume pipes to follow the original drainage pattern.*

### **Dimensions of the Storage cum Percolation Pond (SCP)**

Length of the Pond – 200 m  
Width of the Pond – 200 m  
Depth of the Pond – 4 m  
Surface Area – 40000 Sq.m  
Free Board – 0.9 m  
Storage Capacity – 124000 m³

### **Construction Details**

- *Excavate the top soil up to a depth of 4 m below ground level. Use the excavated soil to prepare short bunds surrounding the SCP.*
- *Provide suitable slope to the sidewalls of SCP in the ratio 1:1 (Horizontal: Vertical) to avoid soil erosion.*
- *In case pitching of the side walls is not carried due to budgetary constraints, provide slope to the side walls in the ration 1.5:1 (Horizontal : Vertical).*
- *Level and consolidate the bottom and side walls of the SCP. Remove all sharp edges and protrusions.*
- *Provide necessary berm of width 1.2 m on all sides of the SCP.*
- ***Provide slope for the base of the SCP towards the outlet side so that accumulated silt, if any, can be removed after monsoon.***

---

### **Pitching of Side walls to avoid Soil Erosion (optional)**

- *Carry out pitching for the side walls of the pond and berm with PCC slabs measuring 0.3 m x 0.45 m x 0.05 m.*
- *Construct a toe wall at the base of the side walls of SCP to check the slipping of pre-cast slabs provided on the side wall (For Toe wall details, refer the CAD drawing).*
- *Level and consolidate the sidewalls of the SCP and provide PCC mix of suitable thickness as a binder for fixing the pre-cast slabs.*
- *Fix pre-cast PCC slabs of size 0.45 m x 0.3 m x 0.05 m on the side walls of the SCP and carryout pointing on the sidewalls.*
- *Maintain water level for each row of pre-cast slabs for better aesthetic view.*
- *Lay pre-cast slabs of different design on top of the berms also.*
- *Provide weep holes with 2 inches PVC pipe, at a rate of 1 m horizontal and 1 m vertical, for the side walls of the pond to facilitate seepage and avoid pressure on the PCC slabs.*
- *Provide Step arrangements with stainless steel railings for easy access into the SCP for maintenance purposes.*
- *Provide attractive grill fencing for safety purposes.*

## Provision of Basic Amenities for the Public

- Grow **flowering plants like Lotus, Lilly, etc. in the pond** and this may give an appearance of a green belt.
- Provide **colourful ornamental grill fencing** all around the pond for safety purposes and a few **sitting arrangements** for relaxation.
- Provide **Separate Bathing Ghats for Gents and Ladies** at suitable locations.
- Provide **Change over Rooms**, especially for Ladies.
- Provide separate **Bio Toilets** for Ladies and Gents and provide water supply from the pond.
- Provide **dustbins** at suitable locations.

**Photo – 17: Lily Plant, Steps with Stainless Steel Railings**



**Photo – 18: Ornamental Grill Fencing for Safety Purposes**



**Photo – 19: Sitting Arrangement**





**Photo – 20: Ladies Bathing Ghat with Change Over Room**



**Photo – 21: Toilet for Ladies and Gents**



## (II) Construction of Strong Bunds surrounding the SCP

- Construct **Bunds** surrounding the SCP with the excavated soil.
- Provide suitable slope to the side walls of the bund in the ratio 1.5:1 (Horizontal : Vertical)
- Consolidate and level the sloping sides of the bund by watering and ramming.

### Dimensions of Bund

Length of Bund	–	Top Perimeter of the pond
Top Width	–	1.5 m
Bottom Width	–	6 m
Height	–	1.5 m

### Measures to arrest soil erosion of side walls of the Bund (Optional)

Needless to mention, in spite of maintaining scientifically designed slope of side walls, there may be a possibility of erosion of soil and subsequent caving in of the walls. This can be overcome by resorting to the following.

Planting of Vetiver (*Vetiveria zizanioides*) on bund and also side walls, particularly on the free board side, is a simple and inexpensive method for effective means to check soil erosion.

### **(III) Construction of Contour Trench / Storm Water Canal**

#### **Dimensions of the Storm Water Canal**

Length of the Canal	=	App. 1000 m
Top Width of the Canal	=	3 m
Bottom Width of the Canal	=	0.9 m
Depth of the Canal	=	1 m

- *Provide suitable slope to the side walls of the canal in the ratio 1:1*
- *Level and consolidate the side walls of the canal by watering and ramming.*
- *Remove all sharp edges and protrusions*
- *Maintain the drains periodically by removing the weeds, silt accumulation etc. both before and after monsoon.*

---

#### **(IV) Construction of RCC Barriers / Barriers with Locally Available Boulders Across the Contour Trench / Drain**

- *Provide RCC Barriers or Gully plugs (Crated boulder masonry) with locally available boulders in the storm water drain at suitable intervals.*
- *The barriers will check the velocity of the flowing water and deposit the silt on the upstream side of the barrier.*

#### **Dimensions of Barrier (Gully Plug) with Random Rubbles**

Length of the Barrier – Width of the drain

Top Width – 0.75 m

Bottom Width – 2 m

Height of the Barrier – 0.6 m

#### **Construction of Gabion Structures across the Contour Trench/Drain**

Gabion Structures may also be constructed along the path of the drain, which will act as an effective barrier. Gabion structure consists of wire mesh boxes interconnected by tying the same with steel wire. Each wire mesh box will be filled with locally available rubbles and boulders.

#### **Dimensions of Gabion Structures**

Length of Gabion Box – 1 m

Width of Gabion Box – 1 m

Height of Gabion Box – 1 m

### **(v) Construction of Silt Traps/Desilting Pits**

- Construct **silt trap** on the upstream side of the barrier.
- Remove the silt from the silt trap periodically for better functioning of the system.

### **Dimensions of Silt Trap/Desilting Pit**

Length of the Silt Trap – Width of the Nallah

Width of the Silt Trap – 3 m

Depth of the Silt Trap – 2 m

- Provide suitable slope to the sidewalls of the pit in the ratio 1.5:1.
- Carry out pitching with Random rubbles to avoid erosion of sidewalls.
- Remove the silt from the pit periodically either manually or with excavators for efficient functioning of the structure.

### **(vi) Construction of RCC Check Weir**

- Construct **RCC Check Weir** of suitable structural design at a favourable location before the inlet point of the settling pond.
- Divert the water from the upstream side of check weir to a settling pond and subsequently to the SCP through 2 no.s of 0.9 m dia RCC hume pipes (**inlet arrangement**).
- Provide **PCC platform** at the downstream side of the check weir to avoid gully erosion.



### **Dimensions of RCC Check Weir**

Length of the Check Weir = Width of the Nallah

Width of the Check Weir = 0.3 m to 0.4 m

Height of the Check Weir = 0.9 to 1.2 m above ground level  
1 m below ground level

**For Construction Details & Pitching of Side walls, Images of Barriers, Gully Plugs etc., Refer SCP – 1 in Recommendation – 1 A.**

### **(VII) Construction of Settling cum Recharge Pond before the Entry Point to the SCP**

- *Construct a **Settling cum Recharge Pond** of the following dimensions at a suitable location and allow the runoff water from the storm water canal to pass through this settling tank through 2 no.s of 0.9 m RCC hume pipes.*
- *Provide proper overflow arrangements to the settling tank with 0.9 m dia RCC hume pipes and divert the water to the SCP.*
- *Desilt the settling pond periodically.*

### **Dimensions of the Settling cum Recharge Pond**

Length of the Tank – 30 m

Width of the Tank – 30 m

Depth of the Tank – 3 m

- *Excavate the soil to depth of 3 m below ground level and dispose the soil elsewhere.*
- *Provide suitable slope to the sidewalls of pond in the ratio 1:1 (Horizontal: Vertical) to avoid soil erosion. Level and consolidate the bottom and side walls of the pond. Remove all sharp edges and protrusions.*
- *Provide necessary berm of width 1.2 m on all sides of the pond.*
- *Provide slope for the base of the pond towards the outlet side so that accumulated silt, if any, can be removed after monsoon.*

### **Pitching of Side walls to avoid Soil Erosion**

- *Carry out pitching for the side walls of the pond and berm with PCC slabs measuring 0.3 m x 0.45 m x 0.05 m or designer tiles of suitable size.*
- *Construct a toe wall at the base of the side walls of pond to check the slipping of pre-cast slabs provided on the side wall.*
- *Level and consolidate the sidewalls of the pond and provide PCC mix of suitable thickness as a binder for fixing the pre-cast slabs.*
- *Fix pre-cast PCC slabs of size 0.45 m x 0.3 m x 0.05 m or designer tiles of suitable size on the side walls of the Pond and carryout pointing on the sidewalls.*
- *Maintain water level for each row of pre-cast slabs for better aesthetic view.*
- *Lay pre-cast slabs of different design on top of the berms also.*
- *Provide weep holes with 2 inches PVC pipe, at a rate of 1 m horizontal and 1 m vertical, for the side walls of the pond to facilitate seepage and avoid pressure on the PCC slabs.*
- *Provide suitable overflow arrangement and allow the comparatively silt free water to the SCP.*

## RECOMMENDATION – 4

### CONSTRUCTION OF MICRO CATCHMENT STRUCTURES

#### Location: Open Area and Slope of the Hills

#### Plan of Action – Micro Catchment Principle

It is recommended to introduce micro catchment structures in the green belt areas and divert the runoff water from nearby areas to mini percolation pits, contour bunds and trenches by providing suitable diversion contours. This will improve the soil moisture content of the immediate subsurface resulting in more saturation and aggressive growth of the plants and trees.

It is recommended to *introduce Micro Catchment principle, an innovative and simple surface water harvesting technique* in the available open area in between the rows of plants and trees.

- ***Construct Mini Percolation Pits (MPP)** in the green belt area on both sides of the road and near factory sheds.*
- *Excavate a pit measuring 1 m length x 1 m width and 1m depth and remove the surface soil.*
- *Maintain a distance of 2 to 4 m between the recharge structures.*
- ***Divert the surface water from the nearby open area by providing diversion contours.***
- *Each structure can hold minimum 1000 liters of water apart from allowing the water for continuous percolation.*

**Figure – 33: Photo Showing the Mini Percolation Pits**





### **SMALL MEANS EVEN MORE WATER**

- The key component of water management is 'Storage'.
- Water can be captured in small tanks and ponds with small catchments or by storing it in a way that it percolates down into the ground and gets stored as ground water.
- Israeli Scientist Michael Evenari came up with a very surprising finding: "Water harvested from small watersheds per hectare of watershed area was much more in quantity than that collected over large watersheds. On hindsight, this makes sense because water collected over larger watersheds will have to run over a large area before it is collected and a large part will get lost in small puddles and depressions, as soil moisture and through evaporation. This loss of water can be stunningly high.
- The amount of rainwater one can collect depends on the amount of land from which the run off can be harvested. Even if you have the same amount of land you will collect more water if you break up the land into many small catchments than if you collect water from it as one catchment.
- Several studies conducted in India by the Central Soil and Water Conservation Research and Training Institute in Dehra Dun also show a clear relationship between size of catchment and amount of runoff that can be captured. One study shows that by just increasing the size of the catchment from 1 ha to about 2 ha reduces the water yield per hectare by as much as 20 per cent. Several other studies conducted by the Central Soil and Water Conservation Research Institute in Agra, Bellary and Kota and another study conducted in the high rainfall region of Shillong, have all found that smaller watersheds give higher amounts of water per hectare of catchment area.

(Excerpts from "MAKING WATER EVERYBODY'S BUSINESS PRACTICE AND POLICY OF WATER HARVESTING", published by Centre for Science and Environment )

## **Staggered Trenches and Bunds**

It is recommended to construct **Staggered Trenches and Bunds** at selective locations in the green belt area as per the following dimensions.

### **Dimensions of Contour Trenches**

Length	–	250 m
Top Width	–	1.8 m
Bottom Width	–	0.6 m
Depth	–	0.6 m

### **Dimensions of Staggered Trenches**

Length	–	3 to 10 m
Width	–	1 to 2 m
Depth	–	0.5 to 1 m

- Provide suitable slope to the side walls of the trenches to check erosion of side walls.
- Level and consolidate the side walls of the trench.

**The bunds may be constructed on the downstream sides of the staggered trenches.**

### **Dimensions of the Bund**

Top Width	–	1 m to 1.5 m
Bottom Width	–	3 m to 4.5 m
Height	–	Average 1 m

- Provide suitable slope to the bund to avoid erosion of side walls.

**Figure – 34: Contour Trenches and Saucer Ponds**



**Figure – 35: Staggered Trench**



## Construction of Saucer Ponds

- Construct **Saucer Ponds** of the following dimensions on the green belt adjoining the storm water drains.
- Interconnect the saucer ponds by 150 mm Dia RCC pipes.
- Divert the water from the storm water drain through 150 mm Dia RCC/PVC pipe.
- Divert the surface water from upstream area to the ponds through a network of diversion contours.

## Dimensions of Saucer Pond

Dia – 2 m to 5 m depending on available area

Depth – 2 m to 3 m depending on subsurface formations

Slope: 1:2

- Excavate the saucer pond to the desired depth.
- Use the excavated soil to provide bunds on the downstream side of the pond which will check the rush of water towards lower areas.
- Provide suitable slope to the side walls of the pond in the ratio 1:2 (1-Vertical: 2-Horizontal)
- Carrying out manual dressing to the side slopes of the pond and remove protrusions and consolidate the side walls by watering and ramming.



## RECOMMENDATION – 5

### MEASURES TO AVOID SEVERE GULLY EROSION OF THE ORE DUMPS AND STOCK PILES AND MINIMIZE SILT FLOW TO NALLAHS

#### (a) Growing Native Plants and Vetiver

- Provide **geo textile membrane** to the sloping terraces of the mine dumps and grow suitable grass and increase the vegetative growth on the slopes. This will retard the head ward erosion of the slopes of the mine dumps and check the flow of silt towards the low lying area to a great extent.
- It is recommended to **grow native plants and vetiver grass (*Vetiveria zizanioides*)** on the sloping walls of the mine dump. The root of the vetiver grass will eventually consolidate the side wall and thus avoid soil erosion.
- During the survey, it is observed that a few plants are vigorously growing on the dump area. Hence, it is advisable to plant these species of plants on the dump area instead of plants of unknown characters.

#### (b) Construction of Retaining Wall and Garland Drains at the Base of the Mine Dumps and Stock Piles

- Provide *retaining wall with random rubbles / locally available boulders to a height of 1.2 to 1.5 m above ground level at the base all along the boundary of the mine dumps. The width of retaining wall may be 0.75 to 0.9 m.*
- *The retaining wall may be constructed with locally available boulders and the boulders may be tied together with by 4" x 4" opening GI wire mesh to a form a continuous retaining wall like structure.*

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**Photo – 22: Retaining Wall with Crated Boulder Masonry**



- Construct **Garland drain** outside the retaining wall to channelize the runoff water towards the nearby gullies.
- Construct **Barriers with locally available boulders** at suitable intervals along the path of the garland drain.

**Dimensions of Garland Drain**

Top Width of the Drain	–	1.5 to 1.8m
Bottom Width of the Drain	–	0.6 to 0.75 m
Depth of the Drain	–	0.6 to 1 m

- Provide suitable slope to the side walls of the drain to avoid erosion of side walls.

## Barriers

- Construct **barriers** at suitable intervals along the path of the drain with locally available boulders.

Length of the Barrier	–	Width of the drain
Top Width	–	0.75 m
Bottom Width	–	2 m
Height of the Barrier	–	0.6 m

## Construction of Settling Pits

- *It is also advisable to introduce settling pits of suitable dimensions along the path of the drain at strategic locations.*
- *Remove the accumulated silt from the desilting pits periodically.*

## Dimensions of the Settling Pit

Length of the Pit	–	2 m
Width of the Pit	–	2 m
Depth of the Pit	–	1.5 m

- *Provide suitable slope to the sidewalls of the pit in the ratio 1.5:1.*
- *Carry out pitching with Random rubbles at avoid erosion of sidewalls.*
- *Remove the silt from the pit periodically either manually or with excavators for efficient functioning of the structure.*

**Special Note: The above recommendations can be extended to all the mine dumps in the mine.**

### **(c) Direct the Flow of Runoff water in a controlled manner**

- It is observed that during heavy monsoon, the runoff water flows out from the top and side slopes of the dumps as **sheet flow**, consequence of which, heavy surface soil erosion takes place.
- It is noted that the vulnerability of gully erosion is more in the loosely dumped fine stacks of ore dump.
- The terracing is inadequate at certain pockets due to the limited space available between the top of the dump and lease boundary.
- The coir matt in the waste dump area is also vulnerable for erosion during high intensity rainfall.
- Collection of runoff water in a section of the terrace without proper drainage towards the down slope accelerates the gully erosion
- Huge quantity of the eroded soil is being carried away by the runoff water and gets deposited all along the path of flow upto the nallah/river.

### **Remedial Measures**

#### **(i) Increase the number of terraces**

- Increase the number of terraces, 2 or 3 instead of a single dump, for each mine dump.
- Provide proper drainage arrangement for each terrace for smooth flow of water towards the down slope side.
- Consolidate the terraces to minimize the gully erosion.



## (ii) Construction of Gutters

- Provide semi-circle gutters of suitable dimensions at equal intervals, prepared out of HDPE sheet or fiber glass (Refer Figure – 21).
- These gutters may be augured firmly on the top and bottom of the dumps by effective PCC grouting.
- This will reduce soil erosion to a considerable extent and improve the colour of runoff water too.

## (iii) Maintain Gradient towards Central Portion of the Dumps

- It is also advisable to maintain gradients of the top surface of the dump area, towards the centre of the dump, instead of allowing runoff water to flow out through the periphery of the top surface.
- This arrangement may allow the gradual percolation of rainwater into the dumps which may emerge as seepage on the bottom side of the dumps or at the downstream areas of the mine depending on the sub surface formation.
- Needless to mention, this seepage emerging from the base of the dumps will be free from silt and will also be colourless.

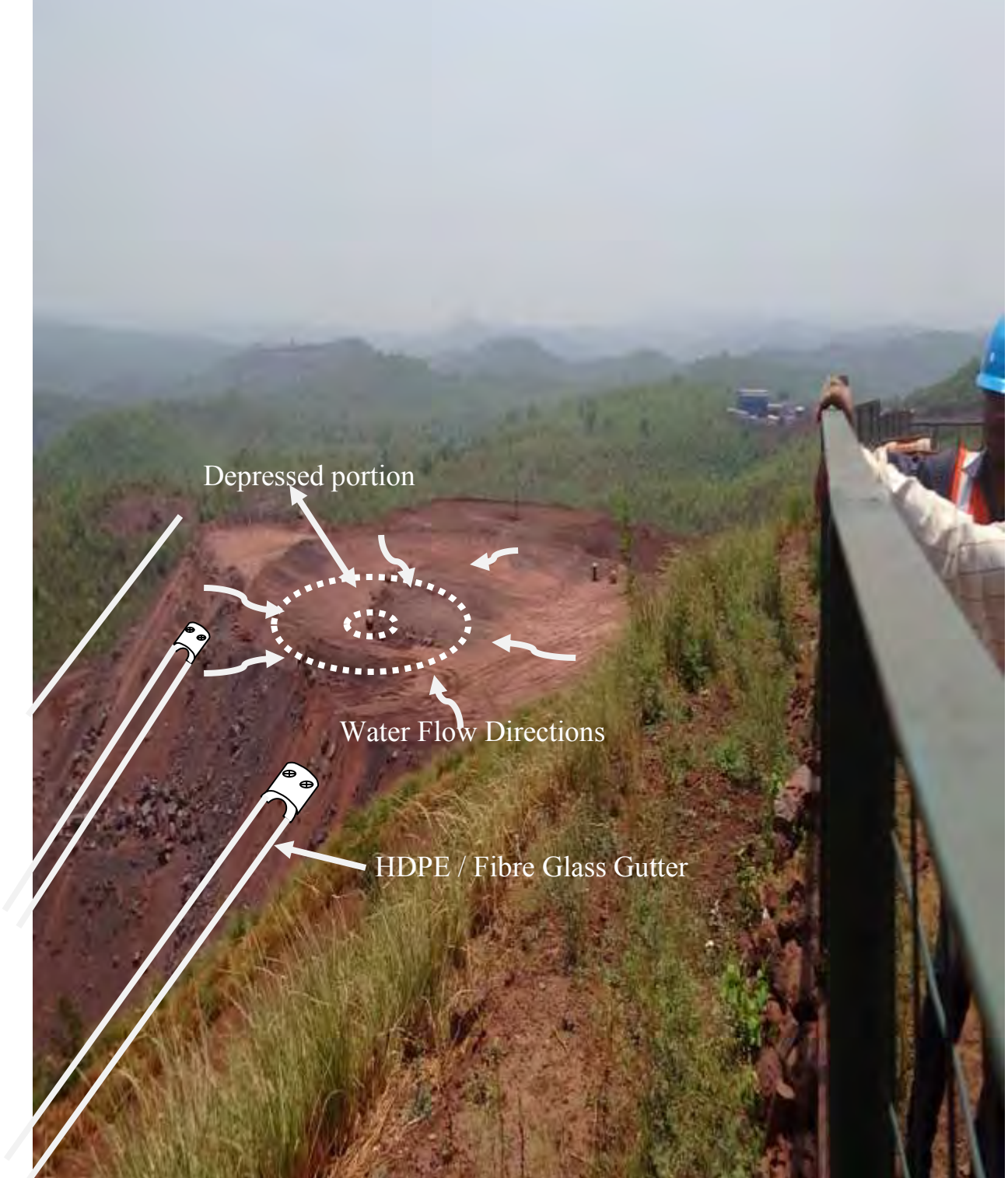
## (iv) Construction of Mini Ponds

- In case of overflow of rainwater from the central portion of the dump, it may result in further soil erosion and damage of the surface area. Therefore, it is advisable to provide mini ponds on the middle of the dumps. The overflow water from the ponds, if any, can be let out of the top surface area in a controlled manner through the proposed fiber glass or HDPE sheet gutters.

### **Benefits of the above Arrangement**

- It will improve the quality of water flowing out of the lease hold area.
- It may accelerate the emergence of seepage on the low lying areas.
- It may drastically reduce the generation of silt.
- It will improve the general environment of the mine as all the dumps may become clean and green instead of a barren unpleasant heap of loose soil.

**Figure – 36: Proposed Water Diversion Arrangement for Dumps**



## **(d) Arrangement to Check the Entry of Silt towards the Nallah/Pond**

### **(i) From the Mine Dumps**

- Provide *retaining wall with random rubbles to a height of 1.2 m above ground level* at the base all along the boundary of the mine dumps.
- Construct *Garland drain* outside the retaining wall to channelize the runoff water towards the nearby gullies.
- Construct *barriers* at suitable intervals along the path of the garland drain.

### **(ii) Arrangement to Remove Silt along the Path of Gullies**

- Provide *gully plugs with locally available boulders in the gullies at suitable intervals*.
- *The gully plugs will check the velocity of the flowing water and deposit the silt on the upstream side of the gully plug.*
- *Remove the silt from the upstream side of the gully plug periodically.*

### **Dimensions of Gully Plug**

Length of the Gully Plug	– Width of the Gully
Top Width	– 1 m
Bottom Width	– 2.5 m
Height of the Gully Plug	– 2/3 rd height from the base of nallah.



**Photo – 23: RR Masonry Gully Plug**



**(iii) To Check the Entry of Silt from Slopes of Mine Cut Areas and Overland Erosion on Mine Approach Roads**

- *Provide **bunds** on the edge of all the approach roads to avoid flow of water along the sides of side walls of mine cut areas.*
- *Construct **small drains** on the inner side of the roads (mine cut side) and provide slope of the road towards the inner side so that the runoff water from the roads and side walls will be channelized into the drains.*
- *Construct **barriers** at suitable intervals along the path of the drains.*

## **Barriers and Settling Pits**

- Construct **barriers** with locally available boulders at suitable intervals across the drain.
- The height of the drain may be upto  $2/3^{\text{rd}}$  depth of the drain.
- Construct **settling pits** at appropriate location and remove the silt from the pits periodically.

## CHAPTER VII

### CONCLUSION

The mining requirements of NINL mines is estimated at 550 cu.m/day and the construction of 4 bore wells at required areas of activity needs detailed hydrogeological and geophysical surveys to pinpoint the sites. The permission for ground water extraction from 2 bore wells, to the tune of 100 m³ per day has been obtained from Central Ground Water Authority (CGWA) vide NOC No. CGWA/NOC/MIN/ORIG/2023/17541 dated 12.01.2023. The detailed study of ground water levels and water quality monitoring in the buffer zone along with the study of aquifer parameters with pumping test and geophysical set up of the area is essential to carry out Ground water modeling studies as per the Standard Operating Procedure (SOP) of CGWA.

The perennial source to meet the daily requirements of the mine is the river water. The river source will be obtained with the approval of Department of Water Resources, Govt. of Odisha, for which, necessary steps have already been initiated. The pumping cost and distance will be the constraints in addition to the risk of monsoon failure and reduced river flow.

The mandatory rainwater harvesting systems as per the site conditions are considered and optimum number of structures are proposed in this report. The scope for creating storage cum recharge pond for all the 3 Blocks is inferred from the studies and the long term water management planning of the project will have definite advantage from the rain water harvesting structures and the same can be implemented in a phased manner.

The detailed Technical Feasibility Study very vividly indicates the tremendous scope and feasibility for implementing Rainwater Harvesting Systems and techniques at the Iron ore mines of **Neelachal Ispat Nigam limited, Odisha State.**

Based on the present scientific study involving various methodologies, recommendations have been made to fulfil the statutory requirements of rain water harvesting in the mine lease area. The active mining area should be provided with garland drains and silt traps to prevent transport of ore dust and suspended solids during rain towards the downstream nallah.

The protection of water environment in the downslope is adequately addressed in the mining plan and additional rain water harvesting structures are proposed with detailed terrain analysis.

Suggestions have been given to arrest the silt flowing through storm water drains and site-specific recharge structures for saturating the top weathered portion.

**The implementing agencies** should have thorough knowledge both in scientific and technical aspects of recharge studies and construction of artificial recharge structures. As we have experienced engineers, hydrogeologists and skilled workers and as we have completed number of projects for both Government Agencies, and leading industries and multi national companies of our country, we feel confident that we can **crystallize all the recommendations from paper to reality.**



**Photo 1- Two Stage Settling Pond near to Mithirda dump area**



**Photo 2- Retaining wall & garland drain near Mineral Stackyard**





**Noise Monitoring Report**  
**Neelachal Ispat Nigam Limited of M/s Tata Steel Limited**  
**Period: October-23 to March-24**

Mine Location	Sample Location	Month	Unit	Results	
				Day	Night
Neelachal Ispat Nigam Limited	Main Gate	October-23	dB(A)	67.2	54.9
		November-23	dB(A)	64.9	52.7
		December-23	dB(A)	68.7	52.6
		January-24	dB(A)	68.3	57.1
		February-24	dB(A)	67.1	54.9
		March-24	dB(A)	68.3	56.2
	Office Area Near Canteen	October-23	dB(A)	52.8	39.7
		November-23	dB(A)	48.3	37.6
		December-23	dB(A)	47.3	38.9
		January-24	dB(A)	48.1	37.6
		February-24	dB(A)	47.3	38.1
		March-24	dB(A)	51.9	42.7
	Mining Area	October-23	dB(A)	72.1	64.3
		November-23	dB(A)	71.1	62.8
		December-23	dB(A)	68.7	62.1
		January-24	dB(A)	64.9	53.8
		February-24	dB(A)	71.6	62.8
		March-24	dB(A)	69.1	58.3
	Dump-1	October-23	dB(A)	64.9	51.6
		November-23	dB(A)	67.2	56.1
		December-23	dB(A)	64.8	53.9
		January-24	dB(A)	67.2	56.7
		February-24	dB(A)	64.9	58.6
		March-24	dB(A)	62.7	54.9
	Stock Yard	October-23	dB(A)	68.3	54.1
		November-23	dB(A)	68.7	52.6
		December-23	dB(A)	58.3	47.6
		January-24	dB(A)	57.4	48.3
		February-24	dB(A)	62.1	52.7
		March-24	dB(A)	58.3	47.6
	Norms Day (6 AM – 10 PM) Night ( 10 PM – 6 AM)	Industrial		75.0	70.0
		Commercial		65.0	55.0
		Residential		55.0	45.0

### Environment Expenditure in FY'24

Sr.No.	Activity	Expenditure (In Lakhs)
1	Operation of mobile water sprinkler for mines	9.76
2	Construction/Maintenance of Garland drain	39.27
3	Construction/Maintenance of Settling Pit	35.87
4	Construction/Maintenance of Toe wall	92.14
5	Environmental Monitoring	12.59
6	Plantation	21.66
Total		211.29