

**STUDY OF BAILADILA DEPOSIT-4 MINE OF NMDC-CMDC LTD.  
FOR ASCERTAINING THE SAFE DISTANCE FROM THE EXISTING  
TREE FERN HABITAT FOR CARRYING OUT MINING ACTIVITIES AND  
INFRASTRUCTURE DEVELOPMENT**



For

**Bailadila Iron ore Deposit-4 of the  
NMDC-CMDC Ltd.**

By



**Environmental Management Division  
Directorate of Extension**

**Indian Council of Forestry Research and Education**

*(An Autonomous Body of Ministry of Environment, Forest & Climate Change, Govt. of India)*

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## **ABBREVIATION**

<b>Sl. No.</b>	<b>Abbreviation</b>	<b>Full form</b>
1.	APCCF	Additional Principal Chief Conservator of Forests
2.	BSI	Botanical Survey of India
3.	CITES	Convention on International Trade in Endangered Species
4.	CMDC	Chhattisgarh Mineral Development Corporation
5.	CTO	Consent to Operation
6.	EC	Environment Clearance
7.	EIA	Environment Impact Assessment
8.	EMP	Environment Management Plan
9.	ERT	Electrical Resistivity Tomography
10.	FC	Forest Clearance
11.	IBM	Indian Bureau of Mining
12.	ICFRE	Indian Council of Forestry Research and Education
13.	IUCN	International Union for Conservation of Nature
14.	IVI	Importance value Index
15.	LoI	Letter of Intent
16.	LULC	Land Use Land Cover
17.	ML	Mine Lease
18.	MMDR	Mines and Minerals (Regulation and Development) Act
19.	MoEF&CC	Ministry of Environment, Forest and Climate Change
20.	MTPA	Million Tonne Per Annum
21.	NMDC	National Mineral Development Corporation
22.	OB	Over Burden
23.	PSU	Public Sector Undertakings
24.	SFD	State Forest Department
25.	UPL	Upper Pit Limit

## **EXECUTIVE SUMMARY**

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1. Bailadila Iron Ore Deposit-4 Mine covers a total area of 646.596 ha with a production capacity of 7.0 MTPA ROM Iron ore and 6.41 MTPA Waste Excavation (Total Excavation 13.41 MTPA) along with 2000 TPH Crushing plant (inside mining lease area) and is located in Bailadila reserve forest, and falls under the Schedule “Mining of Minerals Open Cast Mining -1 (a)” of Category-‘A’ as per Environmental Impact Assessment (EIA) Notification SO 1533, of 14-09-2006 and its subsequent amendment.
2. A water stream named *Galli Nalla* originates and flows in the South direction inside the mining lease of the Bailadila Deposit-4. On the bank of *Galli Nalla*, a rare Tree fern species of the region “*Cyathea arborea* (India Tree fern)” was reported. Though total area of the Mining Lease is 646.596 ha, however, an area of 76.496 ha has been kept for conservation of the Tree fern and same has not been included in the Forest Diversion application. Concomitant to the clarification sought by MoEF&CC on the Forest diversion proposal of the Deposit-4 applied by the proponent vis-à-vis: “State Government has mentioned in their recommendation that there will be negative impact on tree-ferns located on both sides of nalla by the mining activity. Therefore, a study by Indian Council for Forestry Research and Education (ICFRE) needs to be conducted to know exact distance from how far the mining activity and infrastructure has to be proposed from the existing tree-fern area for its conservation. The State shall submit the status of the study so proposed by the authorities of the State Government”. In this regard, APCCF (LM), office of the Principal Chief Conservator of Forest & Chief of Forest Force office, Nava Raipur, Chhattisgarh awarded the study to ICFRE, Dehradun.
3. The study has been conducted with the aim to ascertain the safe distance from existing Tree fern habitat to the mining activity and infrastructure sites for avoidance of negative impact on Tree fern habitat along *Galli Nalla* and to suggest mitigation measures for conservation of reported *Cyathea arborea* (India Tree fern).
4. The present study has been divided into multiple component studies vis-à-vis vegetation study, hydro-geological study, water and soil quality assessment along with geological assessment to arrive at the desired deliverables as per the scope of the study.
5. Two nallas namely *Galli Nalla* and *Sankini Nalla* originate within the mining lease. However, between the western and eastern ridges *Galli Nalla* originates and flows as 2<sup>nd</sup> order stream. Parallel and sub-parallel first order streams developed from eastern slope of



western ridge and western slope of eastern ridge. The first order streams are seasonal; however sub-surface water seepage makes *Galli Nalla* perennial with low velocity of water flow. Drainage system developed from other slopes i.e. eastern flank of eastern ridge and western flank of western ridge are not joining with *Galli Nalla*. They have separate drainage system.

6. The hydrogeological system functioning in the study area is influenced by the geological formations and tectonic settings, with aquifers occurring in consolidated, semi-consolidated, and unconsolidated formations.
7. During the conceptual period, it is envisaged to dispose mine waste in 5 locations, of which 4 dumps are proposed on the western flank of the hill slope and 1 dump proposed on the eastern flank of the hill. Total dump area envisaged is 74.07 ha. Further on the eastern side of the hill, all infrastructures such as crushing plant, PSP, downhill conveyor, internal roads, service center, ETP, mining office, canteen, rest shelter, power sub-station, power line, pump house, pickup weir, water pipe line and security barrack are envisaged covering over an area of 65.90 ha. Explosive magazine over 15.37 ha also planned on the eastern side of the hill slope. Total excavation for in-situ mining envisaged over 94.11 ha and floats ore excavation over 70.52 ha.
8. Waste Dump No. 1 proposed on eastern slope of mining hillock (western ridge Deposit-4) intersected by numerous seasonal streams most often lead to significant impacts on local vegetation, features of seasonal water courses and entire micro-watershed, and therefore on the quality and quantity of water flow from the area towards downstream. Deforestation and forest degradation associated with mining and dumping are likely to result in increased sediment load and accumulation of Iron ore tailings in nearby water bodies. The discharge of suspended particulate matter directly from the degraded mine spoil areas may increase the chance of pollution of surface water sources with adverse impact on aquatic life.
9. It is envisaged to operate mine on the north block initially up to ultimate pit bottom and advance towards south to enable concurrent backfilling of north block. At the end of the life of the mine, entire mine pit of north block and top benches of south block are reclaimed by backfilling and afforestation and lower level of the south block will be converted into water reservoir.
10. Environment Impact Assessment (EIA) & Environment Management Plan (EMP) Report of Bailadila Iron Ore Deposit-4 has specified the Tree fern species inhabiting the study

area as *Cyathea arborea*. However, detailed study of the vegetation, Tree fern and its associate species inhabiting the swampy wetland ecosystem has revealed that the swamps of *Galli Nalla* is predominantly occupied by *Carallia - Calamus – Cyathea – Licuala - Gnetum* community. It is pertinent to mention here that the species of Tree fern inhabiting the *Galli Nalla* ecosystem have been taxonomically identified to be *Cyathea spinulosa* and *Cyathea gigantea*. *Cyathea arborea* is a Tree fern species native to the Caribbean islands. Till date, the species *Cyathea arborea* has not been reported to inhabit either in India or South Asia and its geographic distribution is restricted to the nations in the Caribbean islands group, South and North America, and Malaysia.

11. The primary Tree fern species recorded during the present study namely *Cyathea gigantea* and *Cyathea spinulosa* inhabiting the *Galli Nalla* are not enlisted under the Red List of Plant Species published by Botanical Survey of India (BSI). Moreover, these species are also not currently enlisted in the IUCN Red List. However, both the species finds their mention in CITES Appendix II. The *Gnetum* species (Family: Gnetaceae) is believed to be the ‘living link’ between gymnosperms and angiosperms. The presence of such unique and lesser explored flora in limited population along *Galli Nalla* signifies the diverse yet isolated floral richness in and around *Galli Nalla*.
12. Open cast mining employing HEMM is envisaged in the lease area. As the ore body trends NNE-SSW with steep easterly slope and forms a gentle slope towards west, much impact is not discernible, towards east side of hillock where the *Galli Nalla* is flowing. Spillage of soil due to mine working/movement of earth moving machinery is proposed to be bare minimum towards east side. Such cases, if it exceeds, lead to incessant sediment deposition in the *Galli Nalla*, which ultimately put the aquatic habitat in risk of degradation.
13. Initial mining operations may be restricted to atleast 5 m above the *Galli Nalla* bed across the Strike of the Deposit in the North Block. On reaching the Bench levels in the North Pit to the corresponding levels of the *Galli Nalla*, impact of mining operations on *Galli Nalla* may be monitored periodically on various environmental parameters, particularly for seepage of water. Based on the results, further deepening of the mining activity may be planned.
14. No float ore mining shall be undertaken on the eastern slope of the western ridge of Deposit-4 / western slope of *Galli Nalla*.

15. Proposal has been made in the approved mining plan to develop north pit upto ultimate pit bottom, subsequently the northern pit will be backfilled with mine waste generated from the south pit and south pit will be converted into water reservoir. On successful implementation of the envisaged proposal may not harm Tree fern habitat. However, in the process of developing mine pit, if pit bottom reaches lower level to *Galli Nalla* bed, subsurface water movement and rock character in between UPL and *Galli Nalla* in respect of permeability may be monitored and accordingly suitable preventive measures should be taken if required.
16. Proposal has been made to dump mine waste for first year on the eastern slope of Deposit 4 as Dump No. 1. The proposal has to be modified and no mine waste should be dumped on the eastern slope of the western ridge (Deposit-4) as washoffs from dumps siltation at *Galli Nalla* may adversely affect Tree Fern habitat.
17. Blasting for mining activities may not be undertaken within 100 m horizontal distance from *Galli Nalla*. Maximum explosive weight to be detonated in a delay and total explosive charge to be fired in a blasting round applicable for the safety of nearby domestic houses/structures arrived by vibration study conducted by CSIR for Deposit-5 & 10 (100 m distance to keep Threshold vibration limit- 5 mm/s) [kg] should be followed for blasting on the eastern slope of Deposit-4.
18. Crushing plant, downhill conveyor, Pro Service Centre (PSC), Haulage roads to approach Crushing Plant, conveyor and transfer houses, etc., are proposed on the eastern hill slope of Deposit-4. Considering larger interest of environmental protection and shortest logistic approach to mine there is no alternate place for such infrastructures. Therefore, these infrastructures may be made with appropriate environmental protection measures such as closed conveyors, covered crushing unit from all sides and any other protection measures required for conservation of Tree fern habitat around *Galli Nalla*.
19. The water courses in and around the proposed mine area particularly towards east leading to *Galli Nalla* are likely to be heavily impacted by the proposed mining activities in Deposit-4 mining lease. Hence, suitable action plans for checking the movement of silt loaded water to the *Galli Nalla* may be prepared and adopted along with robust monitoring strategies to protect the natural water courses prevailing within the vicinity of the mine.
20. Regular monitoring and assessment of the water quality, aquatic ecosystems, and biodiversity in *Galli Nalla* and its surrounding area are crucial to evaluate the

effectiveness of mitigation measures and to ensure the long-term sustainability of aquatic habitats.

21. Instead of the already earmarked Tree fern conservation area of 76.496 ha by the lessee, it is suggested for in-situ conservation of Tree fern habitat by demarcating the area formed by the derived safe distance as recorded in the Table 8.1 of Chapter-8 of this report exclusively for habitat/wetland conservation.
22. Ex-situ conservation of Tree fern species may be carried out through raising nursery in any appropriate area where soil is well drained, porous and light to medium in texture with near neutral pH. Tree ferns do not bear seeds and they can only be propagated either through spores, stolons, division or through *in-vitro* method.
23. Along with Tree ferns in the *Galli Nalla* habitat, the conservation of associated species assemblage/ plant community viz. *Carallia* - *Calamus* - *Cyathea* - *Licuala* - *Gnetum* should also be carried out as survival of the primary species are dependent on the latter.
24. The mine authority should also implement duly approved Wildlife Conservation Plan together with the aid and advice of the State Forest Department, Chhattisgarh.
25. Results show that ‘Depth of Edge Influence’ is the deciding factor for determining the safe distance from bank of *Galli Nalla* towards its west i.e. to the eastern slope of western ridge (Deposit-4) which works out to be 150 meters. Similarly, ‘Spore Dispersal Distance’ is the deciding factor for deriving the Safe Distance from bank of *Galli Nalla* towards its east i.e. to the western slope of eastern ridge (Deposit-10) which works out to be 191 meters.
26. Maintenance of the recommended safe distance of 150 meters and 191 meters respectively towards the west and east of *Galli Nalla* bank is subject to the strict adherence to implementation of environmental protection measures suggested under para 7.1, 7.2 and 7.3 of Chapter 7 of this report.
27. It is pertinent to mention that the impacts specified in the Chapter 6 have been predicted based on the approved reports and plans, and observations during field visits towards proposed mining activities and their implications on the ‘Tree fern habitat’. However, once mining operations commence in the Deposit-4 Iron ore block, they may either amplify or mollify the forecasted impacts on the susceptible *Galli Nalla* ecosystem. Therefore, the mine authority is required to undertake detailed “*Impact Assessment Study of Mine Progression on Galli Nalla Ecosystem*” by any reputed third-party organization during the plan period, from the start of operations.

28. In addition to the above, the specific recommendations of the Chhattisgarh State Forest Department (Annexure-IX) and as recorded in Chapter-8 of this Report shall be adhered to.

## **CHAPTER - 1**

### **INTRODUCTION**

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#### **1.1 BACKGROUND**

NMDC-CMDC Ltd. (NCL) is a Joint Venture Company between NMDC Ltd. (A Central Govt. PSU) and CMDC Ltd. (A State Govt. PSU). Ministry of Mines, Govt. of India has reserved the Bailadila Iron Ore Deposit-4 in favour of the JVC i.e. - NMDC-CMDC Limited (NCL). The Bailadila Deposit-4 Mining Lease area is located near village Bacheli, Tehsil Bade Bacheli, District Dantewada in Chhattisgarh. It is located to the north of Bailadila Deposit-5 Mine of the NMDC Ltd. on the same hillock.

Bailadila Iron Ore Deposit-4 Mine covers a total area of 646.596 ha with a production capacity of 7.0 MTPA ROM Iron ore and 6.41 MTPA Waste Excavation (Total Excavation 13.41 MTPA) along with 2000 TPH Crushing plant (inside mining lease area) and is located in Bailadila reserve forest, and falls under the Schedule “Mining of Minerals Open Cast Mining -1 (a)” of Category-‘A’ as per Environmental Impact Assessment (EIA) Notification SO 1533, of 14-09-2006 and its subsequent amendment. The Mining Plan was approved from IBM vide letter no. Dantewada/Fe/Khanij1292/2021/-Raipur, dated 24.09.2021. Application for diversion of the Forest Land has been submitted by the proponent vide proposal no. FP/CG/MIN/146694/2021 dated 04.10.2021 for total area of 682.2722 ha. (570.10 ha inside mining lease, 100.077 ha outside mining lease in the reserve forest and 12.0952 ha *Bade Jhad* ke Jungle).

Inside the Mining lease of the Bailadila Deposit-4, a water stream named *Galli Nalla* originates and flows in the South direction. On the bank of *Galli Nalla*, a rare Tree fern species of the region “*Cyathea arborea* (India Tree fern)” was reported. Though total area of the Mining Lease is 646.596 ha, however, an area of 76.496 ha has been kept for conservation of the Tree fern and same has not been included in the Forest Diversion application. Concomitant to the clarification sought by MoEF&CC on the Forest diversion proposal of the Deposit-4 applied by the proponent vis-à-vis: “*State Government has mentioned in their recommendation that there will be negative impact on tree-ferns located on both sides of nalla by the mining activity. Therefore, a study by experts from Indian Council for Forestry Research and Education (ICFRE) needs to be conducted to know exact distance from how far the mining activity and infrastructure has to be proposed from the existing tree-fern area for its conservation. The State shall submit the status of the study so proposed by the authorities of the State Government*”. In this regard, APCCF (LM), office of

the Principal Chief Conservator of Forest & Chief of Forest Force office, Nava Raipur, Chhattisgarh vide its letter no. भू-प्रबंध/खनिज/331-305/1036 dated 25.04.2024 has approached ICFRE to conduct a “Study of Bailadila Deposit-4 mine of NMDC-CMDC Ltd. for ascertaining the safe distance from the existing Tree fern habitat for carrying out mining activities and infrastructure development”. Accordingly, the ICFRE, Dehradun submitted a proposal to this effect vide its office letter no. 1-23/2006-ADG(EM)EOI/ICFRE Part file/951 dated 07.05.2024 to the APCCF (LM), Chhattisgarh. Thereafter, the APCCF (LM) awarded the assignment to the ICFRE, Dehradun vide its letter no. भू-प्रबंध/खनिज/331-305/1242 dated 22.05.2024 for conduct of the said study. With this background, the study to ‘ascertain the exact distance from how far the mining activity and infrastructure has to be proposed from the existing Tree fern area for its conservation’ has been carried out with the following objectives and scope of work.

## **1.2 OBJECTIVE**

1. To ascertain the safe distance from existing Tree fern habitat to the mining activity and infrastructure sites for avoidance of negative impact on Tree fern habitat along *Galli Nalla*.
2. To suggest mitigation measures for conservation of *Cyathea arborea* (India Tree fern).

## **1.3 SCOPE OF WORK**

1. To delineate and map the habitat of *Cyathea arborea* along *Galli Nalla* in and around the mine lease area.
2. To assess the existing threats and impacts on *Cyathea arborea* due to mining activities.
3. To determine the safe distance adjoining the habitat of Tree fern where mining activities and infrastructure area can be proposed safely.

## **1.4 REPORT FORMAT**

This report comprises of eight chapters as detailed below:

Chapter 1: Introduction

Chapter 2: Approach and Methodology

Chapter 3: Status of the Mining Project

Chapter 4: Hydrogeology and Mining Scenario

Chapter 5: Ecological assessment of Tree fern Habitat

Chapter 6: Prediction of Mining induced impacts on Tree fern

Chapter 7: Mitigation measures to minimise impact of proposed mining & allied activities

Chapter 8: Arriving safe distance between Tree fern and mine workings

## **1.5 RECOMMENDATIONS / COMMENTS OF THE CHHATTISGARH STATE FOREST DEPARTMENT ON THE DRAFT PROJECT REPORT**

The draft project report was submitted to the APCCF (LM) Chhattisgarh State Forest Department vide ICFRE email dated 29.10.2024 for perusal and suggestions, if any on the report. Chhattisgarh State Forest Department vide its letter dated 12.12.2024 has communicated its comments and suggestions on the report to the ICFRE (Annexure-IX). The same have been incorporated in the Chapter-8 of this Report along with the ICFRE recommendations.



## **CHAPTER - 2**

### **APPROACH AND METHODOLOGY**

#### **2.1 APPROACH**

ICFRE team held detailed discussion with the State Forest Department, Chhattisgarh, at the Office of Forest Ranger, Bacheli, on 16 June 2024 and with the officials of NMDC-CMDC Ltd. regarding the proposed working of Deposit-4 mine, following which the ICFRE team conducted detailed field study during 16 June 2024 to 22 June 2024 adopting appropriate scientific methodologies to infer the exact distance from how far the mining activity and infrastructure has to be proposed from the existing Tree fern area for its conservation. List of ICFRE team and officials from the State Forest Department (SFD) associated in the field-based study are given respectively in Table 2.1 and 2.2.

**Table 2.1: List of ICFRE Team Members involved in the Study**

<b>Sl. No.</b>	<b>Name of Team Members</b>	<b>Designation</b>
1.	Dr. Sudhir Kumar	DDG (Extn.) & Scientist – G, ICFRE, Dehradun
2.	Dr. A. N. Singh	ADG (EM) & Scientist – G, ICFRE, Dehradun
3.	Dr. Praveen Kumar Verma	Scientist – D, ICFRE-FRI, Dehradun
4.	Shri. Ajin Sekhar	Scientist – C, ICFRE, Dehradun
5.	Dr. Anish. V. Pachu	Chief Technical Officer, ICFRE-IFGTB, Coimbatore
6.	Shri. N. Nanmathi Selvan	Domain Expert (Geology & Mining)
7.	Dr. C. Gajendran	Domain Expert (Hydrology)
8.	Shri. S. K. Kamboj	Project Consultant, ICFRE, Dehradun
9.	Ms. Kumbhlesh Kamal Rana	Research Associate, ICFRE, Dehradun

**Table 2.2: List of Officers/Staff from SFD, Chhattisgarh associated with the Study**

<b>Sl. No.</b>	<b>Name of Officers/Staff from SFD, Chhattisgarh</b>	<b>Designation</b>
1.	Shri. Ashutosh Mandava	Forest Ranger, Bacheli
2.	Shri. Bhanu Shankar Kashyap	Deputy Ranger, Bacheli
3.	Shri. K. C. Patel	Beat Guard, Padapur, Bacheli

#### **2.2 METHODOLOGY**

The present study has been divided into multiple component studies vis-à-vis vegetation study, hydro-geological study, water and soil quality assessment along with geological assessment to arrive at the desired deliverables as per the scope of the study.

### **2.2.1 Floral Diversity Assessment wrt. Tree Fern Habitat**

Terrestrial floral diversity wrt. existing Tree fern habitat has been recorded through sample survey based on line transect method followed by classification of existing floral diversity into three forms of plant habit (trees, shrubs, herbs). The recorded floral species were then subjected to phyto-sociological studies vis-à-vis Important Value Index (IVI), species frequency, density, abundance, dominance for different plant habit in the study sites. Tree fern associate floral species have also be identified and documented based on field survey and secondary sources. Line transect method of sampling has been adopted over the proposed quadrat sampling owing to field suitability and to derive a better comprehensive view of the floral composition of the study area.

### **2.2.2 Hydro-geological Study**

Understanding of the hydrogeology of the study area is of prime importance to ascertain the safe distance from the existing Tree fern area for carrying out mining activities and infrastructure development. Regional geological maps indicating the location of different geological strata, their geological age sequence, boundaries/contacts of individual formations and the structural expressions like strike, dip, faults, folds, fractures, intrusive bodies etc. along with available data on hydrogeology from different sources were synthesized to correlate the topography and drainage to geological contacts. Detailed hydro-geological mapping using satellite imagery has been worked out to ascertain the ground water regime and habitat suitability of Tree fern habitat.

To analyze land use/land cover (LULC) using GIS and Sentinel-2 data, Sentinel-2 imagery was first imported into GIS software in the GeoTIFF format. A spatial mask was created to delineate the study areas, specifically the *Galli Nalla* and *Sankini Nalla* micro-watersheds. The "Change Detection" tool in GIS was employed to classify land cover into categories such as urban, forest, and water, leveraging Sentinel-2's 10-20 m spatial resolution and 10-day revisit period for high-detail and precision. The resulting classifications were used to visualize and quantify temporal land cover changes. The LULC maps were generated using ESRI's methodology, involving a deep learning model that utilizes six spectral bands from Sentinel-2 surface reflectance data: visible blue, green, red, near-infrared, and two shortwave infrared bands. This model processes over 400,000 Earth observations annually on Microsoft's Planetary Computer, scaled through Microsoft Azure Batch. The outputs are annual composite maps that represent land cover.

For the *Galli Nalla* and *Sankini Nalla* micro-watersheds, high-resolution LULC mappings were derived using Sentinel-2 data and the Impact Observatory's advanced deep learning algorithm. This algorithm was trained on a comprehensive dataset containing human-annotated image pixels curated by the National Geographic Society, ensuring high accuracy and reliability in land classification. The stream flow analysis and drainage network of the study area was generated from 30 m spatial resolution SRTM-DEM (USGS website) using the hydrology tool in GIS software. The required safe distance has been derived based on the cumulative on-field observations and as per the aforesaid modellings which nullified the requirement of additional hydrological modeling by utilizing advanced modelling tools.

### **2.2.3 Water Quality Assessment of the *Galli Nalla***

Since the pteridophytic flora *Cyathea sp.* requires a flourishing water body habitat for continued survival, assessment of water quality of *Galli Nalla* along with other identified habitats assumes greater significance. Basic water quality parameters (temperature, pH, Electrical Conductivity (EC), Dissolved Oxygen (DO), Turbidity, Total Suspended Solids (TSS) and Total Dissolved Solids (TDS)) have been assessed to infer the status of water quality of the Tree fern area adopting universally accepted protocols as standardized by American Public Health Association (APHA) (Clescerl et al., 1998).

### **2.2.4 Air quality prediction**

A time series prediction of ambient air quality and fugitive dust parameters using the Auto Regressive Integrated Moving Average (ARIMA) model based on historical air quality monitoring data, covering multiple seasons over a five-year period (2018 to 2023) has been carried out. The prediction is focused on key air pollutants and fugitive dust emissions, given the opencast mining activities, which are a major source of particulate matter. The ARIMA (Auto Regressive Integrated Moving Average) model is particularly suitable for time series based ambient air quality forecasting, to predict future values based on past values. However, the model doesn't take into account of external influence and seasonal effects.

The air quality parameters monitored in this study include:

- Particulate Matter: PM<sub>2.5</sub> and PM<sub>10</sub>
- Gaseous Pollutants: Sulfur Dioxide (SO<sub>2</sub>) and Nitrogen Oxides (NO<sub>x</sub>)
- Fugitive Dust Parameters: Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), and Total Particulate Matter (TPM)

### **2.2.5 Evaluation of the impact of mining activities on water quality and Tree Fern habitat**

Efficacy of the proposed mining activities of the said project such as management of surface water run-off from external/internal backfilled dumps, quarry area, etc., leading to the adjacent natural water courses, effluent discharges have been assessed based on field observations, approved mining plan and reviewed based on the available information in EIA-EMP, etc. for evaluating the possible impacts of mining activities on water quality and Tree fern habitat.

### **2.2.6 Soil Quality Assessment of Tree Fern habitat**

Soil samples were collected from different points of the study area particularly where Tree fern inhabits and also from points where the species was found to be absent to draw a comparative analysis. Standard techniques were employed for analysis in the lab for nutrient and microbial studies.

Based on the observations and inferences drawn from each component of the study, the safe distance adjoining the Tree fern habitat has been ascertained.

## **2.3 LIMITATIONS OF THE STUDY**

The time period for the study was three months and the study has been conducted based on scientific methodologies and observations during field visits towards proposed mining activities and their implications on the 'Tree fern habitat' along with reviewing and scrutinising the approved reports, and available plans. Once mining operations commence in the Deposit-4 Iron ore block, the predicted impacts on the susceptible *Galli Nalla* ecosystem may either amplify or mollify.

For ascertaining the impacts of various interventions under mining operations on the environment always warrant a longer duration study. In the present case, all possible impacts have been best predicted within the limited three months study period. However, it may suffice when a detailed 'Impact Assessment Study of Mine Progression on *Galli Nalla* Ecosystem' as recommended in Chapter-8 of this report is undertaken by the lessee.

## **CHAPTER - 3**

### **STATUS OF THE MINING PROJECT**

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#### **3.1 BACKGROUND INFORMATION**

The mining lease Bailadila Deposit-4 is located near village Bacheli/Bhansi, Tehsil Bade Bacheli, District Dantewada, Chhattisgarh. It is located at Bailadila range of Bacheli hills trending N-S direction. The Deposit-4 is approachable by kutcha road from Bhansi or from Deposit-5 of the NMDC Ltd. Nearest town to the lease area is Bacheli and District headquarters is located at Dantewada, Chhattisgarh. Bailadila Iron Ore Deposit-4 having extent lease area of 646.596 ha falls within longitude 81°12'02.90192"E to 81°13'07.02661"E and latitude 18°41'26.17920"N to 18°43'38.52758"N and in Survey of India Topo Sheet No. E44J2.

With a 7.0 MTPA capacity of Iron ore production, the ML area covered 646.596 ha of forest land. However, only 570.10 ha of the 646.596 ha of forest land had been requested for forest land diversion. The remaining forest area within the mining lease will not be used for mining activities.

Additionally, in order to develop the screening and beneficiation plant, loading plant, railway siding, stockpiles, water settling/recirculation ponds, offices, and other facilities, an area of 100.077 ha of forest land and 22.4658 ha of revenue land (government, private, and *Bade Jhad ke* Jungle) outside the mining lease will be needed.

Deposit-4 is located on the western ridge of the Bailadila reserve forest, to the north of Deposit-5 and to the south of Deposit-3. A small section of lower-grade lateritic ore, spanning approximately 150 meters, divides the ore body from Deposit-5, which is located as the northern continuation of the north block. Un-enriched banded hematite-quartzite divides Deposit-4 from Deposit-3 on the northern side.

#### **3.2 STATUTORY CLEARANCES**

##### **3.2.1 Details of Mining Lease**

The Bailadila Iron Ore Deposit-4 (total area 646.596 ha) has been reserved by the Ministry of Mines, Government of India on 30.09.2019 (**Annexure-I**), in favour of NMDC-CMDC Ltd. (NCL) for the purpose of Iron ore prospecting and mining under section 17A of the MMDR Act-1957. The Ministry of Mines, Government of India, New Delhi has amended the previous notification no. G.S.R. 697(E) for the updated coordinates of Deposit-4, vide G.S.R.119 (E) dated 18.02.2021 (**Annexure-II**).

A Letter of Intent (LOI) for the grant of a Mining Lease for the aforementioned area of Bailadila Iron Ore Deposit-4 was also issued by the Mineral Resource Department (MRD), Government of Chhattisgarh (GoCG), on 26.06.2021 (**Annexure-III**). The LOI stipulates the need for both Forest and Environmental clearances. Consequently, on 07.08.2021 (**Annexure-IV**), MRD, GoCG published an addendum to the Letter of Intent (LOI) stating that an approved Mining Plan is also required.

Furthermore, the Letter of Intent (LOI) was amended by MRD, GoCG on 05.04.2022, to include 50-year mining lease tenure. Following approval of the mining plan and the acquisition of environmental and forest clearances, GoCG will issue a grant order for the signing of the lease deed.

### **3.2.2 Mining Plan**

The Mining Plan was approved by IBM vide letter no. Dantewada/Fe/Khanij1292/2021/Raipur dated 24.09.2021 (**Annexure-V**).

### **3.2.3 Environmental Clearance (EC)**

Form-1 and PFR were uploaded by lessee on the Parivesh portal of MoEF&CC on 14.01.2022, in order to obtain Terms of Reference for both proposals, namely: Industrial Projects-I sector (Proposal No.: IA/CG/IND/251437/2022, File No.: IA-J-11011/23/2022-IA-II(IND-I)) for the Beneficiation plant outside the Mining Lease of Deposit-4 and non-coal mining (Proposal No.: IA/CG/MIN/251288/2022, File No.: IA-J-11015/104/2021-IA-II(NCM)) for the Bailadila Deposit-4.

The EAC meeting for Bailadila Iron Ore Deposit-4 was held on 17.02.2022, and TOR was issued vide letter no. IA-J-11015/104/2021-IA-II(NCM) dated 11.03.2022 (**Annexure-VI**). The EAC meeting for the Beneficiation Plant outside the mining lease of Deposit-4 mine was held on 10.02.2022 and TOR was issued vide F. no. IA-J-11011/23/2022 IA-II (IND-I) dated 21.02.2022 (**Annexure-VII**).

### **3.2.4 Forest Clearance (FC)**

Lessee has submitted the application for Stage-1 Forest Clearance under proposal No. FP/CG/MIN/146694/2021 dated 04.10.2021 (**Annexure-VIII**) for diversion of 682.2722 ha (570.100 ha inside lease and 112.1722 ha outside lease) forest land in Dantewada Forest Division, South Bastar Dantewada.

### 3.2.5 Consent to Operate (CTO)

Following the issuance of an environmental clearance, permission will be sought to operate for the discharge of effluents under the Water (Prevention and Control of Pollution) Act 1974 and emissions under the Air (Prevention and Control of Pollution) Act 1981.

### 3.3 LAND USE PATTERN OF THE MINING LEASE AREA

The proposed Deposit-4 Mining Lease is located between longitude 81°12'02.90192 "E & 81°13'07.02661 "E and latitude 18°41'26.17920 "N & 18°43'38.52758 "N. The lease area is depicted in the Survey of India Topo Sheet No. E44J2. There are two working mining leases viz., Deposit-10 and Deposit-5 of BIOM Bachel Complex which shares common boundary with the Deposit-4 respectively on its west side (Corner pillars No. C, D & E) and on south side (Corner pillars No. F & G). Out of the total mining lease area of 646.596 ha forest land in Bailadila Reserve Forest allotted for the lessee, the area intended for conservation of Tree fern habitat falling within mining lease is 76.496 ha (under the forest compartments viz., 1826, 1832, 1833, 1834, 1841, 1842, 1885, 1886), which is not included in the forest diversion proposal and hence the total area required for forest diversion within the mining lease is 570.10 ha (**Table 3.1**).

Table 3.1: Proposed land use pattern of ML area							
Sl. N o.	Land use particulars		Land area (ha)				
			During Mining	Post Mining			
				Plantation	Water body	Public use	Un-disturbed
1	Excavation (In-situ)		94.11	72.23	20.04	1.84	0
2	Excavation – Float ore		70.52	70.52	0	0	0
3	Waste dump		74.07	74.07	0	0	0
4	Infrastructure facilities		65.90	43.146	0	22.754	0
5	EMP works area		241.642	241.642	0	0	0
6	Explosive magazine & safety zone		15.37	11.225	0	4.145	0
7	Safety zone along ML boundary		8.488	8.488	0	0	0
Sub-total (Area to be diverted)			570.10	521.321	20.04	28.739	0
8	Tree fern habitat (not to be diverted)	Portion 7A	2.449	0	0	0	2.449
		Portion 7B	74.047	0	0	0	74.047
Grand Total			646.596	521.321	20.04	28.739	76.496
Source: Approved mining plan							

#### 3.3.1 Excavation – Mine pit

The mining in the ML area envisages both reef ore mining and float ore mining to the tune of 94.11 ha and 70.72 ha respectively.

### 3.3.1.1 Excavation (in-situ)

The mine pit excavation is planned to be carried out in two separate blocks sequentially i.e., northern block first followed by southern block over a total area of 94.11 ha. The excavation followed by backfilling on northern block pit by utilizing the waste generated from southern block is scheduled to be completed during 14-21 year of mining operation. Out of the 94.11 ha of mine pit excavation, 72.23 ha is proposed to be backfilled and afforested and the remaining 20.04 ha in the southern block pit and 1.84 ha is respectively proposed to be maintained as water body and for public use. Reclamation by afforestation on the mine benches is planned to be commenced from 21 year onwards.

### 3.3.1.2 Excavation (Float Ore)

The float ore mining excavation is proposed to be carried though out the life of the mine over area of 70.72 ha followed by concurrent backfilling, while reclamation by afforestation is scheduled to be carried out during 22-25 year of mining operation. The area envisaged for float ore mining area is located both on the western as well as eastern slope of the mining hillock.

### 3.3.2 Waste dumps

A total of 5 separate waste dumps are proposed to be formed sequentially in the ML area over a total extent of 74.07 ha followed by reclamation by afforestation during 3-16 year of mining operation (**Table 3.2**).

<b>Table 3.2: Proposed waste dumps</b>					
<b>Dump No.</b>	<b>Area</b>	<b>Capacity (tonnes)</b>	<b>Top RL</b>	<b>Bottom RL</b>	<b>Period of closure</b>
D-1	1.69	183018	1040	1020	1 year
D-2	20.07	10163066	1055	905	8 year
D-3	21.13	8332718	1055	905	10 year
D-4	18.5	10637546	1050	930	12 year
D-5	12.68	6813569	1045	955	14 year
<b>Total</b>	<b>74.07</b>	<b>36129917</b>			
<i>Source: EIA-EMP of Bailadila Iron Ore Deposit-4, Jan. 2024</i>					

#### 3.3.2.1 Dump-1

The over burden waste generated from the initial excavation for Crushing Plant / other infrastructure construction and Haul Road development from Crushing Plant to the Mine Benches is planned to be dumped as Dump-1 on the eastern slope of the western ridge of the hillock with a top RL of 1040 m and bottom RL of 1020 m during the first year of the mining



operation. Suitable protective barrier and garland drain are envisaged for the stabilization of the Dump-1.

#### **3.3.2.2 Dump-2**

It is planned to be formed on the slope at N-NW side of the northern block Mine Pit during 1<sup>st</sup> – 8<sup>th</sup> year of Mining Operation. Appropriate retaining structures have been envisaged for its protection and stabilization.

#### **3.3.2.3 Dump-3**

It is planned to be formed on the slope at Western side of the northern block Mine Pit during 8<sup>th</sup> – 10<sup>th</sup> year of Mining Operation. Appropriate retaining structures have been envisaged for its protection and stabilization.

#### **3.3.2.4 Dump-4**

It is planned to be formed on the slope at Western side of the northern block Mine Pit during 10<sup>th</sup> – 12<sup>th</sup> year of Mining Operation. Appropriate retaining structures have been envisaged for its protection and stabilization.

#### **3.3.2.5 Dump-5**

It is planned to be formed on the slope at S-SW side of the northern block Mine Pit during 12<sup>th</sup> – 14<sup>th</sup> year of Mining Operation. Appropriate retaining structures have been envisaged for its protection and stabilization.

### **3.3.3 Infrastructure within ML area**

Of the total area of 65.90 ha proposed for infrastructure facilities, 43.146 ha is proposed for reclamation and afforestation during 22-24 year and the remaining 22.754 ha is planned for public use. The infrastructure including crushing plant, PSP, part of downhill conveyor, security barracks, explosive magazine etc., are planned on either side of the hill slope leading to *Galli Nalla*.

### **3.3.4 Proposed EMP Works**

The EMP works including gap plantation on the unused area are proposed to be carried out over a total area of 241.642 ha during 2-20 year of mining operation.

### **3.3.5 Explosive magazine**

Explosive magazine and its safety zone is planned over an area of 15.37 ha on the western side of the hill slope leading to *Galli Nalla* and out of which, 11.225 ha is planned for

reclamation by afforestation including gap plantation during 22-23 year of mining operation and the remaining 4.145 ha is planned for public use.

### **3.3.6 Safety zone along ML boundary**

The estimated total area under safety zone around the mining lease boundary is 8.488 ha, which is planned to be protected with proper fencing and maintained undisturbed as per statute during 1-5 year of mining operation.

### **3.3.7 Tree fern habitat protection – not proposed to be diverted**

An area of 76.496 ha on either side of the *Galli Nalla* all along the water course is proposed to be conserved (not included in forest diversion proposal) for the habitat protection of Tree fern species – a characteristic plant species located in the humid shady environment on the banks of the perennial stream.

### **3.3.8 Final reclamation by afforestation at the conceptual stage**

The total area within the mining lease to be reclaimed and afforested put together is 521.321 ha, which is 91.44% of the total land area proposed to be diverted for mining and allied activities (FC Area = 570.10 ha).

Conceptual land use plan			
Land use particulars		Area (ha)	Total area (ha)
I. Land use during Mining			
Total area degraded	Mined out area	164.63	319.97
	Waste dumps	74.07	
	Utility services	81.27	
Non-degraded area	Undisturbed area	326.626	326.626
II. Land use at the conceptual stage			
Mined out area reclaimed & rehabilitated	Area reclaimed but not rehabilitated	1.84	164.63
	Area fully rehabilitated	142.75	
	Reservoir considered rehabilitated	20.04	
Other areas reclaimed & rehabilitated	Waste dump rehabilitated	74.07	481.966
	Virgin area under greenbelt	326.626	
	Rehabilitated area under utility services	54.371	
	Area under utility services not rehabilitated	26.899	
Source: Approved mining plan			

Based on the total allotted area of 646.596 ha, the area to be developed under forest cover at the conceptual stage works out to 597.817 ha, which is 92.46% of the total area. It is therefore inferred that a quite significant extent of the land is proposed to be reclaimed and rehabilitated out of the total put to use for mining and allied activities.

## **CHAPTER – 4**

### **HYDROGEOLOGY AND MINING SCENARIO**

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#### **4.1 REGIONAL GEOLOGY**

Bailadila hills represent southernmost part of Kotri-Dongergarh orogen of Bastar craton known as Bailadila Group (Age 2400 Ma). Kotri-Donger orogen is a long N-S trending belt consisting of several cycles of sedimentation and volcanism that progressively becomes younger towards north. This supracrustal cycles are limited to the geographical confines of the linear belt and do not extent far into the surrounding gneissic terrain. Kotri-Dongergarbelt therefore, described as an intra-cratonic orogen that does not extend beyond the boundary of Bastar Craton. Quartzites and chlorite phyllites (olive green), Loa Conglomerates and superior type Banded Iron Formation in association with fine clastic; tuffs and basic volcanic are the main characteristics of this group.

The Iron ores of Bailadila range belong to the Bailadila series, which are associated with slightly metamorphosed Iron ore bearing sedimentary rocks of pre-Cambrian age. Iron ore occurs as separate ore bodies on the crest of the two sub-parallel hills running north-south. The Bailadila Iron ore series is represented at the bottom by current bedding bearing arkosic rocks followed by a sequence of partly clastic and partly tuffaceous formations such as ferruginous shale magnetite bearing siltstones, alternating cherts and tuff and kaolinitic clayey formation. A formation of intraformational conglomerate containing pebbles of all other units underlies the ferruginous tuffaceous shale unit. The sub-group underlying the conglomerate sometimes contains small pockets of Banded Hematite Quartzite (BHQ) often associated with Iron ore, which are of pre-Cambrian age and the rocks in the series being almost similar in nature that of Iron ore series rocks of Bihar and Karnataka.

Bailadila Iron ore range is trending roughly North-South direction with steep easterly dip varying from 45<sup>0</sup> to 75<sup>0</sup>. There are two parallel mountainous ridges trending for a length of 40 km with average width of 10 km. The ridges merge and coalesce into one ridge in the north of Deposit-10, from where intervening valley starts and gradually widens towards south and it is widest about 7.5 km approximately between Deposit-11C on the eastern arm and Deposit-5 on the western arm. Top most RL of Bailadila ridge is 1276 m in Deposit-11B. All along the valley *Galli Nalla* flows and direction of *Galli Nalla* veers towards south-westerly direction beyond the Iron ore deposits/ ridges.

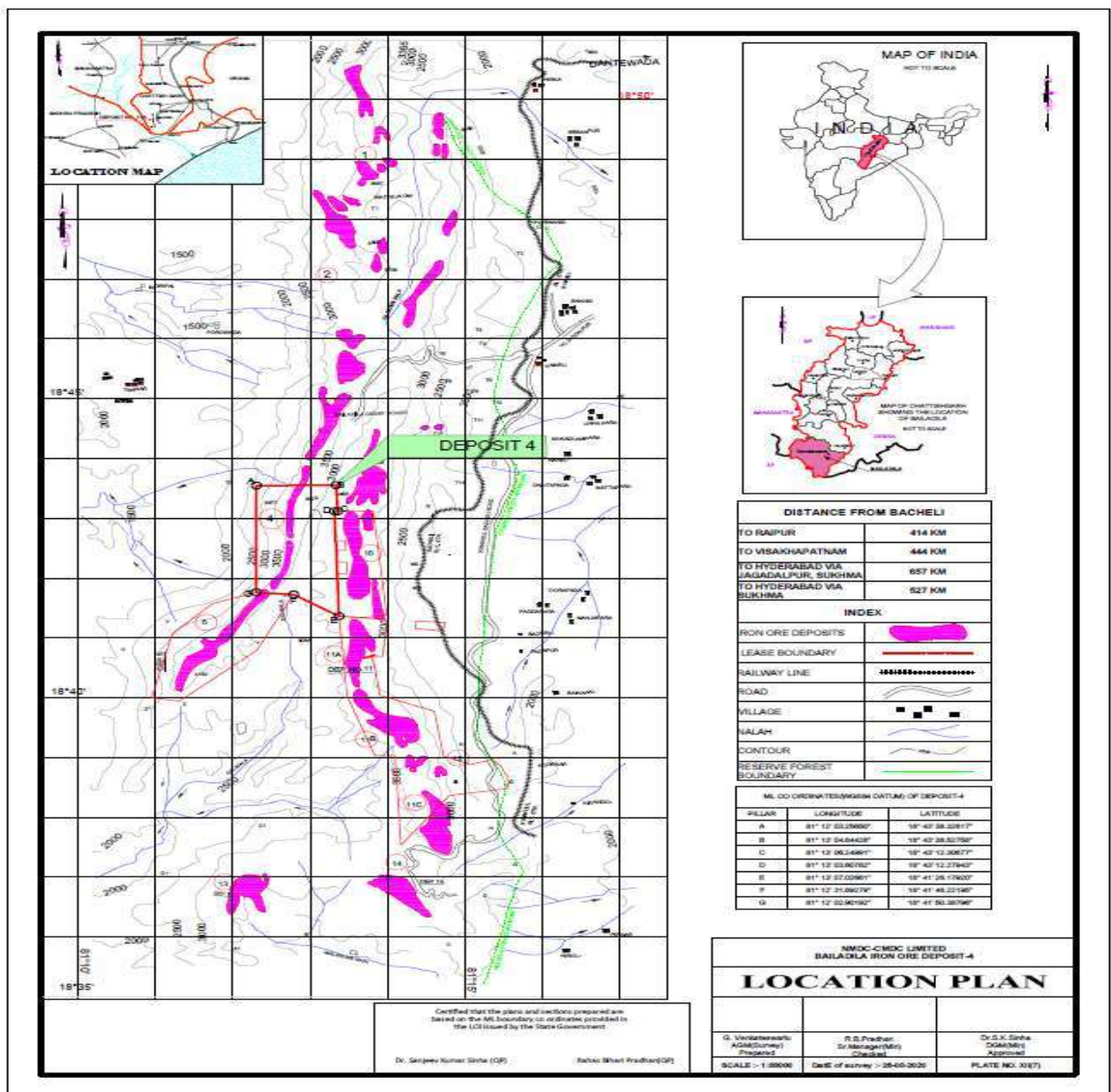
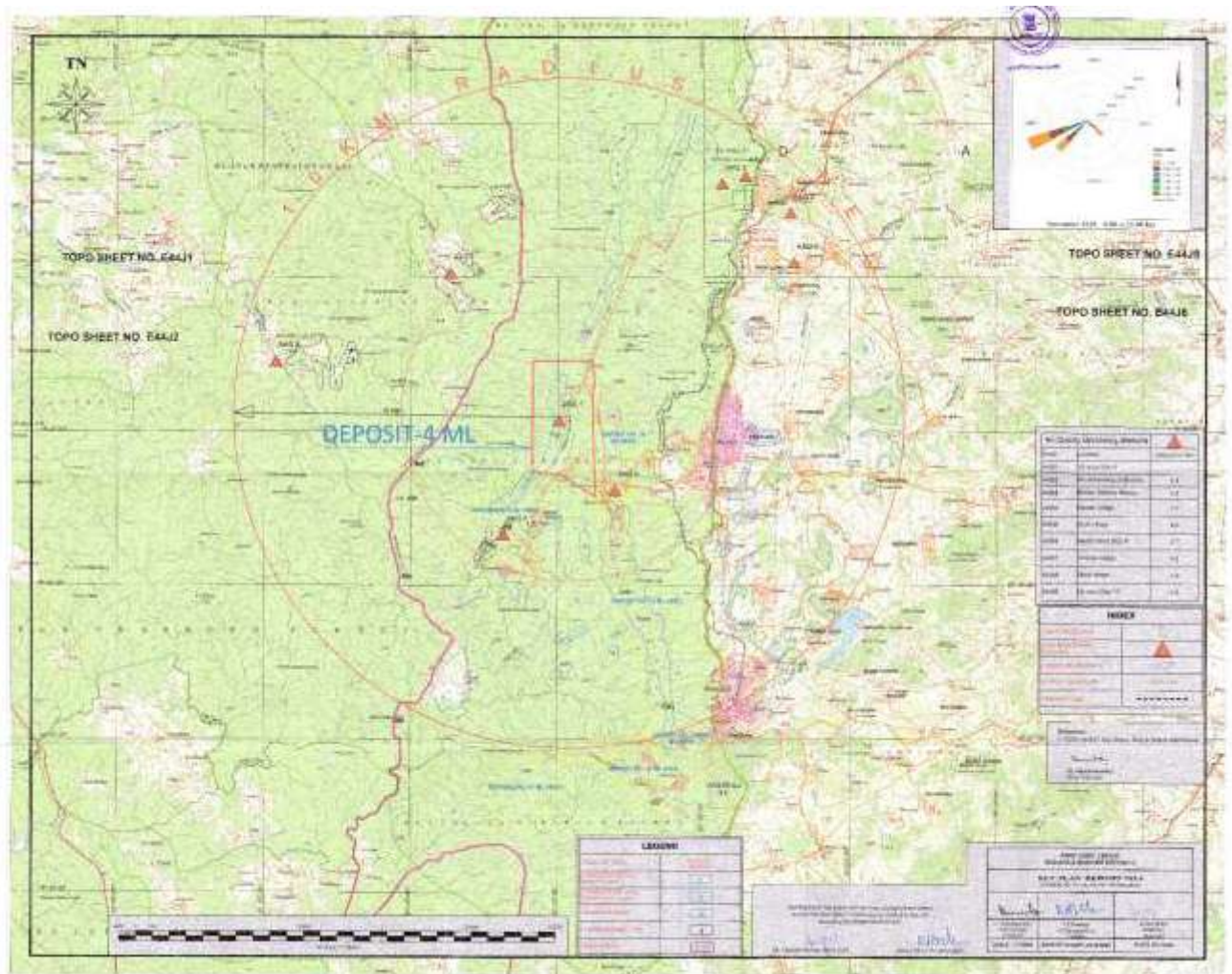


Figure 4.1: Location map exhibit disposition of Iron ore deposits of Bailadila Iron ore range



**Figure 4.2: Key plan showing location of Deposit-4 of Bailadila Iron ore deposit**





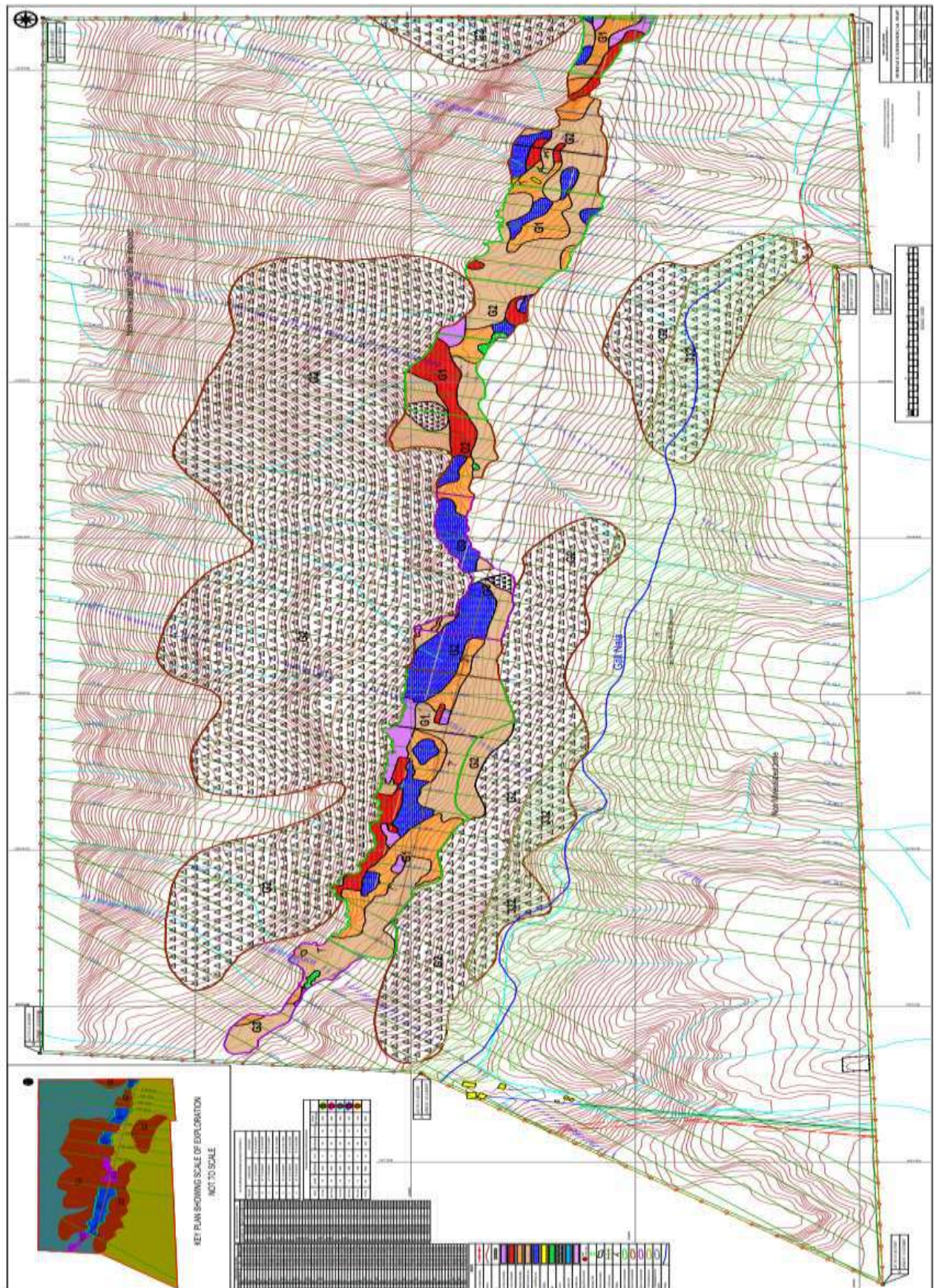
## **4.2 GEOLOGY AND GEOMORPHOLOGY OF BAILADILA IRON ORE DEPOSIT-4**

### **4.2.1 Geology**

Deposit-4 is situated on the north of Deposit-5 and south of Deposit-3 in the western ridge. The ore body is northern continuity of Deposit-5 and narrowing its width. However, on the south of Deposit-4 there is narrow gap/ poor-mineralized area for a length of 150 m which divides the Deposit-5 and Deposit-4. On the northern side mineralisation extends beyond the lease boundary; however there is gap of un-enriched banded hematite quartzite, which divides Deposit-4 and Deposit-3. Within the Deposit-4 there is un-enriched BHQ significantly marking break in the height/ topography of the ridge, this portion divides the Deposit-4 into north block and south block.

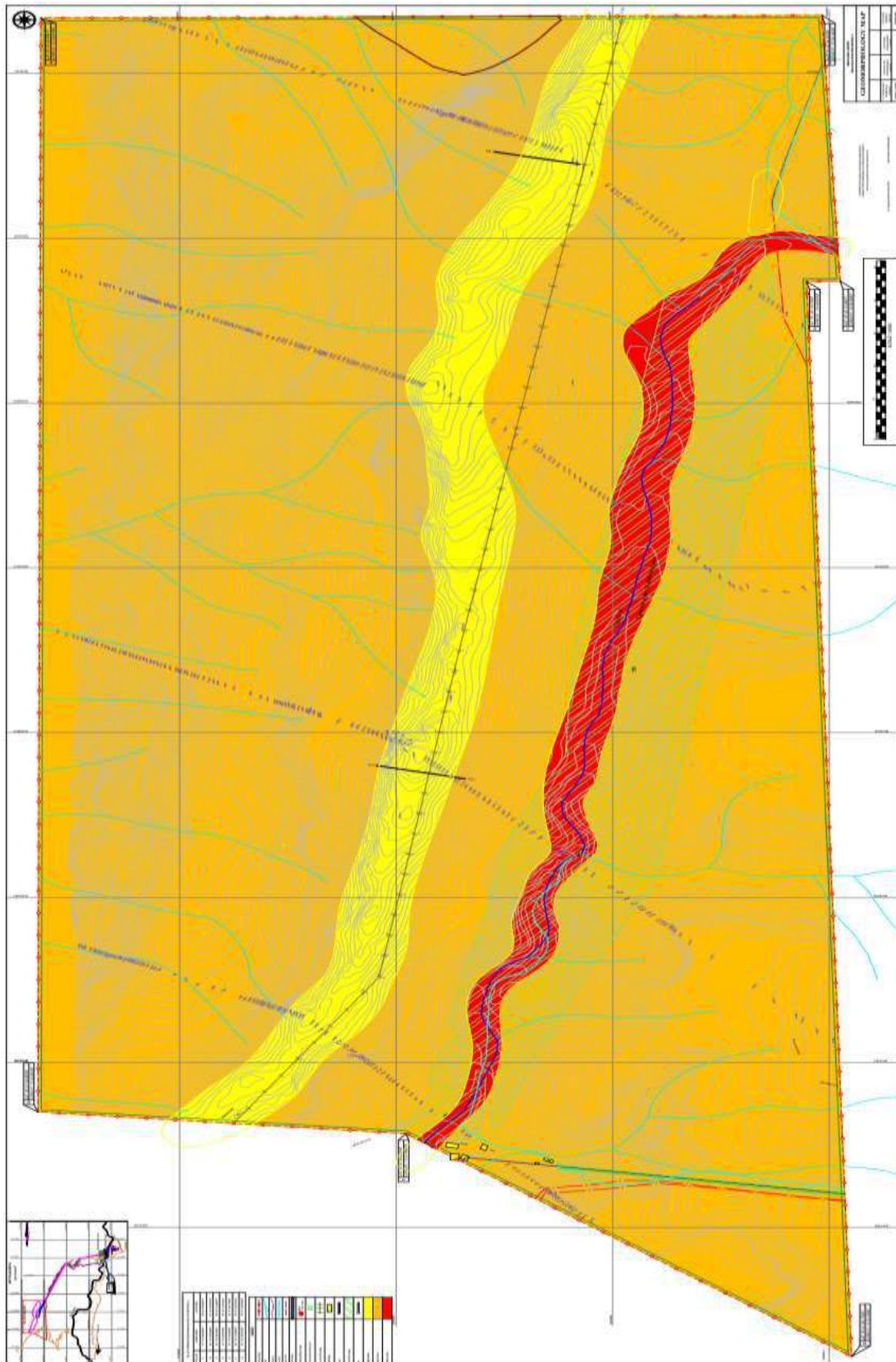
Iron ore occur all along the ridge covering entire lease area over a length of 3300 m along NNE-SSW direction with an average width of 150 m in Deposit-4. Either sides of the hill range form complimentary valleys. A valley between two iron ore rich parallel hill ranges i.e. western ridge and eastern ridge within the mining lease of Deposit-4 forms the study area. The two Iron ore ranges are very narrow, between Deposit-4 on the western ridge and Deposit-10 & 8 on the eastern ridge. Between these two ridges, in the valley *Galli Nalla* originates from 690 m south of northern boundary of the Deposit-4 lease area. The nalla flows from NNE to SSW direction and further flows beyond the southern boundary of mining lease. The width of the nalla at nalla head is 2.5 m on the northern part where it originates and is not perennial. However, its width gradually increases to 25 m on the south within the mining lease area becoming perennial in nature. The gradient of the nalla is 1 in 20. The geological map and geomorphology map of the study area of the mine lease area is provided in Figure 4.5 & 4.6.





**Figure 4.5: Geological map of the study area**





**Figure 4.6: Geomorphology map of the study area**

#### 4.2.2 Drainage Pattern

Drainage system developed significantly from the ridges. Parallel to sub-parallel drainage system developed and flows easterly from the eastern flank of western ridge and similar drainage system developed and flows westerly from western flank of eastern ridge (Figure 4.8). Within the buffer zone of 5 km radius, the nallas developed into 3<sup>rd</sup> order streams. Two nallas namely *Galli Nalla* and *Sankini Nalla* originate within the mining lease (Figure 4.7). However, between the western and eastern ridges *Galli Nalla* originates and flows as 2<sup>nd</sup> order stream. Parallel and sub-parallel first order streams developed from eastern slope of western ridge and western slope of eastern ridge (Figure 4.9). The first order streams are seasonal; however sub-surface water seepage makes *Galli Nalla* perennial with lowest velocity of water flow. Drainage system developed from other slopes i.e. eastern flank of eastern ridge and western flank of western ridge are not joining with *Galli Nalla*. They have separate drainage system.

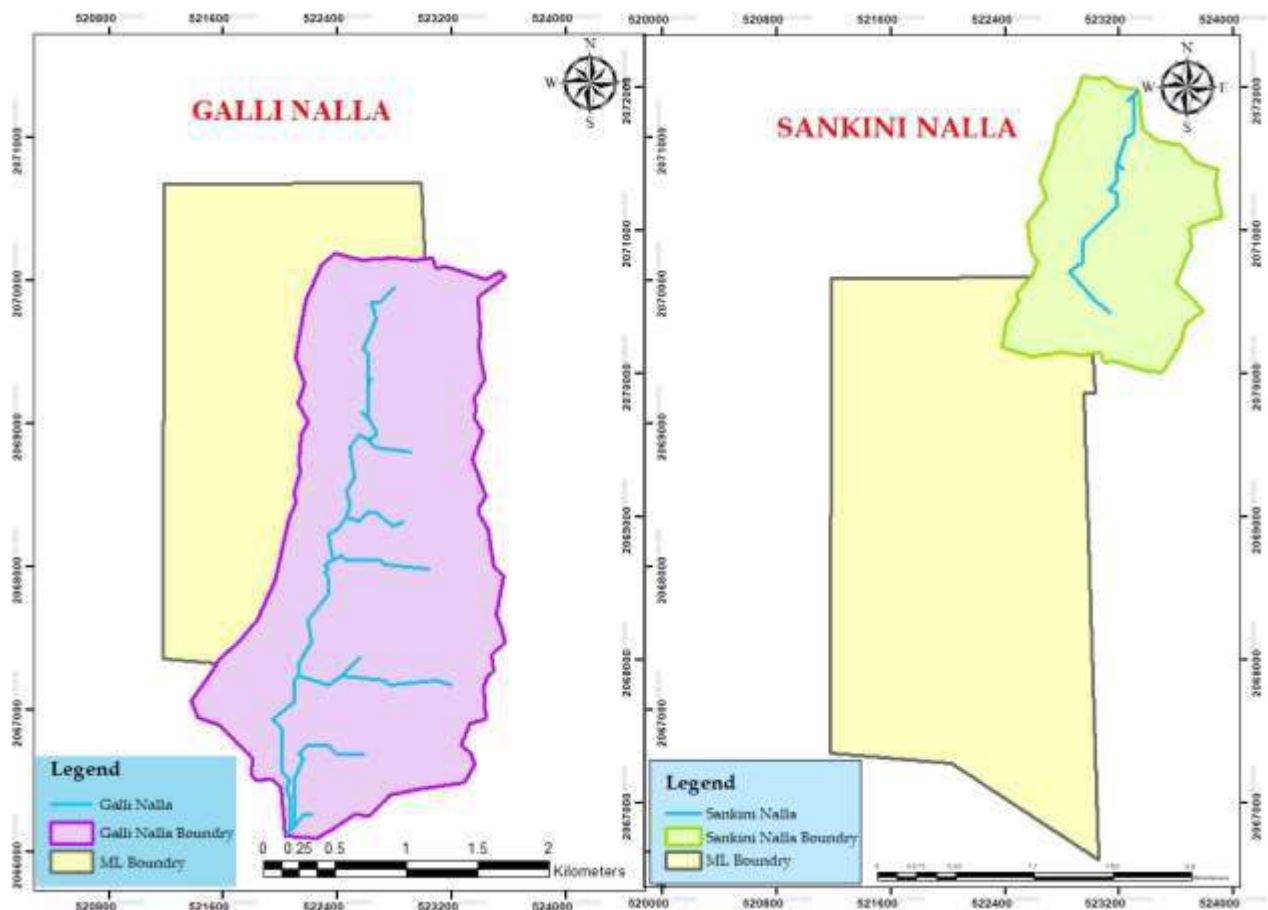
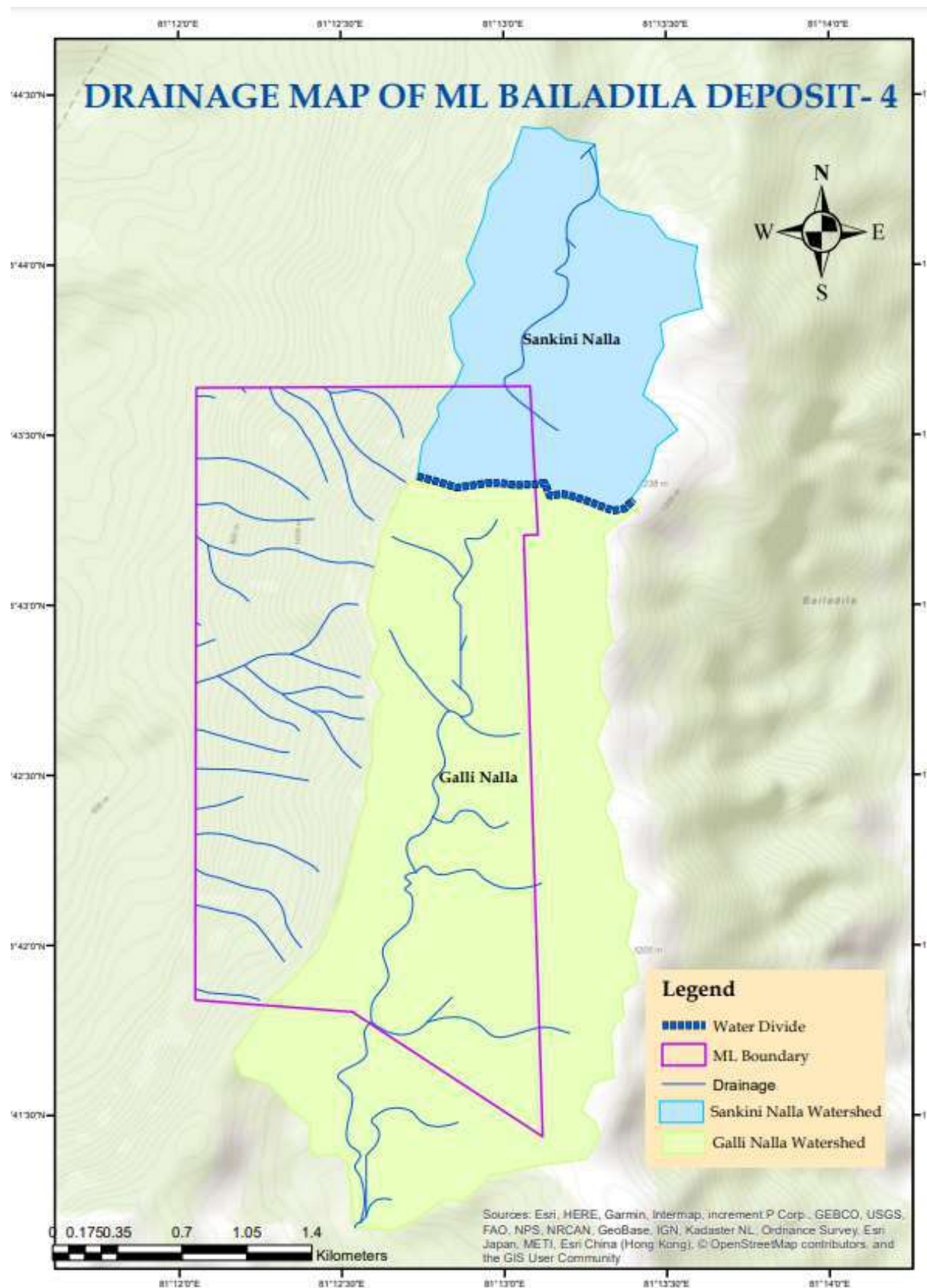
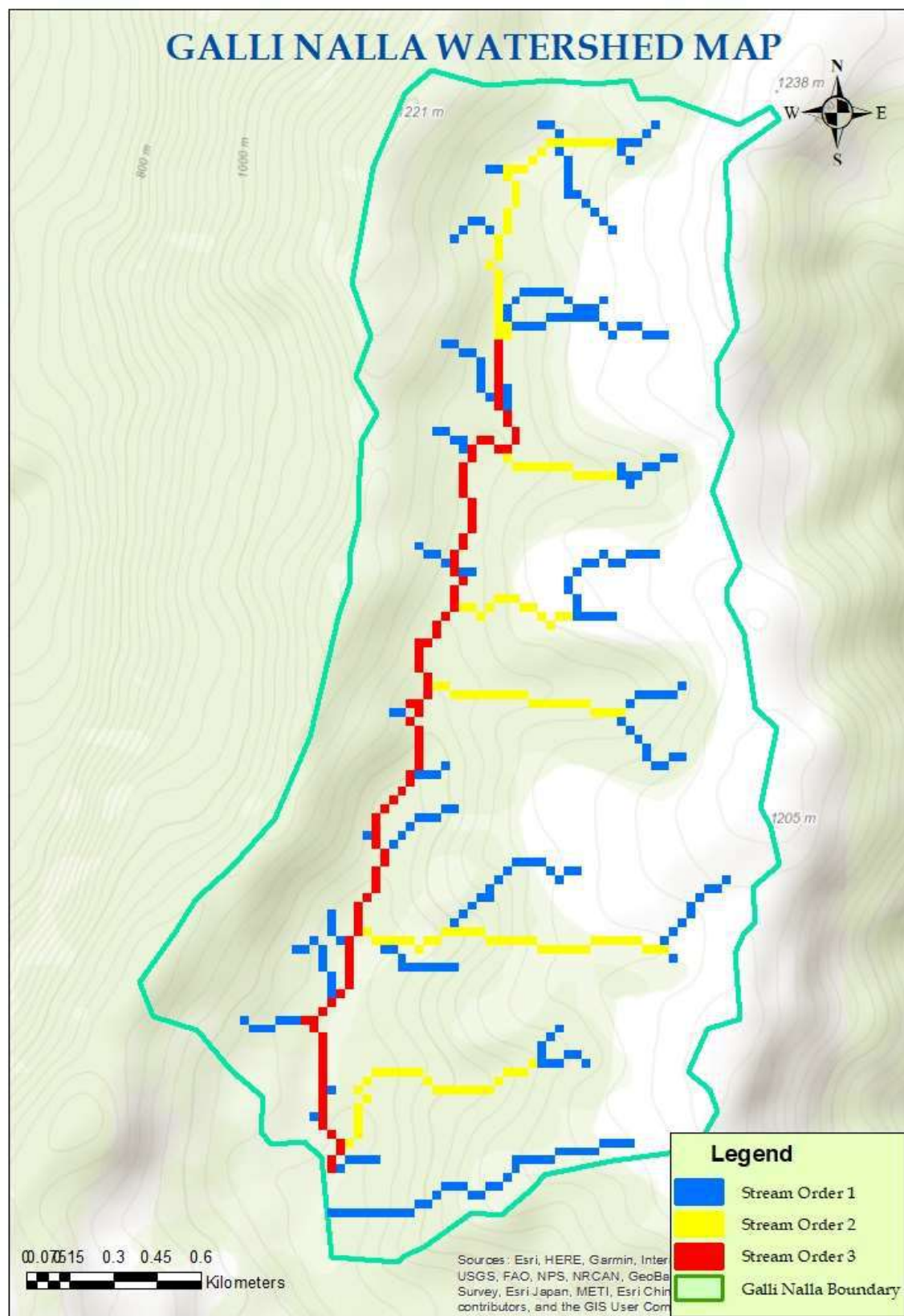


Figure 4.7: *Galli Nalla* and *Sankini Nalla* with ML boundary





**Figure 4.8: Drainage network map of ML area**



**Figure 4.9: Watershed map of Galli Nalla**



Stratigraphically the Deposit-4 capped with soil cover and laterite, banded Iron ore formation underlying the lateritic cap and overlaying ferruginous shale/ slates, tuff and cherts/ white quartzite and conglomerate. On the southern part of the lease area *Galli Nalla* cuttings expose quartzite and conglomerate. Exposure of litho-contact in the nalla facilitates seepage of sub-surface water (Figure 4.10). Iron ore Deposit-4 trends NNE-SSW direction along the strike direction and dipping towards east, amount of dip varying from  $45^{\circ}$  to sub-vertical. The deposit strike length is 3,500 m (including beyond the lease area) and width varies from 80 m to 250 m with an average width of 150 m. Exploration reveals maximum depth of the Iron ore body is 130 m with an average depth of 75 m. Based on physical characteristics and mode of occurrence, the Iron ore are classified as Steel grey hematite, blue grey hematite, laminated hematite, blue dust / flaky ore, lateritic/limonitic ore and float ore. Barring lateritic and limonitic ore Fe content of the Iron ore ranges from 58% to 69.3%. Lateritic and limonitic ore analysis 45.6 % to 62% Fe.



**Figure 4.10: Exposure of litho-contact in the *Galli Nalla***

The Deposit-4 is geologically mapped on 1:1000 scale and explored by drilling 81 boreholes for cumulative meterage of 6086 m. Based on the exploration inputs total resources of the lease area assessed as 129.4 million tonnes, of which 109 million tonnes are reserves and remaining 20.4 million tonnes are resources.

### **4.2.3 Hydrogeology**

The hydrogeological system functioning in the study area is influenced by the geological formations and tectonic settings, with aquifers occurring in consolidated, semi-consolidated, and unconsolidated formations. The consolidated formations consist of granites, schists, and quartzites, which possess secondary porosity due to fracturing, jointing, and weathering. Groundwater occurs in these formations under water table conditions, with the weathered layer facilitating groundwater storage and movement. Semi-consolidated formations, including sandstone and shale, have moderate to high groundwater potential, particularly in weathered and fractured zones. Unconsolidated formations such as alluvium and laterite also contribute to groundwater storage, with alluvial deposits along river courses forming significant aquifers.

Groundwater flow in the study area generally moves towards the east and north-east. The water table elevation ranges between 431.97 to 639.91 meters above mean sea level (mamsl) during the pre-monsoon season and 433.97 to 642.37 mamsl during the post-monsoon season. Depth to water level varies from 1.66 to 11.45 meters below ground level (mbgl) in the pre-monsoon period and from 1.55 to 9.74 mbgl in the post-monsoon period. These variations reflect seasonal fluctuations and groundwater extraction patterns.

#### **4.2.3.1 Groundwater regime**

The groundwater flow regime in the study area is influenced by the geological and structural framework. Water table contours based on pre-monsoon and post-monsoon data from 2023 indicate groundwater flow both locally and regionally, generally moving eastward in the project area and north-eastward in the broader study area. Water levels range from 1.66 to 11.45 meters below ground level (mbgl) in March 2023 (pre-monsoon) and 1.55 to 9.74 mbgl in October 2023 (post-monsoon), with fluctuations between 0.11 and 4.54 mbgl. Gneiss aquifers exhibit up to 5% specific yield, laterite up to 2.5%, and intrusive rocks up to 2%. These variations are essential for understanding groundwater availability and the potential for sustainable extraction.

Groundwater quality parameters such as Electrical Conductivity (EC), Chloride, Nitrate, and Fluoride were found to be within permissible limits as per BIS 10500:2012 standards, indicating suitability for drinking, irrigation, and industrial use. EC values ranged from 1185 to 6745  $\mu\text{S}/\text{cm}$ , with the highest values observed in the northern part of the buffer zone. Chloride concentrations ranged from 138.56 mg/L to 1237.2 mg/L, while nitrate values

ranged from 6.12 to 41.28 mg/L, and fluoride concentrations ranged from 0.32 to 0.52 mg/L (Source: NMDC Hydrological Report).

#### **4.2.3.2 Groundwater interaction with surface water bodies**

Surface water bodies, including the *Sankini Nalla* and *Koyar Nadi*, along with smaller perennial streams (*Galli Nalla*), play a critical role in recharging groundwater. The interaction between groundwater and these surface water bodies is facilitated by the network of fractures and weathered zones. The hydraulic connectivity through these structures ensures the movement of groundwater towards surface water bodies, particularly during dry seasons when groundwater provides base flow to streams. The hydraulic conductivities of different geological units, inferred from Electrical Resistivity Tomography (ERT) surveys, highlight the presence of saturated weathered zones at various depths. For instance, low resistivity values indicating saturated conditions were observed at depths ranging from 2 to 24 meters, suggesting significant groundwater storage in weathered and fractured formations. The resistivity models from ERT profiles reveal the presence of weathered and saturated formations, with significant variations in resistivity indicating different degrees of saturation and rock compactness. For example, ERT Profile No. 1 in front of the GM Office showed a resistivity range from 0.8 to 400 ohm-meters, with saturated weathered formations identified between 2 and 16 meters depth. Long-term water level data analysis from 2009 to 2021 indicates fluctuations due to variations in rainfall patterns, without a significant decline in water levels, suggesting a stable groundwater system.

### **4.3 PROPOSED MINING ACTIVITIES**

Mining operations are proposed / envisaged by open cast method deploying Heavy Earth Moving Machineries with deep hole drilling and blasting. Envisaged height and width of benches on ore and overburden is 12 m and 60 m respectively. Individual bench slope is envisaged at 70° with overall slope of 45°. Maximum depth of mining operation envisaged during the first 5 years plan period is 36 m from hill top. Mining operations are planned in such a way that first 5 years plan period production capacity envisaged is 2 million tonnes per annum, which will be steadily increased to 7 million tonnes per annum for the 9<sup>th</sup> year of the mining operations. As mining operations are yet to be commenced and no ground vibration study conducted. However to predict impact of the mining, ground vibration study conducted for the adjacent mine of NMDC (Deposit-10) is taken into consideration and analyzed in the report.

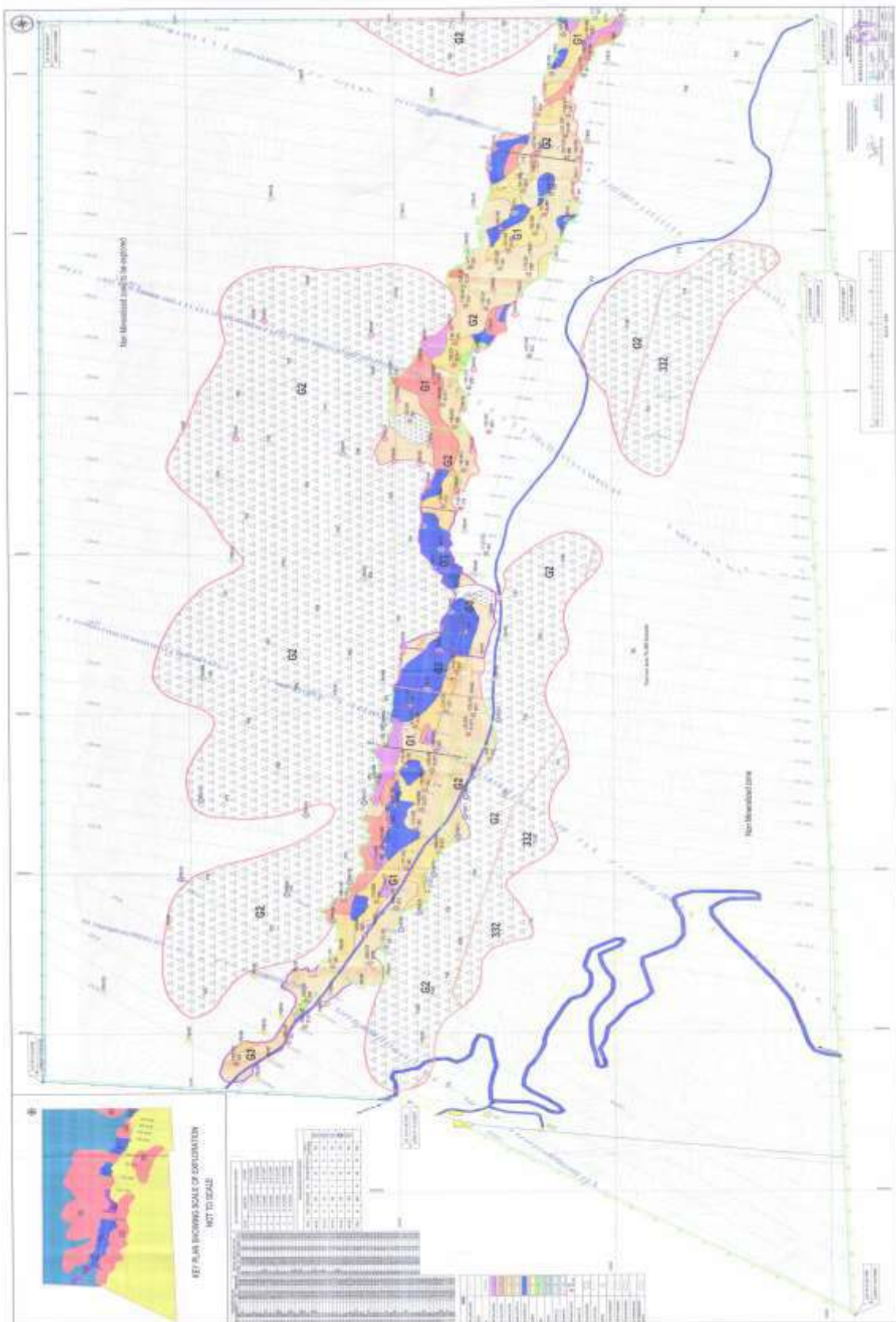
First five years of the mining operations it is planned to deploy comparatively smaller mining equipment to produce 2 million tonnes of Iron ore per annum. Subsequently larger mining equipment are planned to deploy to achieve 7 million tonnes Iron ore production per annum. Mining machineries proposed to be deployed after first 5 years of the plan period is given below:

Sl. No.	Type of the equipment	Capacity(M <sup>3</sup> )	No of equipment
1	Electric Excavator	10 M <sup>3</sup>	8
2	Electric Frontend Loader	8 M <sup>3</sup>	2
3	Bull dozer	850 hp	2
4	Bull dozer	450 hp	4
5	Wheel dozer	500 hp	1
6	Hydraulic drilling machine	150 mm	3
7	Hydraulic drilling machine	100 mm	5
8	Electric drilling machine	250 mm	4
9	Transporting equipment – Dumper	100 T	18
10	Water Tanker	28 M <sup>3</sup>	4

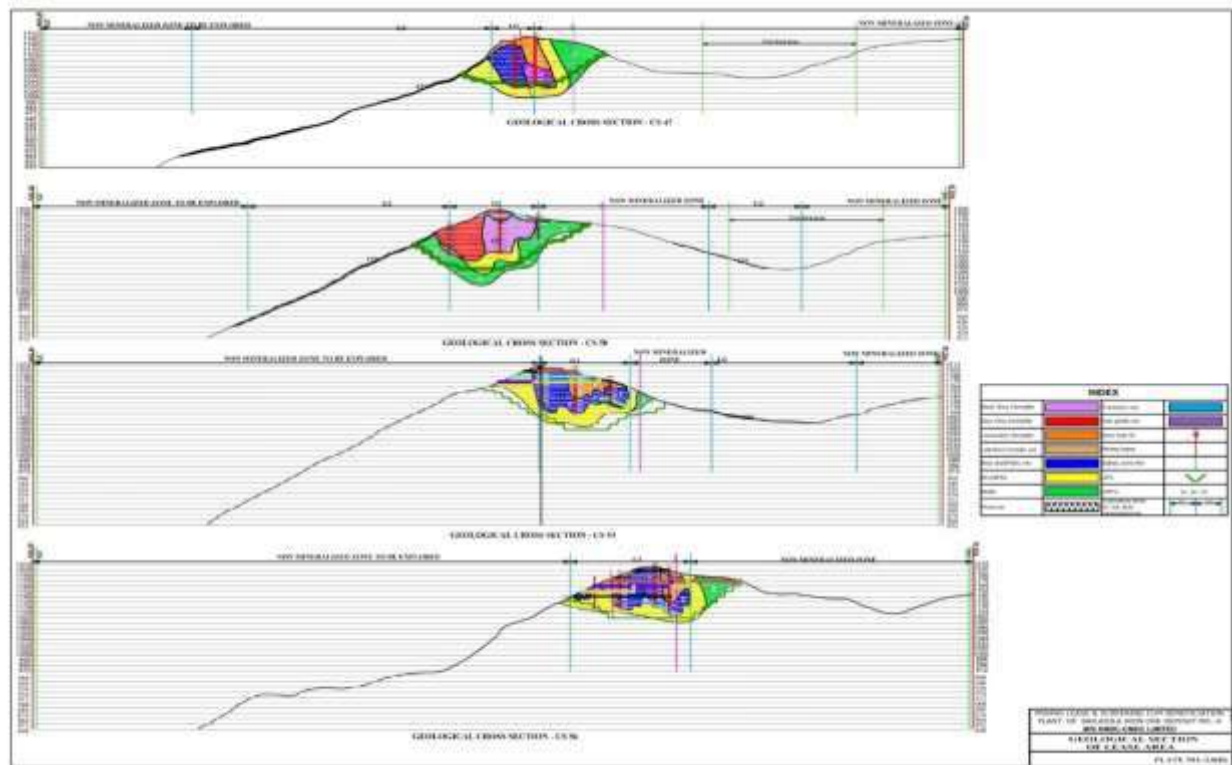
During the conceptual period it is envisaged to dispose mine waste in 5 waste dump locations, of which 4 dumps are proposed on the western flank of the hill slope and 1 dump proposed on the eastern flank of the hill. Total dump area envisaged is 74.07 ha. Further on the eastern side of the hill, all infrastructures such as crushing plant, PSP, downhill conveyor, internal roads, service center, ETP, mining office, canteen, rest shelter, power sub-station, power line, pump house, pickup weir, water pipe line and security barrack are envisaged covering over an area of 65.90 ha. Explosive magazine over 15.37 ha also planned on the eastern side of the hill slope. Total excavation for in-situ mining envisaged over 94.11 ha and floats ore excavation over 70.52 ha.

It is envisaged to operate mine on the north block initially up to ultimate pit bottom and advance towards south to enable concurrent backfilling of north block. At the end of the life of the mine, entire mine pit of north block and top benches of south block are reclaimed by backfilling and afforestation and lower level of the south block will be converted into water reservoir.

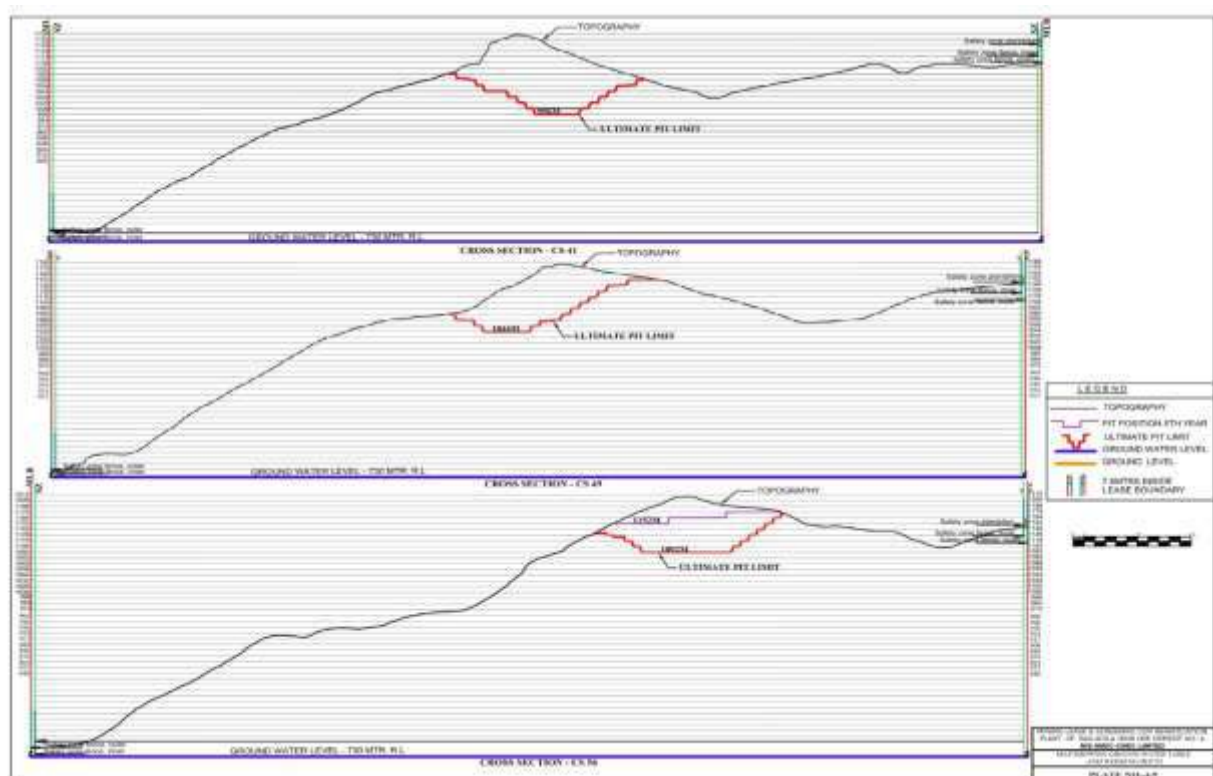




**Figure 4.11: Surface geological plan of Deposit-4 of M/s. NMDC-CMDC Ltd.**



**Figure 4.12: Selective geological cross section of Deposit-4 of M/s. NMDC-CMDC Ltd.**



**Figure 4.13: Selective cross sections showing Ultimate Pit Bottom & Pit Limit**

## CHAPTER - 5

### ECOLOGICAL ASSESSMENT OF TREE FERN HABITAT

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#### 5.1 FLORAL BIODIVERSITY ASSESSMENT

Tree ferns inhabiting on the either side of the *Galli Nalla* present itself as a narrow stretch within the mine lease of Bailadila Deposit-4 Iron ore block. Due to the narrowness of the Tree fern habitat (Core zone of *Galli Nalla*), line transects and rectangular plots (Kent, 2011) of size 250 m × 4 m were laid systematically along the stream. All the trees in each plot were identified and measured for their diameter (at breast height) and number of individuals. Nested quadrats of 3 m × 3 m and 1 m × 1 m were respectively used for shrubs and herbs. These quadrats were placed inside the rectangular plots at a distance of 50 m (5 quadrats in total for each plot) along the center line. A total of eight rectangular plots were laid in the core zone of *Galli Nalla* and eight in the adjoining forests. Taxonomic survey has been carried out for both core zone of *Galli Nalla* and in the adjoining forest area. The species have been identified with the help of regional flora and other published literature (Brandis, 1906; Mooney, 1942; Steward and Brandis, 1874). For the identification of Tree fern and giant fern, the authentic specimen deposited in DD Herbarium of Forest Research Institute, Dehradun has been consulted.

**Data analysis:** The on-field datasets have been quantitatively analyzed for density, frequency and abundance following which the relative values of density, frequency and abundance were determined. These values were summed up to derive Importance Value Index (IVI).

#### Equations employed for phyto-sociological analysis

Frequency denotes the homogeneity of distribution of various species ecosystem, or it is the probability or chance of finding a species in a given sample. It has been calculated as follows and expressed in percentage.

$$\text{frequency} = \frac{\text{Number of quadrats of occurrence}}{\text{Total number of quadrats studied}} \times 100$$

The species which is well distributed and having a chance of being recorded in any part of the ecosystem will have frequency 100%. While a species which is restricted to certain areas will be encountered in low frequency value.

## **Density**

Density is defined as the number of individuals of a species in a unit area and is an expression of the numerical strength of a species in a community. From the sampling data the density has been calculated as follows:

$$\text{Density} = \frac{\text{Total number of individuals of a species}}{\text{Total number of quadrats studied}}$$

## **Basal Area**

The basal area calculated out of the average diameter is as follows:

$$\text{Basal area (Dominance)} = \pi r^2$$

Where,  $\pi = 3.14$  and  $r$  = radius of the species (average of two diameters at right angle)

## **Importance Value Index (IVI)**

Importance Value Index (IVI) is an index used to express the dominance, and ecological success of any species with a single value. Importance Value Index (IVI) was calculated by the summation of relative values of frequency, density and dominance.

$$\text{Relative frequency} = \frac{\text{Frequency of species 'a'}}{\text{Frequency of all the species}} \times 100$$

$$\text{Relative density} = \frac{\text{Density of species 'a'}}{\text{Density of all the species}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Basal area of species 'a'}}{\text{Basal area of all the species}} \times 100$$

$$\text{Importance Value Index (IVI)} = \text{Relative Frequency} + \text{Relative Density} + \text{Relative Dominance}$$

Importance Value Index (IVI) has been calculated separately for each species of the tree, sapling/ shrub and herb, and arranged in order of decreasing importance. The species, which attains highest importance value, has been inferred as the dominant species and the species with lowest importance value is referred as the rare/ least dominant species. The sum total of all three values will never exceed 300.

On the basis of forest type classification by Champion and Seth (1968), the proposed area of 76.49 ha delineated for Tree fern conservation around *Galli Nalla* in Bailadila Iron ore Deposit-4 comes under *Southern Moist Mixed Deciduous Forest (3B/C2)*. This proposed

Tree fern habitat area is situated in a valley between two hillocks and is characterized by swampy habitat that extends for about 3.5 km starting from Deposit-4 to Rajabangla. The presence of many perennial feeder streams on both sides of *Galli Nalla* and the limited penetration of sunlight through out the year help maintain year round water and a humid micro-climate along the stream. Tree fern area presents a typical swampy wetland habitat, characterized by its unique hydrology and vegetation. It is interesting to note that the species composition along the *Galli Nalla* and adjoining forest area is markedly different. The tree canopy tends to be dense and create a perpetual shady environment for the understorey. Detailed study of the vegetation, Tree fern and its associate species inhabiting the swampy wetland ecosystem has revealed that the swamps of *Galli Nalla* is predominantly **occupied by *Carallia - Calamus – Cyathea – Licuala - Gnetum* community** (Table 5.1-5.3). It is pertinent to mention here that the species of Tree fern inhabiting the *Galli Nalla* ecosystem have been taxonomically identified to be *Cyathea spinulosa* and *Cyathea gigantea*. However, Environment Impact Assessment (EIA) & Environment Management Plan (EMP) Report of Bailadila Iron Ore Deposit-4 has specified the Tree fern species inhabiting the study area as *Cyathea arborea*. *Cyathea arborea* is a Tree fern species native to the Caribbean islands. Till date, the species *Cyathea arborea* has not been reported to inhabit either in India or South Asia and its geographic distribution is restricted to the nations in the Caribbean islands group, South and North America, and Malaysia.

The existence of this unique swamp ecosystem is based on biological, biogeomorphological processes, and other ecological functions which govern the fate of continuous flow of water. The vegetation of core zone of *Galli Nalla* forest is markedly different from forests in the buffer zone. The *Galli Nalla* community established as *Carallia – Calamus – Cyathea – Licuala - Gnetum* community possesses unique species assemblages. In tree layer, the species are *Antidesma buniis*, *Antidesma montanum* Blume var. *montanum*, *Atalantia monophylla*, *Carallia brachiata*, *Celtis timorensis*, *Cyathea gigantea*, *Cyathea spinulosa*, *Diospyros malabarica*, *Elaeocarpus lanceifolius*, *Ficus nervosa*, *Gnetum edule*, *Licuala peltata*, *Meliosma simplicifolia*, *Neonauclea purpurea* and *Vitex quinata* intermixed with some common species like *Psydrax dicoccos*, *Phoebe lanceolata*, *Pterocarpus marsupium*, *Terminalia chebula*, *Xylia xylocarpa*. In shrub layer, the species are *Alpinia malaccensis*, *Angiopteris evecta*, *Ardisia thyrsiflora*, *Calamus viminalis*, *Embelia ribes*, *Hoya alexicaca*, *Hyptianthera stricta*, *Licuala peltata*, *Peperomia tetraphylla* and *Zanthoxylum asiaticum* intermixed with some common species in the adjoining forest like *Dioscorea bulbifera*,

*Memecylon edule*, *Jasminum arborescens*, *Maclura spinosa*, *Osbeckia chinensis*, *Pavetta tomentosa*, *Searsia paniculata* etc. The herb layer mostly dominated by several fern species and other angiospermic species inhabit together with seedlings of trees and shrub species. The species are *Adiantum philippense*, *Pteris pellucida*, *Hemionitis farinosa*, *Hellenia speciosa*, *Hedychium coronarium*, *Geophila herbacea*, *Dryopteris sparsa*, *Dicranopteris linearis*, *Curculigo orchiodes*, *Colocasia antiquorum*, *Clematis simplicifolia*, *Chlorophytum arundinaceum*, *Bolbitis appendiculata*, *Asplenium laciniatum*, *Asplenium trichomanes* and *Asplenium trichomanes* (Table : 5.4-5.6).

Among these species, *Atalantia monophylla*, ***Carallia brachiata***, ***Cyathea gigantea***, ***Cyathea spinulosa***, ***Gnetum edule***, ***Licuala peltata***, ***Meliosma simplicifolia***, ***Neonauclea purpurea*** and ***Vitex quinata*** are unique species and often not studied in the Chhattisgarh for its extent, population dynamics and threats, and therefore warrants due conservation efforts to sustain its population.

The vegetation of buffer zone adjoining *Galli Nalla* Forest is distinct in composition from Tree fern habitat of core zone. In tree layer, the major species are *Buchanania lanzan*, *Callicarpa tomentosa*, *Careya arborea*, *Cassine glauca*, *Chloroxylon swietenia*, *Dillenia pentagyna*, *Gardenia gummifera*, *Schleichera oleosa*, *Glochidion heyneanum*, *Psydrax dicoccos*, *Homalium napaulense*, *Lannea coromandelica*, *Macaranga peltata*, *Memecylon edule*, *Ochna obtusata*, *Syzygium cumini*, *Terminalia chebula*, *Terminalia elliptica* and *Xylia xylocarpa*. In shrub layer, the species are *Ampelocissus divaricata*, *Antidesma acidum*, *Chromolaena odorata*, *Alstonia venenata*, *Combretum nanum*, *Dioscorea hispida*, *Olex scandens*, *Combretum nanum*, *Woodfordia fruticosa*, *Catunaregam spinosa*, *Helicteres isora* and *Flemingia strobilifera* etc. while herb layer is dominated by *Acrocephalus hispidus*, *Ageratum conyzoides*, *Andrographis paniculata*, *Aristida setacea*, *Boerhavia diffusa*, *Cheilocostus speciosus*, *Chrysopogon fulvus*, *Commelina benghalensis*, *Cynodon dactylon*, *Digitaria ciliaris*, *Dicranopteris linearis*, *Hedyotis corymbosa*, *Heteropogon contortus*, *Leucas Montana*, *Themeda caudata*, *Thysanolaena maxima*, *Mitracarpus villosus*, *Oldenlandia auricularia*, *Oplismenus burmannii*, *Panicum notatum*, *Scoparia dulcis*, *Strobilanthes heyneana* and *Vernonia cinerea* etc. (Table: 5.4-5.6).

### **Tree fern: Species Diversity & Population Structure**

Ferns have a vital role in establishing the early land flora as they were one of the first vascular plants to colonize the planet having spores as reproductive units and secondary



growth (Kenrick & Crane, 1997). Tree ferns are a well-established clade within the leptosporangiate ferns dominating the order Cyatheaales of Vascular cryptogamic plants Pteridophytes; it constitute about 250 different genera and about 12,000 species (Chang et al. 2011, Paul et al. 2015).

The Tree ferns are believed to be surviving from late Paleozoic (Permian) and mid Mesozoic (Jurassic) to the present Holocene era. Tree ferns (and ferns in general) belong to an ancient order of plants that arose 150 million years ago. This was a period before the dinosaurs, woody trees, and flowering plants (Rothwell and Stockey, 2008; Mehltreter et al., 2010) known to have existed in the planet. Botanically, Tree ferns are not really trees — they don't have true trunks. Their stems are structures called rhizomes from which the fronds arise. The stems are mostly arborescent, the trunks often with marcescent (persisting) leaves or leaf bases; shoot apices and petiole bases are covered with large scales or hairs. Due to their tree habit, Tree ferns always attract the fern enthusiasts and because of their distinctive arborescent growth habit with woody or fibrous trunk topped by a beautiful crown of spreading fronds. The habit of some Tree ferns is massive while some other species possess a creeping or prostrate trunk, and a slow growing cycle. Tree ferns are distributed in a wide range of habitats across the world from damp, sheltered woodland slopes, moist gullies (nalla) to high altitudes in cloud forests and from cool temperate forest to tropical rain forest which sometimes dominate the vegetation. It is also known to occur in open landscapes. Moreover, despite Tree ferns being an important floral group in the structure of forests, these plants are historically neglected in floristic and ecological studies (Weigand and Lehnert, 2016).

Kramer and Green (1990) listed about 624 species of living Tree ferns belonging to 17 genera grouped under 9 families. Similarly, giant fern *Angiopteris* has nearly about 30 species recorded worldwide, as per PPG 1 (2016). Cyatheaceae is most diversified family not only among Tree ferns but also among other Pteridophytes with about 600 Tree fern species under 5 genera and are widely distributed globally (Korall et al, 2006). *Cyathea* is the most widely distributed and most successful Tree fern but due to over exploitation for socioeconomic uses and habitat destruction, Tree fern genus *Cyathea* is rapidly decreasing throughout the world and hence enlisted in CITES (Kholia et al, 2013).

In India, Tree ferns are represented by 12 species and generally distributed in the Eastern Himalayas, Western Himalayas (Singh et al. 1986) North-East India, Western Ghats, Andaman Nicobar and Central India (Fraser-Jenkins 2008a, b, 2009). Out of which, 11

belong to the genus *Cyathea* of Cyatheaceae (Fraser-Jenkins et al. 2017) and 1 belongs to the genus *Cibotium* of Cibotiaceae. Likewise giant ferns are represented by four species belonging to sole genus *Angiopteris*. The Tree ferns family Cyatheaceae is well known for their beautiful huge foliage and fronds. It is the second largest living fern group among the pteridophytes. Mishra and Behra (2020) reported 11 species of genus *Cyathea* in India viz. *C. albosetacea* (Bedd.) Copel., *C. andersonii* (Schott ex Bedd.) Copel., *C. brunoniana* (Clarke) Clarke & Baker, *C. crinita* (Hook.) Copel., *C. gigantea* (Wall. ex Hook.) Holt., *C. henryi* Copel, *C. khasyana* (Moore ex Kuhn) Domin, *C. nicobarica* N. P. Balakr, *C. nilgirensis* Holttum and *C. spinulosa* Wall.ex Hook.

**In Central India, Singh and Sahu (2015) has reported two most common Indian species of Trees ferns from Madhya Pradesh viz *Cyathea gigantea* and *Cyathea spinulosa* which were also present in Galli Nalla in Deposit-4 Iron ore mines.**

H. F. Mooney, an illustrious forester from the colonial era of British-India, published a monumental work in 1942 on Bailadila Range of Chhattisgarh titled '*A Sketch of the Flora of the Bailadila Range in Bastar State*' in Indian Forest Records (Vol.3 no. 7 pages 197-253)' which reported two Tree ferns and one giant fern from the *Galli Nalla* and described as Swamp flora (The *Carallia -Calmus- Cyathea* association) and this association is still present in *Galli Nalla* with luxuriance of mature Tree ferns, sapling and seedling. This community is confined to narrow fringe belt of forest adjoining the natural streams cum swamp. **The Tree ferns were identified as *Cyathea spinulosa* and *Cyathea gigantea*** [which Mooney erroneously identified as *Alsophila glabra* (Figure 5.1 & 5.2) because of the glabrous and non aculeate stipe and rachis, but true *Alsophila glabra* (Blume) Hook. (Synonym of *Cyathea glabra*) is not reported to be found in India but confined to Java and S. E. Asia] along with giant fern *Angiopteris evecta*, but this treatise has been overlooked by almost all present day studies.

### **1. *Cyathea spinulosa* Wall.ex Hook. (Cyatheaceae)**

This larger Tree fern forms a slender trunk up to 6 m tall with large spreading crown. Main trunk is erect, massive, scaly, scale linear-lanceolate, shinning brown densely covered by adventitious roots. Stipes are distinctly dark purplish. Spiny near base, spines pointed and sharp. The tripinnate fronds are covered with spiny and scaly stalks. Laminae bipinnate, glabrous, thin, dark green; pinnae numerous pairs, alternate, short petiolate, lanceolate, apex acuminate, base truncate or subtruncate, lowest pinnae the largest; pinnules numerous,



alternate, margin deeply lobed to the costa; lobes many, falcate, oblong, narrow, acute, margins crenate, serrate, rachis tremendous brown, costae and costules scaly. Sori indusiate, near to costules, in single row either side of the costa large, rounded; indusia light brown, globose. Spores trilete, pale yellow.

**Vernacular/ Common Name:** *Kantawala* Fern, Spiny Fern, Flying spider-monkey Tree fern.

**Distribution:** Cambodia, China, Taiwan, Hongkong, Southern Japan, Bangladesh, India, Nepal, Bhutan, Indonesia, Myanmar (Burma), Taiwan, Thailand, Laos, Vietnam, and Philippines (Chandran 2008; Khoila et al., 2013; Singh and Sahu 2015). **In India it is mostly found in the North-Eastern and Eastern (Arunachal Pradesh, Sikkim, West Bengal, Assam, Meghalaya), Eastern India (Odisha: Koenjhar, Kalahandi, Rayagada, Sambalpur, Sundergarh, Mahendragiri Hills); Western Himalaya (Uttarakhand: Chamoli and Pithoragarh); Western Ghats (Karnataka, Goa, Tamil Nadu); Central India (Chhattisgarh, Jharkhand, Madhya Pradesh) and Andaman & Nicobar (Goel and Pande 2001; Singh and Sahu, 2015) and recorded up to an altitude of 2000 m .**

The species is locally known as *Kantewala* Tree fern in Central India. In Central India, this species is usually found growing along with *Cyathea gigantea* in Chhattisgarh (Bastar - Bailadila Hills) and Madhya Pradesh (Hoshangabad - Pachmarhi Hills, Chhindwara -Tamia).

## **2. *Cyathea gigantea* (Wall. ex Hook.) Holt. (Cyatheaceae)**

Tree fern, 1–3 m tall with a loose crown of leaves; rhizome massive. Fronds herbaceous or submembranaceous, tufted; stipes more than 1 m long, castaneous or reddish purple or black, upper part more or less glabrous; scales black and castaneous on stipe base, 10–12 1–2 mm, middle portion dark brown; few deciduous scales on rachis and costae. Pinnules short stalked, 5–12.5, 1.5–2.5 cm, gradually narrowed towards the apex, distinctly lobed up to 2/3rd of costa; costules 4–7 mm apart; veins 2–6 pairs; basal basioscopic vein usually from costa, herbaceous, dark green on upper surface, light green on lower surface; margins strongly crenate. Sori exindusiate, basal ones are away from costules and upper ones close to costule; paraphyses dark brown, shorter than sporangia. Pinna rachis is dark purplish, smooth, glabrescent or with a few small residual scales. Sori round, exindusiate, closer at top of pinnulet and wide apart at base.

**Distribution:** Bhutan, Bangladesh, China, Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Thailand and Vietnam (Zhang and Nishida 2013). **In India it is**

majorly found in North East India (Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, West Bengal –Darjeeling); Central and Eastern India: Odisha (Similipal Hills, Khordha, Sambalpur district, Rontha Plateau, Kalahandi, Keonjhar, Mahendragiri Hills), Maharashtra, Madhya Pradesh (Pachmarhi), Chhattisgarh (Dantewada), Jharkhand; South India; Andhra Pradesh (West Godavari district, Srikakulam), Tamil Nadu, Karnataka (Dakshina Kannada, Hassan, Kodagu, Uttara Kannada, Shimoga), Kerala and Andaman and Nicobar Islands (Kholia *et al.*, 2016, Paul *et al.*, 2015; Mishra and Behera, 2018; Rao and Kumar, 2024).

The species is locally known as *Bina Kantewala* Tree fern in Central India. In Central India this species distributed in Chhattisgarh (Bastar -Bailadila Hills) and Madhya Pradesh (Hoshangabad - Pachmarhi Hills, Chhindwara -Tamia).

A comparative account of the taxonomical features of the *Cyathea* species identified by the ICFRE team during the study namely *Cyathea spinulosa* and *C. gigantea* along with the earlier reported *Cyathea* species to inhabit the *Galli Nalla* namely *Cyathea arborea* and *C. alata* is presented below:

Characteristics	<i>Cyathea spinulosa</i>	<i>Cyathea gigantea</i>	<i>Cyathea arborea</i>	<i>Cyathea alata</i>
<b>Natural Distribution</b>	Cambodia, China, Taiwan, Hongkong, Southern Japan, Bangladesh, India, Nepal, Bhutan, Indonesia, Myanmar (Burma), Taiwan, Thailand, Laos, Vietnam, and Philippines	Bhutan, Bangladesh, China, Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Thailand and Vietnam	Caribbean islands, South and North America, Malaysia	New Caledonia
<b>Height</b>	Trunk up to 6 m tall	Trunk up to 1–3 m tall	Trunk up to 10 (rarely 15) m tall	Taxonomic details not available
<b>Scale</b>	Covered scale shining dark brown	Covered shiny, dark brown scales	covered with whitish or creamy, papery scale, narrowly ovate-attenuate scales	
<b>Fronnd</b>	Fronnd-axes usually stramineous or light brown	Fronnds thinly textured , bright green and fairly	Fronnds soft textured, fresh green· above, paler below; and without spines	
<b>Stipes</b>	Stipes shining	Stipes dark black		

Characteristics	<i>Cyathea spinulosa</i>	<i>Cyathea gigantea</i>	<i>Cyathea arborea</i>	<i>Cyathea alata</i>
	stramineous-brown, 30-40 cm long	in colour, more than 100 cm long		
<b>Spine on Stipes</b>	Stipes covered with densely long spines throughout	Stipes covered with less short spines usually at the base	stipe spineless	
<b>Lamina</b>	Lamina bipinnate	Lamina bipinnate-tripinnatifid	Lamina bipinnate	
<b>Veins</b>	Veins on ultimate segments forked;	Veins on ultimate segments simple	Veins on ultimate segments 1- to 3-forked.	
<b>Sori</b>	Sori indusiate	Sori exindusiate	Sori indusiate	
<b>Position of Sori</b>	Sori in single row either side of the costa	Sori arranged in 'V' inverted shaped.	Sori usually paired	
<b>Number of spore in sporogonium</b>	16 spores per sporangium	64 spores per sporangium	16 spores per sporangium	

### 3. *Angiopteris evecta* (G.Forst.) Hoffm. (Marattiaceae) (Figure 5.3)

This giant fern forming massive rhizomes, near spherical trunk, 1.5 meters height (approx). Rhizome bears two flat, rounded, dark brown, leathery, stipule-like outgrowths on either side of the petiole insertion; Petioles thick and fleshy with a swollen base and bipinnate very large and spreading glabrous lamina. Pinnae divided in pinnules, numerous, alternate, shortly stalked, linear; the base unequally wedge-shaped to more or less rounded; the margins serrate towards the apical part; the apices acuminate. Sporangia clustered in short double rows of three to seven with no indusium.

**Distribution:** Southeast Asia and Oceania, from Sri Lanka and Bangladesh in the west through to Melanesia, Micronesia and Polynesia in the east, and from Japan in the north to northern and eastern Australia in the south. In India it distributed in North-Eastern states of India (Assam and in Arunachal Pradesh), Central India: Uttar Pradesh, Madhya Pradesh, South India (Nilgiri hills) (Mishra, and Behera, 2018).

**Vernacular/ Common Name:** King fern, Giant fern, Elephant fern, Oriental vessel fern, Madagascar Tree fern, or Mule's Foot fern.

Ethnobotanically, all three species are widely used in time immemorial in Central India in ethnomedicinal, Veterinary and traditional rituals. The local inhabitants continuously harvested their tender shoots, leaves and pith for food and traditional medicine.

These species including giant fern co-occur with each other and are highly localized in the spray zones of flowing streams (swamp), which indicate that they prefer a highly moist environment and undisturbed damp environment. These Tree ferns prefer lithophytic habitats on rocky streamside banks. The swamps/ streams of study area are seriously threatened habitats because of stream diversions depriving many downstream species including the sensitive fern community of the much required water for enduring summer/dry spell. Both the species of *Cyathea* inhabit humic soils in shadowed forest locations and are mostly recorded from shady and moist places. Availability of moisture stands critical from early stages to different transition stage in its life cycle. They also have a considerable influence on the forest community through their effects on nutrient cycling, formation of deep organic layers and by their physical impacts of their macro-litterfall on the regeneration niche.

### **Population structure of Tree Fern and Giant Fern in Galli Nalla**

All three species have good colonizing capacity in *Galli Nalla*. Regeneration of gametophyte is common which remains bisexual and sporophyte production is successful through intragametophytic selfing. Regeneration status of both the Tree fern and giant ferns have been ascertained as good (young > immatures > matures). A total of 250 individuals ha<sup>-1</sup> of young, 111.1 individuals ha<sup>-1</sup> of immature and 25 individuals ha<sup>-1</sup> of matures were recorded for *Cyathea spinulosa*, a total of 250 individuals ha<sup>-1</sup> young, 83 individuals ha<sup>-1</sup> of immatures and 22.5 individuals ha<sup>-1</sup> of matures were recorded for *Cyathea gigantea* (Wall. ex Hook.) Holt. , and a total of 250 individuals ha<sup>-1</sup> of youngs and 22.7 individuals ha<sup>-1</sup> of matures were recorded for *Angiopteris evecta* from core zone of studied area (Table 5.1-5.3).



**Figure 5.1: *Cyathea spinulosa* 1-5, 1. Habit 2. Bipinnate laminae 3. Fronds showing spines 4. Pinnae with distribution pattern of sori 5. Sori indusiate**





**Figure 5.2: *Cyathea gigantea* 1-5, 1. Habit 2. Bipinnate laminae 3-4. Pinnae showing distribution 'V' shape pattern of sorai 5. Sori indusiate**



**Figure 5.3: *Angiopteris evecta* 1-5, 1. Habit 2. Laminae, 3-4. Pinnae showing distributional pattern of sorai 5. Sori**





**Figure 5.4: The Herbarium sample collected by H.F Mooney in 1936 from Bailadila**





**Figure 5.5: Major associated plant species in Tree fern Habitat of of Galli Nalla 1-9.** 1. *Carallia brachiata* 2. *Celtis timorensis* 3. *Licuala peltata* 4. *Atalantia monophylla* 5. *Elaeocarpus lanceifolius* 6. *Gnetum edule* 7. *Symplocos spicata* 8. *Neonauclea purpurea* 9. *Calamus viminalis*

**Table 5.1: Importance values and per ha density of trees in Tree fern Habitat in Galli Nalla**

Species	Individuals ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Ficus benjamina</i> L.	5	1.22	2.53	44.13	47.88
<i>Syzygium cumini</i> (L.) Skeels	15	3.67	4.43	7.20	15.30
<i>Litsea glutinosa</i> (Lour.) Robins	25	6.12	4.43	4.74	15.29
<b><i>Cyathea spinulosa</i> Wall. ex Hook.</b>	<b>25</b>	<b>6.12</b>	<b>4.43</b>	<b>1.60</b>	<b>12.15</b>
<b><i>Cyathea gigantea</i> (Wall. ex Hook.) Holtum</b>	<b>22.5</b>	<b>5.50</b>	<b>3.80</b>	<b>1.60</b>	<b>10.90</b>
<i>Antides mamontanum</i> Blume var. montanum	23.75	5.81	2.53	1.67	10.01
<i>Memecylon edule</i> Roxb.	20	4.89	4.43	0.45	9.77
<i>Antidesma buniis</i> (L.) Spreng.	22.5	5.50	1.90	1.70	9.10
<i>Gnetum edule</i> (Willd.) Blume	15	3.67	5.06	0.37	9.10
<i>Carallia brachiata</i> (Lour.) Merr.	7.5	1.83	1.90	4.72	8.45
<i>Xylia xylocarpa</i> (Roxb.) Taub.	17.5	4.28	2.53	1.31	8.12
<i>Murraya paniculata</i> (L.) Jack.	15	3.67	3.80	0.33	7.80
<i>Macaranga peltata</i> (Roxb.) Muell.- Arg.	7.5	1.83	2.53	2.95	7.31
<i>Phoebe lanceolata</i> Nees	17.5	4.28	2.53	0.49	7.30
<i>Pittosporum napaulense</i> (DC.) Rehder & E.H. Wilson	13.75	3.36	3.16	0.73	7.25
<i>Atalantia monophylla</i> DC.	15	3.67	1.90	1.37	6.94
<i>Homalium napaulense</i> (DC.) Benth.	7.5	1.83	2.53	1.38	5.74
<i>Vitex quinata</i> (Lour.) F.N. Williams	6.25	1.53	2.53	1.61	5.67
<i>Ziziphus xylopyrus</i> (Retz.) Willd.	8.75	2.14	3.16	0.23	5.53
<i>Cassine glauca</i> (Rottb.) Kuntze	10	2.45	1.27	1.38	5.10
<i>Meliosma simplicifolia</i> (Roxb.) Walp.	5	1.22	1.90	1.85	4.97
<i>Xantolis tomentosa</i> (Roxb.) Raf.	7.5	1.83	1.90	0.44	4.17
<i>Glochidion lanceolarium</i> (Roxb.) Dalz.	6.25	1.53	1.90	0.60	4.03
<i>Licuala peltata</i> Roxb. ex Buch.-Ham.	6.25	1.53	1.27	1.21	4.01
<i>Dillenia pentagyna</i> Roxb.	5	1.22	1.27	1.42	3.91
<i>Glochidion heyneanum</i> (Wight & Arn.) Wight	5	1.22	1.90	0.75	3.87
<i>Terminalia elliptica</i> Willd.	3.75	0.92	1.90	0.95	3.77
<i>Mangifera indica</i> L.	3.75	0.92	1.90	0.73	3.55
<i>Celtis timorensis</i> Span.	6.25	1.53	1.27	0.37	3.17
<i>Mallotus philippensis</i> (Lam.) Müll. Arg.	3.75	0.92	1.27	0.95	3.14
<i>Bridelia retusa</i> (L.) A. Juss.	5	1.22	1.27	0.44	2.93
<i>Schleichera oleosa</i> (Lour.) Oken	1.25	0.31	0.63	1.57	2.51
<i>Elaeocarpus lanceifolius</i> Roxb.	2.5	0.61	1.27	0.61	2.49
<i>Ficus nervosa</i> Roth	1.25	0.31	0.63	1.20	2.14
<i>Terminalia chebula</i> Retz.	2.5	0.61	1.27	0.26	2.14
<i>Neonauclea purpurea</i> (Roxb.) Merr.	1.25	0.31	0.63	1.07	2.01
<i>Phanera vahlii</i> (Wight & Arn.) Benth.	2.5	0.61	1.27	0.08	1.96
<i>Ficus semicordata</i> Buch.-Ham. ex	1.25	0.31	0.63	0.84	1.78

J.E. Sm.					
<i>Wendlandia tinctoria</i> (Roxb.) DC.	2.5	0.61	0.63	0.50	1.74
<i>Diospyros malabarica</i> (Desr.) Kostel.	2.5	0.61	0.63	0.48	1.72
<i>Citrus × aurantium</i> L.	2.5	0.61	0.63	0.38	1.62
<i>Cassia fistula</i> L.	2.5	0.61	0.63	0.26	1.50
<i>Kydia calycina</i> Roxb.	2.5	0.61	0.63	0.22	1.46
<i>Artocarpus lakoocha</i> Roxb.	1.25	0.31	0.63	0.49	1.43
<i>Olea paniculata</i> R.Br.	1.25	0.31	0.63	0.47	1.41
<i>Bridelia glauca</i> Blume	2.5	0.61	0.63	0.14	1.38
<i>Chionanthus ramiflorus</i> Roxb.	2.5	0.61	0.63	0.12	1.36
<i>Symplocos spicata</i> Roxb.	2.5	0.61	0.63	0.10	1.34
<i>Pterocarpus marsupium</i> Roxb.	1.25	0.31	0.63	0.38	1.32
<i>Diospyros montana</i> Roxb.	1.25	0.31	0.63	0.18	1.12
<i>Eurya nitida</i> Korth.	1.25	0.31	0.63	0.13	1.07
<i>Litsea monopetala</i> (Roxb.) Pers.	1.25	0.31	0.63	0.13	1.07
<i>Ficus hispida</i> L.f.	1.25	0.31	0.63	0.12	1.06
<i>Neocinnamomum caudatum</i> (Nees) Merr.	1.25	0.31	0.63	0.10	1.04
<i>Schrebera swietenoides</i> Roxb.	1.25	0.31	0.63	0.09	1.03
<i>Miliusa tomentosa</i> (Roxb.) Finet & Gagnep.	1.25	0.31	0.63	0.09	1.03
<i>Casearia tomentosa</i> Roxb.	1.25	0.31	0.63	0.08	1.02
<i>Acacia pennata</i> (L.) Willd.	1.25	0.31	0.63	0.07	1.01
<i>Buchanania lanzan</i> Spreng.	1.25	0.31	0.63	0.07	1.01
<i>Holarrhena pubescens</i> Wall. ex G.Don	1.25	0.31	0.63	0.07	1.01
<i>Trichilia connaroides</i> (Wight & Arn.) Benth.	1.25	0.31	0.63	0.04	0.98

**Table 5.2: Importance values and per ha density of Shrubs including saplings in Tree fern Habitat in Galli Nalla**

Species	Individuals ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Phoebe lanceolata</i> Nees (sapling)	222.22	3.10	3.30	10.50	16.8
<i>Psydrax dicoccos</i> Gaertn.	250.00	3.40	4.40	8.00	15.88
<i>Memecylon edule</i> Roxb. (sapling)	222.22	3.10	3.80	4.50	11.41
<i>Alpinia malaccensis</i> (Burm.f.) Roscoe	194.44	2.70	1.10	6.00	9.72
<i>Macaranga peltata</i> (Roxb.) Muell.-Arg. (sapling)	138.88	1.90	2.70	3.70	8.36
<i>Ardisia solanacea</i> Roxb.	222.22	3.10	2.70	1.50	7.32
<i>Litsea glutinosa</i> (Lour.) Robins (sapling)	166.66	2.30	0.50	4.00	6.80
<i>Combretum decandrum</i> Jacq.	194.44	2.70	2.70	1.30	6.71
<i>Mikania micrantha</i> Kunth	222.22	3.10	2.70	0.70	6.50
<i>Syzygium cumini</i> (L.) Skeels (sapling)	83.33	1.10	1.60	2.80	5.64
<i>Artocarpus lakoocha</i> Roxb. (sapling)	111.11	1.50	1.10	2.90	5.57
<i>Dillenia pentagyna</i> Roxb.	83.33	1.10	1.60	2.50	5.25
<i>Carallia brachiata</i> (Lour.) Merr. (sapling)	83.33	1.10	1.10	2.90	5.19
<i>Colebrookea oppositifolia</i> Sm.	166.66	2.30	2.20	0.60	5.05
<b><i>Cyathea spinulosa</i> Wall. ex Hook.</b>	<b>111.11</b>	<b>1.50</b>	<b>1.60</b>	<b>1.90</b>	<b>5.03</b>

Species	Individuals ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<b>(sapling)</b>					
<i>Homalium napaulense</i> (DC.) Benth. (sapling)	111.11	1.50	1.60	1.90	5.03
<i>Chromolaena odorata</i> (L.) King & Robins	194.44	2.70	1.10	0.80	4.53
<i>Dioscorea bulbifera</i> L.	166.66	2.30	1.60	0.60	4.45
<i>Lantana camara</i> L.	194.44	2.70	1.10	0.70	4.48
<i>Calamus viminalis</i> Willd.	138.8	1.90	1.60	0.70	4.30
<i>Terminalia elliptica</i> Willd. (sapling)	55.55	0.80	1.10	2.40	4.25
<i>Schefflera stellata</i> (Gaertn.) Harms	55.55	0.80	1.10	2.40	4.25
<b><i>Cyathea gigantea</i> (Wall. ex Hook.) Holtum (sapling)</b>	<b>83.33</b>	<b>1.10</b>	<b>1.60</b>	<b>1.40</b>	<b>4.18</b>
<i>Celastrus paniculatus</i> Willd.	166.66	2.30	1.10	0.70	4.14
<i>Elaeagnus latifolia</i> L.	83.33	1.10	1.10	1.90	4.10
<i>Licuala peltata</i> Roxb. ex Buch.-Ham.	83.33	1.10	1.10	1.80	4.05
<i>Xylia xylocarpa</i> (Roxb.) Taub. (sapling)	83.33	1.10	1.10	1.70	3.90
<i>Murraya paniculata</i> (L.) Jack.	83.33	1.10	1.10	1.60	3.86
<i>Ardisia thyrsoiflora</i> D.Don	111.11	1.50	1.60	0.60	3.75
<i>Hiptage benghalensis</i> (L.) Kurz	111.11	1.50	1.60	0.40	3.59
<i>Mangifera indica</i> L. (sapling)	55.55	0.80	1.10	1.70	3.58
<i>Clerodendrum infortunatum</i> L.	111.11	1.50	1.60	0.30	3.50
<i>Rubia cordifolia</i> L.	166.66	2.30	0.50	0.50	3.36
<i>Anodendron parviflorum</i> (Roxb.) I.M.Turner	111.11	1.50	1.10	0.70	3.36
<i>Dioscorea belophylla</i> (Prain) Voigt ex Haines	111.11	1.50	1.10	0.40	3.05
<i>Cissampelos pareira</i> L.	111.11	1.50	1.10	0.40	2.99
<i>Gnetum edule</i> (Willd.) Blume (sapling)	55.55	0.80	0.50	1.50	2.84
<i>Cassine glauca</i> (Rottb.) Kuntze (sapling)	55.55	0.80	1.10	0.90	2.80
<i>Antidesma acidum</i> Retz.	83.33	1.10	1.10	0.40	2.67
<i>Cipadessa baccifera</i> (Roxb. ex Roth) Miq.	55.55	0.80	1.10	0.70	2.54
<i>Desmodium gangeticum</i> (L.) DC.	83.33	1.10	1.10	0.30	2.51
<i>Grewia tiliaefolia</i> Vahl (Sapling)	27.78	0.40	0.50	1.60	2.51
<i>Flemingia macrophylla</i> (Willd.) Kuntze ex Merr.	83.33	1.10	1.10	0.20	2.47
<i>Ziziphus rugosa</i> Lam.	55.55	0.80	0.50	0.90	2.19
<i>Embelia sjeriam-cottam</i> (Roem. & Schult.) DC.	27.76	0.40	0.50	1.20	2.17
<i>Leea indica</i> (Burm.f.) Merr.	55.55	0.80	1.10	0.20	2.10
<i>Glycosmis cochinchinensis</i> (Lour.) Pierre ex Engl.	55.55	0.80	0.50	0.70	2.05
<i>Zanthoxylum asiaticum</i> (L.) Appelhans, Grosso & J.Wen	55.55	0.80	0.50	0.70	2.04
<i>Breynia retusa</i> (Dennst.) Alston	55.55	0.80	1.10	0.10	1.96
<i>Searsia paniculata</i> (Wall. ex G.Don) Moffett	55.55	0.80	0.50	0.60	1.94
<i>Litsea monopetala</i> (Roxb.) Pers.	27.78	0.40	0.50	1.00	1.90
<i>Clausena heptaphylla</i> (Roxb. ex DC.)	27.78	0.40	0.50	0.80	1.74

Species	Individuals ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
Wight & Arn.					
<i>Millettia racemosa</i> (Roxb.) Benth.	27.78	0.40	0.50	0.70	1.65
<i>Helinus lanceolatus</i> Brandis	55.55	0.80	0.50	0.30	1.60
<i>Dracaena terniflora</i> Roxb.	55.55	0.80	0.50	0.30	1.57
<i>Terminalia chebula</i> Retz. (sapling)	27.78	0.40	0.50	0.60	1.54
<i>Tadehagi triquetrum</i> (L.) H. Ohashi	55.55	0.80	0.50	0.20	1.53
<i>Embeliaribes</i> Burm.f.	27.78	0.40	0.50	0.60	1.50
<i>Urena lobata</i> L. subsp. <i>sinuata</i> (L.) Borss. Waalk.	55.55	0.80	0.50	0.20	1.50
<i>Tephrosia purpurea</i> (L.) Pers. subsp. <i>purpurea</i>	55.55	0.80	0.50	0.20	1.50
<i>Holarrhena pubescens</i> Wall. ex G. Don (sapling)	27.78	0.40	0.50	0.50	1.44
<i>Milusa tomentosa</i> (Roxb.) Sinclair (sapling)	27.78	0.40	0.50	0.50	1.44
<i>Pterocarpus marsupium</i> Roxb. (sapling)	27.78	0.40	0.50	0.50	1.44
<i>Desmodium pulchellum</i> (L.) Benth.	27.78	0.80	0.50	0.10	1.40
<i>Ixora parviflora</i> Lam.	27.78	0.80	0.50	0.10	1.40
<i>Flueggea virosa</i> (Roxb. ex Willd.) Voigt	27.78	0.40	0.50	0.40	1.34
<i>Osbeckia chinensis</i> L.	27.78	0.40	0.50	0.40	1.30
<i>Garuga pinnata</i> Roxb. (sapling)	27.78	0.40	0.50	0.30	1.30
<i>Ficus religiosa</i> L. (sapling)	27.78	0.40	0.50	0.30	1.25
<i>Morinda pubescens</i> J.E. Smith	27.78	0.40	0.50	0.30	1.25
<i>Grewia nervosa</i> (Lour.) Panigrahi	27.78	0.40	0.50	0.20	1.16
<i>Maclura spinosa</i> (Willd.) C.C. Berg	27.78	0.40	0.50	0.20	1.15
<i>Grewia hirsuta</i> Vahl	27.78	0.40	0.50	0.20	1.14
<i>Gynochthodes umbellata</i> (L.) Razafim. & B. Bremer	27.78	0.40	0.50	0.20	1.13
<i>Erycibe paniculata</i> Roxb.	27.78	0.40	0.50	0.20	1.11
<i>Jasminum arborescens</i> Roxb.	27.78	0.40	0.50	0.20	1.08
<i>Dalbergia volubilis</i> Roxb.	27.78	0.40	0.50	0.10	1.03
<i>Ventilago madraspatana</i> Gaertn.	27.78	0.40	0.50	0.10	1.03
<i>Hyptianthera stricta</i> (Roxb. ex Sm.) Wight & Arn.	27.78	0.40	0.50	0.10	1.02
<i>Jasminum arborescens</i> Roxb.	27.78	0.40	0.50	0.10	1.02
<i>Cissampelopsis corymbosa</i> (Wall. ex DC.) C. Jeffrey & Y. L. Chen	27.78	0.40	0.50	0.10	1.01
<i>Cynanchum callialatum</i> Buch.-Ham. ex Wight	27.78	0.40	0.50	0.10	1.01
<i>Gymnema sylvestre</i> (Retz.) R.Br. ex Sm.	27.78	0.40	0.50	0.10	1.01
<i>Cissus repanda</i> Vahl.	27.78	0.40	0.50	0.10	1.00
<i>Hemidesmus indicus</i> (L.) R.Br.	27.78	0.40	0.50	0.10	1.00
<b><i>Angiopteris evecta</i> (G. Forst.) Hoffm.</b>	<b>27.78</b>	<b>0.40</b>	<b>0.50</b>	<b>0.10</b>	<b>1.00</b>
<i>Flemingia strobilifera</i> (L.) R.Br. ex Ait.	27.78	0.40	0.50	0.10	1.00
<i>Dioscorea glabra</i> Roxb.	27.78	0.40	0.50	0.10	0.10
<i>Hoya alexicaca</i> (Jacq.) Moon	27.78	0.40	0.50	0.00	0.10
<i>Desmodium ferrugineum</i> Wall. ex	27.78	0.40	0.50	0.00	0.98

Species	Individuals ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
Thwaites					
<i>Dioscorea hispida</i> Dennst.	27.78	0.40	0.50	0.00	0.97
<i>Ampelocissus divaricata</i> (Wall. ex M.A.Lawson) Planch.	27.78	0.40	0.50	0.00	0.97
<i>Leea asiatica</i> (L.) Ridsdale	27.78	0.40	0.50	0.00	0.97
<i>Dioscorea pentaphylla</i> L.	27.78	0.40	0.50	0.00	0.96
<i>Dioscorea oppositifolia</i> L.	27.78	0.40	0.50	0.00	0.96
<i>Smilax zeylanica</i> L.	27.78	0.40	0.50	0.00	0.96
<i>Ipomoea hederifolia</i> L.	27.78	0.40	0.50	0.00	0.98
<i>Melothria heterophylla</i> (Lour.) Cogn.	27.78	0.40	0.50	0.00	0.96
<i>Cajanus cajan</i> (L.) Huth	27.78	0.40	0.50	0.00	0.95
<i>Peperomia tetraphylla</i> (G.Forst.) Hook. & Arn.	27.78	0.40	0.50	0.00	0.95

**Table 5.3: Importance values and per ha density of herbs including seedlings in Tree fern Habitat in Galli Nalla**

Species	Individual per ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Achyranthes bidentata</i> Blume	2000	0.90	0.70	0.02	1.62
<i>Adenostemma viscosum</i> J.R.Forst. &G.Forst.	750	0.30	0.40	0.01	0.71
<i>Adiantum incisum</i> Forssk.	3500	1.60	0.70	0.01	2.31
<i>Adiantum philippense</i> L.	3000	1.40	0.70	0.01	2.11
<i>Ageratum conyzoides</i> L.	2750	1.30	1.10	0.26	2.66
<i>Alocasia fornicata</i> (Roxb.) Schott	500	0.20	0.70	0.04	0.94
<i>Alpinia malaccensis</i> (Burm.f.) Roscoe (seedling)	1500	0.70	0.40	0.28	1.38
<i>Alysicarpus vaginalis</i> (L.) DC.	500	0.20	0.40	0.00	0.60
<b><i>Angiopteris evecta</i> (G.Forst.) Hoffm.</b>	<b>250</b>	<b>0.10</b>	<b>0.40</b>	<b>0.03</b>	<b>0.53</b>
<i>Anisomeles indica</i> (L.) Kuntze (seedling)	1000	0.50	0.70	0.01	1.21
<i>Antidesma montanum</i> Blume var. montanum (seedling)	1750	0.80	1.90	0.36	3.06
<i>Ardisia solanacea</i> Roxb. (seedling)	3000	1.40	1.90	0.11	3.41
<i>Ardisia thyrsoiflora</i> D.Don (seedling)	1250	0.60	1.10	0.76	2.46
<i>Argostemma verticillatum</i> Wall.	500	0.20	0.40	0.00	0.60
<i>Argyreia daltonii</i> C.B.Clarke	250	0.10	0.40	0.11	0.61
<i>Arisaema tortuosum</i> (Wall.) Schott	250	0.10	0.40	0.07	0.57
<i>Artocarpus lakoocha</i> Roxb. (seedling)	250	0.10	0.40	0.14	0.64
<i>Asplenium laciniatum</i> D.Don	750	0.30	0.70	0.09	1.09
<i>Asplenium trichomanes</i> L.	250	0.10	0.40	0.01	0.51
<i>Athyrium falcatum</i> Bedd.	250	0.10	0.40	0.00	0.50
<i>Blumea stricta</i> (DC.) Anderb. & Bengtson	1000	0.50	0.70	0.01	1.21
<i>Bolbitis appendiculata</i> (Willd.) K.Iwats.	750	0.30	0.40	0.01	0.71
<i>Breynia retusa</i> (Dennst.) Alston (seedling)	1000	0.50	1.10	0.25	1.85
<i>Calamus viminalis</i> Willd. (seedling)	1750	0.80	0.70	0.56	2.06
<i>Capillipedium assimile</i> (Steud.) A.Camus	3750	1.70	0.70	0.01	2.41
<i>Carallia brachiata</i> (Lour.) Merr. (seedling)	1250	0.60	0.70	0.64	1.94
<i>Celtis timorensis</i> Span. (seedling)	500	0.20	0.40	0.14	0.74



Species	Individual per ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Chlorophytum arundinaceum</i> Baker	1500	0.70	0.70	0.02	1.42
<i>Chromolaena odorata</i> (L.) King & Robins (seedling)	4750	2.20	1.10	0.69	3.99
<i>Chamaecrista leschenaultiana</i> (DC.) O.Deg.	500	0.20	0.40	0.01	0.61
<i>Cipadessa baccifera</i> (Roxb. ex Roth) Miq. (seedling)	3250	1.50	3.00	0.74	5.24
<i>Clematis simplicifolia</i> Qureshi & Chaudhri	250	0.10	0.40	0.03	0.53
<i>Colocasia antiquorum</i> Schott	750	0.30	0.70	0.01	1.01
<i>Combretum decandrum</i> Jacq. (seedling)	2500	1.20	1.50	1.07	3.77
<i>Commelina clavata</i> C.B. Clarke	1500	0.70	0.70	0.03	1.43
<i>Cryptolepis buchananii</i> R.Br. ex Roem. & Schult.	500	0.20	0.40	0.01	0.61
<i>Conyza stricta</i> Willd.	500	0.20	0.40	0.00	0.60
<i>Crotalaria nana</i> var. <i>umbellata</i> (Wight & Arn.) A.A. Ansari	250	0.10	0.40	0.00	0.50
<i>Crotalaria sericea</i> Burm.f.	500	0.20	0.40	0.01	0.61
<i>Curculigo orchoides</i> Gaertn.	1750	0.80	0.70	0.14	1.64
<i>Cyanoglossum zeylanicum</i> (Vahl. ex Hornem) Thumb. ex Lehm.	1500	0.70	1.10	0.19	1.99
<b><i>Cyathea gigantea</i> (Wall. ex Hook.) Holttum (seedling)</b>	<b>250</b>	<b>0.10</b>	<b>0.40</b>	<b>0.06</b>	<b>0.56</b>
<b><i>Cyathea spinulosa</i> Wall. ex Hook. (seedling)</b>	<b>250</b>	<b>0.10</b>	<b>0.40</b>	<b>0.00</b>	<b>0.50</b>
<i>Cyanotis arachnoidea</i> C.B. Clarke	750	0.30	0.40	0.00	0.70
<i>Davallodes pulchra</i> (D. Don) M. Kato & Tsutsumi	500	0.20	0.40	0.01	0.61
<i>Desmodium pulchellum</i> (L.) Benth. (seedling)	1750	0.80	0.40	0.06	1.26
<i>Dicliptera bupleuroides</i> Nees	1750	0.80	0.40	0.03	1.23
<i>Dicranopteris linearis</i> (Burm.f.) Underw.	500	0.20	0.70	0.00	0.90
<i>Digitaria compacta</i> (Roth) Veldkamp	8000	3.70	0.70	0.01	4.41
<i>Dillenia pentagyna</i> Roxb. (seedling)	500	0.20	0.70	0.54	1.44
<i>Dryopteris sparsa</i> (D. Don) Kuntze	750	0.30	1.10	0.01	1.41
<i>Dysophylla quadrifolia</i> Benth.	1000	0.50	1.10	0.06	1.66
<i>Elaeocarpus lanceifolius</i> Roxb. (seedling)	250	0.10	0.40	0.21	0.71
<i>Eschenbachia stricta</i> (Willd.) Raizada	1750	0.80	0.70	0.10	1.60
<i>Evolvulus alsinoides</i> (L.) L.	10750	5.00	1.10	0.02	6.12
<i>Flemingia bracteata</i> (Roxb.) Wight	1000	0.50	0.70	0.10	1.30
<i>Geophila herbacea</i> (Jacq.) K. Schum.	3750	1.70	0.40	0.07	2.17
<i>Glochidion heyneanum</i> (Wight & Arn.) Wight (seedling)	750	0.30	0.70	0.41	1.41
<i>Glycosmis cochinchinensis</i> (Lour.) Pierre ex Engl. (seedling)	3000	1.40	1.90	0.82	4.12
<i>Gnetum edule</i> (Willd.) Blume (seedling)	2000	0.90	1.50	0.62	3.02
<i>Grona heterophylla</i> (Willd.) H. Ohashi & K. Ohashi	1000	0.50	0.40	0.08	0.98
<i>Gymnema sylvestre</i> (Retz.) R. Br. ex Sm. (seedling)	1000	0.50	1.50	0.37	2.37
<i>Hedychium coronarium</i> J. Koenig	500	0.20	0.40	0.30	0.90
<i>Hellenia speciosa</i> (J. Koenig) S. R. Dutta	1250	0.60	0.70	0.41	1.71
<i>Hemionitis farinosa</i> (Forssk.) Christenh.	1500	0.70	1.10	0.42	2.22
<i>Heteropogon contortus</i> (L.) P. Beauv. ex Roem. &	10500	4.90	2.20	0.02	7.12

Species	Individual per ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
Schult.					
<i>Justicia simplex</i> D.Don	500	0.20	0.40	0.03	0.63
<i>Knoxia corymbosa</i> Willd.	3000	1.40	0.70	0.04	2.14
<i>Kyllinga nemoralis</i> (Forst.) Dandy & Hutch.	3500	1.60	0.70	0.08	2.38
<i>Leersia hexandra</i> Sw.	1750	0.80	1.10	0.01	1.91
<i>Lepidagathis cuspidata</i> Nees	1250	0.60	0.70	0.04	1.34
<i>Leucas angularis</i> Benth.	500	0.20	0.70	0.01	0.91
<i>Leucas montana</i> (Roth) Spreng.	3000	1.40	0.70	0.02	2.12
<i>Licuala peltata</i> Roxb. ex Buch.-Ham. (seedling)	250	0.10	0.40	0.09	0.59
<i>Limnophila chinensis</i> (Osbeck) Merr.	2000	0.90	0.70	0.56	2.16
<i>Lindernia ciliata</i> (Colsm.) Pennell	1750	0.80	0.40	0.14	1.34
<i>Litsea glutinosa</i> (Lour.) Robins (Seedling)	3500	1.60	3.40	0.88	5.88
<i>Ludwigia hyssopifolia</i> (G.Don) Exell	750	0.30	0.40	0.09	0.79
<i>Lygodium flexuosum</i> (L.) Sw.	1000	0.50	0.40	0.19	1.09
<i>Macaranga peltata</i> (Roxb.) Muell.-Arg. (seedling)	1250	0.60	1.50	0.46	2.56
<i>Memecylon edule</i> Roxb.(seedling)	3750	1.70	3.00	1.80	6.50
<i>Merremia tridentata</i> (L.) Hall.f.	500	0.20	0.70	0.00	0.90
<i>Micromeria biflora</i> (Buch.-Ham. ex D.Don) Benth.	6500	3.00	0.40	0.01	3.41
<i>Mikania micrantha</i> Kunth (seedling)	2750	1.30	0.70	0.38	2.38
<i>Mimosa pudica</i> L. (seedling)	500	0.20	0.70	0.11	1.01
<i>Murraya paniculata</i> (L.) Jack. (seedling)	500	0.20	0.70	0.37	1.27
<i>Oldenlandia auricularia</i> (L.) K.Schum.	2000	0.90	0.70	0.02	1.62
<i>Oxalis corniculata</i> L.	5000	2.30	0.40	0.07	2.77
<i>Panicum notatum</i> Retz.	2000	0.90	0.70	0.06	1.66
<i>Phoebe lanceolata</i> Nees (seedling)	2000	0.90	0.70	0.74	2.34
<i>Phrynium capitatum</i> Willd.	6000	2.80	0.70	0.55	4.05
<i>Phyllanthus amarus</i> Schum. & Thonn.	1750	0.80	1.10	0.03	1.93
<i>Phyllanthus rheedei</i> Wight	500	0.20	0.40	0.01	0.61
<i>Phyllanthus urinaria</i> L.	1000	0.50	0.70	0.01	1.21
<i>Plectranthus</i> spp.	1250	0.60	1.90	0.51	3.01
<i>Pleopeltis linearis</i> Bedd.	250	0.10	0.40	0.00	0.50
<i>Polygala erioptera</i> DC.	2000	0.90	0.40	0.03	1.33
<i>Polygala furcata</i> Royle DC.	250	0.10	0.40	0.00	0.50
<i>Polygonum barbatum</i> L.	1000	0.50	0.70	0.02	1.22
<i>Polygonum hydropiper</i> L.	1500	0.70	0.70	0.33	1.73
<i>Pouzolzia pentandra</i> (Roxb.) Benn.	3000	1.40	1.10	0.02	2.52
<i>Psydraxdi coccos</i> Gaertn.	2000	0.90	1.90	0.51	3.31
<i>Pteris cretica</i> L.	2250	1.00	1.10	0.44	2.54
<i>Pteris pellucida</i> C.Presl	3000	1.40	1.90	0.58	3.88
<i>Rotala rotundifolia</i> (Buch.-Ham. ex Roxb.) Koehne	500	0.20	0.40	0.02	0.62
<i>Rubia cordifolia</i> L.	750	0.30	0.40	0.16	0.86
<i>Scoparia dulcis</i> L.	250	0.10	0.40	0.02	0.52
<i>Setaria palmifolia</i> (J.Koenig) Stapf	3500	1.60	0.70	0.01	2.31

Species	Individual per ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Sida cordifolia</i> L.	500	0.20	0.40	0.04	0.64
<i>Smithia ciliata</i> Royle	750	0.30	0.70	0.00	1.00
<i>Solena amplexicaulis</i> (Lam.) Gandhi	500	0.20	0.40	0.00	0.60
<i>Sporobolus diandrus</i> (Retz.) P.Beauv.	3750	1.70	0.70	0.37	2.77
<i>Strobilanthes heyneana</i> Nees	500	0.20	0.70	0.12	1.02
<i>Strobilanthes pavala</i> (Roxb.) J.R.I.Wood	250	0.10	0.40	0.04	0.54
<i>Tadehagi triquetrum</i> (L.) H.Ohashi (seedling)	1000	0.50	0.70	0.08	1.28
<i>Themeda caudata</i> (Nees ex Hook. & Arn.) A.Camus	5250	2.40	1.10	0.01	3.51
<i>Thysanolaena maxima</i> (Roxb.) Kuntze	3500	1.60	0.70	0.34	2.64
<i>Tridax procumbens</i> L.	4500	2.10	1.10	0.03	3.23
<i>Triumfetta pilosa</i> Roth (seedling)	1000	0.50	0.70	77.35	78.55
<i>Uraria lagopodioides</i> (L.) DC.	1500	0.70	1.10	0.02	1.82
<i>Uraria rufescens</i> (DC.) Schindl.	250	0.10	0.40	0.00	0.50
<i>Xantolis tomentosa</i> (Roxb.) Raf. (seedling)	250	0.10	0.40	0.11	0.61
<i>Xylia xylocarpa</i> (Roxb.) Taub. (seedling)	1000	0.50	1.10	0.31	1.91
<i>Ziziphus rugosa</i> Lam. (seedling)	500	0.20	0.70	0.15	1.05

**Table 5.4: Importance values and per ha density of Trees in the earmarked conservation area around Tree fern habitat**

Species	Individual ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Xylia xylocarpa</i> (Roxb.) Taub.	22.5	7.10	5.00	40.80	52.90
<i>Syzygium cumini</i> (L.) Skeels	15	4.80	4.40	7.60	16.80
<i>Terminalia chebula</i> Retz.	17.5	5.60	5.00	5.90	16.50
<i>Dillenia pentagyna</i> Roxb.	17.5	5.60	5.00	4.50	15.10
<i>Terminalia elliptica</i> Willd.	16.25	5.20	4.40	5.30	14.90
<i>Macaranga peltata</i> (Roxb.) Muell.-Arg.	15	4.80	4.40	3.10	12.30
<i>Memecylon edule</i> Roxb.	18.75	6.00	4.40	0.90	11.30
<i>Homalium napaulense</i> (DC.) Benth.	17.5	5.60	3.10	0.20	8.90
<i>Litsea glutinosa</i> (Lour.) Robins	11.25	3.60	3.10	2.10	8.80
<i>Ziziphus xylopyrus</i> (Retz.) Willd.	13.75	4.40	3.80	0.40	8.60
<i>Ochna obtusata</i> DC.	11.25	3.60	4.40	0.30	8.30
<i>Holarrhena pubescens</i> Wall. ex G.Don	8.75	2.80	3.10	1.10	7.00
<i>Schleichera oleosa</i> (Lour.) Oken	5	1.60	2.50	2.90	7.00
<i>Glochidion heyneanum</i> (Wight & Arn.) Wight	8.75	2.80	3.10	1.00	6.90
<i>Mangifera indica</i> L.	5	1.60	1.90	3.00	6.50
<i>Murraya paniculata</i> (L.) Jack.	8.75	2.80	2.50	0.30	5.60
<i>Chamaerops humilis</i> L.	8.75	2.80	1.30	1.50	5.60
<i>Ficus religiosa</i> L.	1.25	0.40	0.60	4.30	5.30
<i>Cassia fistula</i> L.	6.25	2.00	1.90	1.30	5.20
<i>Pittosporum napaulense</i> (DC.) Rehder & E.H.Wilson	6.25	2.00	1.90	1.10	5.00
<i>Buchanania lanzan</i> Spreng.	5	1.60	1.30	1.30	4.20
<i>Cassine glauca</i> (Rottb.) Kuntze	3.75	1.20	1.90	0.50	3.60
<i>Mallotus philippensis</i> (Lam.) Müll. Arg.	3.75	1.20	1.30	0.60	3.10

Species	Individual ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Ficus virens</i> Aiton	1.25	0.40	0.60	2.00	3.00
<i>Ficus racemosa</i> L.	1.25	0.40	0.60	2.00	3.00
<i>Kydiaalycina</i> Roxb.	3.75	1.20	1.30	0.30	2.80
<i>Anogeissus latifolia</i> (Roxb. ex DC.) Wall. ex Guill	2.5	0.80	0.60	0.80	2.20
<i>Gardenia latifolia</i> Ait.	2.5	0.80	1.30	0.20	2.30
<i>Ficus hispida</i> L.f.	2.5	0.80	1.30	0.20	2.30
<i>Nyctanthes arbor-tristis</i> L.	2.5	0.80	1.30	0.10	2.20
<i>Lagerstroemia parviflora</i> Roxb.	2.5	0.80	0.60	0.30	1.70
<i>Bridelia retusa</i> (L.) A.Juss.	2.5	0.80	0.60	0.30	1.70
<i>Pterocarpus marsupium</i> Roxb.	1.25	0.40	0.60	0.60	1.60
<i>Gardenia gummifera</i> L.f.	2.5	0.80	0.60	0.10	1.50
<i>Xantolis tomentosa</i> (Roxb.) Raf.	2.5	0.80	0.60	0.00	1.40
<i>Ficus benghalensis</i> L.	1.25	0.40	0.60	0.30	1.30
<i>Albizia odoratissima</i> (L.f.) Benth	1.25	0.40	0.60	0.30	1.30
<i>Diospyros montana</i> Roxb.	1.25	0.40	0.60	0.20	1.20
<i>Artocarpus lakoocha</i> Roxb.	1.25	0.40	0.60	0.20	1.20
<i>Wendlandia tinctoria</i> (Roxb.) DC.	1.25	0.40	0.60	0.20	1.20
<i>Lannea coromandelica</i> (Houtt.) Merr.	1.25	0.40	0.60	0.10	1.10
<i>Careya arborea</i> Roxb.	1.25	0.40	0.60	0.10	1.10
<i>Miliusa tomentosa</i> (Roxb.) Finet & Gagnep.	1.25	0.40	0.60	0.10	1.10
<i>Chloroxylon swietenia</i> DC.	1.25	0.40	0.60	0.10	1.10
<i>Aegle marmelos</i> (L.) Correa	1.25	0.40	0.60	0.10	1.10
<i>Litsea monopetala</i> (Roxb.) Pers.	1.25	0.40	0.60	0.10	1.10
<i>Diospyros melanoxylon</i> Roxb.	1.25	0.40	0.60	0.10	1.10
<i>Dalbergia latifolia</i> Roxb.	1.25	0.40	0.60	0.10	1.10
<i>Citrus × aurantium</i> L.	1.25	0.40	0.60	0.10	1.10
<i>Casearia graveolens</i> Dalzell	1.25	0.40	0.60	0.10	1.10
<i>Ougeinia oojinensis</i> (Roxb.) Hochr.	1.25	0.40	0.60	0.10	1.10
<i>Stereospermum suaveolens</i> (Roxb.) DC.	1.25	0.40	0.60	0.10	1.10
<i>Soymida febrifuga</i> (Roxb.) A.Juss.	1.25	0.40	0.60	0.10	1.10
<i>Acacia pennata</i> (L.) Willd.	1.25	0.40	0.60	0.10	1.10
<i>Callicarpa tomentosa</i> Vahl.	1.25	0.40	0.60	0.10	1.10
<i>Bauhinia racemosa</i> Lam.	1.25	0.40	0.60	0.10	1.10
<i>Oroxylum indicum</i> (L.) Vent.	1.25	0.40	0.60	0.10	1.10
<i>Sterculia villosa</i> Roxb. ex DC.	1.25	0.40	0.60	0.10	1.10
<i>Trichilia connaroides</i> (Wight & Arn.) Benth.	1.25	0.40	0.60	0.10	1.10
<i>Cleistanthus collinus</i> (Roxb.) Benth. ex Hook	1.25	0.40	0.60	0.00	1.00
<i>Phanera vahlii</i> (Wight & Arn.) Benth.	1.25	0.40	0.60	0.00	1.00
<i>Phoebe lanceolata</i> Nees	1.25	0.40	0.60	0.00	1.00
<i>Grewia tiliifolia</i> Vahl	1.25	0.40	0.60	0.00	1.00
<i>Ficus arnottiana</i> (Miq.) Miq.	1.25	0.40	0.60	0.00	1.00
<i>Flacourtia indica</i> (Burm.f.) Merr.	1.25	0.40	0.60	0.00	1.00
<i>Gnetum edule</i> (Willd.) Blume	1.25	0.40	0.60	0.00	1.00
<i>Phyllanthus emblica</i> L.	1.25	0.40	0.60	0.00	1.00

**Table 5.5: Importance values and per ha density of Shrubs in the earmarked conservation area around Tree fern habitat**

Species	Individual per ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Dendrocalamus strictus</i> (Roxb.) Nees	611.11	8.80	12.20	14.00	35.00
<i>Terminalia chebula</i> Retz. (sapling)	222.22	3.20	0.60	8.60	12.40
<i>Gnetum edule</i> (Willd.) Blume (sapling)	166.67	2.40	0.60	5.40	8.40
<i>Psydrax dicoccos</i> Gaertn. (sapling)	166.66	2.40	4.40	1.40	8.20
<i>Ardisia solanacea</i> Roxb.	222.22	3.20	2.80	1.50	7.50
<i>Clematis gouriana</i> Roxb. ex DC.	250.00	3.60	0.60	1.70	5.90
<i>Holarrhena pubescens</i> Wall. ex G.Don (sapling)	111.11	1.60	1.10	3.10	5.80
<i>Dioscorea bulbifera</i> L.	194.44	2.80	1.70	1.10	5.60
<i>Homalium napaulense</i> (DC.) Benth. (sapling)	83.33	1.20	1.10	3.20	5.50
<i>Grewia hirsuta</i> Vahl	194.44	2.80	0.60	2.10	5.50
<i>Syzygiumcumini</i> (L.) Skeels (sapling)	55.55	0.80	1.70	2.80	5.30
<i>Searsia paniculata</i> (Wall. ex G.Don) Moffett	138.89	2.00	0.60	2.70	5.30
<i>Calamus viminalis</i> Willd.	138.88	2.00	1.70	1.40	5.10
<i>Chromolaena odorata</i> (L.) King & Robins	194.44	2.80	1.10	1.10	5.00
<i>Memecylon edule</i> Roxb. (sapling)	27.78	0.40	3.90	0.70	5.00
<i>Phoebe lanceolata</i> Nees (sapling)	27.78	0.40	3.30	1.20	4.90
<i>Tephrosia purpurea</i> (L.) Pers.subsp. <i>purpurea</i>	222.22	3.20	0.60	1.00	4.80
<i>Dillenia pentagyna</i> Roxb. (sapling)	55.56	0.80	1.70	2.20	4.70
<i>Dioscorea belophylla</i> (Prain) Voigt ex Haines	166.667	2.40	1.10	1.00	4.50
<i>Ventilago madraspatana</i> Gaertn. (sapling)	83.33	1.20	0.60	2.80	4.60
<i>Macaranga peltata</i> (Roxb.) Muell.-Arg. (sapling)	27.78	0.40	2.80	1.30	4.50
<i>Cassine glauca</i> (Rottb.) Kuntze (sapling)	55.56	0.80	1.10	2.60	4.50
<i>Mikania micrantha</i> Kunth	83.33	1.20	2.80	0.40	4.40
<i>Cynanchum callialatum</i> Buch.-Ham. ex Wight	222.22	3.20	0.60	0.40	4.20
<i>Combretum decandrum</i> Jacq.	83.33	1.20	2.80	0.20	4.20
<i>Flueggea virosa</i> (Roxb. ex Willd.) Voigt	111.11	1.60	0.60	2.00	4.20
<i>Gynochthodes umbellata</i> (L.) Razafim. &B. Bremer	111.11	1.60	1.10	1.30	4.00
<i>Rubia cordifolia</i> L.	166.67	2.40	0.60	0.80	3.80
<i>Antidesma acidum</i> Retz.	83.33	1.20	1.10	1.30	3.60
<i>Terminalia elliptica</i> Willd. (sapling)	27.778	0.40	1.10	2.10	3.60
<i>Celastrus paniculatus</i> Willd.	111.11	1.60	1.10	0.80	3.50
<i>Dioscorea pentaphylla</i> L.	111.11	1.60	0.60	1.30	3.50
<i>Litsea glutinosa</i> (Lour.) Robins	55.56	0.80	0.60	2.10	3.50

Species	Individual per ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
(sapling)					
<i>Desmodium pulchellum</i> (L.) Benth.	138.89	2.00	0.60	0.80	3.40
<i>Cissampelos pareira</i> L.	111.11	1.60	1.10	0.60	3.30
<i>Hyptianthera stricta</i> (Roxb. ex Sm.) Wight & Arn.	138.89	2.00	0.60	0.80	3.40
<i>Cipadessa baccifera</i> (Roxb. ex Roth) Miq.	55.55	0.80	1.10	1.40	3.30
<i>Osyris lanceolata</i> Hochst. & Steud. (sapling)	55.55	0.80	0.60	1.80	3.20
<i>Clerodendrum infortunatum</i> L.	83.33	1.20	1.70	0.20	3.10
<i>Combretum nanum</i> Buch.-Ham. ex D. Don	83.33	1.20	1.10	0.70	3.00
<i>Woodfordia fruticosa</i> (L.) Kurz	55.55	0.80	0.60	1.60	3.00
<i>Hiptage benghalensis</i> (L.) Kurz	27.78	0.40	2.20	0.10	2.70
<i>Colebrookea oppositifolia</i> Sm.	27.78	0.40	2.20	0.10	2.70
<i>Xylia xylocarpa</i> (Roxb.) Taub. (sapling)	27.78	0.40	1.10	1.00	2.50
<i>Pterocarpus marsupium</i> Roxb. (sapling)	27.78	0.40	0.60	1.50	2.50
<i>Mangifera indica</i> L. (sapling)	27.78	0.40	1.10	1.00	2.50
<i>Breynia retusa</i> (Dennst.) Alston	55.55	0.80	1.10	0.40	2.30
<i>Grewia tiliaefolia</i> Vahl (sapling)	27.78	0.40	0.60	1.30	2.30
<i>Clausena heptaphylla</i> (Roxb. ex DC.) Wight & Arn.	27.78	0.40	0.60	1.30	2.30
<i>Litsea monopetala</i> (Roxb.) Pers. (sapling)	27.78	0.40	0.60	1.20	2.20
<i>Jasminum arborescens</i> Roxb.	55.56	0.80	1.10	0.10	2.00
<i>Murraya paniculata</i> (L.) Jack.	27.78	0.40	1.10	0.50	2.00
<i>Maclura spinosa</i> (Willd.) C.C. Berg	55.56	0.80	0.60	0.60	2.00
<i>Ziziphus rugosa</i> Lam.	27.78	0.40	0.60	0.90	1.90
<i>Pavetta tomentosa</i> Roxb. ex Sm.	55.55	0.80	0.60	0.50	1.90
<i>Melothria heterophylla</i> (Lour.) Cogn.	55.56	0.80	0.60	0.40	1.80
<i>Dioscorea hispida</i> Dennst.	55.55	0.80	0.60	0.30	1.70
<i>Morinda pubescens</i> J.E. Smith	55.55	0.80	0.60	0.30	1.70
<i>Desmodium ferrugineum</i> Wall. ex Thwaites	55.55	0.80	0.60	0.30	1.70
<i>Desmodium gangeticum</i> (L.) DC.	27.78	0.40	1.10	0.10	1.60
<i>Ixora parviflora</i> Lam.	27.78	0.40	1.10	0.00	1.50
<i>Alstonia venenata</i> R.Br.	27.78	0.40	0.60	0.60	1.60
<i>Milium tomentosa</i> (Roxb.) Sinclair (sapling)	27.78	0.40	0.60	0.50	1.50
<i>Olax scandens</i> Roxb.	55.55	0.80	0.60	0.10	1.50
<i>Osbeckia chinensis</i> L.	27.78	0.40	0.60	0.50	1.50
<i>Bauhinia racemosa</i> Lam. (sapling)	27.78	0.40	0.60	0.30	1.30
<i>Lantana camara</i> L.	27.78	0.40	0.60	0.20	1.20
<i>Dioscorea oppositifolia</i> L.	27.78	0.40	0.60	0.20	1.20
<i>Erycibe paniculata</i> Roxb.	27.78	0.40	0.60	0.20	1.20
<i>Anogeissus latifolia</i> (Roxb. ex DC.)	27.78	0.40	0.60	0.10	1.10



Species	Individual per ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
Wall. ex Guill (sapling)					
<i>Cissampelopsis corymbosa</i> (Wall. ex DC.) C.Jeffrey & Y.L.Chen	27.78	0.40	0.60	0.10	1.10
<i>Dracaena terniflora</i> Roxb.	27.78	0.40	0.60	0.10	1.10
<i>Gymnema sylvestre</i> (Retz.) R.Br. ex Sm.	27.78	0.40	0.60	0.10	1.10
<i>Smilax zeylanica</i> L.	27.78	0.40	0.60	0.10	1.10
<i>Tadehagi triquetrum</i> (L.) H.Ohashi	27.78	0.40	0.60	0.10	1.10
<i>Ipomoea hederifolia</i> L.	27.78	0.40	0.60	0.10	1.10
<i>Flemingia strobilifera</i> (L.) R.Br.exAit.	27.78	0.40	0.60	0.10	1.10
<i>Cissus repanda</i> Vahl.	27.78	0.40	0.60	0.10	1.10
<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	27.78	0.40	0.60	0.10	1.10
<i>Marsdenia tenacissima</i> (Roxb.) Moon.	27.78	0.40	0.60	0.10	1.10
<i>Ampelocissus divaricata</i> (Wall. ex M.A. Lawson) Planch.	27.77	0.40	0.60	0.10	1.10
<i>Leea asiatica</i> (L.) Ridsdale	27.78	0.40	0.60	0.10	1.10
<i>Ichnocarpus frutescens</i> (L.) R.Br.	27.78	0.40	0.60	0.00	1.00
<i>Calotropis gigantea</i> (L.) R.Br.	27.78	0.40	0.60	0.10	1.10
<i>Helicteres isora</i> L.	27.78	0.40	0.60	0.10	1.10
<i>Trema politoria</i> (Planch.) Blume (sapling)	27.78	0.40	0.60	0.00	1.00
<i>Tinospora sinensis</i> (Lour.) Merr.	27.78	0.40	0.60	0.00	1.00
<i>Cajanus cajan</i> (L.) Huth	27.77	0.40	0.60	0.00	1.00
<i>Merremia vitifolia</i> (Burm. f.) Hall. f.	27.78	0.40	0.60	0.00	1.00
<i>Callicarpa tomentosa</i> Vahl. (sapling)	27.78	0.40	0.60	0.00	1.00
<i>Urena lobata</i> L. subsp. <i>sinuata</i> (L.) Borss.Waalk.	27.778	0.40	0.60	0.00	1.00

**Table 5.6: Importance values and per ha density of Herbs in the earmarked conservation area around Tree fern habitat**

Species	Individual ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Memecylon edule</i> Roxb.(seedling)	4000	1.12	2.20	10.92	14.24
<i>Scoparia dulcis</i> L.	11250	3.15	0.63	9.58	13.36
<i>Thysanolaena maxima</i> (Roxb.) Kuntze	14500	4.06	1.26	5.72	11.04
<i>Cipadessa baccifera</i> (Roxb. ex Roth) Miq. (seedling)	3250	0.91	2.52	5.73	9.16
<i>Vernonia cinerea</i> (L.) Less	15250	4.27	2.20	1.73	8.20
<i>Macaranga peltata</i> (Roxb.) Muell.-Arg. (seedling)	4000	1.12	1.57	5.37	8.06
<i>Gnetum edule</i> (Willd.) Blume (seedling)	3000	0.84	1.57	5.26	7.67
<i>Litsea glutinosa</i> (Lour.) Robins (Seedling)	3750	1.05	2.52	3.67	7.24
<i>Heteropogon contortus</i> (L.) P.Beauv. ex Roem. & Schult.	13250	3.71	2.20	0.31	6.22
<i>Oplismenus burmannii</i> (Retz.) P. Beauv.	14750	4.13	1.89	0.09	6.11
<i>Chromolaena odorata</i> (L.) King & Robins (seedling)	4750	1.33	0.94	3.67	5.94
<i>Chrysopogon aciculatus</i> (Retz.) Trin.	14250	3.99	1.57	0.05	5.61
<i>Evolvulus nummularius</i> (L.) L.	11000	3.08	0.94	0.61	4.63
<i>Psyrdrax dicoccos</i> Gaertn.	1500	0.42	1.57	2.55	4.54
<i>Emilia sonchifolia</i> (L.) DC.	3750	1.05	1.57	1.89	4.51
<i>Tridax procumbens</i> L.	10750	3.01	0.94	0.38	4.33
<i>Chrysopogon fulvus</i> (Spring.) Chiov.	10750	3.01	1.26	0.03	4.30
<i>Cynodon dactylon</i> (L.) Pers.	8500	2.38	1.89	0.03	4.30
<i>Ardisia solanacea</i> Roxb. (seedling)	2000	0.56	1.26	2.37	4.19
<i>Combretum decandrum</i> Jacq. (seedling)	1500	0.42	1.26	2.14	3.82
<i>Pteris pellucida</i> C.Presl	2500	0.70	0.94	2.05	3.69
<i>Oplismenus compositus</i> (L.) P. Beauv.	10750	3.01	0.63	0.04	3.68
<i>Eragrostis tenella</i> (L.) P.Beauv. ex Roem. & Schultes	6250	1.75	1.89	0.02	3.66
<i>Digitaria ciliaris</i> (Retz.) Koeler	6750	1.89	1.57	0.03	3.49
<i>Ageratum conyzoides</i> L.	2750	0.77	0.94	1.71	3.42
<i>Imperata cylindrica</i> (L.) Raeuschal	4000	1.12	1.26	0.93	3.31
<i>Themeda caudata</i> (Nees ex Hook. & Arn.) A.Camus	7250	2.03	1.26	0.02	3.31
<i>Pteridium aquilinum</i> (L.) Kuhn	1750	0.49	0.94	1.44	2.87
<i>Cyperus niveus</i> Retz.	5500	1.54	1.26	0.01	2.81
<i>Mikania micrantha</i> Kunth (seedling)	1500	0.42	0.63	1.76	2.81
<i>Dillenia pentagyna</i> Roxb. (seedling)	750	0.21	0.63	1.87	2.71
<i>Xylia xylocarpa</i> (Roxb.) Taub. (seedling)	750	0.21	0.63	1.70	2.54
<i>Evolvulus alsinoides</i> (L.) L.	5500	1.54	0.94	0.02	2.50
<i>Oldenlandia auricularia</i> (L.) K.Schum.	3500	0.98	0.94	0.49	2.41

Species	Individual ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Olas scandens</i> Roxb. (seedling)	1000	0.28	0.63	1.43	2.34
<i>Justicia simplex</i> D.Don	3750	1.05	0.94	0.26	2.25
<i>Glycosmis cochinchinensis</i> (Lour.) Pierre ex Engl. (seedling)	250	0.07	0.31	1.78	2.16
<i>Hedyotis corymbosa</i> (L.) Lam.	4750	1.33	0.63	0.18	2.14
<i>Commelina benghalensis</i> L.	3250	0.91	0.94	0.25	2.10
<i>Byttneria herbacea</i> Roxb.	2000	0.56	0.63	0.89	2.08
<i>Leucas angularis</i> Benth.	3000	0.84	0.94	0.26	2.04
<i>Sida acuta</i> Burm.f.	3000	0.84	0.94	0.26	2.04
<i>Rubia cordifolia</i> L.	1500	0.42	0.63	0.98	2.03
<i>Combretum nanum</i> Buch.-Ham. ex D.Don (seedling)	500	0.14	0.63	1.17	1.94
<i>Cheilocostus speciosus</i> (J.Koenig) C.D.Specht	3000	0.84	0.63	0.44	1.91
<i>Clematis gouriana</i> Roxb. ex DC. (seedling)	1250	0.35	0.63	0.92	1.90
<i>Dysophylla quadrifolia</i> Benth.	1500	0.42	1.26	0.22	1.90
<i>Adiantum philippense</i> L.	2000	0.56	1.26	0.03	1.85
<i>Apluda mutica</i> L.	3250	0.91	0.63	0.29	1.83
<i>Polygonum hydropiper</i> L.	2000	0.56	0.94	0.29	1.79
<i>Leucas montana</i> (Roth) Spreng.	2750	0.77	0.94	0.05	1.76
<i>Helicteres isora</i> L. (seedling)	500	0.14	0.31	1.24	1.69
<i>Athyrium falcatum</i> Bedd.	3000	0.84	0.63	0.22	1.69
<i>Bothriochloa pertusa</i> (L.) A.Camus	3500	0.98	0.63	0.01	1.62
<i>Boerhavia diffusa</i> L.	2250	0.63	0.63	0.42	1.68
<i>Canscora diffusa</i> (Vahl) R.Br. ex Roem. & Schult.	2000	0.56	0.94	0.18	1.68
<i>Capillipedium assimile</i> (Steud.) A.Camus	3750	1.05	0.63	0.01	1.69
<i>Dryopteris sparsa</i> (D.Don) Kuntze	1250	0.35	1.26	0.05	1.66
<i>Justicia diffusa</i> Willd.	2250	0.63	0.94	0.08	1.65
<i>Alstonia venenata</i> R.Br. (seedling)	500	0.14	0.63	0.88	1.65
<i>Cymbopogon martini</i> (Roxb.) Will. Watson	3500	0.98	0.63	0.04	1.65
<i>Gnaphalium luteo-album</i> L.	2000	0.56	0.94	0.13	1.63
<i>Spermacoce ocymoides</i> Burm.f.	4250	1.19	0.31	0.12	1.62
<i>Oxalis corniculata</i> L.	3500	0.98	0.63	0.01	1.62
<i>Panicum notatum</i> Retz.	3500	0.98	0.63	0.01	1.62
<i>Dicranopteris linearis</i> (Burm.f.) Underw.	3000	0.84	0.63	0.04	1.51
<i>Grona heterophylla</i> (Willd.) H.Ohashi&K.Ohashi	1000	0.28	0.31	0.98	1.57
<i>Blechnum orientale</i> L.	750	0.21	0.31	1.05	1.57
<i>Phyllanthus virgatus</i> First. f.	2000	0.56	0.63	0.35	1.54
<i>Aristida setacea</i> Retz.	3000	0.84	0.63	0.01	1.48
<i>Spermacoce verticillata</i> L.	2750	0.77	0.63	0.09	1.49
<i>Phrynium capitatum</i> Willd.	1500	0.42	0.31	0.70	1.43

Species	Individual ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
<i>Adiantum incisum</i> Forssk.	2750	0.77	0.63	0.03	1.43
<i>Strobilanthes heyneana</i> Nees	750	0.21	0.63	0.58	1.42
<i>Polygonum barbatum</i> L.	1250	0.35	0.94	0.12	1.41
<i>Merremia tridentata</i> (L.) Hall.f.	1250	0.35	0.94	0.08	1.37
<i>Colocasia antiquorum</i> Schott	1000	0.28	0.94	0.11	1.33
<i>Desmodium pulchellum</i> (L.) Benth. (seedling)	2000	0.56	0.31	0.45	1.32
<i>Spermaceoce latifolia</i> Aubl.	3250	0.91	0.31	0.10	1.32
<i>Cyanotis arachnoidea</i> C.B.Clarke	2250	0.63	0.63	0.04	1.30
<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	3000	0.84	0.31	0.13	1.28
<i>Leersia hexandra</i> Sw.	1000	0.28	0.63	0.36	1.27
<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Nees	2000	0.56	0.31	0.36	1.23
<i>Sebastiania chamaelea</i> (L.) Muell.- Arg.	1500	0.42	0.63	0.14	1.19
<i>Commelina clavata</i> C.B.Clarke	1500	0.42	0.63	0.11	1.16
<i>Mollugo pentaphylla</i> L.	1250	0.35	0.63	0.18	1.16
<i>Curculigo orchioidea</i> Gaertn.	1750	0.49	0.63	0.03	1.15
<i>Amaranthus viridis</i> L.	1000	0.28	0.63	0.21	1.12
<i>Mitracarpus villosus</i> (Sw.) DC.	750	0.21	0.63	0.27	1.11
<i>Flemingia bracteata</i> (Roxb.) Wight	1000	0.28	0.63	0.19	1.10
<i>Achyranthes bidentata</i> Blume	1500	0.42	0.63	0.05	1.10
<i>Tadehagi triquetrum</i> (L.) H.Ohashi (seedling)	1250	0.35	0.63	0.10	1.08
<i>Lindernia ciliata</i> (Colsm.) Pennell	1250	0.35	0.63	0.04	1.02
<i>Hellenia speciosa</i> (J.Koenig) S.R.Dutta	750	0.21	0.63	0.15	0.99
<i>Anisomeles indica</i> (L.) Kuntze (seedling)	1000	0.28	0.63	0.07	0.98
<i>Sida cordifolia</i> L.	1000	0.28	0.63	0.07	0.98
<i>Dicranopteris linearis</i> (Burm.f.) Underw.	500	0.14	0.63	0.18	0.95
<i>Cyanoglossum zeylanicum</i> (Vahl.ex Hornem) Thumb. ex Lehm.	1000	0.28	0.63	0.02	0.93
<i>Argyreia daltonii</i> C.B.Clarke	250	0.07	0.31	0.54	0.92
<i>Murraya paniculata</i> (L.) Jack. (seedling)	250	0.07	0.31	0.54	0.92
<i>Osyris lanceolata</i> Hochst. & Steud. (seedling)	250	0.07	0.31	0.54	0.92
<i>Crotalaria prostrata</i> Rottl. ex Willd.	1000	0.28	0.63	0.00	0.91
<i>Rotala rotundifolia</i> (Buch.-Ham. ex Roxb.) Koehne	1500	0.42	0.31	0.16	0.89
<i>Alysicarpus vaginalis</i> (L.) DC.	750	0.21	0.63	0.02	0.86
<i>Conyza stricta</i> Willd.	750	0.21	0.63	0.02	0.86
<i>Crotalaria nana</i> var. <i>umbellata</i> (Wight & Arn.) A.A.Ansari	500	0.14	0.63	0.07	0.84
<i>Solena amplexicaulis</i> (Lam.) Gandhi	750	0.21	0.63	0.00	0.84
<i>Dicliptera bupleuroides</i> Nees	1000	0.28	0.31	0.24	0.83
<i>Anogeissus latifolia</i> (Roxb. ex DC.)	250	0.07	0.31	0.39	0.77

Species	Individual ha <sup>-1</sup>	Relative Density	Relative Frequency	Relative Dominance	IVI
Wall. ex Guill (seedling)					
<i>Argostemma verticillatum</i> Wall.	250	0.07	0.31	0.39	0.77
<i>Arisaema tortuosum</i> (Wall.) Schott	250	0.07	0.31	0.35	0.73
<i>Ludwigia hyssopifolia</i> (G.Don) Exell	500	0.14	0.31	0.29	0.74
<i>Strobilanthes pavala</i> (Roxb.) J.R.I.Wood	500	0.14	0.31	0.27	0.72
<i>Biophytumum braculum</i> Welw.	1250	0.35	0.31	0.01	0.67
<i>Blumea lacera</i> (Burm.f.) DC.	250	0.07	0.31	0.27	0.65
<i>Desmodium laxiflorum</i> DC	250	0.07	0.31	0.26	0.64
<i>Phyllanthus rheedei</i> Wight	750	0.21	0.31	0.11	0.63
<i>Microlepia speluncae</i> (L.) T.Moore	500	0.14	0.31	0.17	0.62
<i>Acrocephalus hispidus</i> (L.) Nicolson & Sadashiv.	750	0.21	0.31	0.05	0.57
<i>Triumfetta pilosa</i> Roth (seedling)	500	0.14	0.31	0.12	0.57
<i>Bolbitis appendiculata</i> (Willd.) K.Iwats.	750	0.21	0.31	0.04	0.56
<i>Crotalaria sericea</i> Burm.f.	500	0.14	0.31	0.08	0.53
<i>Limnophila chinensis</i> (Osbeck) Merr.	250	0.07	0.31	0.15	0.53
<i>Ludwigia perennis</i> L.	250	0.07	0.31	0.13	0.51
<i>Polygala erioptera</i> DC.	500	0.14	0.31	0.00	0.45
<i>Mukia maderaspatana</i> (L.) Roem.	250	0.07	0.31	0.02	0.40
<i>Plectranthus</i> spp.	250	0.07	0.31	0.01	0.39
<i>Merremia vitifolia</i> (Burm. f.) Hall. f. (seedling)	250	0.07	0.31	0.01	0.39

## 5.2 FAUNAL DIVERSITY ASSESSMENT

The study area also encompasses appreciable faunal diversity. Inferences about the faunal diversity were drawn based on secondary sources such as Divisional Working Plan record and EIA/EMP Bailadila Iron Ore Deposit-4, available literature and on-field spottings (Figure 5.6) which are tabulated as below.

**Table 5.7: List of the fauna found in Dantewada Forest Division (Based on Divisional Working Plan record)**

S. N.	Local Name	English Name	Scientific name
<b>(A) Wild Animals</b>			
1.	Bandar	Rhesus Macaque (Red faced monkey)	<i>Macaca mullata</i> (Zimmermann)
2.	Bandar	Common Langur	<i>Presbytis entellus</i> (Dufrense)
3.	Barasingha	Swamp Deer	<i>Cervus duvaceli</i> (Cuvier)
4.	Bhendiya	Wolf	<i>Canis Lupus pallipes</i>
5.	Bhalu	Sloth Bear	<i>Melursus ursinus</i> (Shaw)
6.	Chital	Spotted Deer	<i>Axis axis</i> (Evxleban)
7.	Chuchunder	Grey musk shrew	<i>Suncus murinus</i> (Linnacus)
8.	Chuha (Musa)	Field Rat	<i>Bendicota bengalensis</i>
9.	Gaur	Indian Bison	<i>Bos gaurus</i> (H.Smith)

S. N.	Local Name	English Name	Scientific name
10.	Gilheri	Three striped squirrel	<i>Funambulus pennanti</i> (Wroughton)
11.	Gilheri	Malabar squirrel	<i>Soiurns species</i>
12.	Gilheri	Flyings squirrel	<i>Manis crassicaudata</i>
13.	Chowsingha (Jangli-Bakri)	Four horned antelope	<i>Tetracerus quadricornis</i> (Blainville)
14.	Jangli-Billi	Jangle Cat	<i>Felis chaus</i> (Guldensteadt)
15.	Jangli-Kutta	Indian Wild Dog	<i>Coun alpinus</i> (Pallas)
16.	Khargosh	Indian Hare	<i>Lepus nigricollis</i> (F.Cuvier)
17.	Koliha(Siyar)	Jackal	<i>Canis aureus</i> (Linnaeus)
18.	Kotari	Barking Deer	<i>Muticus muntjac</i>
19.	Lakhar bagha	Striped Hyaena	<i>Hyaena hyaena</i> (Linnaeus)
20.	Lomri	Indian Fox	<i>Vulpes bengalensis</i> (Shaw)
21.	Newala	Common mongoose	<i>Herpestes edwardsi</i> (Geefrey)
22.	Otter	The common otter	-
23.	Nilgai	Blue Bull	<i>Boselaphus tragocamelus</i>
24.	Sahi	Indian percupine	<i>Hystrix indica</i> (Kerr)
25.	Sambhar	Sambhar	<i>Cervus unicolour</i> (Keer)
26.	Suar	Indian wild boar	<i>Sus scrofa</i> (Linnaeus)
27.	Tendwa(Gulbagh)	Panther	<i>Panthera pardus</i> (Linnaeus)
<b>(B) Snake</b>			
1.	Cobra	Cobra	<i>Naja naja</i> (Linnaeus)
2.	Ajgar	Python	<i>Python molurus</i>
3.	Chuhamar Sarp	Rattle Snake	<i>Ptyas mucosus</i> (Linnaeus)
4.	Russel Viper	Viper	<i>Vipera russeli</i> (Shaw)
5.	Krait	Krait	<i>Bungamus caeruleus</i> (Schneider)
6.	Deo Sarp	Deo Sarp	<i>Bungamus</i>
7.	Pani Sarp	Pani Sarp	<i>Natrix piscator</i> (Schneider)
<b>(C) Lizard</b>			
1.	Monitor Lizard	Monitor Lizard	<i>Varanus monitor</i> (Linnaeus)
<b>(D) Crocodile</b>			
1.	Magar	Crocodile	<i>Crocodylus crocodilus</i>
2.	Ghadiyal	Ghadiyal	<i>Gavialis gangeticus</i>
<b>(E) Fishes</b>			
1.	Catla	<i>Catla catla</i> (Ham.)	
2.	Chanda	<i>Chanda ranga</i> (Ham.)	
3.	Magur	<i>Clarias batrachus</i> (Ham.)	
4.	Singh	<i>Heteropneustes fossilis</i> (Bloch)	
5.	Rohu	<i>Labio rohita</i>	
6.	Mahasir	<i>Walago sffu</i>	
7.	Kotri	<i>Forfor gundius</i>	
<b>(F) Birds</b>			
1.	Bater, lowwa	Iangle Bush Quail	<i>Perdicula asiatica</i> (Latham)
2.	Bater	Grey Quail	<i>Coturnix coturnix</i> (Linnaeus)
3.	Baya	Baya weaver bird	<i>Poceus philippinus</i> (Linnaeus)
4.	Bhangraj	Racket-Tailed Dreng	<i>Dicrurus adsimilis</i> (bechatein)
5.	Bulbul	Red vented bulbul	<i>Pyconotus cafer</i> (Linnaeus)
6.	Cheel	Common pariah kite	<i>Milvus migrans</i> (Beddaert)
7.	Chhota Kilkila	Small blueking fisher	<i>Alcedo atthis</i> (Linnaeus)
8.	Dudharaj	Paradise flycatcher	<i>Tirpsiphone paradisi</i> (Linnaeus)
9.	Gai-Bagula	Cattle-Egret	<i>Bulbulcus ibis</i> (Linnaeus)
10.	Gauriyya	House sparrow	<i>Passer domesticus</i> (Linnaeus)



S. N.	Local Name	English Name	Scientific name
11.	Ghughu	Indian great horned owl	<i>Bubo bubo</i> (Linnaeus)
12.	Gidh	Bengal vulture	<i>Gyps Bengalensis</i> (Gmelin)
13.	Giria	Cotton teal	<i>Nettapus coromadelianus</i> (Gmelin)
14.	Harial	Common green Pigeon	<i>Treron phoenicoptera</i> (Latham)
15.	Hoppoe	Hoppoe	<i>Upupa epops</i>
16.	Jangli Kowwa	Indian Jangle Crow	<i>Corvus macrothyches</i> (Walgler)
17.	Jangli Murgi	Grey Jangle Fowl	<i>Gallus Sonneratii</i> (Temminck)
18.	Jangli Murgi	Red Jangle fowl	<i>Gallus Gallus</i> (Linnaeus)
19.	Kabutar	Blue-rock Pigeon	<i>Columba livia</i> (Gmelin)
20.	Kali Mayna	Bastar Hill Myna	<i>Grecula religiosa</i> (Linnaeus)
21.	Katphora	Rufous wood pecker	<i>Micro Ptirnus brachyurua</i>
22.	Katphora	Indian Golden backed pecker	<i>Dinopium Javanense</i>
23.	Katphora	Lisser Golden backed pecker	<i>Dinopium-benghalense</i>
24.	Katphora	Great Black wood pecker	<i>Dryocopus Javensis</i>
25.	Kowwa	House crow	<i>Carvus splondens</i> (Vicillot)
26.	Koel	Koel	<i>Eudynamys scolopaceae</i> (Linnaeus)
27.	Mor, Mayur	Common Peafowl	<i>Pave Cristatus</i> (Linnaeus)
28.	Myna	Indian myna	<i>Acridotheres tristis</i> (Linnaeus)
29.	Nakta	Comb Duck	<i>Sarkidicrnis melanotos</i> (Pennaeus)
30.	Nilkanth	Blue Jay (Roller)	<i>Coracias benghalensis</i>
31.	Nilkanth-Basant	Blue throated barbet	<i>Megalaima asiatica</i>
32.	Pan-dubki	Lesser Whistling Teak	<i>Dendrocygna Javanica</i> (Horsfield)
33.	Sarus	Sarus Crane	<i>Grus antigone</i> (Linnaeus)
34.	Teetar Kala	Painted Partiridge	<i>Francolinus Pictus</i> (Jardine & Selby)
35.	Teetar Safed	Grey Partridge	<i>Francolinus Pondiceriunus</i> (Gmelin)
36.	Tota	Large Indian Parakeet	<i>Psitta-cula eupatria</i> (Linnaeus)
37.	Ullo	Barn Owl	<i>Tyto alba</i> (Scopoli)
38.	Ullo	Brown fish Owl	<i>Bubo Zeylenensis</i> (Gmelin)

**Table 5.8: Faunal Diversity in Core zone of Mining lease area**

S.N.	Common/ Local Name	Scientific Name	WPA (1972) Schedule	IUCN Status (Global)
<b>Mammals</b>				
1.	Field Rat	<i>Bandicota bengalensis</i>	V	LC
2.	Five striped squirrel	<i>Funambulus pennantii</i>	IV	LC
3.	Indian Hare	<i>Lepus nigricollis</i>	IV	LC
4.	Indian Fox	<i>Vulpes bengalensis</i>	II	LC
5.	Blue Bull (Nilgai)	<i>Boselaphus tragocamelus</i>	III	LC
<b>Reptiles</b>				
1.	Indian Rat Snake (Dhaman)	<i>Ptyas mucosa</i>	II	LC
2.	Common Krait	<i>Bungarus caeruleus</i>	IV	LC
<b>Birds</b>				
1.	Jungle Bush Quail	<i>Perdicula asiatica</i>	IV	LC
2.	Grey Quail	<i>Coturnix pectoralis</i>	IV	LC
3.	Baya weaver bird	<i>Ploceus philippinus</i>	IV	LC

4.	Fork-tailed Drengo	<i>Dicrurus adsimilis</i>	IV	LC
5.	Red vented bulbul	<i>Pycnonotus cafer</i>	IV	LC
6.	Common Pariah Kite	<i>Milvus migrans</i>	-	LC
7.	Small blue kingfisher	<i>Alcedo atthis</i>	IV	LC
8.	Indian Paradise flycatcher	<i>Terpsiphone paradisi</i>	-	LC
9.	Cattle Egret	<i>Bubulcus ibis</i>	IV	LC
10.	House sparrow	<i>Passer domesticus</i>	-	LC
11.	Cotton Pigmy Goose	<i>Nettapus coromandelianus</i>	IV	LC
12.	Common Hoppoe	<i>Upupa epops</i>	-	LC
13.	White Bellied Wood Pecker	<i>Dryocopus Javensis</i>	IV	LC
14.	Common Myna	<i>Acridotheres tristis</i>	IV	LC
EX		Extinct		
EW		Extinct In The Wild		
RE		Regionally Extinct (regional category)		
CR		Critically Endangered		
EN		Endangered		
VU		Vulnerable		
LR/cd		Lower Risk: Conservation Dependent		
NT or LR/nt		Near Threatened		
LC or LR/lc		Least Concern		
DD		Data Deficient		
NA		Not Applicable (regional category)		
Source: Primary source (Based on Survey and Interaction with Local Villagers)				

Source: EIA/EMP Bailadila Iron Ore Deposit-4

**Table 5.9: Faunal Diversity in Core zone area of Screening cum Beneficiation Plant**

S.N.	Common/ Local Name	Scientific Name	WPA (1972) Schedule	IUCN Status (Global)
<b>Mammals</b>				
1.	Field Rat	<i>Bandicota bengalensis</i>	V	LC
2.	Three striped squirrel	<i>Funambulus pennantii</i>	IV	LC
3.	Jangle Cat	<i>Felis chaus</i>	II	LC
4.	Indian Hare	<i>Lepus nigricollis</i>	IV	LC
5.	Indian Fox	<i>Vulpes bengalensis</i>	II	LC
<b>Reptiles</b>				
1.	Cobra	<i>Naja naja</i>	II	LC
2.	Indian Rat Snake (Dhaman)	<i>Ptyas mucosa</i>	II	LC
3.	Common Krait	<i>Bungarus caeruleus</i>	IV	LC
<b>Birds</b>				
1.	Jungle Bush Quail	<i>Perdicula asiatica</i>	IV	LC
2.	Grey Quail	<i>Coturnix pectoralis</i>	IV	LC
3.	Baya weaver bird	<i>Ploceus philippinus</i>	IV	LC
4.	Fork-tailed Drengo	<i>Dicrurus adsimilis</i>	IV	LC
5.	Red vented bulbul	<i>Pycnonotus cafer</i>	IV	LC
6.	Common Pariah Kite	<i>Milvus migrans</i>	-	LC
7.	Small blue kingfisher	<i>Alcedo atthis</i>	IV	LC
8.	Indian Paradise flycatcher	<i>Terpsiphone paradisi</i>	-	LC
9.	Cattle Egret	<i>Bubulcus ibis</i>	IV	LC
10.	House sparrow	<i>Passer domesticus</i>	-	LC
11.	Cotton Pigmy Goose	<i>Nettapus coromandelianus</i>	IV	LC
12.	Yellow Footed Green	<i>Treron phoenicopterus</i>	IV	LC

	Pigeon			
13.	Common Hoppoe	<i>Upupa epops</i>	-	LC
14.	Large Billed Crow (formerly as Jungle Crow)	<i>Corvus macrorhynchos</i>	-	LC
15.	Red Jungle Fowl	<i>Gallus gallus</i>	IV	LC
16.	Blue rock Pigeon	<i>Columba livia</i>	-	LC
17.	Rufous woodpecker	<i>Micropternus brachyurus</i>	IV	LC
18.	Common Flame Back	<i>Dinopium javanense</i>	IV	LC
19.	White Bellied Wood Pecker	<i>Dryocopus Javensis</i>	IV	LC
20.	House crow	<i>Corvus splendens</i>	V	LC
21.	Koel (Cuckoos)	<i>Eudynamys scolopaceus</i>	IV	LC
22.	Common Myna	<i>Acridotheres tristis</i>	IV	LC
23.	Comb Duck	<i>Sarkidiornis melanotos</i>	IV	LC
24.	Indian Roller (Blue Jays)	<i>Coracias benghalensis</i>	IV	LC
25.	Blue Throated Barbet	<i>Psilopogon asiaticus</i>	-	LC
26.	Common Barn Owl	<i>Tyto alba</i>	-	LC
27.	Brown Fish Owl	<i>Ketupa zeylonensis</i>	IV	LC
EX		Extinct		
EW		Extinct In The Wild		
RE		Regionally Extinct (regional category)		
CR		Critically Endangered		
EN		Endangered		
VU		Vulnerable		
LR/cd		Lower Risk: Conservation Dependent		
NT or LR/nt		Near Threatened		
LC or LR/lc		Least Concern		
DD		Data Deficient		
NA		Not Applicable (regional category)		
Source: Primary source (Based on Survey and Interaction with Local Villagers)				

Source: EIA/EMP Bailadila Iron Ore Deposit-4

**Table 5.10: Faunal diversity in buffer zone**

S.N.	Common/ Local Name	Scientific Name	WPA (1972) Schedule	IUCN Status (Global)
<b>Mammals</b>				
1.	Rhesus Macaque (Red)	<i>Macaca mulatta</i>	II	LC
2.	Common Langur (Grey Langur)	<i>Semnopithecus entellus</i>	II	LC
3.	Sloth Bear	<i>Melursus ursinus</i>	I	VU
4.	Spotted Deer (Cheetal)	<i>Axis axis</i>	III	LC
5.	Grey Musk Shrew	<i>Suncus murinus</i>	-	LC
6.	Field Rat	<i>Bandicota bengalensis</i>	V	LC
7.	Five striped squirrel	<i>Funambulus pennantii</i>	IV	LC
8.	Indian Pangolin	<i>Manis crassicaudata</i>	I	EN
9.	Indian Giant Flying Squirrel	<i>Petaurista philippensis</i>	II	LC
10.	Jangle Cat	<i>Felis chaus</i>	II	LC
11.	Indian Hare	<i>Lepus nigricollis</i>	IV	LC
12.	Jackal	<i>Canis aureus</i>	II	LC
13.	Barking Deer	<i>Muntiacus muntjak</i>	III	LC
14.	Indian Fox	<i>Vulpes bengalensis</i>	II	LC
15.	Common Mongoose	<i>Urva edwardsii</i>	II	LC

S.N.	Common/ Local Name	Scientific Name	WPA (1972) Schedule	IUCN Status (Global)
16.	Blue Bull (Nilgai)	<i>Boselaphus tragocamelus</i>	III	LC
17.	Indian Porcupine	<i>Hystrix indica</i>	IV	LC
18.	Sambar Deer	<i>Rusa unicolor</i>	III	VU
19.	Indian Wild Boar	<i>Sus scrofa</i>	III	LC
20.	Panther	<i>Panthera pardus</i>	I	VU
<b>Reptiles</b>				
1.	Cobra	<i>Naja naja</i>	II	LC
2.	Python	<i>Python molurus</i>	I	NT
3.	Indian Rat Snake (Dhaman)	<i>Ptyas mucosus</i>	II	LC
4.	Viper	<i>Daboia russelii</i>	II	LC
5.	Common Krait	<i>Bungarus caeruleus</i>	IV	LC
6.	Water Snake (Checkered keelback Snake)	<i>Fowlea piscator</i>	II	LC
7.	Bengal Monitor Lizard	<i>Varanus bengalensis</i>	I	NT
<b>Birds</b>				
1.	Jungle Bush Quail	<i>Perdicula asiatica</i>	IV	LC
2.	Grey Quail	<i>Coturnix pectoralis</i>	IV	LC
3.	Baya Weaver Bird	<i>Ploceus philippinus</i>	IV	LC
4.	Fork-tailed Drengo	<i>Dicrurus adsimilis</i>	IV	LC
5.	Red Vented Bulbul	<i>Pycnonotus cafer</i>	IV	LC
6.	Common Pariah Kite	<i>Milvus migrans</i>	-	LC
7.	Small Blue-king Fisher	<i>Alcedo atthis</i>	IV	LC
8.	Indian Paradise Flycatcher	<i>Terpsiphone paradise</i>	-	LC
9.	Cattle Egret	<i>Bulbulcus ibis</i>	IV	LC
10.	House sparrow	<i>Passer domesticus</i> (Linnaeus)	-	LC
11.	Eurasian Eagle Owl	<i>Bubo bubo</i>	IV	LC
12.	Cotton Pigmy Goose	<i>Nettapus coromandelianus</i>	IV	LC
13.	Yellow Footed Green Pigeon	<i>Treron phoenicopterus</i>	IV	LC
14.	Common Hoppoe	<i>Upupa epops</i>	-	LC
15.	Large Billed Crow (formerly as Jungle Crow)	<i>Corvus macrorhynchos</i>	-	LC
16.	Red Jungle Fowl	<i>Gallus gallus</i>	IV	LC
17.	Blue Rock Pigeon	<i>Columba livia</i> (Gmelin)	-	LC
18.	Bastar Hill Myna (Common Hill Myna)	<i>Gracula religiosa</i>	I	LC
19.	Rufous Woodpecker	<i>Micropternus brachyurus</i>	IV	LC
20.	Common Flame Back Woodpecker	<i>Dinopium Javanense</i>	IV	LC
21.	White Bellied Wood Pecker	<i>Dryocopus javensis</i>	IV	LC
22.	House crow	<i>Corvus splendens</i>	V	LC
23.	Koel (Cuckoos)	<i>Eudynamys scolopaceus</i>	IV	LC
24.	Common Peafowl	<i>Pavo cristatus</i>	I	LC
25.	Common Myna	<i>Acridotheres tristis</i>	IV	LC
26.	Comb Duck	<i>Sarkidiornis melanotos</i>	IV	LC
27.	Indian Roller (Blue Jays)	<i>Coracias benghalensis</i>	IV	LC
28.	Blue Throated Barbet	<i>Psilopogon asiaticus</i>	-	LC
29.	Lesser Whistling Teal (Duck)	<i>Dendrocygna javanica</i>	IV	LC
30.	Painted Partridge (or	<i>Francolinus pictus</i>	IV	LC

S.N.	Common/ Local Name	Scientific Name	WPA (1972) Schedule	IUCN Status (Global)
	Painted Francolin)			
31.	Grey Francolin (formerly Partridge)	<i>Ortygornis pondicerianus</i>	IV	-
32.	Large Indian Parakeet	<i>Psittacula eupatria</i>	-	NT
33.	Common Barn Owl	<i>Tyto alba</i>	-	LC
34.	Brown fish Owl	<i>Ketupa zeylonensis</i>	IV	LC
EX		Extinct		
EW		Extinct In The Wild		
RE		Regionally Extinct (regional category)		
CR		Critically Endangered		
EN		Endangered		
VU		Vulnerable		
LR/cd		Lower Risk: Conservation Dependent		
NT or LR/nt		Near Threatened		
LC or LR/lc		Least Concern		
DD		Data Deficient		
NA		Not Applicable (regional category)		
Source: Primary source (Based on Survey and Interaction with Local Villagers)				

Source: EIA/EMP Bailadila Iron Ore Deposit-4



Figure 5.6: On field spottings of different faunal species along Galli Nalla



### 5.3 SOIL QUALITY ASSESSMENT

Composite soil samples following standard methodologies were collected from different areas/ sampling points along the *Galli Nalla* (Figure 5.7 & 5.8) and the collected samples were brought to laboratory of ICFRE-FRI, Dehradun for further chemical analysis of parameters vis-à-vis pH, EC ( $\mu\text{S}/\text{cm}$ ), OC (%), OM (%), Nitrogen (kg/ha), Phosphorus (kg/ha), Potassium (kg/ha), Calcium (kg/ha) and Sodium (kg/ha). Multiple soil samples were also collected from outside the *Galli Nalla* but within the lease area and the results of each parameter were compared with the respective results of samples collected from inside the *Galli Nalla*.



**Figure 5.7: Soil sampling points: outside the origin of *Galli Nalla* but within the ML**



**Figure 5.8: Soil sampling points: inside the *Galli Nalla***



The samples were ground and passed through 2 mm sieve and then through 100 mm sieve. The samples obtained from 100 mm mesh were subjected to soil chemical analysis. The results obtained are tabulated as given below (Table 5.11):

**Table 5.11: Nutrient status of soil samples collected from different locations within ML**

Parameters	Inside <i>Galli Nalla</i>		Outside <i>Galli Nalla</i>
	Inside <i>Galli Nalla</i>	Active Rhizospheric Zone of Tern Fern	
pH	5.51	5.88	5.65
EC (dS/m)	8.44	8.89	2.63
OC%	9.53	3.08	5.75
OM%	16.44	5.314	9.50
N kg/ha	374.53	313.95	404.38
p (kg/ha)	47.44	51.41	58.30
K (kg/ha)	231.17	154.56	164.09
Ca (kg/ha)	1954.68	1640.80	343.86
Na (kg/ha)	159.71	148.96	144.80

The results of the soil analysis show that the soil is slightly acidic in nature with pH varying between 5.51 – 5.88. The soil samples collected from inside *Galli Nalla* have reported high in nutrients such as organic carbon, organic matter, Potassium, Calcium and Sodium content when compared to the soil sourced from outside *Galli Nalla*. Acidic pH and higher organic carbon content may be attributed to the increased litter decomposition occurring within the *Galli Nalla* wetland. Increased decomposition of organic matter releases more humic acid into the substratum making the soil profile acidic. High Electrical Conductivity of soil inside the *Galli Nalla* (8.44 -8.89 dS/m) stems from the possible presence of soluble salts in the stream water together with the salts leached out into the stream where *Galli Nalla* cuts and weathers the exposed lithological units. This is also corroborated with the reported results of soil samples collected from outside the *Galli Nalla* which shows a marked difference (relatively lower concentration) in EC, and organic matter content when compared with the respective results from soils sampled from inside the *Galli Nalla*. However, the soils sampled from outside the stream flow area have reported relatively higher nitrogen and phosphorous content.

Soil sampled from the active rhizospheric zone of the Tree fern inside the *Galli Nalla*, has also reported high in major nutrient contents but, relatively lower than the samples collected from the non-rhizospheric zones inside the *Galli Nalla*. This is attributed to the fact that the Tree ferns are in their active growth phase and they extract nutrients from the soil and store

them in their roots temporarily, which are later translocated and utilized for carbon fixation and physiological development. Presence of soil stratum rich in major nutrients and organic matter ensure and sustain the growth and development of the tern ferns and dependent associate species within the *Galli Nalla* ecosystem.

#### **5.4 WATER QUALITY ASSESSMENT**

Important physico-chemical water quality parameters viz., Temperature (°C), pH, Conductivity (µS/cm), TDS (ppm) and Salinity (ppm) were measured in-situ by employing the *PCSTestr 35* multi-parameter instrument. The locations along the entire course of *Galli Nalla* falling within mining lease from its origin in between the lease hold area of both the Deposit-10 & proposed Deposit-4 to the location where it crosses the main road lead to other facilities of the Bacheli Complex were sampled during the period from 22 to 23 June 2024.

The physico-chemical water quality data collected during the present study (June, 2024) were compared to that of collected as part of the RR & EM Plan preparation of Deposit-11A, 10 & 5 at locations upstream and downstream of the *Galli Nalla* during January, 2021 & April, 2022. Also, the present water quality data were compared to that of recorded from the other streams originating from the mining area of Bacheli Complex during January, 2021 & April, 2022 for a logical conclusion.

The details of sampling locations of physico-chemical water quality from upstream and downstream of the *Galli Nalla* during January, 2021 & April, 2022 are provided in **Table 5.12** and the corresponding data are provided in **Table 5.13 & Figure 5.10**, while that of from other streams in and around the Bacheli Complex during January, 2021 & April, 2022 are provided in **Table 5.14** and the corresponding data are provided in **Table 5.15 & Figure 5.11**. The observation on physico-chemical water quality from upstream and downstream of the *Galli Nalla* within the proposed Deposit-4 mining lease during June 2024 is provided in **Table 5.16** and **Figure 5.12**.

##### **5.4.1 Temperature (°C)**

The ambient surface water temperature measured in-situ at the upstream and downstream of *Galli Nalla* (Figure 5.9) varied from 18.50 to 20.01°C respectively with a mean of  $19.26 \pm 1.07^\circ\text{C}$  during January 2021 and from 22.10 to 23.40°C respectively with a mean of  $22.75 \pm 0.92^\circ\text{C}$  during April, 2022, while that of other water courses located in the adjoining area of Bacheli Complex varied from 22.60°C to 26.70°C with a mean of  $24.70 \pm 1.45^\circ\text{C}$  during

January, 2021 and from 25.20°C to 26.70°C with a mean of  $26.10 \pm 0.79^\circ\text{C}$  during April, 2022. The parameter measured at *Galli Nalla* within the proposed Deposit-4 mining lease varied from 22.10 to 23.40°C with a mean of  $22.60 \pm 0.51^\circ\text{C}$  during June, 2024. The apparent difference in the parameter among the sampling locations i.e., *Galli Nalla* and other streams in Bacheli Complex may be due to the seasonal influence as well as prevailing environmental perturbations in the area including land use land cover changes and other related anthropogenic factors.



**Figure 5.9: Water quality assessment of *Galli Nalla***

#### **5.4.2 pH**

The ambient pH measured in-situ at the upstream and downstream of *Galli Nalla* varied from 7.95 to 8.51 respectively with a mean of  $8.23 \pm 0.40$  during January, 2021 and from 7.86 to 7.56 respectively with a mean of  $7.71 \pm 0.21$  during April, 2022, while that of other water courses located in the adjoining area of Bacheli Complex varied from 7.64 to 8.71 with a mean of  $8.15 \pm 0.45$  during January, 2021 and from 7.65 to 7.85 with a mean of  $7.77 \pm 0.10$  during April, 2022. The parameter measured at *Galli Nalla* within the proposed Deposit-4 mining lease during June, 2024 varied from 4.30 to 5.36 with a mean of  $4.95 \pm 0.37$ . Results of the observations indicate that ambient pH of both the *Galli Nalla* as well as the other streams located in and around Bacheli Complex was slightly alkaline during January, 2021 and near neutral during April, 2022. However, the parameter measured at *Galli Nalla* within the proposed Deposit-4 mining lease during June, 2024 was slightly acidic in nature. The apparent difference in the parameter in *Galli Nalla* during June, 2024 compared to that of other seasons as well other sampling locations point to the fact that there is relatively more seasonal influence on the parameter at upstream locations compared to that of downstream locations as well as that of other streams in the area, probably attributable to prevailing environmental perturbations associated with mostly monsoon flow.

#### **5.4.3 Conductivity ( $\mu\text{S}/\text{cm}$ )**

The ambient conductivity measured in-situ at the upstream and downstream locations of *Galli Nalla* varied from 19.0 to 18.0  $\mu\text{S}/\text{cm}$  respectively with a mean of  $18.50 \pm 0.71$   $\mu\text{S}/\text{cm}$  during January, 2021 and from 24.0 to 20.90  $\mu\text{S}/\text{cm}$  respectively with a mean of  $22.45 \pm 2.19$   $\mu\text{S}/\text{cm}$  during April, 2022, while that of other water courses located in the adjoining area of Bacheli Complex varied from 7.10 to 102.60  $\mu\text{S}/\text{cm}$  with a mean of  $52.10 \pm 28.56$   $\mu\text{S}/\text{cm}$  during January, 2021 and from 30.50 to 39.30  $\mu\text{S}/\text{cm}$  with a mean of  $36.23 \pm 4.97$   $\mu\text{S}/\text{cm}$  during April, 2022. The parameter measured at *Galli Nalla* within the proposed Deposit-4 mining lease during June, 2024 varied from 9.20 to 15.50  $\mu\text{S}/\text{cm}$  with a mean of  $12.0 \pm 2.3$   $\mu\text{S}/\text{cm}$ . The noticeable variations in ambient water conductivity in the *Galli Nalla* compared to that of other streams in Bacheli Complex is mostly attributable to seasonal flow as well as prevailing environmental perturbations in the area including land use land cover changes and other related anthropogenic factors.

#### **5.4.4 TDS (ppm)**

The ambient TDS measured in-situ at the upstream and downstream locations of *Galli Nalla* varied from 13.60 to 12.90 ppm respectively with a mean of  $13.25 \pm 0.49$  ppm during January, 2021 and from 17.10 to 14.90 ppm respectively with a mean of  $16.0 \pm 1.56$  ppm during April, 2022, while that of other water courses located in the adjoining area of Bacheli Complex varied from 12.20 to 72.90 ppm with a mean of  $36.80 \pm 20.15$  ppm during January, 2021 and from 21.70 to 27.70 ppm with a mean of  $24.60 \pm 3.00$  ppm during April, 2022. The parameter measured at *Galli Nalla* within the proposed Deposit-4 mining lease during June 2024 varied from 6.40 to 12.40 ppm with a mean of  $8.68 \pm 2.13$  ppm. The noticeable variations in ambient water conductivity in the *Galli Nalla* compared to that of other streams in Bacheli Complex is mostly attributable to influence of seasonal flow as well as prevailing environmental perturbations in the area including land use land cover changes and other related anthropogenic factors.

#### **5.4.5 Salinity (ppm)**

The ambient salinity measured in-situ at the upstream and downstream locations of *Galli Nalla* varied from 15.50 to 15.40 ppm respectively with a mean of  $15.45 \pm 0.07$  ppm during January, 2021 and from 18.70 to 17.30 ppm respectively with a mean of  $18.0 \pm 0.99$  ppm during April, 2022, while that of other water courses located in the adjoining area of Bacheli

Complex varied from 16.60 to 53.20 ppm with a mean of  $36.84 \pm 12.33$  ppm during January, 2021 and from 22.30 to 25.90 ppm with a mean of  $23.90 \pm 1.83$  ppm during April, 2022. The parameter measured at *Galli Nalla* within the proposed Deposit-4 mining lease during June, 2024 varied from 12.80 to 16.0 ppm with a mean of  $14.10 \pm 1.11$  ppm. The noticeable variations in ambient water conductivity in the *Galli Nalla* compared to that of other streams in Bacheli Complex is mostly attributable to influence of seasonal flow as well as prevailing environmental perturbations in the area including land use land cover changes and other related anthropogenic factors.

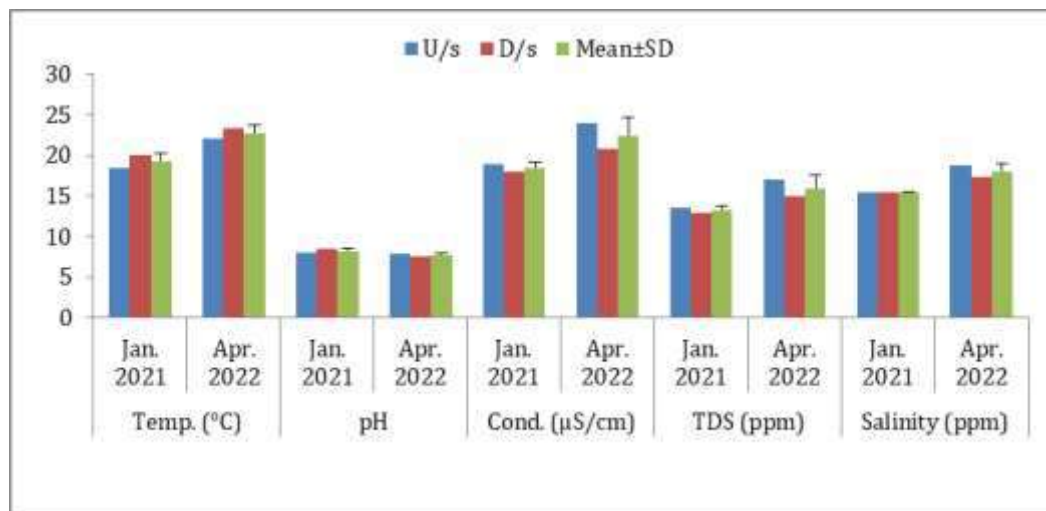
The ambient physico-chemical water quality parameters measured in-situ in the *Galli Nalla* during June 2024 compared to that of recorded during January 2021 and April 2022 from the same stream upstream and downstream as well from other streams in and around Bacheli Complex revealed that the parameters concerned are influenced both by season mainly due to monsoon flow as well as prevailing environmental perturbations including land use land cover changes associated with mining and allied activities and other anthropogenic factors.

**Table 5.12: Sampling locations for physico-chemical water quality from upstream and downstream of the *Galli Nalla* during January 2021 & April 2022**

Sl. No.	Sampling locations	Lat. (N)	Long. (E)	Alt. (m)
1	<i>Galli Nalla</i> u/s. (Near Tree fern habitat)	18°41'55.26"	81°12'37.30"	980
2	<i>Galli Nalla</i> d/s. (Near Pump House)	18°40'01.53"	81°12'30.47"	883

**Table 5.13: Physico-chemical water quality from upstream and downstream of the *Galli Nalla* during January 2021 & April 2022**

Parameters	Period	Locations		Mean $\pm$ SD
		U/s.	D/s.	
Temp. (°C)	Jan. 2021	18.50	20.01	$19.26 \pm 1.07$
	Apr. 2022	22.10	23.40	$22.75 \pm 0.92$
pH	Jan. 2021	7.95	8.51	$8.23 \pm 0.40$
	Apr. 2022	7.86	7.56	$7.71 \pm 0.21$
Cond. ( $\mu$ S/cm)	Jan. 2021	19.00	18.00	$18.50 \pm 0.71$
	Apr. 2022	24.00	20.90	$22.45 \pm 2.19$
TDS (ppm)	Jan. 2021	13.60	12.90	$13.25 \pm 0.49$
	Apr. 2022	17.10	14.90	$16.00 \pm 1.56$
Salinity (ppm)	Jan. 2021	15.50	15.40	$15.45 \pm 0.07$
	Apr. 2022	18.70	17.30	$18.00 \pm 0.99$



**Figure 5.10: Graphical representation of physico-chemical water quality parameters recorded from upstream and downstream of the Galli Nalla during January 2021 & April 2022**

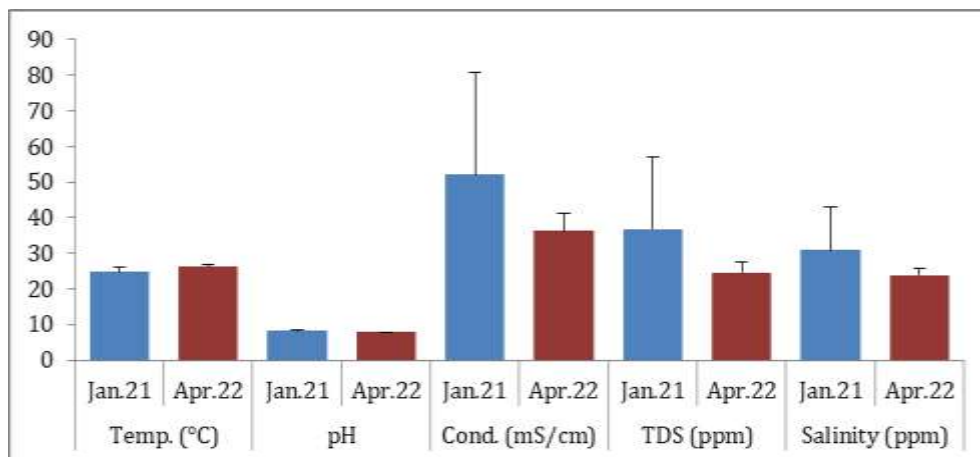
**Table 5.14: Details of sampling locations for physico-chemical water quality from streams in and around the Bacheli Complex during January 2021 & April 2022**

Sl. No.	Sampling locations	Lat. (N)	Long. (E)
1	Nalla near 10-11 Loading Point	18°41'45.19"	81°14'02.95"
2	Bacheli source Nalla	18°41'22.31"	81°13'51.78"
3	Check Dam near Bus stop-Bacheli	18°41'38.60"	81°14'14.90"
4	Bacheli Nalla d/s. Patelpara	18°41'55.30"	81°12'37.40"
5	Pyka Nalla	18°40'45.78"	81°14'55.82"
6	Discharge-Tailing Dam-2	18°40'45.85"	81°15'18.27"
7	Panchamurthy Nalla d/s. Patelpara	18°41'55.30"	81°12'37.40"
8	Panchamurthy Nalla u/s.	18°39'52.75"	81°14'52.51"

**Table 5.15: Physico-chemical water quality parameters recorded from streams in and around the Bacheli Complex during January 2021 & April 2022**

Parameters	Period	Min.	Max.	Mean ± SD
Temp. (°C)	Jan.21	22.60	26.70	24.70 ± 1.45
	Apr.22	25.20	26.70	26.10 ± 0.79
pH	Jan.21	7.64	8.71	8.15 ± 0.45
	Apr.22	7.65	7.85	7.77 ± 0.10
Cond. (μS/cm)	Jan.21	17.10	102.60	52.10 ± 28.56
	Apr.22	30.50	39.30	36.23 ± 4.97
TDS (ppm)	Jan.21	12.20	72.90	36.80 ± 20.15
	Apr.22	21.70	27.70	24.60 ± 3.00
Salinity (ppm)	Jan.21	16.60	53.20	30.84 ± 12.33
	Apr.22	22.30	25.90	23.90 ± 1.83

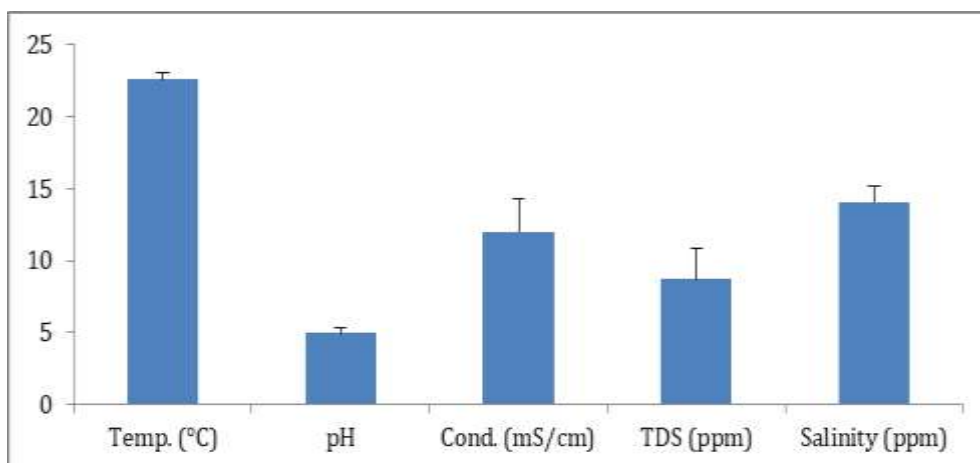




**Figure 5.11: Graphical representation of physico-chemical water quality parameters recorded from streams in and around the Bachel Complex during January 2021 & April 2022**

**Table 5.16: Physico-chemical water quality parameters recorded from Galli Nalla during June 2024 w.r.t Tree fern habitat study**

Parameters	Min.	Max.	Mean $\pm$ SD
Temp. (°C)	22.10	23.40	22.6 $\pm$ 0.51
pH	4.30	5.36	4.95 $\pm$ 0.37
Cond. ( $\mu$ S/cm)	9.20	15.50	12.0 $\pm$ 2.3
TDS (ppm)	6.40	12.40	8.68 $\pm$ 2.13
Salinity (ppm)	12.80	16.00	14.1 $\pm$ 1.11



**Figure 5.12: Graphical representation of physico-chemical water quality parameters recorded from Galli Nalla during June 2024 w.r.t Tree fern habitat study**

## **CHAPTER - 6**

### **PREDICTION OF MINING INDUCED IMPACTS ON TREE FERN**

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Mining is process of extracting minerals and ores from earth through excavation. Winning ores and minerals are essential activities for supplying raw materials to industries to support the socio-economic progress of the country. Open pit mining indubitably alters the original topography of the earth and renders unequivocal impacts on land, water, air, noise and biological environment. Sustainable mining aims to attain a perfect balance between mining and environmental conservation. To ensure suitable protection measures, level of impact of mining on various environmental parameters need to be assessed. The present study has a special emphasis to assess the impact of mining over the Tree fern species existing within the mining lease area and to suggest suitable measures to protect the rare flora.

#### **6.1 EFFECTS ON LAND DEGRADATION AND ALTERATION OF TOPOGRAPHY DUE TO MINING**

The Tree fern is found to inhabit and grow on the banks of *Galli Nalla* flowing towards SSW direction along the valley situated at the bottom of eastern slopes of western ridge (Deposit-4). Iron ore mineralization occurs on the entire length of ridge. The ore body has a lenticular shaped surface appearance. The width of the Iron Ore Deposit varies from 80 m to 250 m. The average width of the ore body is 150 m with a maximum elevation of about 1210 m on the north-eastern side of the hill range and lowest elevation of about 1020 m on the southwestern side of the hill range. The ore body is divided into north and south blocks which are separated by unenriched BHQ. Detailed exploration has established the ore body up to a maximum depth of 130 m. The average depth of bore hole is around 75 m.

*Galli Nalla* head is located at an elevation of about 1100 m on the northeastern part of the mining lease on the valley between the western and eastern Iron ore bearing ridges and lowest elevation is about 950 m at the southwestern part of the mining lease area.

As per conceptual Plan, the ultimate pit limit of Bailadila Deposit-4 is spread over an area of 94.11 Ha. It is proposed to excavate North Block initially and after fully exhausting the Mineable Iron Ore of the North Block, winning of Iron Ore in the South Block will be taken up in the later years of the life of the Mine. The lowest bench of the ultimate pit limit will be 1044 MRL and 996 MRL in the North Block and the South Block respectively. Two pits will be formed at the end of the life of the mine of Bailadila Deposit-4 mine. The pit formed in the North Block would be backfilled after extracting all the Ores and associated waste materials of the Deposit during the life of the Mine. Part of the South Block mined out pit shall be

restored as a water reservoir and doing so, an area of 20.04 Ha will be covered by water body.

To have better understanding of the locational relationship between the Ultimate Pit Limit (UPL) and *Galli Nalla*, few Cross Sections have been prepared starting from the head of the *Galli Nalla* at an interval of 100 Mtrs intersecting the UPL and *Galli Nalla* bed from North to south direction. Summary of the same is given in the following table -

<b>Sl. No.</b>	<b>Cross Section (West-East)</b>	<b>UPL Top to <i>Galli Nalla</i> Distance (Mtrs)</b>	<b>UPL Bottom to <i>Galli Nalla</i> Distance (Mtrs)</b>	<b>Level difference between UPL Bottom and <i>Galli Nalla</i> in Mtrs {above (+) / below (-)}</b>
1	North Block N1	371	463	(-) 26
2	North Block N2	335	462	(-) 16
3	North Block N3	347	487	(-) 16
4	North Block N4	343	521	(-) 11
5	North Block N5	335	518	(-) 05
6	North Block N6	381	605	(-) 24
7	North Block N7	405	575	(-) 20
8	North Block N8	341	512	(-) 16
9	North Block N9	291	403	(-) 14
10	North Block N10	280	379	(-) 10
11	North Block N11	286	337	(-) 18
12	North Block N12	250	332	(+) 35
13	South Block S1	210	308	(-) 09
14	South Block S2	184	332	(-) 32
15	South Block S3	179	312	(-) 44
16	South Block S4	130	251	(-) 39
17	South Block S5	173	317	(-) 34
18	South Block S6	188	315	(-) 29
19	South Block S7	252	405	(-) 20
20	South Block S8	216	384	(-) 04
21	South Block S9	228	365	(+) 12
22	South Block S10	309	407	(+) 21
23	South Block S11	216	291	(+) 38
24	South Block S12	245	314	(+) 58
25	South Block S13	320	384	(+) 63
26	South Block S14	410	410	(+) 115

In the North Pit, Maximum and Minimum distance of the Top Most Bench of the UPL from the *Galli Nalla* will be 405 m and 250 m respectively. Also, in the North Pit, Maximum and Minimum distance of the Bottom Most Bench of the UPL from the *Galli Nalla* will be 605 m and 332 m respectively. In the later years of the North Pit, bottom most benches of the North

Block Pit will be going down below the *Galli Nalla* Level except between section lines N10 to N12.

Similarly, in the South Pit, Maximum and Minimum distance of the Top Most Bench of the UPL from the *Galli Nalla* will be 410 m and 130 m respectively. Also, in the Southern Pit, Maximum and Minimum distance of the Bottom Most Bench of the UPL from the *Galli Nalla* will be 410 m and 251 m respectively.

From the Cross-Sections, thus conceptualised, it is to be deciphered that final Excavated areas in the North Block and South Block likely be in the shape of closed Pits spanning over both the Slopes of the Deposit-4 (Western Ridge). As per available data, all the working faces of the mine will be terminated in the competent rock. During the Rain, Geometry of the Mine Benches, Oval Shape of the Mine Pit and wider barrier of consolidated rock types may prevent free flow of the water in Slurry form towards any direction of the Mine. However, seepage of water into the mine pit need to be monitored.

During the time of exploratory drilling, no water table had been encountered. Ground water of confined and permanent nature may be expected only at much lower levels since the hills have got abrupt relief over 600 meters from the plains.

During the course of the Mining in the North Block, when lowest benches will be going down the level of the *Galli Nalla*, and there is apprehension about interference of sub-surface water regime to affect water flow towards *Galli Nalla* and on the other hand, during the rainy season. However, it is important to note that on the northern part *Galli Nalla* is not perennial. Moreover, northern mine pit is proposed to be backfilled and lowest bench will be at a distance of more than 332m and therefore under the circumstances possibilities of affecting water regime as well as Tree fern habitat appears to be remote.

In case of south block, ultimate pit bottom is envisaged at 996 m, which is going down below the *Galli Nalla* level between cross section S1 and S8 in the last stage of the Mining. Lowest bench of the South Block Pit will be at a distance of more than 251m, moreover, mine pit of south block is proposed to be converted in to water reservoir and therefore under the circumstances it will not affect water regime as well as Tree fern habitat.

Float ore mining has been proposed on the eastern slope of the western ridge at two locations having dimension of 25.24 ha (1262 x 200 m) & 16.87 ha (750 x 225 m). The proposed float mining will alter the original surface and expose soft/ unconsolidated strata, which is more

susceptible to erosion and wash offs. The eroded material may likely to be accumulating on the Galli Nalla bed which over a period of time will obstructs free flow of water.



**Figure 6.1: Map showing sectional lines of ML area**



## **6.2 TOPOGRAPHIC ADVANTAGE FOR DEVELOPMENT OF PERENNIAL NALLA/STREAM AND IMPACT OF MINING ON WATER REGIME**

The eastern bank of the nalla / eastern slope of the western ridge (Deposit-4) has uniformly steep slope, and parallel drainage of 1<sup>st</sup> order seasonal stream developed over the slope. Gradient of the slope is 1 in 3.4 to 1 in 4.9. However western slope of the eastern ridge (Deposit-10) is moderately gentle slope having rolling topography, gradient of the slope is 1 in 4.5 to 1 in 10.3. Upper elevation of the slope is marked by 3 prominent flat terraces, which extend beyond the western lease boundary. Sub-parallel drainage system has been developed over the gentle slope. On either side of the nalla, for an average width of 150 m, flood plains have been developed with a very gentle slope of 1 in 7 gradient. It is found that Tree fern is growing in patches along the nalla on the southern part. It is further observed that these Tree ferns prefer lithophytic habitats on rocky streamside banks and is found to grow within the rock crevices or along the soft layers/ cleavages/ bedding plane of the rock (Figure 6.2). No 1<sup>st</sup> order stream originates from eastern slope of the hill which perennially drains water to *Galli Nalla* and no seepage of water has been observed from the eastern slope. However, it is found that 1<sup>st</sup> order stream originates from western slope of Deposit-10 (western bank of *Galli Nalla*) drains water to *Galli Nalla* as well as seepage of sub-surface water has been observed from the western slope of Deposit-10. Gentle slope and flat terraces of the western bank facilitate percolation of water and its downward movement along lithological contacts and finally drains into *Galli Nalla* where lithological contact has been exposed by nalla cutting. *Any alteration on the western slope of Deposit-10 may adversely affect sub-surface water regime.*



**Figure 6.2: Lithophytic habitat of Tree fern in *Galli Nalla***



### **6.3 EFFECTS OF DUMPING ON TREE FERN HABITAT**

Lateritic material, shale and banded Iron formations (BIF) analyzing less than 45 % Fe has been considered as waste. Total mineable waste in the Bailadila Deposit-4 is 68.17 MT. The overall stripping ratio of deposit is 1:0.63. The maximum waste excavation of 6414000 Tonnes will be done during the first 16 Year of operations. The waste generated during the 1st year of excavation from northern block pit is planned to be dumped on eastern side slope leading to *Galli Nalla* as Dump-1 with an estimated total area of 1.69 ha and a height of 20 m, whereas the remaining waste is proposed to be dumped on the N-NW slope of the hill as Dump-2 with an estimated area of 20.7 ha and a height of 150 m during 2<sup>nd</sup> – 8<sup>th</sup> year of mining operations is proposed on the western slope of the western ridge (Deposit-4). Other three dumps are proposed to be formed on the slope west of the hillock during 8<sup>th</sup> year onwards. Backfilling of north block pit has been planned after extracting all the ores and associated waste materials of the deposit during the life of the Mine i.e., 14-21 year of mining operations.

Waste dumps 1 proposed on eastern slope of mining hillock (western ridge - Deposit-4) intersected by numerous seasonal streams most often lead to significant impacts on local vegetation, features of seasonal water courses and entire micro-watershed, and therefore of quality and quantity of water flow from the area towards downstream. Deforestation and forest degradation associated with mining and dumping are likely to result in increased sediment load and accumulation of Iron ore tailings in nearby water bodies. The discharge of suspended particulate matter directly from the degraded mine spoil areas may increase the chance of pollution of surface water sources and of putting the aquatic life in peril. While dumping on western slope of the hillock (western ridge - Deposit-4) is relatively safe due to absence of perennial water courses, although intersected by numerous seasonal first order streams leading to *Tumaka nalla*. Extensive float ore mining is proposed on the eastern side of the western ridge. Therefore, *the Dump-1 on eastern slope of western ridge together with proposed float ore mining are most likely to cause potential damages on the vegetation cover and surface water courses flowing towards the proposed earmarked conservation area around Galli Nalla due to the following reasons.*

On the eastern slope of the hill range on southern part, waste dump no 1 is proposed over an area of about 1.69 ha, which is located about 105 m away from the *Galli Nalla*. Prominent wind direction of the region is SW to NE with an average velocity ranging from 1.5 to 4.5 m per second. *Galli Nalla* is located on the east of proposed dump no.1. Even though, wind born

dust from dump may not hugely impact *Galli Nalla*, siltation due to rain/ surface water movement is very likely to stem from proposed dump no.1.

#### **6.4 EFFECTS OF GROUND VIBRATION AND NOISE POLLUTION DUE TO BLASTING**

Mining operations in Deposit-4 is yet to be started, therefore no Ground Vibration study conducted for the deposit specifically. However, Ground Vibrations tests were conducted for Deposit-5 and 10. Deposit-10 is located on the eastern side of Deposit-4, on parallel ridge. Deposit 5 is located on the northern continuity of the Deposit-4 on the same ridge, geologically both are continuous deposit and rock types and nature of the deposit are similar. Therefore, considering results of GV test conducted for Deposit-5 is applied and predicted intensity of vibration at different locations on the Deposit-4. The exercise has been attempted and possible vibration close to tree fern habitat is assessed, accordingly the applicable recommendations made for Deposit-5 shall be applicable for Deposit-4. Ground Vibrations results furnished in the *“Report on Advice for optimisation of blast design parameters at Bailadila Opencast Mine, Bacheli Complex, NMDC to improve productivity of mine with effective utilization of explosive energy and reduction of blast hazards”* conducted by CSIR-Central Institute of Mining & Fuel Research (Council of Scientific & Industrial Research conducted during September 2019 are taken into consideration for the present study.

In the Deposit-5 & 10, total 19 experimental blasts consisting of 15 production blasts and 4 signature hole blasts were conducted. The blasts were conducted for blast hole diameter of 150 mm and 250 mm. The hole depth during experimental blasts were in the range of 8.3 m-15.5 m. The holes were charged with Site Mixed Emulsion (SME) explosive. Blast holes were connected with Nonel initiation systems.

Seismographs were deployed to record the vibrations at different locations in and around mine premises at Deposit-5. Altogether 33 vibration data were recorded for blasts conducted at Deposit-5 (D-5). Distance of vibration monitoring from face ranges between 44m– 920m for blasts conducted at Deposit-5.

Ground vibrations were monitored in terms of peak particle velocity (PPV) that varied from <0.5mm/s to 71.4 mm/s for blasts conducted at Deposit-5 depending upon the distance of measuring transducers of seismographs from the blasting face and the amount of explosives detonated in particular delay of the blast.

The maximum level of vibration recorded from blast at D-5 was 71.4 mm/s at peak dominant frequency of 4.00 Hz for blast conducted at BHD-10 blast face on 01.12.2018. The vibration was recorded at a distance of 55 m in left back side of the blast face. The blast was conducted with total explosive charge of 2580 kg and maximum charge per delay of 320kg. The maximum vibration recorded near the surface structure was 6.93 mm/s at peak dominant frequency of 5.43 Hz. The surface structure crusher house was located at a distance of 290 m from the blast face. All the recorded vibration near surface structures were within limit as per the standard prescribed by DGMS.

The principal frequencies of ground vibrations recorded were in the range of 3.0 Hz- 15.3 Hz for blasts conducted at D-5. Plot states dominance of frequency falls below 8 Hz. So, blast induced ground vibration should be restricted within 10 mm/s for safety of nearby industrial structures and 5 mm/s for the safety of domestic houses not belonging to owner as per DGMS standard.

The air overpressure levels recorded from different blasts varied between 91.5 dB(L)- 148dB (L) for blasts conducted at D-5. However, the maximum air over pressure near surface structures were below 130 dB(L) the levels of air overpressure near surface structures recorded during blasts were well within the safe limit around structures.

In all the blasts, ejections of flyrocks were within limit. The throws of the blasted materials were also controlled and restricted within the blasting area only. The maximum explosive weight per delay and total explosive charge in a blasting round has been suggested for the mine based on output of statistical analysis of gathered vibration data. The suggested explosive charge per delay at various distances for D-5 is provided in Table 6.1. The suggested total explosive charge to be fired in a blasting round, when surface structures are located at various distances from the blasting face has been presented in Table 6.2.

Optimized powder factor & burden-spacing has been computed for different rock types available at the mine using various empirical models. The suggested Charge factor for different rock types is given in table below:

<b>Rock type</b>	<b>Suggested charge factor</b>
Steel Grey Hematite	0.9 - 1.29
Blue Grey Hematite	0.88 - 1.27
BHQ	0.65 - 0.93
Lateritic ore/ laminated ore	0.42 – 06.1

**Table 6.1: Recommended explosives weight to be detonated in a delay at blasting faces of Deposit-5, BIOM, Bachel Complex, NMDC for the safety of houses/structures concerned**

Distance of structures from the blasting faces [m]	Maximum explosive weight to be detonated in a delay keeping the safety of nearby domestic houses/structures (Threshold vibration limit- 5 mm/s) [kg]	Maximum explosive weight to be detonated in a delay keeping the safety of nearby industrial buildings (Threshold vibration limit- 10 mm/s) [kg]
100	45	115
150	102	259
200	181	460
250	284	719
300	408	1035
350	556	1409
400	726	1841
450	919	2330
500	1134	2876
600	1633	4141
700	2223	5637
800	2904	7363

**Table 6.2: Recommended total explosive charge to be fired in a blasting round at blasting faces of Deposit-5, BIOM, Bachel Complex, NMDC for the safety of houses/structures concerned**

Distance of structures from the blasting faces [m]	Total explosive charge to be fired in a blasting round keeping the safety of nearby domestic houses/structures (Threshold vibration limit- 5 mm/s) [kg]	Total explosive charge to be fired in a blasting round keeping the safety of nearby industrial buildings (Threshold vibration limit- 10 mm/s) [kg]
100	518	1338
150	1164	3011
200	2070	5354
250	3235	8365
300	4658	12045
350	6340	16395
400	8280	21414
450	10480	27102
500	12938	33460
600	18631	48182
700	25359	65581
800	33121	85657

Considering, the envisaged bench parameters, if mining operations undertaken at a depth of 75 m in the northern block, distance between UPL and *Galli Nalla* will be 730 m which is safe distance in respect of land degradation that may not have impact on tree fern habitat along *Galli Nalla*.

In case of mining operations in the northern block undertaken upto bottom of ore body i.e upto 130 m, Ultimate Pit Bottom will be lower than *Galli Nalla* floor level and UPL will be close to *Galli Nalla*, however envisaged bench width of 60 m will be reduced in non operating benches. In case of southern block development of pit upto 130 m depth will not affect tree fern habitat along *Galli Nalla*, as the pit is proposed to be converted into reservoir and distance between UPL and *Galli Nalla* is 133 m. To minimize vibration due to blasting, mine management should adhere to the maximum explosive weight to be detonated in a delay and total explosive charge to be fired in a blasting round applicable for the safety of nearby domestic houses/structures for 100 m distance to keep Threshold vibration limit- 5 mm/s) [kg].

## **6.5 EFFECTS OF AIR POLLUTION DUE TO PROPOSED MINING, INFRASTRUCTURE AND ALLIED ACTIVITIES**

Air/dust pollution emanating from the mining activities can induce physiological stress to the plant community inhabiting the *Galli Nalla* by adversely altering the rate of stomatal closure, thereby reducing the availability of CO<sub>2</sub> to the leaves, limiting carbon fixation and subsequently lowering the Net Photosynthetic Rate (NPR). Prolonged exposure to increased level of pollutants in the ambient air may limit the population extent of the *Carallia* - *Calamus* - *Cyathea*- *Licuala*- *Gnetum* community. Land Use Land Cover (LULC) change analysis has shown that the tree population in the area of interest has decreased from 55% to 52% during 2017-2023. Particulate matter and dust emanating from mining operations may also pose grave threat to both humans and wildlife inhabiting the landscape.

Additionally, a time series prediction of ambient air quality and fugitive dust parameters using the Auto Regressive Integrated Moving Average (ARIMA) model based on historical air quality monitoring data, covering multiple seasons over a five-year period (2018 to 2023) has been worked out. Since mining operations are yet to commence in Deposit-4, The ARIMA model of air quality prediction for Deposit-4 has been developed using seasonal ambient air quality data collected in the vicinity of the mine area ie from Deposit-5 and Deposit-10 which are adjacent working mines in the same landscape. The dataset includes pollutant levels recorded during winter, summer, and post-monsoon seasons from 2020 to 2023 along with model predicted data of 2018 & 2019.

### **Existing Ambient Air Quality Trend (2018-2023)**

#### **PM<sub>10</sub>**

Throughout the period from 2018 to 2021, PM<sub>10</sub> concentrations were consistently high during both winter and summer seasons, significantly exceeding the CPCB's annual average standard of 60 µg/m<sup>3</sup>. The highest levels were observed during winter, indicating a strong influence of mining operations and associated dust generation. A downward trend in PM<sub>10</sub> levels was observed in 2022 and 2023, with some improvement seen across all seasons. Although the levels are closer to the standards, winter concentrations still pose a concern, suggesting that dust control measures have had some impact but require further enhancement to ensure year-round compliance.

#### **PM<sub>2.5</sub>**

PM<sub>2.5</sub> concentrations exceeded the permissible limit of 40 µg/m<sup>3</sup> in all seasons from 2018 to 2021, with pronounced peaks during winter. This pattern highlights the significant contribution of fine particulate matter from mining activities and potentially other combustion sources. The data for 2022 and 2023 shows a marked reduction in PM<sub>2.5</sub> levels, indicating progress towards cleaner air. However, the levels during winter still slightly exceed the CPCB standards, emphasizing the need for ongoing efforts to control fine particle emissions in the mining area.

#### **Sulfur Dioxide**

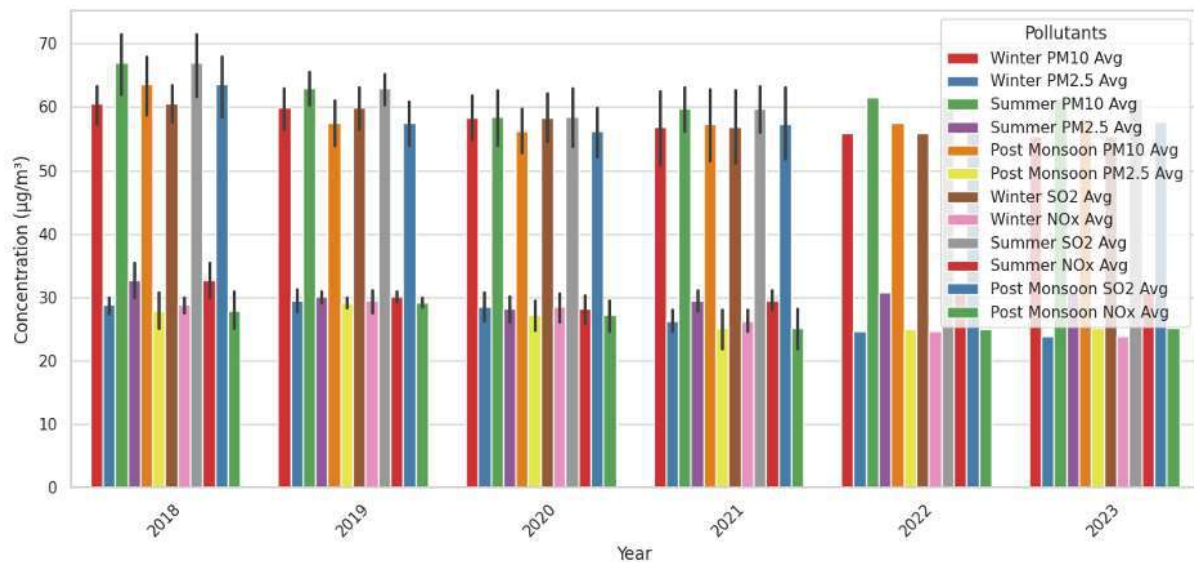
Sulfur Dioxide (SO<sub>2</sub>) concentrations remained largely within the CPCB's annual average standard of 50 µg/m<sup>3</sup> throughout the period from 2018 to 2023, with only minor exceedances observed occasionally during the winter season. These exceedances could be linked to emissions from fuel combustion and industrial activities in the mining vicinity. The data for 2022 and 2023 suggests better control over SO<sub>2</sub> emissions, maintaining levels well below the standard, reflecting effective regulatory measures and cleaner fuel practices.

#### **Nitrogen Oxides**

Nitrogen Oxides (NO<sub>x</sub>) levels were close to the permissible limit of 40 µg/m<sup>3</sup> from 2018 to 2021, with occasional exceedances during winter. This is likely due to emissions from heavy machinery and vehicles used in the mining processes. The data for 2022 and 2023 shows a notable decrease in NO<sub>x</sub> concentrations, particularly in non-winter seasons, suggesting



improvements in emission control technologies and a move towards cleaner practices. However, winter peaks still require attention to bring the levels within safe limits consistently.



**Figure 6.3: Ambient Air Quality Trend**

### Overall Trends and Insights

**General Improvement:** A positive trend in air quality is evident from 2022 onwards, with noticeable reductions in PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>x</sub> levels across most seasons. This improvement indicates that pollution control measures in the mining area are becoming more effective.

**Seasonal Challenges:** Despite the overall decline in pollutant levels, winter remains the most challenging season for air quality, with concentrations of PM<sub>10</sub>, PM<sub>2.5</sub>, and NO<sub>x</sub> still exceeding the standards. These seasonal variations suggest the impact of temperature inversions and limited atmospheric dispersion, which can trap pollutants closer to the ground.

### Existing Fugitive Dust Parameters Trend

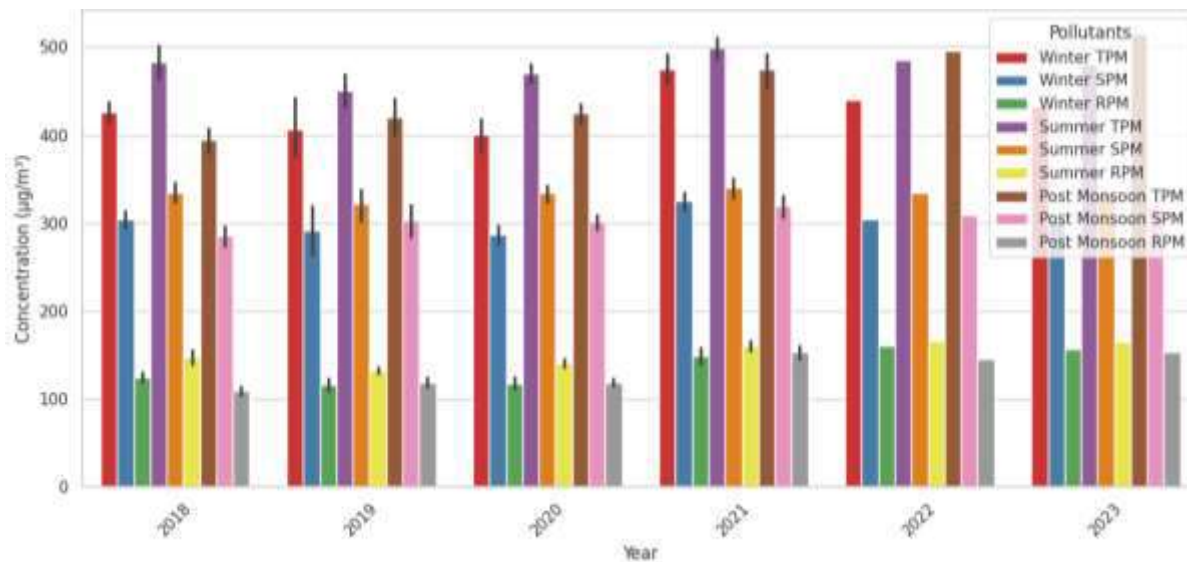
The graph depicts (Figure 6.4) pollutant concentrations for Total Particulate Matter (TPM), Suspended Particulate Matter (SPM), and Respirable Particulate Matter (RPM) across three seasons (Winter, Summer, and Post-Monsoon) from 2018 to 2023 in a mining area. These are the key observations:

- **Winter TPM & RPM:** Consistently high across all years, peaking at 450–500 µg/m<sup>3</sup>, indicating severe pollution levels during the colder months.

- **Summer TPM & RPM:** Similarly high levels, ranging from 400–480  $\mu\text{g}/\text{m}^3$ , likely exacerbated by dry, dusty conditions in mining areas.
- **Post-Monsoon TPM & RPM:** Slight reductions compared to winter and summer, but still significantly elevated at 350–400  $\mu\text{g}/\text{m}^3$ .
- **SPM Levels:** SPM remains high across all seasons, with values generally ranging between 200–400  $\mu\text{g}/\text{m}^3$ , indicative of heavy dust and particulate matter from mining activities.

Mining activities, such as blasting, excavation, transportation, and material handling, typically generate large amounts of dust and particulate matter. These activities can lead to:

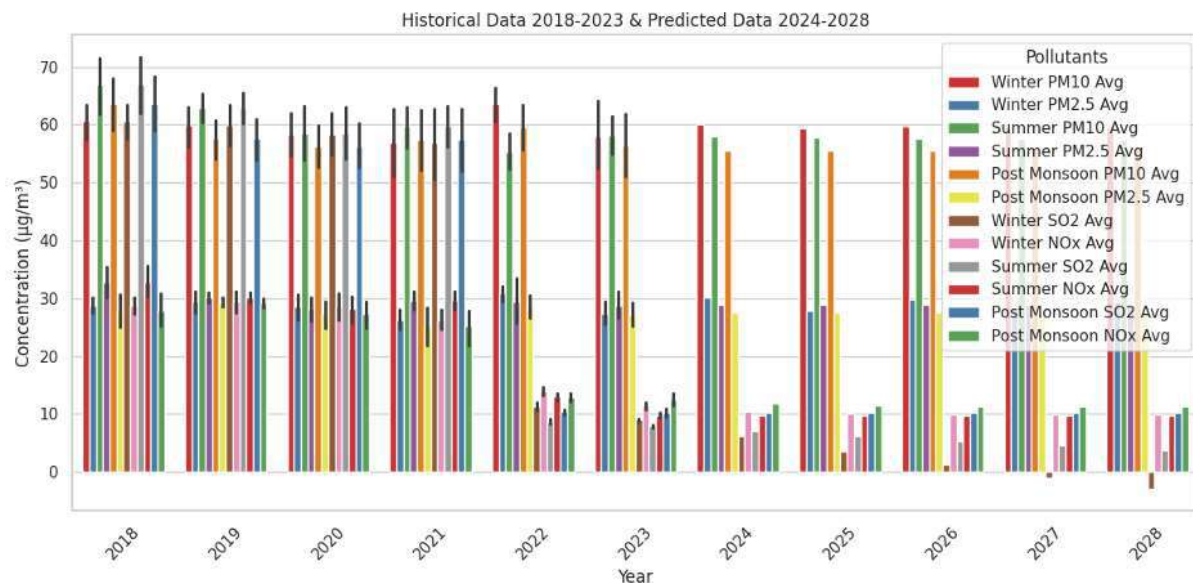
- High TPM and RPM levels, particularly during winter and summer when natural dust suppression (such as rainfall) is absent.
- The post-monsoon reduction in TPM/RPM may reflect temporary relief provided by rainfall, but the levels remain well above acceptable standards, indicating that dust generation from mining persists despite seasonal changes.



**Figure 6.4: Fugitive dust parameters trend (2018-2023)**

#### **Predication Of Ambient Air Quality (2024 – 2028)**

The prediction for air quality parameters from 2024 to 2028 based on ARIMA (Auto Regressive Integrated Moving Average) model is shown in Figure 6.5.



**Figure 6.5: Ambient air quality predicted (2024-2028)**

### **PM<sub>10</sub> and PM<sub>2.5</sub> Trend:**

#### **1. Winter (December-February)**

- *Impact of Mining:* During the winter months, PM<sub>10</sub> and PM<sub>2.5</sub> levels are predicted to peak. This can primarily be due to:
  - Mining operations generating large amounts of dust from activities like blasting, excavation, and transportation.
  - Temperature inversions in winter trap pollutants near the surface, leading to higher concentrations.
- *Predicted Trend:* PM<sub>10</sub> levels are expected to hover around or slightly exceed the annual limit of 60 µg/m<sup>3</sup>, with periodic exceedances of the 24-hour limit of 100 µg/m<sup>3</sup> in high-activity areas. PM<sub>2.5</sub> follows a similar pattern, often approaching the 40 µg/m<sup>3</sup> annual limit during winter.

#### **2. Summer (March-May)**

- *Impact of Mining:* Mining activities during the summer contribute to elevated levels of PM<sub>10</sub> and PM<sub>2.5</sub> due to:
  - Dry and windy conditions, which lead to the dispersion of dust and particulate matter from mining sites.
  - Increased mining operations to meet production demands, which intensifies dust generation.
- *Predicted Trend:* Both PM<sub>10</sub> and PM<sub>2.5</sub> are expected to show high concentrations during these months, often nearing the regulatory thresholds.

The PM<sub>10</sub> levels may exceed the 24-hour limit of 100 µg/m<sup>3</sup> in periods of intense mining activity, particularly if dust control measures are not adequately implemented.

### **3. Post-Monsoon (October-November)**

- *Impact of Mining:* After the monsoon season, PM<sub>10</sub> and PM<sub>2.5</sub> levels generally decrease as:
  - Rainfall helps to suppress dust, reducing the amount of particulate matter in the air.
  - Mining activities might slow down temporarily due to wet conditions.
- *Predicted Trend:* The post-monsoon period sees a significant drop in particulate matter concentrations. PM<sub>10</sub> and PM<sub>2.5</sub> levels during these months are expected to remain well below the annual standards, reflecting the natural reduction in dust due to rains and lower mining activity.

## **SO<sub>2</sub> Trend:**

### **1. Winter (December-February)**

- *Impact of Mining:* SO<sub>2</sub> levels may slightly increase during the winter, though the mining operations themselves are not typically a major source of SO<sub>2</sub>. However, combustion of fuel for mining vehicles and equipments can contribute to localized SO<sub>2</sub> emissions.
- *Predicted Trend:* While SO<sub>2</sub> levels are expected to remain well within the annual limit of 50 µg/m<sup>3</sup>, there may be small spikes during periods of heavy diesel use in winter.

### **2. Summer (March-May)**

- *Impact of Mining:* SO<sub>2</sub> levels could rise slightly in the summer months due to the higher demand for energy in mining operations, especially if coal or diesel is used as a fuel source.
- *Predicted Trend:* Even during peak mining activity, SO<sub>2</sub> is predicted to stay well below the standard, as emissions from fuel combustion in mining vehicles and machinery are relatively low compared to other industrial sectors.

### **3. Post-Monsoon (October-November)**

- *Impact of Mining:* During the post-monsoon period, SO<sub>2</sub> levels are expected to remain low as mining activities slow down and diesel consumption decreases.

- *Predicted Trend:* SO<sub>2</sub> levels during this period will likely be the lowest of the year, far below the annual threshold.

## **NO<sub>x</sub> Trend:**

### **1. Summer (March-May)**

- *Impact of Mining:* NO<sub>x</sub> levels are most likely to peak during the summer months due to:
  - Increased use of heavy-duty machinery and transportation vehicles, which emit NO<sub>x</sub> from diesel combustion.
  - High temperatures that can exacerbate NO<sub>x</sub> formation in the atmosphere.
- *Predicted Trend:* NO<sub>x</sub> concentrations may approach the annual limit of 40 µg/m<sup>3</sup> during these months, especially in areas where mining operations are at full capacity. Temporary exceedances of the 24-hour limit of 80 µg/m<sup>3</sup> could occur near active mining sites.

### **2. Winter (December-February)**

- *Impact of Mining:* NO<sub>x</sub> levels could rise slightly in winter due to increased use of diesel machinery. However, the cooler temperatures and lower atmospheric dispersion lead to more localized increases.
- *Predicted Trend:* NO<sub>x</sub> levels are predicted to remain below the standards but may show slight increases during the winter due to the combined effects of mining emissions and poor dispersion conditions.

### **3. Post-Monsoon (October-November)**

- *Impact of Mining:* The post-monsoon period tends to see reduced NO<sub>x</sub> levels due to decreased mining activity and better atmospheric conditions.
- *Predicted Trend:* NO<sub>x</sub> concentrations will likely stabilize or decrease during this time, staying well within the regulatory limits.

## **Key Periods and Trends with Respect to Mining**

- **Winter (December-February):** Mining activity leads to higher concentrations of PM<sub>10</sub> and PM<sub>2.5</sub>, exacerbated by cold weather conditions and poor dispersion of dust. Although SO<sub>2</sub> and NO<sub>x</sub> levels are not as significantly affected, diesel fuel combustion during this period can cause localized spikes.

- **Summer (March-May):** Mining dust, combined with dry conditions, results in high PM<sub>10</sub> and PM<sub>2.5</sub> levels, potentially breaching 24-hour standards. NO<sub>x</sub> levels are also likely to be high due to increased machinery usage during peak mining operations.
- **Post-Monsoon (October-November):** Air quality tends to improve during this period due to the natural dust suppression from rainfall. Mining activity typically slows down, resulting in lower levels of all pollutants, including PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>x</sub>.

**Table 6.3: Summary of Predicted Ambient Air Quality**

Year	Winter PM <sub>10</sub> Avg (µg/m <sup>3</sup> )	Summer PM <sub>10</sub> Avg (µg/m <sup>3</sup> )	Post Monsoon PM <sub>10</sub> Avg (µg/m <sup>3</sup> )	Winter PM <sub>2.5</sub> Avg (µg/m <sup>3</sup> )	Summer PM <sub>2.5</sub> Avg (µg/m <sup>3</sup> )	Post Monsoon PM <sub>2.5</sub> Avg (µg/m <sup>3</sup> )	Winter SO <sub>2</sub> Avg (µg/m <sup>3</sup> )	Summer SO <sub>2</sub> Avg (µg/m <sup>3</sup> )	Post Monsoon SO <sub>2</sub> Avg (µg/m <sup>3</sup> )	Winter NO <sub>x</sub> Avg (µg/m <sup>3</sup> )	Summer NO <sub>x</sub> Avg (µg/m <sup>3</sup> )	Post Monsoon NO <sub>x</sub> Avg (µg/m <sup>3</sup> )
2024	65	63	40	40	38	20	30	28	15	38	40	20
2025	64	62	38	38	37	19	29	27	14	37	39	19
2026	63	61	35	37	36	18	28	26	13	36	38	18
2027	62	60	34	36	35	17	27	25	12	35	37	17
2028	60	58	32	35	33	16	26	24	11	34	36	16

Model predictions show that PM<sub>10</sub> and PM<sub>2.5</sub> levels will remain high during the winter and summer seasons, likely exceeding air quality standards in some periods. SO<sub>2</sub> and NO<sub>x</sub> levels are expected to remain within limits, but temporary exceedances may occur during peak mining periods, especially in summer. To ensure air quality standards are met, dust suppression measures, better fuel management, and emission controls will be critical, especially during periods of high mining activity.

### **Prediction Of Fugitive Dust (2024-2028)**

#### **1. ARIMA Predictions for TPM (2024–2028)**

- The ARIMA model predicts consistent increases in TPM levels, with notable spikes in 2024 and 2026, where values approach or exceed 450 µg/m<sup>3</sup> in the winter season.
- Summer TPM values remain high, around 400 µg/m<sup>3</sup>, which is in line with the continued mining operations and seasonal dry winds.
- The post-monsoon season TPM values show slight drops but still hover around 300–350 µg/m<sup>3</sup>, indicating that while precipitation might temporarily reduce dust, the underlying mining activities keep emissions significant.

The model captures the annual cycle and projects an increasing trend in TPM emissions, primarily driven by the underlying seasonal patterns and mining activities. It indicates that



unless emissions control measures are enhanced, TPM concentrations will continue to rise, particularly in peak mining seasons.

## **2. ARIMA Predictions for SPM (2024–2028)**

- The model predicts an overall increase in SPM levels, especially in winter and summer. Predicted winter SPM for 2026 reaches nearly 500 µg/m<sup>3</sup>.
- Summer SPM levels follow a similar trend, with levels exceeding 400 µg/m<sup>3</sup> in some years, especially in 2024 and 2027.
- Post-monsoon SPM shows a more moderate rise but remains above 250 µg/m<sup>3</sup>.

The ARIMA model captures an upward trend in SPM emissions, reflecting continuous mining activity and limited natural factors (such as rain) to mitigate the dust levels. The predictions show a concerning increase in SPM levels, particularly during the winter and summer seasons, which could lead to deteriorating air quality.

## **3. ARIMA Predictions for RPM (2024–2028)**

- The ARIMA model predicts RPM values to peak during the summer season, with values exceeding 300 µg/m<sup>3</sup> in 2025 and 2026.
- Winter RPM levels are slightly lower but still problematic, with values predicted to be around 250–300 µg/m<sup>3</sup> for the forecast period.
- Post-monsoon RPM values are expected to be lower, around 150–200 µg/m<sup>3</sup>, but this still exceeds safe limits for air quality.

The model highlights that RPM, despite being smaller in concentration than TPM or SPM, follows a similar upward trajectory. The predicted levels remain high enough to warrant concern for public health, particularly in terms of respiratory ailments for populations near the mining area.

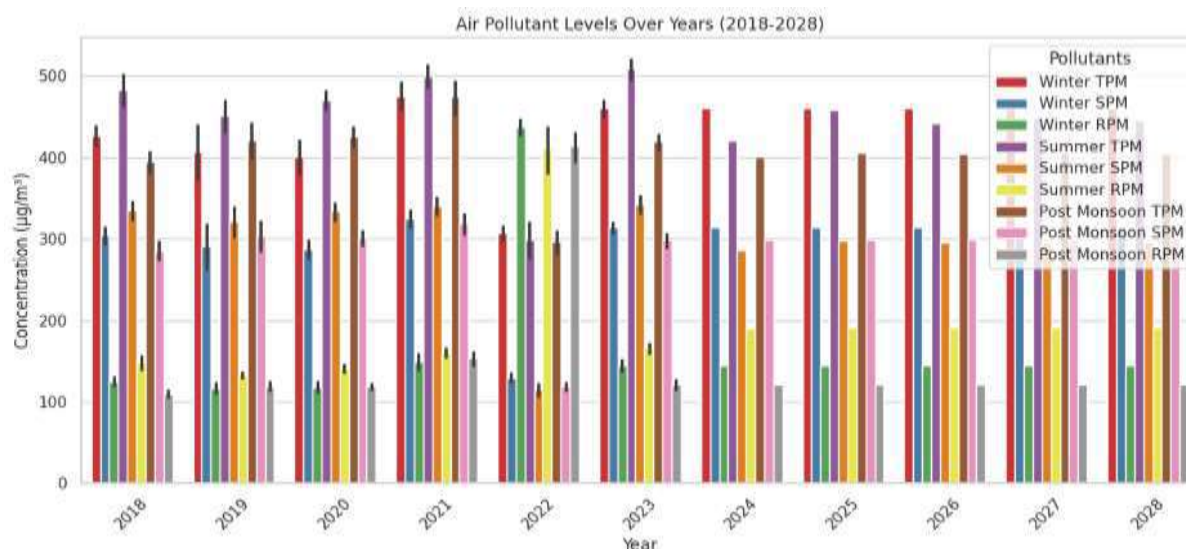
**Table 6.4: Summary Predicated Fugitive Dust Parameters**

<b>Year</b>	<b>Season</b>	<b>TPM (µg/m<sup>3</sup>)</b>	<b>SPM (µg/m<sup>3</sup>)</b>	<b>RPM (µg/m<sup>3</sup>)</b>
<b>2024</b>	Winter	450	480	280
<b>2024</b>	Summer	420	440	320
<b>2024</b>	Post-Monsoon	350	280	180
<b>2025</b>	Winter	460	470	290
<b>2025</b>	Summer	430	450	310
<b>2025</b>	Post-Monsoon	340	270	170
<b>2026</b>	Winter	470	490	300
<b>2026</b>	Summer	440	460	330
<b>2026</b>	Post-Monsoon	360	290	200
<b>2027</b>	Winter	440	460	270
<b>2027</b>	Summer	430	440	310
<b>2027</b>	Post-Monsoon	340	260	160

2028	Winter	420	450	250
2028	Summer	410	430	300
2028	Post-Monsoon	330	250	150

## Key Insights and Trend Interpretation

1. **Upward Trend in Pollutants:** The ARIMA model predicts a gradual but consistent increase in all pollutants (TPM, SPM, RPM) from 2024 to 2028. This trend aligns with continued mining activities in the region, which remain the primary driver of fugitive dust emissions.
2. **Seasonal Peaks:** Both **winter** and **summer** seasons are expected to see the highest pollutant concentrations, with **winter TPM and SPM** reaching critical levels. The dry and cold air in winter, coupled with mining, prevents proper dispersion of particulate matter, leading to high pollutant concentrations.
3. **Post-Monsoon Relief (Temporary):** While the post-monsoon period shows a reduction in pollutant levels, particularly in RPM, the overall concentration remains higher than acceptable air quality standards, suggesting that the relief provided by rains is temporary and not adequate to mitigate the mining impacts.



**Figure 6.6: Fugitive Dust Parameter Prediction (2024-2028)**

The ARIMA model predictions are based on data collected from monitoring stations within the core mining zone, specifically from operational areas such as working benches and haul roads of the adjacent mines of Deposit-5 and Deposit-10. The model effectively forecasts air quality trends for Deposit-4 core mining zone. Additionally, the EIA-EMP report of the Deposit-4 has employed Air Quality Dispersion Modeling System (AERMOD) to assess air

pollution concentration and deposition in the ML area. While AERMOD forecasts ground level impact, ARIMA model has been utilized in the present study primarily for trend forecasting of pollutants. It is inferred from the results of the predicted ARIMA model that there can be a gradual and consistent increase in major pollutants from 2024 to 2028 with winter seasonal peaks. The effect of these air pollutants on tree fern physiology and its habitat per se need to be ascertained through a further detailed study once the mining operations commence and progress in the block. Further, as per the approved mining plan, on the eastern slope of the western ridge (Deposit-4), several infrastructure facilities such as mineral stack, crushing plant, down hill conveyor and mine road are proposed. Such activities will also contribute to air and noise pollution. Air pollution stemming from such activities will adversely impact Tree fern habitat until suitable mitigation measures are inbuilt in the mining plan. All activities have been proposed to be under closed enclosure. Additionally, special care wrt. air pollution abatement during construction phase is henceforth required.

## **6.6 IMPACT OF MINING ON BIODIVERSITY & ASSOCIATED SPECIES OF TREE FERN**

Opencast mining may inflict considerable damage on the ecology of the hillocks as there is a considerable risk of erosion from open-pit mine waste (OB dumps) contaminating surface water courses during the monsoon, dust pollution on native vegetation, noise pollution, vibration impact on human and animal life from blasting and moving HEMM vehicles, etc. Once mining operations commence in the area approved as per the Lease deed and Mining Plan, it is more likely that the existing habitat may fragment resulting in the displacement of native biota. During the field visit, it has been ascertained that the primary floral community inhabiting the *Galli Nalla* is ***Carallia - Calamus - Cyathea- Licuala- Gnetum* community**. *Carallia brachiata* is a typical mangrove species for which water level in the *nalla* and muddy soil as existing in the study area are crucial determinants for its continued survival. **The primary Tree fern species recorded during the present study namely *Cyathea gigantea* and *Cyathea spinulosa* inhabiting the *Galli Nalla* are not enlisted under the Red List of Plant Species published by Botanical Survey of India (BSI). Moreover, these species are also not currently enlisted in the IUCN Red List. However, both the species finds their mention in CITES Appendix II. The *Gnetum* species (Family: Gnetaceae) is believed to be the ‘living link’ between gymnosperms and angiosperms. The presence of such unique and lesser explored flora in limited population along *Galli Nalla* signifies the diverse yet isolated floral richness in and around *Galli Nalla*.**

***Mining operations on the eastern slope of the western ridge (Deposit-4) are bound to adversely impact the existing plant communities due to their likelihood of interference with surface and subsurface water regime, induced edaphic stress with respect to mine progression, dumping and concomitant leaching and siltation in Galli Nalla coupled with decline in Net Photosynthetic Rate (NPR) envisaged due to air pollution.***

Additionally, the study area also hosts a multitude of faunal species including mammals, amphibians, reptiles, crustaceans, arachnids and avian-fauna, as evident from EIA/EMP and other secondary source publications. Presence of IUCN protected mammals reported from the study area such as Indian Pangolin (*Manis crassicaudata*) also needs appropriate protection measures that are essential for maintaining their breeding grounds and for sustaining its ecological niche along the *Galli Nalla*.

## **6.7 IMPACT OF MINING ON WATER REGIME**

The BIOM Bachel Complex in Bailadila range falls under the catchments of four river systems viz., *Berudi*, *Sankini*, *Malenger* and *Taliperu* that form part of the Godavari River sub-basin mainly through Indravati River, which is one of its major tributaries. The proposed Deposit-4 Iron ore mine is drained by natural water courses that criss-cross the hill ridges towards both west and south by *Tumaka Nalla* to *Berudi* and *Galli Nalla* to *Taliperu* river respectively, while a relatively smaller area is drained by water courses that form part of *Sankini* river towards north. The only prominent perennial stream falls within the mining lease is *Galli Nalla* of the *Taliperu* river system running from north to south almost all along the entire length of the mining lease and fed by streams from both east and west side slopes of the two hillocks. The drainage pattern of the area is dendritic to sub-dendritic in nature. The supplementary studies conducted on baseline environment by various agencies have clarified the nature of environmental setting of the proposed Deposit-4 mining area. Soil erosion map 2.4 of the *Soil, water and moisture conservation plan report Part-B prepared by We the Foresters Welfare Society Chhattisgarh and provided to ICFRE by the proponent* indicates that the catchment areas of both the *Galli Nalla* as well as *Tumaka Nalla* are characterized by areas vulnerable for sheet erosion, while the soil erosion ranking map indicates that the *Galli Nalla* area is ranked 3 representing 'high' soil erosion. According to the slope map 2.10 of the same report, the predominant slope class in the area is moderate steep to steep (15-35%) followed by steep slope (35-50%), strongly slope (10-15%) and moderately slope (5-10%) in the decreasing order. Forest cover map 2.11 indicates that the

area is covered predominantly by moderate dense forest followed by open forest. Soil texture map 2.13 clarifies that the area is predominantly occupied by clay loam soil.

Both float ore mining and reef ore mining on hill slope and hill top respectively are envisaged in the lease area. Within the lease area, mining is proposed to be carried out on the western ridge of Bailadila hill, while on the western slope of eastern ridge, only infrastructure like magazine and its buffer zone and security barracks are proposed. The proposed float ore mining area of 70.52 ha is falling on both the western and eastern slope of the western ridge. Concurrent backfilling followed by technical reclamation is proposed for the float ore mining area. As the area is an undulating hilly terrain having dominance of moderately dense forest vegetation, moderate steep to steep (15-35%) slope and clay loam soil potentially vulnerable for sheet erosion, significant impacts are envisaged in the land use land cover pattern on account of float ore mining. *Disturbances leading to uncover the forest vegetation patch most likely may cause significant soil erosion and consequent runoff laden with silt and sediments, which may pose serious impairment not only in morpho-dynamics of water courses by sediment loading, but also quality of water by suspended particulate matter.* The potential loss of forest vegetation and surface water courses is envisaged due to float ore mining and associated activities on the eastern slope of the mining hillock leading to *Galli Nalla*. This may endanger the buffer zone vegetation of the perennial stream of *Galli Nalla* and thereby the aquatic habitat.

In the reef ore mining area of 94.11 ha, the mining is proposed to be carried out by a system of benches. The bench height will be maintained at 12 m and its minimum operating width will be 30 m. The top benches are proposed to be formed at 1200 mRL and bottom benches are at 996 mRL. It is reported that the mining in the deposit does not intersect the ground water table as the ore body is located much above that. **Open cast mining employing HEMM is envisaged in the lease area. As the ore body trends NNE-SSW with steep easterly slope and forms a gentle slope towards west, much impact is not discernible due to open cast working towards east side of hillock where the *Galli Nalla* is flowing. Spillage of soil due to mine working/movement of earth moving machinery is proposed to be bare minimum towards east side. Such cases, if it exceeds, lead to incessant sediment deposition in the *Galli Nalla*, which ultimately put the aquatic habitat in risk of degradation.**

## **6.8 IMPACT OF PROPOSED INFRASTRUCTURE FACILITIES ON TREE FERN HABITAT**

The infrastructure over a total area of 65.90 ha within mining lease includes crushing plant, Pro Service Centre (PSC), part of downhill conveyor, security barracks, etc., and are planned on either side of the hill slope leading to *Galli Nalla*. Haulage roads to approach Crushing Plant, Screening Plant, Loading Plant, conveyor and transfer houses, etc., are proposed to utilize an estimated area of 28 ha. In most of the areas, existing ‘kaccha’ road of 4 m width is planned to be widened & strengthened to facilitate two-way traffic.

*The proposed infrastructure establishment such as crushing plant, PSC, downhill conveyor, etc., on the eastern slope of the western ridge bordering the earmarked conservation area around Galli Nalla bound to increase the chances of forest degradation of the proposed conservation area, altering the drainage network and prevailing flow regime, air borne emission of suspended matter leading to dust deposition on vegetation canopy, water contamination, etc.* Owing to being in close proximity to the earmarked conservation area around the *Galli Nalla*, the infrastructure establishment may pose significant impacts to the perennial water course and associated habitat. On the other hand the magazine and its safety zone as well as security barrack planned to be established on the western slope of eastern ridge may also impact the *Galli Nalla* conservation area as the area is located downstream to the active dumping area of adjacent Deposit-10 mine and the seasonal surface water courses emanating from the mining/dumping area are observed to have been impacted due to silt and sedimentation.



## **CHAPTER - 7**

### **MITIGATION MEASURES TO MINIMISE IMPACT OF PROPOSED MINING & ALLIED ACTIVITIES**

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**7.0** Based on the statutory reports viz., EIA-EMP & Approved Mining Plan, the area proposed to be degraded on account of mining and allied activities within the lease is 319.97 ha, which is 49.49% of the total area (646.596 ha) allotted for mining to the lessee. Measures to be implemented to minimize the impacts of mining and for the overall environmental protection of the area are detailed in the reports. Ancillary studies pertaining to environment and biodiversity conservation of the proposed mining area of Deposit-4 conducted by various agencies have identified many potential problems associated with implementation of Deposit-4 mining lease and have suggested comprehensive recommendations for the control of environmental damages and improvement of mining environment with budgetary provisions. To mitigate the environmental impacts, it is crucial to prioritize the preservation and restoration of biodiversity in the surrounding areas. Efforts should focus on rehabilitating the mined-out areas through reclamation by employing various physical and engineering means as well as re-vegetation by planting with mixed native vegetation communities. Implementing effective environmental management practices, such as sediment control measures, water and moisture conservation strategies can help mitigate the adverse impacts on the ecosystem by augmenting the native biodiversity and therefore restore the ecological balance.

Ecological restoration provides an effective solution for sustainable management of resources and essentially includes the management of all types of physical, chemical and biological disturbances of soils such as soil pH, fertility, microbial community and different soil nutrient cycles that transforms the degraded land into a productive state. The scope of ecological restoration includes activities such as erosion control of surface soil, appropriate surface water management, afforestation/reforestation by planting with local/native three tier vegetation species as well as habitat and range improvement for targeted vegetation species. Hence, restoration and reclamation measures should be carried out concurrently with waste excavation and dumping so as to achieve effective stabilization of degraded land masses and success of re-vegetation process.

#### **7.1 MINING**

- In the North Block, when lowest benches will be going down the level of the *Galli Nalla*, there is apprehension about interference of sub-surface water regime to affect water flow towards *Galli Nalla*. However, during the rainy season, Bottom benches of the North Pit

will be acting as the sump for water storage and may help in enriching the sub-surface water regime of the hill. It is important to note here that on the northern part *Galli Nalla* is not perennial. As, northern mine pit is proposed to be backfilled and lowest bench will be at a distance of more than 332m and thus the envisaged mine pit development may not be any adverse effect on water regime as well as Tree fern habitat.

- In the south block, during the later years of the Mine, ultimate pit bottom will be going down below the *Galli Nalla* level between cross sections S1 and S8. Lowest bench of the South Block Pit will be at a distance of more than 251m, moreover, mine pit of south block is proposed to be converted in to water reservoir and therefore under the circumstances there should not be any adverse effect on water regime as well as Tree fern habitat.
- The proposed float ore mining on the eastern slope of the western ridge (Deposit-4) will alter the original surface and expose soft/ unconsolidated strata, which is more susceptible to erosion and wash offs. The eroded material may likely be accumulating on the *Galli Nalla* bed. Over a period of time, the accumulated erode material may obstruct free flow of water in *Galli Nalla* and henceforth the growth and sustenance of Tree Fern.

### **7.1.1 PREVENTIVE MEASURES**

1. Initial mining operations may be restricted to atleast 5 m above the *Galli Nalla* bed across the Strike of the Deposit in the North Block. On reaching the Bench levels in the North Pit to the corresponding levels of the *Galli Nalla*, impact of mining operations on *Galli Nalla* may be monitored periodically on various environmental parameters, particularly for seepage of water. Based on the results, further deepening of the mining activity may be planned.
2. No float ore mining shall be undertaken on the eastern slope of the western ridge of Deposit-4 / western slope of *Galli Nalla*.
3. Proposal has been made in the approved mining plan to develop north pit upto ultimate pit bottom, subsequently the northern pit will be backfilled with mine waste generated from the south pit and south pit will be converted into water reservoir. On successful implementation of the envisaged proposal may not harm Tree fern habitat. However, in the process of developing mine pit, if pit bottom reaches lower level to *Galli Nalla* bed, subsurface water movement and rock character in between UPL and *Galli Nalla* in

respect of permeability may be monitored and accordingly suitable preventive measures should be taken if required.

4. Proposal has been made to dump mine waste for first year on the eastern slope of Deposit 4 as Dump No. 1. The proposal has to be modified and no mine waste should be dumped on the eastern slope of the western ridge (Deposit-4) as washoffs from dumps siltation at *Galli Nalla* may adversely affect Tree Fern habitat.
5. Blasting for mining activities may not be undertaken within 100 m horizontal distance from *Galli Nalla*. Maximum explosive weight to be detonated in a delay and total explosive charge to be fired in a blasting round applicable for the safety of nearby domestic houses/structures arrived by vibration study conducted by CSIR for Deposit-5 & 10 (100 m distance to keep Threshold vibration limit- 5 mm/s) [kg] should be followed for blasting on the eastern slope of Deposit-4. (Refer para 6.4).
6. Crushing plant, downhill conveyor, Pro Service Centre (PSC), Haulage roads to approach Crushing Plant, conveyor and transfer houses, etc., are proposed on the eastern hill slope of Deposit-4. Considering larger interest of environmental protection and shortest logistic approach to mine there is no alternate place for such infrastructures. Therefore, these infrastructures may be made with appropriate environmental protection measures such as closed conveyors, covered crushing unit from all sides and any other protection measures required for conservation of Tree fern habitat around *Galli Nalla*.
7. No alteration of topography on either slope of *Galli Nalla* should be attempted, which may affect ground water seepage and siltation of the *Galli Nalla*.

## **7.2 DUMP AND SURFACE WATER MANAGEMENT**

The water courses/water bodies that receive runoff from the disturbed waste dumps and mine pits can get contaminated with silt and sediments, which affect the water quality and normal aquatic life leading to degradation of aquatic habitat and colonization of invasive alien species. The presence of heavy siltation/sedimentation with Iron ore tailings that caused severe degradation of water quality in and around the mining lease especially the *Kadampal* Tailing Dam, *Panchamurthy Nalla*, etc., has already been reported from the mining zone in Bailadila hill range. The discharge of sediments and contaminants into water bodies can result in adverse effects on aquatic organisms, including fish, invertebrates, and aquatic plants. Sedimentation can suffocate benthic habitats, reduce water clarity, and hinder the penetration of light, affecting photosynthesis and the overall productivity of aquatic

ecosystems. Contaminants from mining activities, such as heavy metals, may accumulate in the aquatic food chain, leading to toxic effects on various organisms. To mitigate the impacts on aquatic life, it is crucial to implement appropriate sediment control measures, such as sedimentation ponds or basins, to capture and settle the suspended solids before the water enters nearby water bodies as well as silt arresting structures along the water courses.

Implementing best management practices for mining operations, such as proper waste management, effective erosion control, and regular monitoring of water quality parameters, is essential to minimize the release of silt and sediment into water bodies. Furthermore, restoration and rehabilitation efforts should be undertaken to improve the condition of water bodies affected by siltation and contamination. These efforts may involve sediment removal, water body dredging, and the implementation of measures to enhance water quality, such as vegetative buffer strips and wetland creation.

In addition to the measures proposed under section 7.1.1, recommendations for effective implementation of the environmental protection measures for proposed land use changes on account of mining in Bailadila Deposit-4 are given as under:

1. The water courses in and around the proposed mine area particularly towards east leading to *Galli Nalla* are likely to be heavily impacted by the proposed mining activities in Deposit-4 mining lease. Hence, suitable action plans for checking the movement of silt loaded water to the *Galli Nalla* prepared and adopted along with robust monitoring strategies to protect the natural water courses prevailing within the vicinity of the mine.
2. The likely environmental changes in *Galli Nalla* water due to the proposed mining in Deposit-4 mining lease may be periodically monitored for implementing appropriate measures for revamping their physical and biological environment.
3. The possible erosion from proposed OB waste dumps on west side leading to *Tumaka Nalla* and that from float ore mining, waste dump and infrastructure leading to *Galli Nalla* on east side, and consequent water quality impairment may be controlled by providing retaining wall and garland drain for the waste dumps, etc. and suitable grade stabilization as well as erosion control structures for the seasonal water courses, etc., depending on the prevailing conditions. The vulnerable dump slope may be protected by providing suitable gully control measures such as long wood check dam, brush

wood check dam, loose boulder check dam, etc., as well as geo-textile/coir-mat followed by stabilization with vegetation for steep slope areas.

4. Gap plantation may be carried out in the safety zone area with mixed native tree species to increase thick vegetation cover so as to protect the location from further erosion.
5. Regular monitoring and assessment of the water quality, aquatic ecosystems, and biodiversity in *Galli Nalla* and its surrounding area are crucial to evaluate the effectiveness of mitigation measures and ensure the long-term sustainability of aquatic habitats.

### **7.3 BIODIVERSITY**

*Galli Nalla* is characterized by its unique hydrology, hydric soil and hydrophytes that cumulatively sustain the population of Tree ferns and the associated flora. The life cycle of Tree fern and giant ferns are exclusively dependent on constant soil moisture and water availability. Mining and its allied operations, and their impacts on the water regime, soil contamination, and elevated ambient temperatures are bound to weigh down heavily upon the growth, life cycle and regeneration of Tree fern and its associated species. Strong exposure to light or prolonged exposure to darkness will inhibit the growth of sporophyte and gametophyte, eventually impacting the regeneration of the fern species.

Henceforth, in addition to the measures suggested under sections 7.1 and 7.2, the following mitigation measures are also suggested to ensure the survival and continued sustenance of biodiversity in *Galli Nalla* ecosystem.

1. **In-situ conservation of Tree fern habitat** by demarcating the area formed by the derived safe distance as per Table 8.1 of Chapter-8 of this report exclusively for habitat/wetland conservation.
2. **Ex-situ conservation of Tree fern species** through raising nursery in any appropriate area where soil is well drained, porous and light to medium in texture with near neutral pH. Tree ferns do not bear seeds and they can only be propagated either through spores, stolons, division or through *in-vitro* method.
3. Along with Tree ferns in the *Galli Nalla* habitat, the **conservation of associated species assemblage/ plant community** viz. *Carallia - Calamus - Cyathea - Licuala - Gnetum* should also be carried out as survival of the primary species are dependent on the latter.

4. The mine authority should also implement duly approved **Wildlife Conservation Plan** together with the aid and advice of the State Forest Department, Chhattisgarh.
5. It is pertinent to mention that the impacts specified in the Chapter 6 have been predicted based on the approved reports and plans, and observations during field visits towards proposed mining activities and their implications on the ‘Tree fern habitat’. However, once mining operations commence in the Deposit-4 Iron ore block, they may either amplify or mollify the forecasted impacts on the susceptible *Galli Nalla* ecosystem. Therefore, the mine authority is required to undertake detailed “**Impact Assessment Study of Mine Progression on Galli Nalla Ecosystem**” by any reputed third-party organization during the plan period, from the start of operations

## **CHAPTER - 8**

### **ARRIVING SAFE DISTANCE BETWEEN TREE FERN HABITAT AND MINE WORKINGS**

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Based on the detailed geological, hydrological and ecological assessment of the study area and the impacts envisaged based on the proposed mining activities under the Bailadila Deposit-4 Iron ore mines, it is suggested that eastern slope of the western ridge should be utilized as minimum as possible and areas near to *Galli Nalla* should be maintained as no disturbance zone for any mining or infrastructural activities as the aforesaid slope is the primary determinant to ensure continued sustenance of the fragile *Galli Nalla* ecosystem/ Tree fern habitat.

Mining of minerals are essential activities for supplying raw materials to industries to support the socio-economic progress of the country however, minerals are many times associated with sensitive natural environment. In order to ensure sustainable mining activities for larger interest of economic development with minimum environmental degradation, suitable environmental protection measures have to be adopted. Strict adherence to implementation of environmental protection measures suggested under para 7.1, 7.2 and 7.3 of Chapter 7 need to be followed.

For determination of safe distance for mining operations from the tree fern habitat, following established scientific approach and methodologies focusing on tree fern species vulnerability, ecological, phenological and dispersal aspects, and other anthropogenic factors, have been considered as follows:

#### **8.1 CRITICAL DETERMINANTS**

##### **a. Edge Effect**

Edge effects refer to the changes in plant species population or community structures that occur at the boundary of two habitats. These effects can lead to increased vulnerability of species due to factors like increased light, wind, temperature fluctuations, and susceptibility to invasive species.

The **Depth of Edge Influence (DEI)** is a measure used to determine how far edge effects penetrate into the habitat. Most edge effects have been documented to occur between **100 – 300 m** from the edge of the habitat of interest (Oliveira *et al.*, 2004; Ewers and Didham, 2006; Nascimento and Laurance, 2004). The spatial scale in which edge effects occurs vary with respect to the combination of ecological, plant phenological and other anthropogenic



factors which are at play, but with most changes happening up to **200 m** distance range (Broadbent *et al.*, 2008, Laurence *et al.*, 2002).

Tree ferns are primarily located along either sides of *Galli Nalla* with lithophytic habitat, however the associate plant community (*Carallia* - *Calamus* – *Licuala* - *Gnetum* community) crucial for survival of tree ferns inhabit sporadically along the *Galli Nalla*

- Using the model

$$DEI=k \times H$$

Where: k = coefficient representing the set of ecological factors

H = average height of the trees of interest (Tree ferns and associates)

- Average height (H) = 15 meters
- Coefficient (k) = 10 (based on studies that show edge effects penetrate up to 10 times the canopy height)
- Thus:  $DEI=15 \times 10=150$  meters

***Therefore, a minimum of 150 meters on either side of the Galli Nalla is required to mitigate edge effects.***

*It is pertinent to mention here that the lessee has already demarcated an area of 76.496 hectares for tree fern habitat conservation and average width of the conservation strip is 277 meters (Figure 8.1) which is inclusive of the average width of Galli Nalla (10 metres) flowing through the centre of the proposed conservation area.*

The average distance currently maintained from *Galli Nalla* on its either sides in the demarcated conservation area works out to be  $(277 - 10)/2 = 134$  meters which is suboptimal to the required minimum distance of 150 meters on either side of the *Galli Nalla* to mitigate adverse effects.



**Figure 8.1: Demarcated area of 76.496 hectares for tree fern habitat conservation**

## **b. Species Dispersal**

Dispersal distance is the range over which the Tree Ferns can spread its spores, ensuring genetic diversity and population stability.

### **Spore Dispersal Distance (SDD):**

According to the ballistic model of fern spore release, ‘Terminal velocity’ is used to predict the distance at which the spore will be deposited on the ground. However, there are additional variables that may influence the dispersal of a particle such as topography, type of vegetation, foliage of associate plants, canopy opening etc.

$$\text{Spore Dispersal Distance } D = \frac{h \times w}{V_t}$$

Where,

D = Distance of dispersal of tree fern spores

h = Height of release of tree fern spores in meters

w = Prevailing wind speed in m/sec.

V<sub>t</sub> = Terminal velocity in m/sec.

$$\begin{aligned} D &= \frac{3.0 \times 3.0}{0.047} \\ &= \mathbf{191 \text{ meters}} \end{aligned}$$

Prevailing wind speed ( $v$ ) = 3.0 m/s (As per EIA/EMP). Terminal velocity of fern spores of *Cyathea* sp. is reported to be  $4.7 \pm 0.95$  cm/sec which corresponds to 0.047 m/sec (Gómez-Noguez *et al.*, 2022). Average height of release of spores considered is 3.0 meters.

As per EIA study report the first predominant wind direction is from South-West to North-East and second predominant wind direction is from North-West to South-East therefore, winds blow towards the eastern bank of the *Galli Nalla* only. Hence, Tree fern colonization as per the derived spore dispersal distance stands valid only towards the eastern bank of the *Galli Nalla*.

The distance currently maintained from *Galli Nalla* on its either side in the demarcated conservation strip i.e. 134 meters is apparently inadequate with respect to the *required minimum distance of 191 meters on the eastern side of the Galli Nalla to facilitate effective colonization and genetic exchange. Even if an additional safe distance of 57 meters (191 m - 134 m) is maintained from the eastern boundary of the Tree fern habitat (already demarcated 76.496 ha) to the western slope of the eastern ridge (Deposit-10), propensivity of spore germination and survival would be greater in the habitat around Galli Nalla having lithophytic marsh wetland characteristics. But considering habitat advantage and spore dispersal influence, a minimum safe distance of 191 meters is recommended to be maintained from eastern side of Galli Nalla to the western slope of the eastern ridge (Deposit-10).*

### **c. Blasting induced Ground vibrations:**

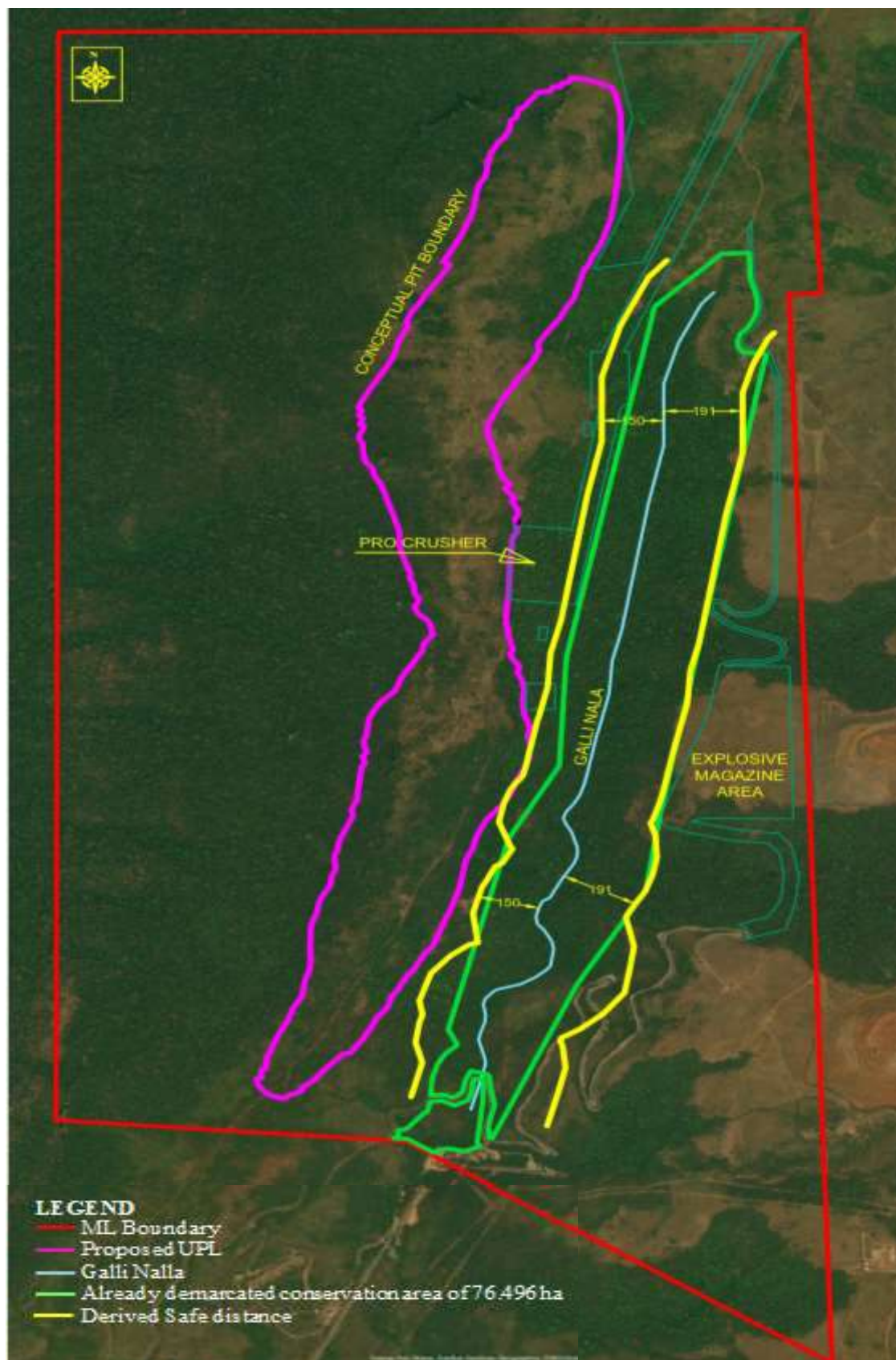
Ground vibration studies under taken in Deposit-5 & 10 by CSIR recommended that 100 m safe distance should be kept from domestic houses and structures to ensure threshold vibration limit at 5 mm/s (kg). *The same safe distance of 100 meters may be applied in case of blasting distance from Galli Nalla* (refer para 6.4).

## **8.2 DETERMINATION OF SAFE DISTANCE**

By integrating all the four factors, *the minimum safe distances required to be maintained from the Galli Nalla respectively towards the eastern slope of western ridge (Deposit-4) and towards the western slope of the eastern ridge (Deposit-10) have been worked out as under.*

**Table 8.1: Determination of safe distance from bank of *Galli Nalla* towards its west and east**

Sl. No.	Critical Determinants	Safe Distance from bank of <i>Galli Nalla</i> towards its west i.e. to the eastern slope of western ridge (Deposit-4)		Safe Distance from bank of <i>Galli Nalla</i> towards its east i.e. to the western slope of eastern ridge (Deposit-10)		RESULT & INFERENCE
		Worked out Safe Distance required to be maintained from the bank of <i>Galli Nalla</i> to the eastern slope of western ridge (Deposit-4)	Average distance currently maintained from bank of <i>Galli Nalla</i> to the eastern slope of western ridge (Deposit-4) in the demarcated conservation area of 76.496 Hectares	Worked out Safe Distance required to be maintained from the bank of <i>Galli Nalla</i> to the western slope of the eastern ridge (Deposit -10)	Average distance currently maintained from bank of <i>Galli Nalla</i> to the western slope of the eastern ridge (Deposit -10) in the demarcated conservation area of 76.496 Hectares	
1.	Depth of Edge Influence	150 meters	134 meters	150 meters	134 meters	Considering all factors in toto, a safe distance of <b>150 meters</b> is recommended to be maintained from bank of <i>Galli Nalla</i> towards the eastern slope of western ridge (Deposit-4) and <b>191 meters</b> is recommended to be maintained from bank of <i>Galli Nalla</i> towards the western slope of the eastern ridge (Deposit -10). The recommended distances are inclusive of the distance (134 m on both sides) currently maintained by the proponent in the demarcated conservation area of 76.496 hectares.
2.	Spore Dispersal Distance	Considering prevailing wind direction, spore dispersal will not be possible towards west		191 meters		
3.	Blasting induced Ground vibrations	100 meters		100 meters		
Safe Distance Determining Factor		Depth of Edge Influence = 150 meters		Spore Dispersal Distance = 191 meters		



**Figure 8.2: Map depicting the derived safe distance to be maintained from either banks of Galli Nalla**

Therefore, from the Table 8.1, it is evident that ‘Depth of Edge Influence’ is the deciding factor for determining the safe distance from bank of *Galli Nalla* towards its west i.e. to the eastern slope of western ridge (Deposit-4) which works out to be **150 meters**. Similarly, ‘Spore Dispersal Distance’ is the deciding factor for deriving the Safe Distance from bank of *Galli Nalla* towards its east i.e. to the western slope of eastern ridge (Deposit-10) which works out to be **191 meters** (Figure 8.2).

**It is also reiterated that**

1. Maintenance of the recommended safe distance of 150 meters and 191 meters respectively towards the west and east of *Galli Nalla* bank is subject to the strict adherence to implementation of environmental protection measures suggested under para 7.1, 7.2 and 7.3 of Chapter 7 of this report.
2. No float ore mining shall be undertaken on the eastern slope of the western ridge of Deposit-4 / western slope of *Galli Nalla*.
3. Proposal has been made to dump mine waste for first 3 years on the eastern slope of Deposit-4 as Dump No. 1. The proposal has to be revoked and no mine waste dumping should be done on the eastern slope of the western ridge (Deposit-4) as washoffs from dumps will add to siltation in *Galli Nalla* that will adversely affect Tree Fern habitat.
4. No loose stacking of minerals be made on the eastern slope of the western ridge of Deposit-4 / western slope of *Galli Nalla*.
5. It is pertinent to mention that the impacts specified in the Chapter 6 have been predicted based on the approved reports and plans, and observations during field visits towards proposed mining activities and their implications on the ‘Tree fern habitat’. However, once mining operations commence in the Deposit-4 Iron ore block, they may either amplify or mollify the forecasted impacts on the susceptible *Galli Nalla* ecosystem. Therefore, the mine authority is required to undertake detailed “*Impact Assessment Study of Mine Progression on Galli Nalla Ecosystem*” by any reputed third-party organization during the plan period, from the start of operations.

**The specific recommendations / comments of Chhattisgarh State Forest Department on the ICFRE Draft Project Report was communicated vide its letter dated 12.12.2024 (Annexure-IX). The same are recasted as below:**

1. As per ICFRE recommendation, Maintenance of the recommended safe distance of 150 meters and 191 meters respectively towards the west and east of Galli Nalla bank. The recommendations of ICFRE may be adhered to.
2. Mining operations on reaching the bench levels in North pit of deposit-4 to the corresponding levels of *Galli Nalla*, there should be comprehensive study by reputed institution to determine whether further mining operations can be allowed or not in reference to impact on Tree fern survival.
3. No float ore mining shall be undertaken on the eastern slope of the western ridge of Deposit-4 / western slope of *Galli Nalla*.
4. Proposal has been made to dump mine waste for first 3 years on the eastern slope of Deposit-4 as Dump No. 1. The proposal has to be revoked and no mine waste dumping should be done on the eastern slope of the western ridge (Deposit-4) as washoffs from dumps will add to siltation in Galli Nalla that will adversely affect Tree Fern habitat.
5. No loose stacking of minerals be made on the eastern slope of the western ridge of Deposit-4 / western slope of *Galli Nalla*.
6. When the mining operations will commence in the Deposit-4 Iron ore block, they may either amplify or mollify the forecasted impacts on the susceptible Galli Nalla ecosystem. Therefore, Every Year the mine authority should undertake detailed “Impact Assessment Study of Mine Progression on *Galli Nalla* Ecosystem” by any reputed third-party organization during the plan period, from the start of operations.
7. Contingency funding provision should be made for site specific, need based action required for prevention of silt deposition in *Galli Nalla*.

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गजमती सं० डी० एल०-33004/99

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# भारत का राजपत्र

## The Gazette of India

असाधारण

EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (i)

PART II—Section 3—Sub-section (i)

प्राधिकार से प्रकाशित

PUBLISHED BY AUTHORITY

सं. 572]

नई दिल्ली, सोमवार, सितम्बर 30, 2019/आश्विन 8, 1941

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NEW DELHI, MONDAY, SEPTEMBER 30, 2019/ASVINA 8, 1941

खान मंत्रालय

अधिसूचना

नई दिल्ली, 30 सितम्बर, 2019

**सा. का. नि. 697(अ).**—केंद्रीय सरकार, छत्तीसगढ़ की राज्य सरकार से परामर्श के पश्चात्, खान और खनिज (विकास और विनियमन) अधिनियम, 1957 (1957 का 67) की धारा 17क की उप-धारा (1क) के द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, मैसर्स राष्ट्रीय खनिज विकास निगम - छत्तीसगढ़ खनिज विकास निगम लिमिटेड (एन. सी. एल.), राष्ट्रीय खनिज विकास निगम लिमिटेड (इस्पात मंत्रालय के प्रशासनिक नियंत्रणाधीन केंद्रीय सरकार का एक पब्लिक सेक्टर का उपक्रम) और मैसर्स छत्तीसगढ़ खनिज विकास निगम लिमिटेड (छत्तीसगढ़ सरकार का एक पब्लिक सेक्टर का उपक्रम) का एक संयुक्त उद्यम के माध्यम से खनिज लौह अयस्क के पूर्वेक्षण अथवा खनन प्रचालन करने के लिए बैलाडिला आरक्षित वन निक्षेप सं. 4, जिला इक्षिणी बस्तर, छत्तीसगढ़ में ऐसे आरक्षित क्षेत्र के नीचे यथानिर्दिष्ट सीमा (अक्षांश और देशांतर द्वारा सीमांकित) के भीतर पड़ने वाले 646.596 हेक्टेयर के क्षेत्र को पांच वर्ष की अवधि के लिए आरक्षित करती है :-

खनिज का नाम	स्थिति	क्षेत्र	पिन्तर	अक्षांश	देशांतर
लौह अयस्क	बैलाडिला आरक्षित वन, निक्षेप सं. 4 जिला इक्षिणी बस्तर, छत्तीसगढ़	646.596 हेक्टेयर	A	81°12'10.40"	18°43'45.70"
			B	81°13'10.80"	18°43'40.90"
			C	81°13'08.80"	18°43'05.90"
			D	81°13'05.50"	18°43'05.80"
			E	81°12'57.30"	18°41'27.70"
			F	81°12'28.80"	18°41'52.90"
			G	81°11'57.70"	18°41'58.70"

(फा. सं. 4/2/2018-एम VII)

निरंजन कुमार सिंह, संयुक्त सचिव

5110/GU/2019

(1)

## MINISTRY OF MINES

## NOTIFICATION

New Delhi, the 30th September, 2019

**G.S.R. 697(E).**—In exercise of the powers conferred by sub-section (1A) of section 17A of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957), the Central Government, after consultation with the State Government of Chhattisgarh hereby reserves an area of 646.596 hectares in Bailadila reserve forest, Deposit No. 4, District South Bastar, Chhattisgarh for mineral iron ore for undertaking prospecting or mining operations through M/s National Mineral Development Corporation – Chhattisgarh Mineral Development Corporation Limited (NCL), a joint venture of National Mineral Development Corporation Limited (a Central Government Public Sector Undertaking under the administrative control of Ministry of Steel), and Chhattisgarh Mineral Development Corporation Limited (a Government of Chhattisgarh Public Sector Undertaking), for a period of five years lying within the boundary (demarcated by latitude and longitude) of such reserve area as specified below:-

Name of Mineral	Location	Area	Pillar	Longitude	Latitude
Iron ore	Bailadila reserve forest, deposit No. 4, District South Bastar, Chhattisgarh	646.596 hect.	A	81°12'10.40"	18°43'45.70"
			B	81°13'10.80"	18°43'40.90"
			C	81°13'08.80"	18°43'05.90"
			D	81°13'05.30"	18°43'05.80"
			E	81°12'57.30"	18°41'27.70"
			F	81°12'28.80"	18°41'52.90"
			G	81°11'57.70"	18°41'58.70"

[F. No. 4/2/2018-M.VI]

NIRANJAN KUMAR SINGH, Jt. Secy.



# भारत का राजपत्र The Gazette of India

सी.जी.-डी.एल.-अ.-18022021-225248  
CG-DL-E-18022021-225248

असाधारण  
EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (i)  
PART II—Section 3—Sub-section (i)

प्राधिकार से प्रकाशित  
PUBLISHED BY AUTHORITY

सं. 79] नई दिल्ली, बृहस्पतिवार, फरवरी 18, 2021/माघ 29, 1942  
No. 79] NEW DELHI, THURSDAY, FEBRUARY 18, 2021/MAGHA 29, 1942

खान मंत्रालय

अधिसूचना

नई दिल्ली, 18 फरवरी, 2021

सा.का.नि. 119(अ).—केंद्रीय सरकार, खान और खनिज (विकास और विनियमन) अधिनियम, 1957 (1957 का 67) की धारा 17क की उप-धारा (1क) के द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, छत्तीसगढ़ के राज्य सरकार से परामर्श से भारत सरकार, खान मंत्रालय की अधिसूचना संख्या 697(अ) तारीख 30 सितंबर, 2019 जो भारत के राजपत्र, असाधारण, भाग II, खंड 3, उप-खंड (ii) में प्रकाशित की गई थी, में निम्नलिखित संशोधन करती है, अर्थात्:—

2. उक्त अधिसूचना में “खनिज का नाम” शब्दों के साथ आरंभ होकर और “18° 41'58.70” उत्तर आंकड़े के साथ अंत होने वाले के स्थान पर निम्नलिखित रखा जाएगा:

खनिज का नाम	स्थिति	क्षेत्र	पिलर	अक्षांश	देशांतर
लौह अयस्क	बैलाडिला आरक्षित वन, निक्षेप सं. 4 जिला दक्षिण बस्तर, छत्तीसगढ़	646.596 हेक्टेयर	ए	81°12'03.25650”पूर्व	18°43'38.32617” उत्तर
			बी	81°13'04.84428”पूर्व	18°43'38.52758” उत्तर

			सी	81°13'06.24991"पूर्व	18°43'12.30677" उत्तर
			डी	81°13'03.60782"पूर्व	18°43'12.27943" उत्तर
			ई	81°13'07.02661"पूर्व	18°41'26.17920" उत्तर
			एफ	81°12'31.89279"पूर्व	18°41'48.22195" उत्तर
			जी	81°12'02.90192"पूर्व	18°41'50.38796" उत्तर

[फा. सं. 4/2/2018-एम VI]

डॉ. वीणा कुमारी डरमल, संयुक्त सचिव

**MINISTRY OF MINES****NOTIFICATION**

New Delhi, the 18th February, 2021

**G.S.R. 119(E).**—In exercise of the powers conferred by sub-section (1A) of section 17A of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957) the Central Government in consultation with the State Government of Chhattisgarh, hereby makes the following amendments in the notification of the Government of India in the Ministry of Mines, dated 30<sup>th</sup> September, 2019 published in the Gazette of India, Extraordinary, Part II, Section 3, sub-section (i), *vide* number 697(E), dated the 30<sup>th</sup> September, 2019, namely:

2. In the said notification, beginning with the words "Name of Mineral" and ending with the figure "18°41'58.70" N", the following shall be substituted:

Name of Mineral	Location	Area	Pillar	Longitude	Latitude
Iron ore	Bailadila reserve forest, deposit No. 4, District South Bastar, Chhattisgarh	646.596 hects.	A	81 <sup>0</sup> 12'03.25650"E	18 <sup>0</sup> 43'38.32617"N
			B	81 <sup>0</sup> 13'04.84428"E	18 <sup>0</sup> 43'38.52758"N
			C	81 <sup>0</sup> 13'06.24991"E	18 <sup>0</sup> 43'12.30677"N
			D	81 <sup>0</sup> 13'03.60782"E	18 <sup>0</sup> 43'12.27943"N
			E	81 <sup>0</sup> 13'07.02661"E	18 <sup>0</sup> 41'26.17920"N
			F	81 <sup>0</sup> 12'31.89279"E	18 <sup>0</sup> 41'48.22195"N
			G	81 <sup>0</sup> 12'02.90192"E	18 <sup>0</sup> 41'50.38796"N

[F. No. 04/02/2018-M.VI]

Dr. VEENA KUMARI DERMAL, Jt. Secy.



छत्तीसगढ़ शासन  
खनिज साधन विभाग  
मंत्रालय

महानदी भवन, नवा रायपुर, अटल नगर-492 002

क्रमांक एफ 2-20/2005/12,

नवा रायपुर अटल नगर, दिनांक

जून, 2021

प्रति,

मुख्य कार्यपालन अधिकारी,  
एनएमडीसी-सीएमडीसी लिमिटेड(एनसीएल),  
ग्रीन विले सिटी, हाऊसिंग बोर्ड कालोनी,  
सेजबहार, बोरिया कला, शदाणी दरबार के सामने,  
एनएच-30, रायपुर, छत्तीसगढ़ -492 015.

26 JUN 2021

विषय:- जिला दक्षिण बस्तर दंतेवाड़ा, बैलाडीला डिपॉजिट नं. 4 के कुल रकबा 646.596 हेक्टर क्षेत्र खनिज लौह अयस्क का खनिपट्टा की स्वीकृति हेतु-मेसर्स एनएमडीसी-सीएमडीसी लिमिटेड (एनसीएल)।

संदर्भ:- आपका पत्र क्रमांक No. NCL/HO/Dep-4/LEASE/2017/597, Date 09.10.2019.

जिला दक्षिण बस्तर दंतेवाड़ा, बैलाडीला डिपॉजिट-4 के कुल रकबा 646.596 हेक्टेयर क्षेत्र में खनिज आयरन ओर का खनिपट्टा हेतु मेसर्स एनएमडीसी-सीएमडीसी लिमिटेड (एनसीएल) द्वारा दिनांक 21.11.2019 को आवेदन पत्र प्रस्तुत किया गया है।

2/ प्रश्नाधीन क्षेत्र का विवरण निम्नानुसार है :-

- 2.1 एनएमडीसी-सीएमडीसी लिमिटेड (एनसीएल) एक संयुक्त उपक्रम की कम्पनी (JVC) है जिसमें एनएमडीसी एवं सीएमडीसी लिमि. का क्रमशः 51:49 की भागीदारी है। राज्य के स्वंज/स्टील उद्योगों की लौह अयस्क की आवश्यकता की आपूर्ति संबंधी कठिनाई को ध्यान में रखते हुए इस संयुक्त उपक्रम कम्पनी (JVC) द्वारा बैलाडीला डिपॉजिट क्रमांक-04 का विकास किये जाने हेतु एनएमडीसी एवं सीएमडीसी में मध्य सहमति हुई है और एक औपचारिक सहमति (मेमोरेडम आफ अंडरस्टैंडिंग) निष्पादित किया गया है।
- 2.2 प्रश्नाधीन क्षेत्र में एनएमडीसी के पक्ष में पूर्ववर्ती मध्यप्रदेश शासन के पत्र क्र. 4043/4381/12, दिनांक 03.09.1971 द्वारा पूर्वेक्षण अनुज्ञप्ति स्वीकृत किया गया था। पूर्वेक्षण कार्य के आधार पर एनएमडीसी ने क्षेत्र पर 107 मिलियन टन लौह अयस्क के माइनेबल भण्डार प्रमाणित किये हैं।
- 2.3 एनएमडीसी द्वारा जिला दक्षिण बस्तर दंतेवाड़ा के बैलाडीला स्थित डिपॉजिट क्रमांक-4 के वन कक्षा क्रमांक 659, 661, 662, 663, 664, 665, 666, 667, 668, 672 एवं 676, 778 (टोपोशीट 65 एफ/2) के क्षेत्र पर खनिज लौह अयस्क का खनिपट्टा स्वीकृति हेतु आवेदन पत्र दिनांक 27.02.1991 प्रस्तुत किया गया, जिस पर निर्णय लेते हुए विभागीय पत्र दिनांक 30.09.2010 के माध्यम से पूर्वानुमोदन प्रस्ताव भारत सरकार, खान मंत्रालय को प्रेषित किया गया। जिसके परिप्रेक्ष्य में भारत सरकार, खान मंत्रालय ने अपने पत्र क्रमांक 5/103/2010-M.IV, दिनांक 30.11.2011 द्वारा 20 वर्ष की अवधि के लिए खनिपट्टा स्वीकृत किए जाने हेतु एनएमडीआर एक्ट, 1957 की धारा-5(1) के तहत पूर्वानुमोदन एवं धारा-6(1)(बी) के तहत निर्धारित सीमा में छूट निम्नानुसार अतिरिक्त शर्त के तहत प्रदान की गई :-

"There shall be no change in the equity ratio of 51:49 in the Joint Venture between M/s National Mineral Development Corporation Ltd. and M/s Chhattishgarh Mineral Development Corporation without the approval of the Central Government."

- 2.4 उपरोक्त के संदर्भ में विभागीय समसंख्यक पत्र दिनांक 13.01.2012 द्वारा एनएमडीसी को खनिपट्टा स्वीकृति हेतु आईबीएम द्वारा अनुमोदित मायनिंग प्लान एवं वन संरक्षण अधिनियम 1980 के तहत आवश्यक अनुमति वन विभाग से प्राप्त कर प्रस्तुत करने हेतु (LoI) लेख किया गया।



- 2.5 एनएमडीसी ने पत्र दिनांक 13.08.2013 के माध्यम से भारतीय खान ब्यूरो, नागपुर के पत्र दिनांक 26.07.2013 द्वारा रकबा 646.596 हेक्टेयर क्षेत्र का अनुमोदित मायनिंग प्लान प्रस्तुत किया गया, किन्तु भारत सरकार, पर्यावरण एवं वन मंत्रालय से वांछित वन एवं पर्यावरणीय अनुमति प्रस्तुत नहीं किया गया।
- 2.6 विभागीय समसंख्यक पत्र दिनांक 13.01.2012 द्वारा जारी LoI के संदर्भ में एनएमडीसी द्वारा वन एवं पर्यावरणीय समितियाँ आदि MMDR Act, 1957 (यथा संशोधित 2015) की धारा-10A(2)(c) अनुसार निर्धारित तिथि 11.01.2017 तक प्रस्तुत नहीं की जा सकी। अतएव MMDR Act, 1957 (यथा संशोधित 2015) की धारा-10A(2)(c) सहपठित खनिज (परमाणु और हाइड्रोकार्बन ऊर्जा खनिजों से भिन्न) रियायत नियम, 2016 के नियम-8(4) के तहत विषयक खनिपट्टा प्रकरण में खनिपट्टा स्वीकृति आदेश जारी नहीं किया गया जो कि अधिनियम के उक्त प्रावधानों के तहत स्वमेव समाप्त हो गया।
- 2.7 एनएमडीसी द्वारा उक्त के संदर्भ में माननीय उच्च न्यायालय छत्तीसगढ़, बिलासपुर के समक्ष प्रकरण क्रमांक W.P.(c) No. 100/2017., NMDC Ltd Vs UoI & Others दायर किया गया। एनएमडीसी द्वारा याचिका वापस लेने के कारण माननीय न्यायालय के आदेश दिनांक 21.04.2017 द्वारा उक्त रिट पिटिशन dismissed as withdrawn किया गया है।
- 2.8 संयुक्त उद्यम कम्पनी (JVC) एनएमडीसी-सीएमडीसी लिमिटेड (एनसीएल) द्वारा उपर्युक्त क्षेत्र जिला बस्तर के बैलाडीला आयरन ओर डिपॉजिट-4 के कुल रकबा 646.596 हेक्टेयर को MMDR Act, 1957(यथा संशोधित 2015) की धारा-17A(1A) के तहत खनिपट्टा स्वीकृति हेतु दिनांक 21.11.2019 को आवेदन प्रस्तुत किया गया। जिसके संदर्भ में विभागीय समसंख्यक पत्र दिनांक 17.01.2018 द्वारा धारा-17A(1A) के तहत उपर्युक्त क्षेत्र को एनसीएल के पक्ष में आरक्षित करने हेतु भारत सरकार, खान मंत्रालय को प्रस्ताव प्रेषित किया गया।
- 2.9 भारत सरकार, खान मंत्रालय, नई दिल्ली की अधिसूचना दिनांक 30.09.2019 द्वारा मेसर्स एनएमडीसी-सीएमडीसी लिमिटेड (एनसीएल) के पक्ष में MMDR Act, 1957(यथा संशोधित 2015) की धारा-17A(1A) के तहत बैलाडीला डिपॉजिट क्रमांक-4 के कुल रकबा 646.596 हेक्टेयर के निम्नलिखित क्षेत्र को 05 वर्ष की अवधि के लिए आरक्षित किया गया है :-

खनिज का नाम	स्थिति	क्षेत्र	पिलर	अक्षांश	देशांतर
लौह अयस्क	बैलाडीला आरक्षित वन, निक्षेप सं. 4 जिला दक्षिण बस्तर, छत्तीसगढ़	646.596 हेक्टेयर	A	81°12'10.40"	18°43'45.70"
			B	81°13'10.80"	18°43'40.90"
			C	81°13'08.80"	18°43'05.90"
			D	81°13'05.50"	18°43'05.80"
			E	81°12'57.30"	18°41'27.70"
			F	81°12'28.80"	18°41'52.90"
			G	81°11'57.70"	18°41'58.70"

- 2.10 उक्त के संदर्भ में एनसीएल द्वारा जिला दक्षिण बस्तर दंतेवाड़ा के बैलाडीला आयरन ओर डिपॉजिट-4 के कुल रकबा 646.596 हेक्टेयर क्षेत्र को MMDR Act, 1957(यथा संशोधित 2015) की धारा-17A(1A) के तहत खनिज लौह अयस्क के खनिपट्टा स्वीकृति हेतु दिनांक 21.11.2019 को आवेदन प्रस्तुत किया गया, जिसे संचालक भूमिकी तथा खनिकर्म, छत्तीसगढ़ ने अपने प्रस्ताव दिनांक 29.04.2020 द्वारा इस विभाग को प्रेषित किया।
- 2.11 उपरोक्त के परिप्रेक्ष्य में विभागीय समसंख्यक पत्र दिनांक 02.12.2020 द्वारा एनएमडीसी-सीएमडीसी लिमिटेड (एनसीएल) के पक्ष में पैरा-2.9 की तालिका में उल्लेखित क्षेत्र पर MMDR Act, 1957 (यथा संशोधित 2015) की धारा-17A(2A) के तहत 05 वर्ष की अवधि के लिए खनिज लौह अयस्क का खनिपट्टा स्वीकृति का सैद्धांतिक निर्णय लिया जाकर क्षेत्र में खनन कार्य हेतु वन संरक्षण अधिनियम, 1980 एवं पर्यावरण संरक्षण अधिनियम, 1986 के तहत आवश्यक वन एवं पर्यावरणीय अनुमति प्राप्त कर इस विभाग को प्रस्तुत करने की अनुमति प्रदान की गई है।





3/ भारत सरकार, खान मंत्रालय, नई दिल्ली द्वारा जारी अधिसूचना दिनांक 18.02.2021 अनुसार शासकीय उपक्रम की कंपनी मेसर्स एनएमडीसी-सीएमडीसी लिमिटेड (एनसीएल) के पक्ष में MMDR Act, 1957 (यथा संशोधित 2015) की धारा-17A(1A) के तहत बैलाडीला डिपॉजिट क्रमांक-4 के कुल रकबा 646.596 हेक्टेयर क्षेत्र को 05 वर्ष की अवधि के लिए खनिज लौह अयस्क का पूर्वेक्षण अथवा खनन प्रचालन करने के लिए आरक्षित किया गया है। क्षेत्र में मेसर्स एनएमडीसी लिमि. के पक्ष में पूर्वेक्षण अनुज्ञप्ति स्वीकृत था। पूर्वेक्षण कार्य के आधार पर एनएमडीसी ने क्षेत्र पर 107 मिलियन टन लौह अयस्क के माइनेबल भण्डार प्रमाणित किये हैं। प्रश्नाधीन क्षेत्र में लौह अयस्क खनन हेतु भारतीय खान ब्यूरो, नागपुर ने पत्र दिनांक 26.07.2013 द्वारा मायनिंग प्लान अनुमोदित किया गया है।

4/ अतः उपरोक्त तथ्यों के प्रकाश में एनएमडीसी-सीएमडीसी लिमिटेड (एनसीएल) के पक्ष में पैरा-2.15 एवं 2.16 की तालिका में उल्लेखित क्षेत्र पर MMDR Act, 1957 (यथा संशोधित 2015) की धारा-17A(2A) के तहत 05 वर्ष की अवधि के लिए खनिज लौह अयस्क का खनिजपट्टा स्वीकृति का सैद्धांतिक निर्णय लिया जाकर क्षेत्र में खनन कार्य हेतु वन संरक्षण अधिनियम, 1980 एवं पर्यावरण संरक्षण अधिनियम, 1986 के तहत आवश्यक वन एवं पर्यावरणीय अनुमति प्राप्त कर इस विभाग को प्रस्तुत करने की अनुमति प्रदान की जाती है।

5/ वन संरक्षण अधिनियम, 1980 एवं पर्यावरण संरक्षण अधिनियम, 1986 के तहत जारी की जा रही इस अनुमति से उपर्युक्त आवेदित क्षेत्र पर प्रवेश करने या खनन कार्य करने का कोई अधिकार कंपनी को प्राप्त नहीं होगा।

संलग्न:-नक्शा।

(कुन्दन कुमार बजारे)

अवर सचिव

छत्तीसगढ़ शासन,

खनिज साधन विभाग

पृ0क्रमांक एफ 2-20/2005/12,

नवा रायपुर, अटल नगर दिनांक

प्रतिलिपि :-

1. सचिव, भारत सरकार, खान मंत्रालय, शास्त्री भवन, नई दिल्ली।
2. सचिव, भारत सरकार, वन एवं पर्यावरण मंत्रालय (एफसी डिवीजन) पर्यावरण भवन सीजीओर काम्प्लेक्स, लोधी रोड, नई दिल्ली।
3. सदस्य सचिव, छत्तीसगढ़ पर्यावरण संरक्षण मंडल, पर्यावास भवन, सेक्टर-19, नवा रायपुर अटल नगर, छत्तीसगढ़।
4. क्षेत्रीय खान नियंत्रक, भारतीय खान ब्यूरो, दूसरी मंजिल, जीएसआई फील्ड प्रशिक्षण केन्द्र, महालेखाकार ऑफिस कॉम्प्लेक्स, पोस्ट विधान सभा, रायपुर, छत्तीसगढ़।
5. महानिदेशक, सेफ्टी ऑफ मार्टिन्स, सीपत रोड, बिलासपुर, छत्तीसगढ़।
6. संचालक, भौमिकी तथा खनिकर्म, इन्द्रावती भवन, नवा रायपुर अटल नगर, छत्तीसगढ़।
7. अध्यक्ष सह प्रबंध निदेशक, एन.एम.डी.सी. लिमिटेड, खनिज भवन 10-3-311/ए, कैस्टल हिल्स मासाब टैंक, हैदराबाद।
8. अतिरिक्त प्रधान मुख्य वन संरक्षक (भू-प्रबंध), नोडल अधिकारी वन संरक्षण अधिनियम, 1980 छत्तीसगढ़ अरण्य भवन, जेल रोड, रायपुर।
9. प्रबंध संचालक, छत्तीसगढ़ मिनरल डेवेलपमेंट कॉर्पोरेशन लिमिटेड, सोनाखान भवन, रिंग रोड, रायपुर, छत्तीसगढ़।
10. कलेक्टर, जिला-दक्षिण बस्तर दंतोवाड़ा, छत्तीसगढ़।
11. की ओर आवश्यक कार्यवाही हेतु सूचनार्थ।
11. गार्ड फाईल।

(हस्ताक्षर)

अवर सचिव

छत्तीसगढ़ शासन

खनिज साधन विभाग



छत्तीसगढ़ शासन  
खनिज साधन विभाग  
मंत्रालय

महानदी भवन, नवा रायपुर, अटल नगर-492 002

क्रमांक एफ 2-20/2005/12,

नवा रायपुर अटल नगर, दिनांक 07 AUG 2021

प्रति,

✓ मुख्य कार्यपालन अधिकारी,  
एनएमडीसी-सीएमडीसी लिमिटेड(एनसीएल),  
ग्रीन विले सिटी, हाऊसिंग बोर्ड कालोनी,  
सेजबहार, बोरिया कला, शदाणी दरबार के सामने,  
एनएच-30, रायपुर, छत्तीसगढ़ -492 015.

विषय:- जिला दक्षिण बस्तर दंतेवाड़ा, बैलाडीला, डिपॉजिट नं. 4 के कुल रकबा 846.596 हेक्टर क्षेत्र खनिज लौह अयस्क का खनिपट्टा की स्वीकृति हेतु-मेसर्स एनएमडीसी-सीएमडीसी लिमिटेड (एनसीएल)।

- संदर्भ:- 1. इस विभाग का समसंख्यक पत्र दिनांक 26.06.2021.  
2. आपका पत्र क्रमांक No. NCL/HO/Dep-4/Lease/2020/878, Date 15.07.2021.  
3. आईबीएम, रायपुर पत्र क्र. RPR-1309/01/2016-MP, Date 14.07.2021.

कृपया संदर्भित पत्रों का अवलोकन करें। मेसर्स एनएमडीसी-सीएमडीसी लिमिटेड (एनसीएल) के पत्र दिनांक 15.07.2021 तथा भारतीय खान ब्यूरो (आईबीएम) रायपुर के पत्र दिनांक 14.07.2021 के परिप्रेक्ष्य में जिला दक्षिण बस्तर दंतेवाड़ा, बैलाडीला, डिपॉजिट नं. 4 के कुल रकबा 846.596 हेक्टर क्षेत्र खनिज लौह अयस्क का खनिपट्टा की स्वीकृति हेतु जारी आशय पत्र दिनांक 26.06.2021 के अनुक्रम में प्रश्नाधीन क्षेत्र हेतु खनिज (परमाणु, हाइड्रो कार्बन और ऊर्जा खनिजों से भिन्न) रियायत नियम, 2016 के नियम-13 के तहत भारतीय खान ब्यूरो से अनुमोदित मायनिंग प्लान प्रस्तुत करने की अनुमति प्रदान की जाती है।

2/ इस विभाग के समसंख्यक पत्र दिनांक 26.06.2021 द्वारा जारी आशय पत्र में उल्लिखित शेष शर्तें यथावत रहेंगी।

(कुन्दन कुमार बजारे)

अवर सचिव

छत्तीसगढ़ शासन,  
खनिज साधन विभाग

पृ0क्रमांक एफ 2-20/2005/12,

नवा रायपुर अटल नगर, दिनांक

प्रतिलिपि :-

1. सचिव, भारत सरकार, खान मंत्रालय, शास्त्री भवन, नई दिल्ली।
2. सचिव, भारत सरकार, वन एवं पर्यावरण मंत्रालय (एफसी डिवीजन) पर्यावरण भवन सीजीओर काम्प्लेक्स, लोधी रोड, नई दिल्ली।
3. सदस्य सचिव, छत्तीसगढ़ पर्यावरण संरक्षण मंडल, पर्यावास भवन, सेक्टर-19, नवा रायपुर अटल नगर, छत्तीसगढ़।
4. क्षेत्रीय खान नियंत्रक, भारतीय खान ब्यूरो, दूसरी मंजिल, जीएसआई फील्ड प्रशिक्षण केन्द्र, महालेखाकार ऑफिस कॉम्प्लेक्स, पोस्ट विधान सभा, रायपुर, छत्तीसगढ़ की ओर उनके पत्र क्र. RPR-1309/01/2016-MP, Date 14.07.2021 के संदर्भ में उपरोक्तानुसार सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

5. महानिदेशक, सेफ्टी ऑफ माईन्स, सीपत रोड, विलासपुर, छत्तीसगढ़,
6. संचालक, भौमिकी तथा खनिकर्म, इन्द्रावती भवन, नवा रायपुर अटल नगर, छत्तीसगढ़।
7. अध्यक्ष सह प्रबंध निदेशक, एन.एम.डी.सी. लिमिटेड, खनिज भवन 10-3-311/ए, कैस्टल हिल्स मासाब टैंक, हैदराबाद।
8. अतिरिक्त प्रधान मुख्य वन संरक्षक (भू-प्रबंध), नोडल अधिकारी वन संरक्षण अधिनियम, 1980 छत्तीसगढ़ अरण्य भवन, जेल रोड, रायपुर।
9. प्रबंध संचालक, छत्तीसगढ़ मिनरल डेव्हलपमेंट कार्पोरेशन लिमिटेड, सोनाखान भवन, रिग रोड, रायपुर, छत्तीसगढ़,
10. कलेक्टर, जिला-दक्षिण बस्तर दंतवाड़ा, छत्तीसगढ़
- की ओर आवश्यक कार्यवाही हेतु सूचनार्थ।
11. गार्ड फाईल।

  
 अवर सचिव  
 छत्तीसगढ़ शासन  
 खनिज साधन विभाग

Speed post/Email



भारत सरकार, खान मंत्रालय  
GOVERNMENT OF INDIA, MINISTRY OF MINES  
भारतीय खान ब्यूरो, क्षेत्रीय खान नियंत्रक कार्यालय- रायपुर  
INDIAN BUREAU OF MINES, OFFICE OF REGIONAL CONTROLLER OF MINES, RAIPUR  
फोन- 0771-2282530 /2285590 / 95, ईमेल- ro.raipur@ibm.gov.in



फाइल क्र.- दंतेवा/लौह/खयो-1292/2021-रायपुर / 291

दिनांक- 24/09/2021

प्रेषित- मेसर्स एन एम डी सी-सि एम डी सी लिमिटेड (एनसील)  
ग्रीन विले सिटी, हाउसिंग बोर्ड कालोनी,  
सेजबहार, बोरिया कला, रायपुर, छत्तीसगढ़ - 492 015  
ईमेल- ceonmdccmdc@gmail.com

विषय- खनिज रियायत नियम (परमाणु और हाइड्रोकार्बन ऊर्जा खनिजों से भिन्न) 2016 के नियम 16(1) एवं खनिज संरक्षण एवं विकास नियमावली 2017 के नियम 23 के अंतर्गत प्रस्तुत निकट ग्राम- बचेली तहसील- बचेली जिला- दक्षिण बस्तर दन्तेवाड़ा, डिपोजिट नं.- 4, छत्तीसगढ़ में स्थित कुल रकबा 646.596 ह० खनिज लौह अयस्क की खनन योजना सह उत्तरोत्तर खान बंद करने की योजना की प्रस्तुति।

संदर्भ- 1 आपका पत्र दिनांक 10/08/2021 एवम 22/09/2021.  
2. इस कार्यालय का सम्बंधित पत्र दिनांक 02/09/2021.

महोदय

खान एवं खनिज (विकास एवं विनियम) अधिनियम 1957 की धारा 5 की उप धारा 2 के अनुच्छेद (ख) तथा खनिज (परमाणु और हाइड्रोकार्बन ऊर्जा खनिजों से भिन्न) रियायत नियम 2016 के नियम 16 के उप नियम 3 एवम नियम 17 सपठित भारत सरकार के आदेश क्रमांक एस.ओ.(ई) दिनांक 18/05/2016 के द्वारा प्रदत्त अधिकारों का प्रयोग करते हुए मैं एतद द्वारा उल्लेखित खनन योजना का अनुमोदन करता हूं। यह अनुमोदन निम्नलिखित शर्तों के अधीन हुआ है-

- 1 इस खनन योजना सह उत्तरोत्तर खान बंद करने की योजना का अनुमोदन केंद्र सरकार अथवा अन्य किसी प्राधिकारी द्वारा खान पर समय-समय पर लागू किए गए कानूनों पर प्रतिकूल प्रभाव डाले बिना किया गया है।
- 2 दस्तावेज में अथवा प्लेट में दर्शाए गए प्रस्ताव आवेदक पट्टा धारक द्वारा प्रस्तुत लीज नक्शा पर आधारित ह० तथा प्रस्ताव अनुमोदन की तारीख से लागू है।
- 3 यह भी स्पष्ट किया जाता है कि इस खनन योजना सह उत्तरोत्तर खान बंद करने की योजना के अनुमोदन में खान एवं खनिज (विकास और विनियम) अधिनियम, 1957 या खनिज (परमाणु और हाइड्रोकार्बन ऊर्जा खनिजों से भिन्न) रियायत नियम 2016 या और किसी अन्य कानून जिसमें वन (संरक्षण) अधिनियम, 1980, पर्यावरण संरक्षण अधिनियम- 1986, खान अधिनियम 1952 सहित अन्य किन्हीं कानूनों के किसी अन्य प्रावधान की शर्तों के अनुसार किसी भी प्रकार से सरकार का अनुमोदन समाविष्ट नहीं है।
- 4 भारतीय खान ब्यूरो ने भूमि पर खनन पट्टे की सीमा का सत्यापन नहीं किया है अतः आवेदक पट्टा धारक द्वारा प्रस्तुत सटीक एरिया की सीमाओं की सत्यता के संबंध में कोई जिम्मेदारी नहीं ली जाती है।



-1-

Agm(muh)nu



- 5 किसी भी अवस्था में यदि यह देखा जाता है कि खनन योजना में दी गई सूचना या दिनांक असत्य अथवा तथ्यों को गलत ढंग से प्रस्तुत किया है तो खनन योजना सह उत्तरोत्तर खान बंद करने की योजना का अनुमोदन तुरंत प्रभाव से वापस लेना माना जाएगा।
- 6 यह अनुमोदन खनन पट्टे की लीज रजिस्ट्रेशन की तिथि से प्रभावी होंगे। यह अनुमोदन लीज अवधि की वृद्धता के अधीन होगा।
- 7 **Performance security** की अवधि समाप्ति की दिनांक को अथवा इससे पहले, **Performance security** का वित्तीय आश्वासन राज्य सरकार को प्रस्तुत किया जाएगा।
- 8 पर्यावरण वन और जलवायु परिवर्तन मंत्रालय द्वारा जारी पर्यावरण मंजूरी, अंतिम पर्यावरण प्रभाव आकलन रिपोर्ट (**EIA Report**) की प्रति के साथ इस कार्यालय को प्रस्तुत की जाएगी।
- 9 माइनिंग लीज डीड की प्रति माइनिंग लीज रजिस्ट्रेशन की तिथि से 15 दिनों के भीतर इस कार्यालय को प्रस्तुत की जाएगी।

संलग्न:- अनुमोदित खनन योजना।

भवदीय

BABULAL GURJAR Digitally signed by  
BABULAL GURJAR  
Date: 2021.09.27  
18:13:58 +05'30'

(बी. एल. गुर्जर)  
क्षेत्रीय खान नियंत्रक  
भारतीय खान ब्यूरो

प्रतिलिपि ईमेल द्वारा - सूचनार्थ

- 1 खान नियंत्रक (मध्य), भारतीय खान ब्यूरो, इंदिरा भवन, सिविल लाईन, नागपुर 440001 -  
**Email- com.cz@ibm.gov.in**
- 2 संचालक भौमिकी एवम खनिकर्म, छत्तिसगढ़ इंद्रावती भवन द्वितीय तल डी ब्लोक, केपिटल कोम्प्लेक्स, नया रायपुर, छत्तिसगढ़- को अनुमोदित खनन योजना की प्रति के साथ प्रेषित है।  
**Email- dgm.cg@gov.in**
- 3 निदेशक, खान सुरक्षा निदेशालय, सरोज विहार, खामतरई, बिलासपुर, छत्तिसगढ़-495006  
**Email- wz.bspdgms@gmail.com**
- 4 डॉ संजीव कुमार सिन्हा एवम श्री आर. बी. बिहारी प्रधान, कस्टल हिल्स, मसब टैंक, हवराबाद - 500028  
**Email- sinhask@nmhc.co.in , rbpradhan@nmhc.co.in**
- 5 खान पत्रावली/ खनन योजना

क्षेत्रीय खान नियंत्रक  
भारतीय खान ब्यूरो

# Annexure-VI

No. IA-J-11015/104/2021-IA-II (NCM)

Government of India  
Ministry of Environment, Forest and Climate Change  
Impact Assessment Division  
\*\*\*

2<sup>nd</sup> Floor, Prithvi Wing,  
Indira Paryavaran Bhavan,  
Jor Bagh Road, Aliganj,  
New Delhi-110 003

Dated: 11<sup>th</sup> March, 2022

To,

M/s NMDC-CMDC Ltd (NCL),  
Green Valley City, Housing Board Colony,  
Boriyakala, Sejbahar, Raipur,  
Chhattisgarh – 492 015.

**Subject:- Proposal for Terms of Reference (ToR) of M/s National Mineral Development Corporation - Chhattisgarh Mineral Development Corporation Limited (NCL), a joint venture of National Mineral Development Corporation Limited (a Central Government Public Sector Undertaking under the administrative control of Ministry of Steel), and Chhattisgarh Mineral Development Corporation Limited (a Government of Chhattisgarh Public Sector Undertaking) is for mining of Iron ore in Bailadila Iron Ore Deposit-4 Mine with production capacity of 7.0 MTPA ROM Iron ore and 6.41 MTPA Waste Excavation (Total Excavation 13.41 MTPA) along with 2000 TPH Crushing plant in the mine lease area of 646.596 ha, located at Village & Tehsil Bacheli, District Dantewada, Chhattisgarh – [File. No: IA-J-11015/104/2021-IA-II(NCM) Proposal No: IA/CG/MIN/251288/2021; Consultant: M/s Ecomen Laboratories Pvt Limited] - Terms of Reference (ToR) regarding.**

Sir,

This has reference to the online proposal no. IA/CG/MIN/251288/2021 of M/s National Mineral Development Corporation - Chhattisgarh Mineral Development Corporation Limited (NCL), a joint venture of National Mineral Development Corporation Limited (a Central Government Public Sector Undertaking under the administrative control of Ministry of Steel), and Chhattisgarh Mineral Development Corporation Limited (a Government of Chhattisgarh Public Sector Undertaking) is for mining of Iron ore in Bailadila Iron Ore Deposit-4 Mine with production capacity of 7.0 MTPA ROM Iron ore and 6.41 MTPA Waste Excavation (Total Excavation 13.41 MTPA) along with 2000 TPH crushing plant in the mine lease area of 646.596 ha, located at Village & Tehsil Bacheli, District Dantewada, Chhattisgarh. The mine lease area is located between Latitude 18°41'26.17920"N to 18°43'38.52758"N and Longitude 81°12'02.90192"E to 81°13'07.02661"E. The mine lease area falls under the Survey of India Toposheet No: 65F/2 and falls in Seismic Zone-II. The Project Proponent presented the KML file during the presentation to indicate the location of mine lease on Google Earth.

2. The Project Proponent initially made an online application vide proposal no: IA/CG/MIN/241426/2021 dated 30.11.2021 and submitted Form1 and Prefeasibility report under the provisions of the EIA Notification, 2006. The proposal was earlier considered in the 43<sup>rd</sup> EAC (Non-Coal Mining) meeting held during 14<sup>th</sup> – 16<sup>th</sup> December, 2021. During the meeting, the Committee noted that the Project Proponent informed that the Mineral beneficiation plant is proposed outside the mine lease area. The Committee observed that the instant proposal is covered under category of 2(b) of EIA notification, 2006, which is standalone and outside the mine lease area and hence the EAC (Non-Coal Mining) Committee cannot appraise the instant project proposal. Therefore, the Committee returned the proposal in present form and was of the view that the Project Proponent should revise the Form1 and PFR accordingly with the factual information and data.

3. Now, the Project Proponent submitted a fresh proposal vide proposal no: IA/CG/MIN/251288/2021 dated 14.01.2022 and submitted Form1 and Prefeasibility report under the provisions of the EIA Notification, 2006. The proposed project activity is listed at schedule no. 1(a) Mining of Minerals under Category "A" of the schedule of the EIA Notification, 2006 as the mining lease area is greater than 100 ha and appraised at Central level.

**4. Details of Mine lease:**

S.no	Lease particulars	Date of the grant	Name of the Mineral	Validity	Granted by	Mine lease area in Ha
1	Ministry of Mines vide Notification G.S.R. 697(E) reserves an area of 646.596ha in Bailadila reserve forest, Deposit No. 4, District South Bastar, Chhattisgarh for mineral iron ore for undertaking prospecting or mining operations	30.09.2019	Iron ore	5 years	Ministry of Mines, Gol	646.596
2	Letter of Intent for grant of mining lease vide Lr No: F-2-2-/2005/12	26.06.2021	Iron ore	5 years	Mineral Resource Department, Government of Chhattisgarh	646.596

3	Amendment in Letter of Intent granted vide Lr No 2-20/2005/12 prescribing the requirement of approved Mining Plan	07.08.2021	Iron ore	5 years	Mineral Resource Department, Government of Chhattisgarh	646.596
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5. The Project Proponent submitted that Approval of Mining Plan including Progressive Mine Closure Plan approved by Indian Bureau of Mines vide Lr No Dantewada /Fe/Khanij-1292/2021/-Raipur dated 24.09.2021 over an area of 646.596ha.

6. The Project Proponent submitted that fully mechanized opencast method of mining will be adopted. PP submitted it is proposed to deploy 150 mm dia rotary percussive drills along with crawler drills of 100mm dia for mine development and bench preparation of mines during 1<sup>st</sup> five years of operation. Charge per hole is around average of 140 kg for 150 mm dia hole & around average of 400 kg for 250 mm dia hole in ore and waste. PP reported that the mineable reserves estimated about 109.01 MT which will last for about 21 years with proposed production capacity of 7 MTPA. PP also reported that bench height of 12m and bench width of 30m will be maintained during operation phase. The ultimate pit slope will be 45°. Ore production and waste removal will be done by 3.2 cum bucket excavator. 4.0 cu.m Front-end loaders will be used for loading purposes including final products. PP submitted that the haulage of blasted ore from mining faces to the mobile ore dressing plant will be done by means of conventional off high way heavy duty dumpers having a payload capacity of 25 T. The same capacity truck will be used for waste transportation to waste dump. PP also submitted that the during the 1<sup>st</sup> five years of mining operations, mobile ore dressing plant will be installed at the mine site for production of CLO/Lump (-40+10mm size & -20mm +10mm) & Fines (-10 mm). Once the Crushing plant along with Downhill Conveyor facilities are installed the ore will be Crushed in the Crusher and subsequently transported through Downhill conveyor for further processing. The crushing plant proposed to be installed at hilltop within the mine lease boundary. To connect Primary Stockpile at hilltop and Screening Plant at foothill, various options of downhill conveyor system have been worked out. The crushed ore will be transported through downhill closed conveyor belt system to the screening plant. Once, these facilities are installed, ROM ore, (-) 1,200 mm, from the mine shall be fed to the crushing plant with the help of dumpers at the truck dumping position. The crushed ore of (-) 350mm after being passed through the metal detector is fed to a scalping screen for separation of (-) 150mm size material. The oversize (+150mm) from the scalping screen will pass through secondary cone crusher and reduce to (-) 150mm size. During the plan period, only dry process will be adopted. There will not be any generation of sub-grade middling's and rejects. ROM excavated from the pit will be directly fed to the ore dressing plant. Hence, quantity of the ROM excavation and feed to the plant will be same. Since, dry process is proposed to be adopted during first five year plan period, product grade will be same as feed grade of the plant. The products, i.e., CLO (-40+10 mm) & Fines (-10 mm) generated at mine head by mobile ore dressing plant installed temporarily during this mining plan period will be

transported to loading plant proposed near Bhansi Railway Station for onward dispatch to NMDC Steel Plant at Nagarnar, Jagdalpur (C.G.) and other customers. PP reported that the waste generation till the life of the mine will be 68.173 Million Tonne (MT). Waste (Shale and Banded Hematite Quartzite) will be dumped in the waste dump at top level of 1040 MRL (dump1) and 995MRL (dump2) during this plan period which is outside ultimate pit limit. Remaining amount of waste will be backfilled in the North block after extracting all the ores and associated waste materials during the life of the mine. PP reported that the mining activity will not intersect the ground water table during life of the mine.

7. The Project Proponent reported that the water requirement envisaged to be around 4,250 cu.m per day which will be met from the source of existing Sankini Nalla at EL. (+) 1025.00 at Hill-top and Nerli Nalla at EL. (+) 450.00 at Foot-Hill. PP also submitted that Permission for withdrawal of water from Sankini Nalla and Nerli Nalla will be obtained from Water Resource Department, Government of Chhattisgarh.

**8. Nearest village / town/ highway/railway station / water bodies:**

Particulars	Particular's Name	Distance & Directions
Village	Nerli	4.7 km, NE
	Bhansi	7.5 km, NE
	Hiroli	7.8 km, W
	Gyatapara	5.0 km, E
	Padhapur	4.5 km SE
Town	Bacheli Town	3.1 km, ESE
	Kirandul Town	6.3 km, SE
Highway	SH-5	3.7 km, E
Railway station	Bacheli Railway station ,	2.7 km, E
	Bhansi Railway station,	7.5 km, NNE
	Kirandul Railway station	7.7 km, SE
Water bodies	Tumka Nala	3.0km, W
	Berudi Nadi	6.0km, W
	Mari Nadi	3.2km, NW
	Pali Nadi	5.3km, NW
	Sankani Nadi	5.4km, E,
	Koyar Nadi	8.2km, SE
	Kadampal Dam	8.2km, SE

9. The Project Proponent reported that the entire mine lease area of 646.596 ha is forest land. PP submitted that the forest clearance will be obtained for a total area of 570.1 ha [646.596ha - 76.496ha (tree fern area not to be diverted)] inside the mining lease area and 100.077ha outside the mining lease area. PP also submitted that application for Stage-I Forest Clearance applied vide proposal no. FP/CG/MIN/146694/2021 dated 04.10.2021 and is under process. PP also reported that there are no National Park, Wildlife Sanctuary, Eco Sensitive Areas, Elephant/Tiger Reserve, Biosphere Reserve within 10km radius of the mining lease area.

10. The Project Proponent submitted that during plan period of first five years greenbelt/plantation will be developed over an area of 58.48 ha. Greenbelt will be

undertaken once the mining operation commences and will be developed over 7.5 m (8.488ha) around the mining lease boundary. PP also submitted that afforestation will be carried out on 144.59 Ha of left out excavation area. At conceptual stage, total afforested area will be 521.321 Ha. (Including gap plantation) excluding the Tree fern area. Soil binding species like *Agave Sislan* (Sisal), *Dendrocalmus Strictus* (Kanta Bamboo) etc., will be planted to stabilize the slope. Densification to the extent of 2700 saplings per hectate of native and pioneer species like *Albizza lebbek* (Siris), *Anilotica* (Babul), *Acateshu* (Karanji), *Dendrocalmus Strictus* (Bamboo), *Phoenix lumilis* (Khajur) etc., succeeded by leguminoseae variety will be planted on the terraces. PP submitted that plantation will be undertaken in consultation with the Forest Department. PP earmarked a budget of Rs 3.20 Cr towards green plant & plantation till the end of life of mine. PP also earmarked a budget of Rs 1.0 Cr towards nursery.

11. The Project Proponent submitted that the mine lease area does not cover any habitation and the mining activities do not involve any displacement of human settlement.

12. The Project Proponent submitted that there is no any litigation pending against the project and/or land in which the project is proposed to be set up.

13. The Project Proponent submitted that the estimated total capital cost of the project is Rs 4091.33 Cr. The mine will provide employment to 700 persons.

**14. Observation and Recommendation of the Committee:**

The proposal for Terms of Reference was considered in the 46<sup>th</sup> EAC (Non-Coal Mining) meeting held during 15<sup>th</sup>-17<sup>th</sup> February, 2022. After detailed deliberations made by the Project Proponent and the Consultant, the Committee **recommended** the proposal for grant of Terms of Reference (ToR) for M/s National Mineral Development Corporation - Chhattisgarh Mineral Development Corporation Limited (NCL), a joint venture of National Mineral Development Corporation Limited (a Central Government Public Sector Undertaking under the administrative control of Ministry of Steel), and Chhattisgarh Mineral Development Corporation Limited (a Government of Chhattisgarh Public Sector Undertaking) for mining of Iron ore in Bailadila Iron Ore Deposit-4 Mine with production capacity of 7.0 MTPA ROM Iron ore and 6.41 MTPA Waste Excavation (Total Excavation 13.41 MTPA) along with 2000 TPH crushing plant in the mine lease area of 646.596 ha, located at Village & Tehsil Bacheli, District Dantewada, Chhattisgarh for undertaking detailed EIA/EMP study subject to the specific conditions in addition to the standard ToR conditions applicable for non-coal mining projects.

15. The matter was examined in the Ministry in accordance with the Environmental Impact Assessment Notification, 2006 and further amendments thereto and the undersigned is directed to say that the Ministry of Environment Forest & Climate Change after accepting the recommendation of EAC during its 46<sup>th</sup> EAC (Non-Coal Mining) meeting held during 15<sup>th</sup>-17<sup>th</sup> February, 2022 hereby accords Specific and Standard Terms of Reference (ToR) for M/s National Mineral Development Corporation - Chhattisgarh Mineral Development Corporation Limited (NCL), a joint venture of National Mineral Development Corporation Limited (a Central Government Public Sector Undertaking under the administrative control of ToR- M/s NMDC-CMDC Ltd (NCL) – Chhattisgarh



Ministry of Steel), and Chhattisgarh Mineral Development Corporation Limited (a Government of Chhattisgarh Public Sector Undertaking) for mining of Iron ore in Bailadila Iron Ore Deposit-4 Mine with production capacity of 7.0 MTPA ROM Iron ore and 6.41 MTPA Waste Excavation (Total Excavation 13.41 MTPA) along with 2000 TPH crushing plant in the mine lease area of 646.596 ha, located at Village & Tehsil Bacheli, District Dantewada, Chhattisgarh for undertaking detailed EIA/EMP study subject to the following specific conditions in addition to the standard ToR conditions applicable for non-coal mining projects:-

**A. SPECIFIC TERMS OF REFERENCE**

- i. The Project Proponent should install the continuous ambient air quality monitoring stations in such numbers as per the scientific study and in consultation with CPCB.
- ii. The Project Proponent needs to carry out the cumulative impact assessment by considering all the mining activity of the adjoining mines, crusher and beneficiation plant in the study area and should indicate the capacity of the each mine considered for predication of air quality modeling. The control case and worst-case scenario needs to be demonstrated with controlling factor and GLCs values for all the pollutants needs to be clearly mentioned. The input parameters used for the modeling also needs to be submitted.
- iii. The Project Proponent should prepare the EMP considering the scenario of pollution to be generated for normative and peak total excavation for assessing air and noise pollution by considering all the mining activity.
- iv. The Project Proponent needs to submit the restoration plan for waste dumps to be located in the forest land. PP should also submit the map demarcating the mineralized and non-mineralized zone in the forest land and non-forest land in the mine lease area.
- v. The Project Proponent needs to carry out the Public Hearing as per provisions of EIA Notification, 2006. PP should also submit the time bound action plan on concerns of the public through proper separate budget for the concerns of the local people in terms of health care facilities for COVID, betterment of schools nearby and to facilitate the online education system by providing Wi-Fi connectivity, smart classrooms and desktops/tablets, infrastructure, and environment protection.
- vi. The Project Proponent should submit the detailed plantation/greenbelt plan in tabular format (year wise for entire life of mine) with proper capital and recurring cost. PP shall undertake the adequate plantation with the seedling of 10 ft height with at least 90% survival rate and the peripheral plantation shall be completed within 6 months from the start of mining operations. The casualties of each year shall be replaced every year with new saplings and such number of saplings shall not be counted in the number of saplings proposed to plant in that year. PP shall undertake the progressive

bench plantation up to HFL for eco restoration of water bodies. Undertaking in this regard needs to be submitted by the PP.

- vii. The Project Proponent needs to submit the certificate obtained from Forest Department regarding tree fern area not to be diverted at the time of appraisal of EC.
- viii. The Project Proponent needs to submit the certified EC compliance report of adjacent mines for Deposit 5 & Deposit 10 at the time of appraisal of EC.

#### **B. STANDARD TOR FOR MINING PROJECT**

- 1) Year-wise production details since 1994 should be given, clearly stating the highest production achieved in any one year prior to 1994. It may also be categorically informed whether there had been any increase in production after the EIA Notification 1994 came into force, w.r.t. the highest production achieved prior to 1994. The production details need to submit since inception of mine duly authenticated by Department of Mines & Geology, State Government.
- 2) A copy of the document in support of the fact that the Proponent is the rightful lessee of the mine should be given.
- 3) All documents including approved mine plan, EIA and Public Hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management, mining technology etc. and should be in the name of the lessee.
- 4) All corner coordinates of the mine lease area, superimposed on a High-Resolution Imagery/toposheet, topographic sheet, geomorphology and geology of the area should be provided. Such an Imagery of the proposed area should clearly show the land use and other ecological features of the study area (core and buffer zone).
- 5) Information should be provided in Survey of India Toposheet in 1:50,000 scale indicating geological map of the area, geomorphology of land forms of the area, existing minerals and mining history of the area, important water bodies, streams and rivers and soil characteristics.
- 6) Details about the land proposed for mining activities should be given with information as to whether mining conforms to the land use policy of the State; land diversion for mining should have approval from State land use board or the concerned authority.
- 7) It should be clearly stated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large, may also be detailed in the proposed safeguard measures in each case should also be provided.

- 8) Issues relating to Mine Safety, including subsidence study in case of underground mining and slope study in case of open cast mining, blasting study etc. should be detailed. The proposed safeguard measures in each case should also be provided.
- 9) The study area will comprise of 10 km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine / lease period.
- 10) Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.
- 11) Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area, distance from mine lease, its land use, R&R issues, if any, should be given.
- 12) A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees.
- 13) Status of forestry clearance for the broken-up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished.
- 14) Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.
- 15) The vegetation in the RF / PF areas in the study area, with necessary details, should be given.
- 16) A study shall be got done to ascertain the impact of the Mining Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly, detailed mitigative measures required, should be worked out with cost implications and submitted.
- 17) Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar site Tiger/Elephant Reserves/(existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished.
- 18) A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and

fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled-I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.

- 19) Proximity to Areas declared as 'Critically Polluted' or the Project areas likely to come under the 'Aravali Range', (attracting court restrictions for mining operations), should also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB or State Mining Dept. Should be secured and furnished to the effect that the proposed mining activities could be considered.
- 20) Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the mine lease w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Mining Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).
- 21) R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need-based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the mine lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects should be discussed in the Report.
- 22) One season (non-monsoon) [i.e. March - May (Summer Season); October - December (post monsoon season); December - February (winter season)] primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-dominant downwind direction. The mineralogical composition of PM<sub>10</sub>, particularly for free silica, should be given.
- 23) Air quality modelling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modelling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.

- 24) The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated.
- 25) Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided.
- 26) Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided.
- 27) Impact of the Project on the water quality, both surface and groundwater, should be assessed and necessary safeguard measures, if any required, should be provided.
- 28) Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed Hydro Geological Study should be undertaken and Report furnished. The Report inter-alia, shall include details of the aquifers present and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished.
- 29) Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be.
- 30) Information on site elevation, working depth, groundwater table etc. Should be provided both in AMSL and BGL. A schematic diagram may also be provided for the same.
- 31) A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the Project. Phase-wise plan of plantation and compensatory afforestation should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to pollution.
- 32) Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered. Project Proponent shall conduct Impact of Transportation study as per Indian Road Congress Guidelines.
- 33) Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report.
- 34) Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA

report.

- 35) Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed.
- 36) Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.
- 37) Measures of socio-economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.
- 38) Detailed environmental management plan (EMP) to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if any, occupational health impacts besides other impacts specific to the proposed Project.
- 39) Public Hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan with budgetary provisions to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.
- 40) Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.
- 41) The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.
- 42) A Disaster Management Plan shall be prepared and included in the EIA/EMP Report.
- 43) Benefits of the Project if the Project is implemented should be spelt out. The benefits of the Project shall clearly indicate environmental, social, economic, employment potential, etc.
- 44) Activity-wise time-bound action plan on the issues raised and commitment made during public hearing to be submitted as part of the final EMP Report in compliance of the Ministry's OM F.No.22-65/2017-IA.III dated 30<sup>th</sup> September, 2020.

16. Besides the above, the below mentioned general points are also to be followed: -

- a) All documents to be properly referenced with index and continuous page numbering.
- b) Where data are presented in the Report especially in Tables, the period in which the data were collected and the sources should be indicated.
- c) Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the Project.
- d) Where the documents provided are in a language other than English, an English translation should be provided.
- e) The Questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry shall also be filled and submitted.
- f) While preparing the EIA report, the instructions for the Proponents and instructions for the Consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II (I) dated



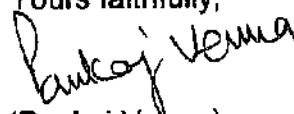
4<sup>th</sup> August, 2009, which are available on the website of this Ministry, should be followed.

- g) Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation.
- h) As per the circular no. J-11011/618/2010-IA.II (I) dated 30.5.2012, certified report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project, should be obtained from the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.
- i) The EIA report should also include (i) surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area.

17. The prescribed TOR would be valid for a period of four years for submission of the EIA/EMP report, as per the notification S.O 751 (E) dated 17.02.2020. The instant TOR is valid up to four years from the date of issuance of TOR.

18. The Project Proponent should submit the EIA/EMP report as per the generic structure prescribed in Appendix-III of the EIA Notification, 2006 after incorporating the details of public hearing conducted and covering the above-mentioned issues, to take further necessary action for obtaining environmental clearance in accordance with the procedure prescribed under the EIA Notification, 2006.

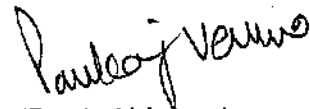
19. This issues with the approval of the Competent Authority.

Yours faithfully,  
  
(Pankaj Verma)  
Scientist 'E'

**Copy to:**

1. **The Secretary**, Ministry of Mines, Government of India, Shastri Bhawan, New Delhi-110 001.
2. **The Secretary**, Department of Environment, Government of Chhattisgarh.
3. **The Secretary**, Department of Mines and Geology, Government of Chhattisgarh, Chhattisgarh.
4. **The Chairman**, Chhattisgarh Environment Conservation Board, Nanak Niwas, Civil Lines, Raipur, Chhattisgarh.

5. **The Additional Principal Chief Conservator of Forests(C)**, Ministry of Environment, Forest and Climate Change, Regional Office (WCZ), Ground Floor, East Wing, New Secretariat Building, Civil Lines, Nagpur - 440001.
6. **The Controller General**, Indian Bureau of Mines, Indira Bhavan, Civil Lines, Nagpur-440 001.
7. **Regional Officer**, Ministry of Environment, Forest and Climate Change, Integrated Regional Office, Ground Floor, East Wing, New Secretariat Building, Civil Lines, Nagpur - 440001.
8. **The Chairman**, Central Pollution Control Board, Parivesh Bhawan, CBD-Cum-Office Complex, East Arjun Nagar, New Delhi-110 032.
9. **The Member Secretary**, Chhattisgarh State Pollution Control Board, Commercial Complex, Chhattisgarh Housing Board Colony, Kabir Nagar, Raipur, Chhattisgarh.
10. **The Member Secretary**, Central Ground Water Authority, 18/11, Jam Nagar House, Man Singh Road, New Delhi-110011.
11. **The Chief Wildlife Warden**, Govt. of Chattisgarh, Aranya Bhavan, Jail Road, Fafadih Chowk, Raipur - 492001.
12. **The District Collector**, District Dantewada, Govt. of Chhattisgarh.
13. **Guard File.**
14. **PARIVESH Portal.**

  
(Pankaj Verma)  
Scientist 'E'

F. No. IA-J-11011/23/2022-IA-II(IND-I)  
Government of India  
Ministry of Environment, Forest and Climate Change  
(Impact Assessment Division)

Indira Paryavaran Bhawan  
Jor Bagh Road, Aliganj,  
New Delhi – 110003  
E-mail: r.sundar@nic.in  
Tel: 011-24695304

Dated: 21<sup>st</sup> February, 2022

To

**Shri. Pankaj,**  
CEO,  
M/s. NMDC – CMDC Limited  
Green Valley City, Housing Board Colony, Post Sejbahar, NH-30  
Raipur Chhattisgarh - 492015  
Email: ceonmdccmdc@gmail.com

**Subject:** Screening Cum Beneficiation Plant (750 TPH of 4 lines each) along with 2200 TPH Downhill Conveyor System and Loading Facilities in 195.537 Ha. Area (Forest area of 100.077 Ha. and 95.46 Ha. of revenue land) located at outside the Mine Lease area of Bailadila Iron Ore Deposit-4 (646.596 Ha.) by M/s. NMDC – CMDC Limited at Village Bhansi, Tehsil Bachel, District Dantewada, Chhattisgarh – Prescribing of Terms of Reference – regarding.

Sir,

1. This refers to the online application of M/s. NMDC – CMDC Limited made vide proposal no. IA/CG/IND/251437/2022 dated 25/01/2022 in prescribed format (Form-1), copy of pre-feasibility report and proposed ToRs for undertaking detailed EIA study as per the EIA Notification, 2006 for the project mentioned above. The proposed project activity is listed at schedule no. 2(b) Mineral Beneficiation under Category “A” of the schedule of the EIA Notification, 2006 and appraised at central level.
2. The proposal cited above was considered in 53<sup>rd</sup> meeting of Reconstituted Expert Appraisal Committee (Industry 1 sector) held on 10-11<sup>th</sup> February, 2022. The EAC proceeding of the said meeting is furnished as below:

**Details submitted by Project proponent**

3. The project of M/s. NMDC – CMDC Limited will be Village Bhansi, Tehsil Bachel, District Dantewada, Chhattisgarh for Screening Cum Beneficiation Plant (750 TPH of 4 lines each) along with 2200 TPH Downhill Conveyor System and Loading Facilities.

4. Environmental site settings:

S No.	Particulars	Details	Remarks
i.	Total Land	195.537 ha [Forest area: 100.077 ha. and Revenue land: 95.46 ha]	Land use: Forest land and Revenue land.

*Terms of Reference for project titled “Screening Cum Beneficiation Plant (750 TPH of 4 lines each) along with 2200 TPH Downhill Conveyor System and Loading Facilities in 195.537 Ha. Area (Forest area of 100.077 Ha. and 95.46 Ha. of revenue land) located at outside the Mine Lease area of Bailadila Iron Ore Deposit-4 (646.596 Ha.) by M/s. NMDC – CMDC Limited at Village Bhansi, Tehsil Bachel, District Dantewada, Chhattisgarh.”*

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S No.	Particulars	Details	Remarks																																																			
ii.	Land acquisition details as per MoEF&CC O.M. dated 7/10/2014.	Total land of 195.537 ha is yet to be acquired. Out of 195.537 ha, 100.077 ha is forest land 100.077 ha (falling outside ML area). for obtaining Forest clearance. 95.46 Ha. of revenue land is required at Bhansi for establishment of ancillary facilities.	For the diversion of Forest land, PP has submitted application vide proposal no. FP/CG/MIN/146694/2021 on 04/10/2021.																																																			
iii.	Existence of habitation & involvement of R&R, if any.	<p>Project Site: About 95.46 Ha. of revenue land is required at Bhansi for establishment of ancillary facilities. R&amp;R Policy as per “The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation And Resettlement Act, 2013” will Be Prepared In Respect Of The Project Affected Families (PAFs).</p> <p>Study Area:</p> <table><tr><td>Habitation</td><td>Distance</td><td>Direction</td></tr><tr><td>Bacheli</td><td>2.65 km</td><td>SSW</td></tr><tr><td>Bhansi</td><td>0.12 km</td><td>East</td></tr></table>	Habitation	Distance	Direction	Bacheli	2.65 km	SSW	Bhansi	0.12 km	East																																											
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iv.	Latitude and Longitude of all Corners of the project site.	<p>Screening cum Beneficiation Plant</p> <table><tr><td>Point</td><td>Latitude</td><td>Longitude</td></tr><tr><td>S1</td><td>N18° 46' 23.47</td><td>E81° 15' 27.23</td></tr><tr><td>S2</td><td>N18° 46' 23.45</td><td>E81° 15' 39.40</td></tr><tr><td>S3</td><td>N18° 46' 05.19</td><td>E81° 15' 39.37</td></tr><tr><td>S4</td><td>N18° 46' 05.21</td><td>E81° 15' 27.20</td></tr></table> <p>Tailing Pond</p> <table><tr><td>Point</td><td>Latitude</td><td>Longitude</td></tr><tr><td>SL7</td><td>N18° 44' 35.41</td><td>E81° 15' 52.24</td></tr><tr><td>SL8</td><td>N18° 44' 35.64</td><td>E81° 15' 52.91</td></tr><tr><td>TP1</td><td>N18° 44' 40.64</td><td>E81° 16' 08.03</td></tr><tr><td>TP2</td><td>N18° 43' 59.32</td><td>E81° 16' 10.19</td></tr><tr><td>TP3</td><td>N18° 44' 05.40</td><td>E81° 15' 46.89</td></tr><tr><td>TP4</td><td>N18° 44' 34.03</td><td>E81° 15' 48.04</td></tr></table> <p>Admin Office</p> <table><tr><td>Point</td><td>Latitude</td><td>Longitude</td></tr><tr><td>AD1</td><td>N18° 46' 26.68</td><td>E81° 16' 00.70</td></tr><tr><td>AD2</td><td>N18° 46' 29.93</td><td>E81° 16' 00.53</td></tr><tr><td>AD3</td><td>N18° 46' 30.09</td><td>E81° 16' 03.95</td></tr><tr><td>AD4</td><td>E81° 16' 04.11</td><td>N18° 46' 26.84</td></tr></table>	Point	Latitude	Longitude	S1	N18° 46' 23.47	E81° 15' 27.23	S2	N18° 46' 23.45	E81° 15' 39.40	S3	N18° 46' 05.19	E81° 15' 39.37	S4	N18° 46' 05.21	E81° 15' 27.20	Point	Latitude	Longitude	SL7	N18° 44' 35.41	E81° 15' 52.24	SL8	N18° 44' 35.64	E81° 15' 52.91	TP1	N18° 44' 40.64	E81° 16' 08.03	TP2	N18° 43' 59.32	E81° 16' 10.19	TP3	N18° 44' 05.40	E81° 15' 46.89	TP4	N18° 44' 34.03	E81° 15' 48.04	Point	Latitude	Longitude	AD1	N18° 46' 26.68	E81° 16' 00.70	AD2	N18° 46' 29.93	E81° 16' 00.53	AD3	N18° 46' 30.09	E81° 16' 03.95	AD4	E81° 16' 04.11	N18° 46' 26.84	
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v.	Elevation of the project site	Screening cum Beneficiation Plant- 580 m AMSL Loading Plant- 532 m AMSL Tailing pond- 500 m AMSL																																																				
vi.	Water body (Rivers, Lakes Pond, Nala, Natural Drainage,	<p>Project Site: Nil.</p> <p>Study Area:</p> <table><tr><td>Water Body</td><td>Distance</td><td>Direction</td></tr><tr><td>Sankini nallah</td><td>3.0 km</td><td>West</td></tr></table>	Water Body	Distance	Direction	Sankini nallah	3.0 km	West																																														
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Terms of Reference for project titled "Screening Cum Beneficiation Plant (750 TPH of 4 lines each) along with 2200 TPH Downhill Conveyor System and Loading Facilities in 195.537 Ha. Area (Forest area of 100.077 Ha. and 95.46 Ha. of revenue land) located at outside the Mine Lease area of Bailadila Iron Ore Deposit-4 (646.596 Ha.) by M/s. NMDC – CMDC Limited at Village Bhansi, Tehsil Bacheli, District Dantewada, Chhattisgarh."

S No.	Particulars	Details			Remarks
	Canal etc.) exists within the project site as well as study area	Nerli Nalla	4.5 km	East	
vii.	Existence of ESZ/ ESA/ national park/ wildlife sanctuary/ biosphere reserve/ tiger reserve/ elephant reserve etc. if any within the study area	NIL			

5. The unit configuration and capacity of proposed project is given as below:

S No	Plant Equipment/ Facility	Configuration	Capacity	Remarks
1.	Downhill Conveyor System	7.55 km	2200 TPH	--
2.	Screening Plant with Plant with Beneficiation Facilities	4x750 TPH	3000 TPH	--
3.	Tertiary Crushing	2x800 TPH	1600 TPH	--
4.	Loading and Stacking Facilities	1	3000 TPH	--
5.	Slimes Disposal into Tailing Pond along with Slurry Pipeline	1	68.130 ha. Capacity: 9.50 million tons (40 lakh m <sup>3</sup> )	--

6. The details of the raw material requirement for the proposed project along with its source and mode of transportation is given as below:

Raw Material	Quantity required per annum	Source	Distance from site (Kms)	Mode of Transportation
ROM Iron Ore	7.00 MTPA	Bailadila Iron Ore Deposit- 4 Mine	13-15 km	During first 5 years of operation, the processed ore after in-pit crushing & screening is proposed to be transported by Tippers of 25-ton capacity by utilizing existing road (proposed to be strengthened) covering a distance of 13-15 km from hilltop to Loading plant area proposed to established near Bhansi railway station. After establishment of infrastructure facilities outside lease, the crushed ROM will be conveyed through downhill conveyor system from the crushing plant

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Raw Material	Quantity required per annum	Source	Distance from site (Kms)	Mode of Transportation
				inside lease area to the Screening cum Beneficiation Plant outside lease area. The products from the plant will be conveyed to the Loading plant at Bhansi through a conveyor. The CLO and Fine ore will be transported through rail from Bhansi railway siding.

7. The water requirement for the proposed project is estimated to be 8,630 m<sup>3</sup>/day, which will be sourced from the existing Sankini Nalla and Nerli Nalla. Considering the future requirements including Mine, infrastructure, and proposed township, water Requirement is envisaged to be around 20,000 m<sup>3</sup>/day at the peak rated capacity which will be met from the source of existing Sankini Nalla and Nerli Nalla. NMDC-CMDC has submitted application for obtaining water permission for 20,000 KLD with Water Resource Department, Raipur, vide letter No. NCL/ HO/ Dep-4/ WR/ 2021/960 Dated 08/12/2021.
8. The power requirement for the proposed project is estimated as 6 MVA (Mining and infrastructure both interlinked projects), which will be obtained from the Chhattisgarh State Power Distribution Company Limited.
9. The capital cost of the is Rs. 4,091.33 Crores. The capital cost for environmental protection measures will be submitted in EIA/EMP report. The employment generation from the proposed project is 700 people. The cost of the project and employment includes both mining and infrastructure projects.
10. It has been reported by PP that, there is no violation under EIA Notification, 2006/court case/ show cause/ direction related to the project under consideration.
11. Name of the EIA consultant: M/s. Ecomen laboratories Private Limited [S No 156, NABET Certificate/ Ext. ltr no. NABET/EIA/2023/RA 0203 valid up to 21/09/2023; Rev. 18, January 05, 2022].
12. Proposed Terms of Reference (Baseline data collection period: December 2021 to February 2022):

Attributes	Parameters	Sampling		Remarks
		No. of Location	Frequency	
A. Air				
a. Meteorological parameters	Wind speed & direction, temperature, Relative humidity, rainfall	1	Hourly recording 24hrly	
b. AAQ parameters	PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , NO <sub>x</sub> , CO, O <sub>3</sub> , CO, NH <sub>3</sub> , C <sub>6</sub> H <sub>6</sub> , As, Ni, BaP & Pb	10	24 hourly sample twice a week for a month covering one-full season	

Terms of Reference for project titled "Screening Cum Beneficiation Plant (750 TPH of 4 lines each) along with 2200 TPH Downhill Conveyor System and Loading Facilities in 195.537 Ha. Area (Forest area of 100.077 Ha. and 95.46 Ha. of revenue land) located at outside the Mine Lease area of Bailadila Iron Ore Deposit-4 (646.596 Ha.) by M/s. NMDC - CMDC Limited at Village Bhansi, Tehsil Bachel, District Dantewada, Chhattisgarh."



Attributes	Parameters	Sampling		Remarks
		No. of Location	Frequency	
			CO: 8-hour sample.	
<b>B. Noise</b>	Noise levels in dBA Leq day time & Leq night time	10	Once during study period	
<b>C. Water</b>				
Surface water/ Ground water quality parameters	Physical, Chemical and Bacteriological parameters as per IS: 2296/10500 standards.	11	Once during study period.	(6 surface water and 5 for ground water)
<b>D. Land</b>				
a. Soil quality	pH, conductivity, texture, NPK, organic matter, moisture content, grain size distribution.	6	Once during study period	
b. Land Use	Land use / land cover will be prepared through using IRS satellite data (LISS-IV) and Arc GIS/ Erdas imagine software.	Study area	Once during study period	
<b>E. Biological</b> a. Aquatic b. Terrestrial	Flora and Fauna, studies authenticated separately for core and buffer zone based on primary field survey, clearly indicating that Schedule of fauna present. In case of any schedule-1 fauna found in the study area, specific wildlife conservation plan will be prepared. Secondary data shall be collected from Forest Deptt's working plans and primary data through field survey.	Study area	Once during study period	
<b>F. Socio-economic parameters</b>	Socio-economic characteristics	Study area	Secondary data from Census 2011 and	

Terms of Reference for project titled "Screening Cum Beneficiation Plant (750 TPH of 4 lines each) along with 2200 TPH Downhill Conveyor System and Loading Facilities in 195.537 Ha. Area (Forest area of 100.07" Ha. and 95.46 Ha. of revenue land) located at outside the Mine Lease area of Bailadila Iron Ore Deposit-4 (646.596 Ha.) by M/s. NMEC – CMDC Limited at Village Bhansi, Tehsil Bachel, District Dantewada, Chhattisgarh."



Attributes	Parameters	Sampling		Remarks
		No. of Location	Frequency	
			primary data from field survey.	

#### Observations of the Committee

13. The EAC noted the following:
- The instant proposal is for seeking ToR for undertaking EIA study for setting up of 7.0 MTPA IOBP along with 2200 TPH downhill conveyer, loading and unloading facility and tailing pond.
  - Total land of 195.537 ha is proposed for project out of which 100.077 ha is forest area and 95.46 ha area is revenue land.
  - 2 Km Slurry pipeline to tailing pond will be passed through Reserved Forests (RF). Railway siding also passes through 2 RFs. There are 16 roads to be constructed which will also pass through 2 RFs.
  - With respect to the ongoing baseline data collection, 10 Nos of AAQ stations selected are grossly inadequate for staggered project area. Along the conveyor route also at least one AAQ station is required. Baseline data already collected is not acceptable as the number of stations are inadequate. AAQ stations shall be decided based on meteorology and topography of the area.

#### Recommendations of the Committee

14. After deliberations, the Committee recommended the project proposal for prescribing following specific ToRs for undertaking detailed EIA and EMP study in addition to the generic ToRs enclosed at Annexure-1 read with additional ToRs at Annexure-2:
- Project proponent shall collect fresh one season Ambient Air Quality (AAQ) data based on meteorology and topography of the area.
  - A scheme for Dry disposal of Iron Ore Beneficiation Plant (IOBP) tailings after dewatering shall be submitted.
  - Cumulative impact assessment shall be carried out for iron ore mines and beneficiation plant.
  - Detail regarding no. of trees to be cut, girth & height, age and species of the trees shall be provided in the EIA/EMP report.
  - R&R shall be implemented as per Land Acquisition, Rehabilitation and Resettlement (LARR) Act 2013. The details shall be furnished in EIA report.
  - Status of Forest Clearance for the diversion of 100.07 ha of forest land shall be submitted.
  - Details regarding downhill pipe conveyor, Right of Way for the conveyor and the noise control measures to be adopted in the conveyor route shall be submitted.
  - Action plan to limit the particulate matter emission from all the stacks below 30 mg/Nm<sup>3</sup> shall be furnished.
  - Action plan for fugitive emission control in the plant premises shall be provided.
  - Action plan for green belt development in 33% of total area with tree density of 2500 plants per ha shall be submitted. This shall include 20 m green belt development inside the project area towards the Bhansi Village located at distance of 250 meter from the project site.
  - Action plan for rain water harvesting shall be submitted.


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- xii. Action plan for the stock piles with impervious floor, provision of garland drains and catch pits to trap run off material shall be submitted.
- xiii. Action plan for developing connecting and internal road in terms of MSA as per IRC guidelines shall be submitted.
- xiv. Details of flora and fauna existing in the study area shall duly be authenticated by the concerned DFO of the area. In case of existence of any endangered species and schedule I fauna, authenticated conservation plan shall be submitted.


**Decision of MoEF&CC**

15. The undersigned is directed to inform that Ministry of Environment, Forest and Climate Change has examined the proposal in accordance with the Environment Impact Assessment (EIA) Notification, 2006 & further amendments thereto and after accepting the recommendations of the Expert Appraisal Committee (Industry-1) hereby decided to accord above-said specific ToRs, in addition to the standard ToRs and Sector Specific ToRs as enclosed at Annexure I read with additional ToRs at Annexure-2 for carrying out detailed EIA/EMP for the above project.
16. It is requested that the draft EIA Report may be prepared in accordance with the above-mentioned specific ToRs and enclosed generic ToRs and additional ToRs and thereafter further necessary action including conduct of public consultation may be taken for obtaining Environment Clearance in accordance with the procedure prescribed under the EIA Notification, 2006 as amended.
17. The ToRs are valid for a period of four years from date of issue of this letter as per the Ministry's Notification S.O. 751 (E) dated 17/02/2020.
18. This issue with the approval of the Competent Authority.

  
(Sundar Ramanathan)  
Scientist 'E'

**Copy to: -**

1. Secretary, Department of Environment, Government of Chhattisgarh.
2. Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum office complex, East Arjun Nagar, Delhi-110032.
3. Chairman, Chhattisgarh Environment Conservation Board, Nanak Niwas, Civil Lines, Raipur, Chhattisgarh.
4. Regional Officer, Ministry of Environment, Forest and Climate Change, Integrated Regional Office, Aranya Bhawan, North Block, Sector-19 Naya Raipur, Atal Nagar, Chhattisgarh - 492002.
5. Member Secretary, Central Ground Water Authority, A2, W3 Curzon Road Barracks, K.G. Marg, New Delhi-110001.
6. Chief Wildlife Warden, Govt. of Chhattisgarh, Aranya Bhawan, Jail Road, Fafadih Chowk, Raipur - 492001.
7. District Collector, Dantewada, District, Chhattisgarh.
8. Guard File/Record File/Monitoring File.
9. MoEF&CC website.

  
(Sundar Ramanathan)  
Scientist 'E'

*Terms of Reference for project titled "Screening Cum Beneficiation Plant (750 TPH of 4 lines each) along with 2200 TPH Downhill Conveyor System and Loading Facilities in 195.537 Ha. Area (Forest area of 100.077 Ha. and 95.46 Ha. of revenue land) located at outside the Mine Lease area of Bailadila Iron Ore Deposit-4 (646.596 Ha.) by M/s. NMDC - CMDC Limited at Village Bhansi, Tehsil Bacheli, District Dantewada, Chhattisgarh."*



**GENERIC TERMS OF REFERENCE (ToR) IN RESPECT OF INDUSTRY SECTOR**

- 1. Executive Summary**
- 2. Introduction**
  - i. Details of the EIA Consultant including NABET accreditation
  - ii. Information about the project proponent
  - iii. Importance and benefits of the project
- 3. Project Description**
  - i. Cost of project and time of completion.
  - ii. Products with capacities for the proposed project.
  - iii. If expansion project, details of existing products with capacities and whether adequate land is available for expansion, reference of earlier EC if any.
  - iv. List of raw materials required and their source along with mode of transportation.
  - v. Other chemicals and materials required with quantities and storage capacities
  - vi. Details of Emission, effluents, hazardous waste generation and their management.
  - vii. Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)
  - viii. The project proponent shall furnish the requisite documents from the competent authority in support of drawl of ground water and surface water and supply of electricity.
  - ix. Process description along with major equipment and machineries, process flow sheet (Quantitative) from raw material to products to be provided
  - x. Hazard identification and details of proposed safety systems.
  - xi. Expansion/modernization proposals:
    - a. Copy of all the Environmental Clearance(s) including Amendments thereto obtained for the project from MoEF&CC/SEIAA shall be attached as an Annexure. A certified copy of the latest Monitoring Report of the Regional Office of the Ministry of Environment, Forest and Climate Change as per circular dated 30<sup>th</sup> May, 2012 on the status of compliance of conditions stipulated in all the existing environmental clearances including Amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing /existing operation of the project from SPCB/PCC shall be attached with the EIA-EMP report.
    - b. In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA Notification 1994 and/or EIA Notification 2006 shall be provided. Copies of Consent to Establish/No Objection Certificate and Consent to Operate (in case of units operating prior to EIA Notification 2006, CTE and CTO of FY 2005-2006) obtained from the SPCB shall be submitted. Further, compliance report to the conditions of consents from the SPCB shall be submitted.
- 4. Site Details**
  - i. Location of the project site covering village, Taluka/Tehsil, District and State, Justification for selecting the site, whether other sites were considered.
  - ii. A toposheet of the study area of radius of 10km and site location on 1:50,000/1:25,000 scale on an A3/A2 sheet. (Including all eco-sensitive areas and environmentally sensitive places)
  - iii. Co-ordinates (lat-long) of all four corners of the site.
  - iv. Google map-Earth downloaded of the project site.

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- v. Layout maps indicating existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities etc. If located within an Industrial area/Estate/Complex, layout of Industrial Area indicating location of unit within the Industrial area/Estate.
- vi. Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular.
- vii. Land use break-up of total land of the project site (identified and acquired), government/private - agricultural, forest, wasteland, water bodies, settlements, etc shall be included. (Not required for industrial area)
- viii. A list of major industries with name and type within study area (10km radius) shall be incorporated. Land use details of the study area
- ix. Geological features and Geo-hydrological status of the study area shall be included.
- x. Details of Drainage of the project upto 5km radius of study area. If the site is within 1 km radius of any major river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum Flood Level of the river shall also be provided. (Mega green field projects)
- xi. Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.
- xii. R&R details in respect of land in line with state Government policy.

#### 5. Forest and wildlife related issues (if applicable):

- i. Permission and approval for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department. (If applicable).
- ii. Land use map based on High resolution satellite imagery (GPS) of the proposed site delineating the forestland (in case of projects involving forest land more than 40 ha).
- iii. Status of Application submitted for obtaining the stage I forestry clearance along with latest status shall be submitted.
- iv. The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden-thereon.
- v. Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State Government for conservation of Schedule I fauna, if any exists in the study area.
- vi. Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972, to the Standing Committee of the National Board for Wildlife.

#### 6. Environmental Status

- i. Determination of atmospheric inversion level at the project site and site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall.
- ii. AAQ data (except monsoon) at 8 locations for PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub>, CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.
- iii. Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAQPM Notification of Nov. 2009 along with – min., max., average

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and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report.

- iv. Surface water quality of nearby River (60m upstream and downstream) and other surface drains at eight locations as per CPCB/MoEF&CC guidelines.
- v. Whether the site falls near to polluted stretch of river identified by the CPCB/MoEF&CC.
- vi. Ground water monitoring at minimum at 8 locations shall be included.
- vii. Noise levels monitoring at 8 locations within the study area.
- viii. Soil Characteristic as per CPCB guidelines.
- ix. Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.
- x. Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule-I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished.
- xi. Socio-economic status of the study area.

## 7. Impact Assessment and Environment Management Plan

- i. Assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features. In case the project is located on a hilly terrain, the AQIP Modelling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be well assessed. Details of the model used and the input data used for modelling shall also be provided. The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any.
- ii. Water Quality modelling – in case, if the effluent is proposed to be discharged in to the local drain, then Water Quality Modelling study should be conducted for the drain water taking into consideration the upstream and downstream quality of water of the drain.
- iii. Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided. In this regard, options for transport of raw materials and finished products and wastes (large quantities) by rail or rail-cum road transport or conveyor-cum-rail transport shall be examined.
- iv. A note on treatment of wastewater from different plant operations, extent recycled and reused for different purposes shall be included. Complete scheme of effluent treatment. Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E (P) Rules.
- v. Details of stack emission and action plan for control of emissions to meet standards.
- vi. Measures for fugitive emission control
- vii. Details of hazardous waste generation and their storage, utilization and disposal. Copies of MOU regarding utilization of solid and hazardous waste shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/recover techniques, Energy conservation, and natural resource conservation.
- viii. Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided.
- ix. Action plan for the green belt development plan in 33 % area i.e. land with not less than 1,500 trees per ha. Giving details of species, width of plantation, planning

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schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.

- x. Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources.
- xi. Total capital cost and recurring cost/annum for environmental pollution control measures shall be included.
- xii. Action plan for post-project environmental monitoring shall be submitted.
- xiii. Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and damage control. Disaster management plan should be linked with District Disaster Management Plan.

#### 8. Occupational health

- i. Details of existing Occupational & Safety Hazards. What are the exposure levels of above mentioned hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved,
- ii. Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre-designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre-placement and periodical examinations give the details of the same. Details regarding last month analysed data of abovementioned parameters as per age, sex, duration of exposure and department wise.
- iii. Annual report of health status of workers with special reference to Occupational Health and Safety.
- iv. Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers.

#### 9. Corporate Environment Policy

- i. Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.
- ii. Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.
- iii. What is the hierarchical system or administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given.
- iv. Does the company have system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report

- 10. Details regarding infrastructure facilities such as sanitation, fuel, restroom etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.
- 11. To address the Public Hearing issues, provisions contained. under Ministry's Office Memorandum vide F.No. 22-65/2017-IA.III dated 30/09/2020 shall be complied.
- 12. Any litigation pending against the project and/or any direction/order passed by any Court of

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Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance/ATR to the notice(s) and present status of the case.

13. A tabular chart with index for point wise compliance of above ToRs.
14. The ToRs prescribed shall be valid for a period of three years for submission of the EIA-EMP reports along with Public Hearing Proceedings (wherever stipulated).

**The following general points shall be noted:**

- i. All documents shall be properly indexed, page numbered.
- ii. Period/date of data collection shall be clearly indicated.
- iii. Authenticated English translation of all material in regional languages shall be provided.
- iv. The letter/application for environmental clearance shall quote the MOEF&CC file No. and also attach a copy of the letter.
- v. The copy of the letter received from the Ministry shall be also attached as an annexure to the final EIA-EMP Report.
- vi. The index of the final EIA-EMP report must indicate the specific chapter and page no. of the EIA-EMP Report
- vii. While preparing the EIA report, the instructions for the proponents and instructions for the consultants issued by MOEF&CC vide O.M. No. J-11013/41/2006-IA.II (I) dated 4th August, 2009, which are available on the website of this Ministry shall also be followed.
- viii. The consultants involved in the preparation of EIA-EMP report after accreditation with Quality Council of India (QCI)/National Accreditation Board of Education and Training (NABET) would need to include a certificate in this regard in the EIA-EMP reports prepared by them and data provided by other organization/Laboratories including their status of approvals etc. Name of the Consultant and the Accreditation details shall be posted on the EIA-EMP Report as well as on the cover of the Hard Copy of the Presentation material for EC presentation.
- ix. ToRs' prescribed by the Expert Appraisal Committee (Industry) shall be considered for preparation of EIA-EMP report for the project in addition to all the relevant information as per the 'Generic Structure of EIA' given in Appendix III and IIIA in the EIA Notification, 2006. Where the documents provided are in a language other than English, an English translation shall be provided. The draft EIA-EMP report shall be submitted to the State Pollution Control Board of the concerned State for conduct of Public Hearing. The SPCB shall conduct the Public Hearing/public consultation, district-wise, as per the provisions of EIA notification, 2006. The Public Hearing shall be chaired by an Officer not below the rank of Additional District Magistrate. The issues raised in the Public Hearing and during the consultation process and the commitments made by the project proponent on the same shall be included separately in EIA-EMP Report in a separate chapter and summarized in a tabular chart with financial budget (capital and revenue) along with time-schedule of implementation for complying with the commitments made. The final EIA report shall be submitted to the Ministry for obtaining environmental clearance.

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**ADDITIONAL ToRS FOR BENEFICIATION PLANT**

1. Complete process flow diagram describing each unit, its processes and operations, along with material and energy inputs & outputs (material and energy balance).
2. Details regarding pollution control measures to be adopted in the mineral handling area, loading and unloading areas including all transfer points shall be submitted.
3. The Project proponent shall submit action plan for conditioning of the ore with water to mitigate fugitive dust emission, without affecting flow of ore in the ore processing and handling areas.
4. Treatment details regarding effluent generated from the ore beneficiation plant and the mode of transportation of tailing slurry shall be submitted.
5. Separate chapter on design of the tailing/slime pond by considering the rainfall in the area, proximity of the tailing/slime pond to the nearby water bodies and safety etc., shall be submitted.
6. Action plan for regular monitoring of ground water level and quality in and around the project area of beneficiation plant and tailing/slime pond shall be submitted by establishing a network of existing wells and constructing new piezometers.
7. Details regarding establishment of garland drain around the tailing/slime pond and the quantity of decanted water to be re-circulated from the tailing/slime pond shall be submitted along with complete water balance.
8. Technology to be adopted for maximum recovery of ore in order to reduce slurry discharge and to increase the life of the tailing/slime pond shall be submitted.

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## Executive Summary

Executive summary of the report in about 8-10 pages incorporating the following:

- i. Project name and location (Village, District, State, Industrial Estate (if applicable))
- ii. Products and capacities. If expansion proposal, then existing products with capacities and reference to earlier EC.
- iii. Requirement of land, raw material, water, power, fuel, with source of supply (Quantitative)
- iv. Process description in brief, specifically indicating the gaseous emission, liquid effluent and solid and hazardous wastes. Materials balance shall be presented.
- v. Measures for mitigating the impact on the environment and mode of discharge or disposal.
- vi. Capital cost of the project, estimated time of completion
- vii. Site selected for the project – Nature of land – Agricultural (single/double crop), barren, Govt./private land, status of its acquisition, nearby (in 2-3 km.) water body, population, within 10km other industries, forest, eco-sensitive zones, accessibility, (note – in case of industrial estate this information may not be necessary)
- viii. Baseline environmental data – air quality, surface and ground water quality, soil characteristic, flora and fauna, socio-economic condition of the nearby population
- ix. Identification of hazards in handling, processing and storage of hazardous material and safety system provided to mitigate the risk.
- x. Likely impact of the project on air, water, land, flora-fauna and nearby population
- xi. Emergency preparedness plan in case of natural or in plant emergencies
- xii. Issues raised during public hearing (if applicable) and response given
- xiii. CSR plan with proposed expenditure.
- xiv. Occupational Health Measures
- xv. Post project monitoring plan

\*\*\*\*\*

**FORM - A**

Form for seeking prior approval of Central Government under section 2 of the Forest(Conservation) Act, 1980 for Diversion of fresh forest area

**PART - I**

(To be filled up by User Agency)

**A. General Details****A-1. Project Details**

- (i). **Proposal No.** : FP/CG/MIN/146694/2021
- (ii). **Name of Project for which Forest Land is required** : Bailadila Iron Ore Mine Deposit-4
- (iii). **Short narrative of the proposal and Project/scheme for which the forest land is required** : Proposal for diversion of 682.2722Ha (570.100 Ha inside lease and 112.1722 Ha outside lease) forest land for Bailadila Iron Ore Deposit-4 Mine of NMDC-CMDC Limited in Dantewada Forest Division, South Bastar Dantewada Dt, CG
- (iv). **State** : Chhattisgarh
- (v). **Category of the Proposal** : Mining
- (vi). **Shape of forest land proposed to be diverted** : Hybrid
- (vii). **Estimated cost of the Project(Rupees in lacs)** : 409133
- (viii). **Area of forest land proposed for diversion(in ha.)**: 682.2722
- (ix). **Non-forest land required for this project(in ha.)**: 10.3706
- (x). **Total period for which the forest land is proposed to be diverted(in years)**: 50


**A-2. Details of User Agency**

- (i). **Name** : NMDC CMDC LIMITED
- (ii). **Address1** : Green Valley City, Housing Board Colony, Post Sejbahar, NH-30 Raipur CG 492015
- (iii). **Address2** : NIL
- (iv). **State** : Chhattisgarh
- (v). **District** : Raipur
- (vi). **Pin** : 492015
- (vii). **Landmark** : Shadani Darbar NH-30
- (viii). **Email address** : ceonmdccmdc@gmail.com
- (ix). **Landline Telephone No.** : 771-2971919
- (x). **Fax No.** : 771-2971920
- (xi). **Mobile No.** : 9630099335
- (xii). **Website (if any)** : NIL
- (xiii). **Legal status of User Agency** : Central PSU

**A-3. Details of Person Making Application**

- (i). **First Name**: Pankaj
- (ii). **Middle Name**: Kumar
- (iii). **Last Name**: Sharma
- (iv). **Gender**: Male
- (v). **Designation**: CEO
- (vi). **Address 1**: Green Valley City, Housing Board Colony Boriakala, Post Sejbahar, NH 30, Raipur CG 492015
- (vii). **Address 2**: NIL
- (viii). **State**: Chhattisgarh
- (ix). **District**: Raipur
- (x). **Tehsil**: Raipur
- (xi). **Pin**: 492015
- (xii). **Landmark**: Shadani Darbar NH 30
- (xiii). **Email Address**: ceonmdccmdc@gmail.com
- (xiv). **Landline Telephone No.:** 771-2971919
- (xv). **Fax No.:** 07712971920
- (xvi). **Mobile No.:** 7477066437



(xvii). Copy of documents in support of the competence/authority of the person making this application to make application on behalf of the User Agency: 

## B. Details of land required for the Project

B-1. Details of proposal seeking prior approval of Central Government under the Act for diversion of forest land for the Project already submitted in the past

List of proposal submitted in Past							
S.no	Proposal Status.	Proposal No.	Moef File No.	Area Proposed for Diversion(Ha.)	Area Diverted(Ha.)	Date of In-Principle Approval	Date of Final Approval
<b>NIL</b>							

B-2. Details of forest land proposed to be diverted

B-2.1 Details of Divisions involved

Details of Divisions involved			
S.no	Division Name	Forest Land(ha.)	Non-Forest Land(ha.)
1.	Dantewada	682.2722	10.3706
Total		682.2722	10.3706

B-2.2 Details of Districts involved

District wise breakup			
S.no	District Name	Forest Land(ha.)	Non-Forest Land(ha.)
1.	Dantewada	682.2722	10.3706
Total		682.2722	10.3706

B-2.3 Village wise breakup

Villages wise breakup			
S.no	Village	Forest Land(ha.)	Non-Forest Land(ha.)
1	Porokameli	11.5299	2.7774
2	Badekameli	0.4	0.3786
3	Bhansi	670.3423	7.2146
Total		682.2722	10.3706

B-2.4 Component wise breakup

Component wise breakup			
S.no	Component	Forest Land(ha.)	Non-Forest Land(ha.)
1	Area under Mining (In-situ)	94.11	0
2	Area under Mining (Float Ore)	70.52	0
3	Overburden/Waste Dumping	74.07	0
4	Infrastructure (Crushing Plant, Workshop, Administ	65.9	0
5	Explosive Magazine Area	15.37	0
6	Green belt- Safety Zone along the ML Boundary	8.488	0
7	Area under Environmental Protection, improvement a	241.642	0
8	Major part of Downhill conveyor system including o	43	0
9	Screening Plant including all allied facilities	18.281	0
10	Loading Plant including all allied facilities	16.6496	3.4043
11	Railway siding	6.1603	6.3669
12	Existing roads widening / strengthening for two-wa	27.516	0
13	Pump House	0.4	0
14	Pipe line	0.1653	0.5994

<b>Total</b>	<b>682.2722</b>	<b>10.3706</b>
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**C. Maps of forest land proposed to be diverted**

Division 1. : Dantewada																																									
<p>(i). Area of forest land proposed to be diverted(in ha.) : 682.2722</p> <p>(ii). Nature of the Project: Hybrid</p> <p>(a). No. of patches : One</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th colspan="3" style="text-align: center; padding: 5px;">Patch wise details</th> </tr> <tr> <th style="width: 10%;">Patch No.</th> <th style="width: 20%;">Area of Patch(in ha.)</th> <th style="width: 70%;">Kml File of PatchesTo view KML file on google the same may be downloaded and then open if in google earth install in your computer.</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td style="text-align: center;">570.1</td> <td style="text-align: center;"> <a href="#">View File</a> </td> </tr> </tbody> </table> <p>(b). No. of Segments : Eight</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th colspan="3" style="text-align: center; padding: 5px;">Segment wise details</th> </tr> <tr> <th style="width: 10%;">Segments</th> <th style="width: 20%;">Segment Area(in ha.)</th> <th style="width: 70%;">Kml File of Segments (To view KML file on google the same may be downloaded and then open if in google earth install in your computer).</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">1.</td><td style="text-align: center;">43</td><td style="text-align: center;"> <a href="#">View File</a></td></tr> <tr><td style="text-align: center;">2.</td><td style="text-align: center;">12.0952</td><td style="text-align: center;"> <a href="#">View File</a></td></tr> <tr><td style="text-align: center;">3.</td><td style="text-align: center;">1.041</td><td style="text-align: center;"> <a href="#">View File</a></td></tr> <tr><td style="text-align: center;">4.</td><td style="text-align: center;">18.281</td><td style="text-align: center;"> <a href="#">View File</a></td></tr> <tr><td style="text-align: center;">5.</td><td style="text-align: center;">27.516</td><td style="text-align: center;"> <a href="#">View File</a></td></tr> <tr><td style="text-align: center;">6.</td><td style="text-align: center;">10.239</td><td style="text-align: center;"> <a href="#">View File</a></td></tr> <tr><td style="text-align: center;">7.</td><td style="text-align: center;">0</td><td style="text-align: center;"> <a href="#">View File</a></td></tr> <tr><td style="text-align: center;">8.</td><td style="text-align: center;">0</td><td style="text-align: center;"> <a href="#">View File</a></td></tr> </tbody> </table> <p>(iii). Copy of Survey of India Toposheet indicating boundary of forest land proposed to be diverted:  </p> <p>(iv). Scanned copy of the Geo-referenced map of the forest land proposed to be diverted prepared by using GPS or Total Station:  </p>			Patch wise details			Patch No.	Area of Patch(in ha.)	Kml File of PatchesTo view KML file on google the same may be downloaded and then open if in google earth install in your computer.	1.	570.1	<a href="#">View File</a>	Segment wise details			Segments	Segment Area(in ha.)	Kml File of Segments (To view KML file on google the same may be downloaded and then open if in google earth install in your computer).	1.	43	<a href="#">View File</a>	2.	12.0952	<a href="#">View File</a>	3.	1.041	<a href="#">View File</a>	4.	18.281	<a href="#">View File</a>	5.	27.516	<a href="#">View File</a>	6.	10.239	<a href="#">View File</a>	7.	0	<a href="#">View File</a>	8.	0	<a href="#">View File</a>
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**D. Justification for locating the Project in forest land and details of alternatives examined:**

- (i). Copy of note containing justification for locating the Project in forest land:
- (ii). Whether a copy of map indicating location of alternative examine is required to be provided: Yes
- (a). Copy of map indicating location of alternative examined:

**E. Employment likely to be generated**

- (i). Whether the Project is likely to generate employment?: Yes
- (ii). Permanent/Regular Employment(Number of persons): 700
- (iii). Temporary Employment(Number of person-days): 200

**F. Displacement of People due to the Project, if any**


- (i). Whether Project involves displacement?: Yes

(a). Total Number of families : 31

(b). Number of Scheduled Caste families : NIL

(c). Number of Schedule Tribes families : 17

(d). Number of other families : 14

(ii). Copy of Rehabilitation and Resettlement Plan: 

(a). Copy of approval to Ministry of Tribal Affairs, Government of India to Rehabilitation and Resettlement: 

#### G. Details of Cost-Benefit analysis for the Project

(i). Whether the Project requires Cost-Benefit analysis?: Yes

(a). Copy of Cost-Benefit analysis: 

#### H. Status of Environmental Clearance

(i). Whether the Project requires Clearance under the Environment (Protection) Act 1986 ? : Yes

(a). Status of the Environmental Clearance to the Project: EC under process

(ii). Environmental Clearance File No.: IA-J-11015/104/2021-IA-II(NCM)

#### I. Status of Wildlife Clearance

(i). Whether the Project or a part thereof is located in any Protected Area or their Eco sensitive zone? : No

#### J. Applicability of special provisions governing Scheduled Areas

(i). Whether the Project or a part thereof is located in a Scheduled Area? : Yes

#### K. Status of settlement of rights under the Forest Rights Act, 2006 on the forest land proposed to be diverted

(i). Whether the process for settlement of Rights under the Forest Rights Acts 2006 on the forest land proposed to be diverted has been completed? : No

#### L. Details of land identified for Compensatory Afforestation

(i). Whether non-forest or Revenue forest land is required to be provided by User Agency?: Not Applicable

(ii). Whether the area of non-forest land or Revenue forest land required to be provided by User Agency for raising Compensatory Afforestation is less than area of forest land proposed to be diverted ? : Not Applicable

(iii). Reason for not providing Non-Forest Land: Not Applicable

#### M. Mining Details

##### M-1. Details of Mineral Concessions

(i). Whether the forest land is acquired under Coal Bearing Areas Act: No

(a). Reference number of Letter of Intent for grant of mining lease. (approval letter of the State Mines and Geology Department): S.No.F2-20/2005/12 Nav Raipur Atal nagar June 2021





(b). Date of issue of the Letter of Intent (LOI) for grant of mining lease: 26 Jun 2021

(c). Copy the Letter of Intent (LOI): 

(d). Total area of the mining lease (in ha.): 646.596


(e). Area of forest land located in the mining lease (in ha.): 646.596

#### M-2. Details of Mining Plan

- (i). Date of approval of mining plan: 24 Sep 2021
- (ii). Approval authority: IBM
- (iii). Copy of approval of mining plan: 
- (iv). Copy of approved mining plan: 
- (v). Nature of mining (underground/opencast): Opencast
- (vi). Copy of the detailed land use plan in 1:4,000 scale prepared by using GPS or Total Station : 
- (vii). Copy of map of the outer boundary of mining lease area:  [View file](#)

#### M-3. Details of prospecting undertaken to assess mineral reserves

- (i). Whether detailed prospecting to assess mineral reserve in the lease has been undertaken: Yes

prospecting undertaken to assess mineral reserves					
S.no	Designation of authority responsible for grant of the original prospecting licence	Date of grant of prospecting licence	Period of validity of extension prospecting licence From date	Period of validity of extension prospecting licence To date	Copy of prospecting licence
1	MP Govt	18 Jul 1972	03 Sep 1971	04 Sep 1973	

#### M-4. Details of extension (if any) of original prospecting licence issued in the past

- (i). Whether detailed prospecting to assess mineral reserve in the lease has been undertaken: No

#### M-5. Brief details of prospecting activities undertaken in the mining lease :

- (i). Detail of prospecting activity under taken in the mining lease: A total of 6085.65 meters of drilling has been completed in 81 bore holes. A total of 400 mts of Aditing done of 2 adits.

##### M-5.1 Details of bore holes drilled for prospecting :

Bore holes drilled for prospecting				
S.no	No. of Bore holes (in forest land)	Diameters(in inch.) forest land	No. of Bore holes (in non-forest land)	Diameters(in inch.) non-forest land
1	81	3.5	0	0

##### M-5.2 Estimated Reserve along with accuracy and confidence level

Estimated Reserve along with accuracy and confidence level						
Minerals	Estimated Reserve (million tones)	% accuracy (+ -)	% confidence level	Estimated Reserve (million tones)	% accuracy (+ -)	% confidence level
Iron Ore	109.01	64.8	95	0	0	0

#### M-6. Details of approval under the Forest (Consevation) Act,1980 obtained for undertaking prospecting activities in the forest land located in the mining lease

- (i).Whether approval under the Forest (Conservation) Act, 1980 for undertaking prospecting activities in the forest land located in the mining lease have been obtained No


Details of approval under the Forest(Consevation) Act,1980					
S.no	MoEF File No	Date of approval	Area of forest land diverted(in ha.)	From Date	To Date
NIL					

#### M-7. Mineral wise details






















- (i). No. of minerals: One

Mineral wise details						
Minerals	Estimated reserve in non forest land(million tons.)	Estimated reserve in forest land(million tons.)	Estimated annual extraction(million tons.)	Estimated life of mine(Yrs.)	Total estimated extraction during mining lease period(million tons.)	Estimated mineral reserve at the end of mining lease(million tons.)
Iron Ore	0	109.01	7	21	109.01	0















M-7.1 Proposed use of the minerals proposed to be raised from the mining lease







- (i). Proposed use of the minerals proposed to be raised from the mining lease: Non captive
- (ii). Copy note containing details of the plan for the transportation of the minerals proposed to be raised from the mining lease: 

Additional information Details

Documents		
S.No	Documents	Remarks
1		Registration and processing fee details
2		Gazette notification issued by Ministry of Mines, GoI and subsequent Orders issued by the Chhattisgarh State Government in respect of Letter of Intent for the Mining Lease of Dep-4
3		Bore Hole closure report certified by DFO Dantewada
4		Declaration by NCL for no proposal in past
5		Certificate of undertaking for CA and safety zone charges
6		DEP-4 Exploration report
7		Drawing showing overlapping area of roads by conveyor gallery
8		Copy of IBM approved mining plan
9		Letter to District Collector - Dantewada for conducting the Gram Sabha
10		Undertaking by NCL for conducting DGPS survey outside ML area
11		Replies to EDS, dated – 07.10.2021 raised by Nodal Officer, Raipur
12		Replies to EDS dated – 25.02.2022 raised by Nodal Officer, Raipur
13		Undertaking of CA Scheme Amount Payment
14		Undertaking of FRA
15		Details of Revenue Forest NOC
16		Undertaking of NPV Payment
17		Undertaking of CAMPA FUND DEPOSIT
18		Biodiversity plan
19		Receiving Copy of 44 Point Checklist Submission to DFO Dantewada
20		Wildlife Management Plan
21		Forest Land Schedule - Notified Forest + Revenue Forest Proposed



		for Diversion
22		DGPS Report for 682.269 Ha
23		CA Land from Janjgir Champa for 846 Ha
24		CA Land from Marwahi for 530.302 Ha
25		Justification Statement with Landuse
26		Revenue Fores 12.0952 Ha NOC Details
27		Gram Panchayat NOC and Proceedings for Land Acquisition for Dep 04
28		CA: DGPS Report of 530 Ha in Marwahi Division
29		CA: DGPS Report of 846 Ha in Janjgir Champa
30		CA: DFO Suitability Certificate of 846 Ha in Janjgir Champa
31		CA: DFO Suitability Certificate of 530 Ha in Marwahi
32		Regarding Chief Secretary Letter for providing Double Degraded Land for CA
33		Regarding Collector NOC of Revenue Forest Land
34		FMIS Vegetation Map showing ML & OML Area: Sheet No 65 F 01
35		FMIS Vegetation Map showing ML & OML Area: Sheet No 65 F 02
36		FMIS Vegetation Map showing ML & OML Area: Sheet No 65 F 05
37		FMIS Vegetation Map showing ML & OML Area: Sheet No 65 F 06
38		Reply to EDS, Dated - 23.06.2023
39		Dantewada Collector NOC for Revenue Forest - 21.07.2023
40		Chief Secretary NOC reg Non-Availability of Non-Forest Land for CA
41		DFO Forwarding Letter for Reply to EDS dt 22.06.2023
42		MoEF EDS Reply: Annexures to Query No.20. Soil and Mositure Conservation Plan
43		MoEF EDS Reply: Annexures to Query No.20. Wildlife Management Plan
44		MoEF EDS Reply: Annexures to Query No.20.3 SIA Bhansi
45		MoEF EDS Reply: Annexures to Query No.20.4 SIA Porokameli
46		MoEF EDS Reply: Annexures to Query No20.5 EIA and EMP Part 1
47		MoEF EDS Reply: Annexures to Query No20.5 EIA and EMP Part 2
48		MoEF EDS Reply: Annexures to Query No. 26; Annexures 26.1 and 26.2
49		MoEF EDS Reply: Annexures to Query No. 24
50		MoEF EDS Reply: Annexures to Query No. 21
51		MoEF EDS Reply: Annexures to Query No. 23
52		MoEF EDS Reply: Annexures to Query No. 7
53		MoEF EDS Reply: Annexures to Query No. 14
54		MoEF EDS Reply: Annexures to Query No. 12

55		MoEF EDS Reply: Annexures to Query No. 1
56		MoEF EDS dated 7 March 2024 Reply from User Agency NMDC CMDC Ltd
57		MoEF EDS Reply: Annexure to Query No.3
58		MoEF EDS Reply: Annexures to Query No. 4
59		MoEF EDS Reply: Annexures to Query No.17 and 19
60		MoEF EDS dated 16 May 2024 Reply from User Agency NMDC CMDC Ltd

Print





## कार्यालय प्रधान मुख्य वन संरक्षक एवं वन बल प्रमुख, छत्तीसगढ़

अरण्य भवन, सेक्टर-19, नार्थ ब्लॉक, कैपिटल काम्प्लेक्स, नवा रायपुर, अटल नगर-492002

(अपर प्रधान मुख्य वन संरक्षक - भू-प्रबंध)

दूरभाष: 0771 - 2512840

ई - मेल: apccf-lm.cg@gov.in

क्र./भू-प्रबंध/खनिज/331-305/2957-A

रायपुर, दिनांक 12/12/2024

प्रति,

सहायक महानिदेशक  
भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद  
पो.ओ. न्यू फारेस्ट, देहरादून  
248006 (उत्तराखण्ड)

**विषय:-** 'Study of Baildila Iron Ore Deposit-4 Mine of NMDC-CMDC Limited for ascertaining the safe distance from the existing Tree Fern Habitat for carrying out mining activities and infrastructure development' की मसौदा अध्ययन रिपोर्ट जमा करने के संबंध में।

- संदर्भ:-** 1. सहायक महानिदेशक, भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद, देहरादून पत्र क्रमांक/1-138/2024-ADG (EM)/ Deposit-4 Mine/NMDC/ICFRE/1358 दिनांक 29-10-2024  
2. वन मंडलाधिकारी, दंतेवाड़ा वन मंडल का पत्र क्रमांक/ मा. चि./ 8723 दिनांक 12.12.2024

-000-

विषयांतर्गत संदर्भित पत्रों का अवलोकन करने का कष्ट करें। संदर्भित पत्र-1 से प्रकरण में भारत सरकार, पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, नई दिल्ली के पत्र दिनांक 07.03.2024 के बिन्दु क्रमांक - viii के अनुक्रम में आई.सी.एफ.आर.ई देहरादून के पत्र दिनांक 29.10.2024 द्वारा 'Study of Baildila Iron Ore Deposit-4 Mine of NMDC-CMDC Limited for ascertaining the safe distance from the existing Tree Fern Habitat for carrying out mining activities and infrastructure development' से संबंधित अध्ययन रिपोर्ट अवलोकन एवं सुझाव हेतु इस कार्यालय को प्रेषित किया गया था

अतः आई.सी.एफ.आर.ई देहरादून द्वारा प्राप्त अध्ययन रिपोर्ट पर वन मंडलाधिकारी, दंतेवाड़ा वन मंडल द्वारा संदर्भित पत्र-2 के माध्यम से 07 बिन्दुओं की संशोधन/सुझाव प्रेषित किया गया है।

कृपया वन मंडलाधिकारी, दंतेवाड़ा द्वारा प्रेषित उक्त सुझावों को सम्मिलित करते हुए अंतिम रिपोर्ट तैयार कर अवगत कराने का कष्ट करें।

**संलग्न:-** उपरोक्तानुसार

अपर प्रधान मुख्य वन संरक्षक  
(भू-प्र./वन (सं. एवं सं.)अ)  
छत्तीसगढ़

पृ. क्र0/भू-प्रबंध/खनिज/331-305/2958  
प्रतिलिपि सूचनार्थ एवं आवश्यक कार्यवाही हेतु:

रायपुर, दिनांक 12/12/2024

1. मुख्य वन संरक्षक, जगदलपुर वृत्त, जगदलपुर, छत्तीसगढ़।
2. वन मंडलाधिकारी, दंतेवाड़ा वन मंडल, दंतेवाड़ा, छत्तीसगढ़।
3. मुख्य कार्यपालन अधिकारी, एन.एम.डी.सी. - सी.एम.डी.सी., ग्रीन वेली सिटी, हाऊसिंग बोर्ड कालोनी, बोरियाकला, सेजबहार, रायपुर।

अपर प्रधान मुख्य वन संरक्षक  
(भू-प्र./वन (सं. एवं सं.)अ)  
छत्तीसगढ़



**कार्यालय वनमण्डलाधिकारी  
दन्तेवाड़ा वनमण्डल दन्तेवाड़ा, (छ.ग.)**

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क्रमांक/मा.चि./ 8723

दन्तेवाड़ा, दिनांक 12/12/2024

प्रति,

अपर प्रधान मुख्य वन संरक्षक  
(भू-प्र./वन (सं. एवं सं.) अ)  
नवा रायपुर, अटल नगर (छ.ग.)

विषय :- 'Study of Bailadila Iron Ore Deposit-4 Mine of NMDC-CMDC Limited for ascertaining the safe distance from the existing Tree Fern Habitat for carrying out mining activities and infrastructure development' की मसौदा अध्ययन रिपोर्ट जमा करने के संबंध में।  
संदर्भ :- आपका पत्र क्रमांक/भू-प्रबंध/खनिज/331-305/2593 दिनांक 06.11.2024

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विषयान्तर्गत सन्दर्भित पत्र के परिपालन में लेख है कि भारत सरकार, पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, नई दिल्ली के पत्र दिनांक 07.03.2024 के बिन्दु क्रमांक-viii के अनुक्रम में आई.सी.एफ.आर.ई. देहरादून के पत्र दिनांक 29.10.2024 द्वारा विषयांकित प्राप्त अध्ययन रिपोर्ट का अवलोकन उपरान्त अध्ययन रिपोर्ट में संशोधन/सुझाव निम्नानुसार है -

1. As per ICFRE recommendation, Maintenance of the recommended safe distance of 150 meters and 191 meters respectively towards the west and east of Galli Nalla bank. The recommendations of ICFRE may be adhered to.
2. Mining operations on reaching the bench levels in North pit of Deposit-4 to the corresponding levels of Galli Nalla, there should be comprehensive study by reputed institution to determine whether further mining operations can be allowed or not in reference to impact on tree fern survival.
3. No float ore mining shall be undertaken on the eastern slope of the western ridge of Deposit-4/ western slope of Galli Nalla.
4. Proposal has been made to dump mine waste for first 3 years on the eastern slope of Deposit-4 as Dump No. 1. The proposal has to be revoked and no mine waste dumping should be done on the eastern slope of the western ridge (Deposit-4) as wash offs from dumps will add to siltation in Galli Nalla that will adversely affect Tree Fern habitat.
5. No loose stacking of minerals be made on the eastern slope of the western ridge of Deposit-4/ western slope of Gall Nalla.
6. When the mining operations will commence in the Deposit-4 Iron ore block, they may either amplify or mollify the forecasted impacts on the susceptible Galli Nalla ecosystem. Therefore, Every Year the mine authority should undertake detailed "Impact Assessment Study of Mine Progression on Galli Nalla Ecosystem" by any reputed third-party organization during the plan period, from the start of operations.
7. Contingency funding provision should be made for site specific, need based action required for prevention of silt deposition in Galli Nalla.


प्रतिवेदन आपकी ओर आवश्यक कार्यवाही हेतु सम्प्रेषित है।

वनमण्डलाधिकारी  
दन्तेवाड़ा वनमण्डल, दन्तेवाड़ा



प्रतिलिपि :-

- (1) मुख्य वन संरक्षक जगदलपुर वृत्त, जगदलपुर की ओर सूचनार्थ सम्प्रेषित।
- (2) मुख्य कार्यपालन अधिकारी, एन.एम.डी.सी.-सी.एम.डी.सी., ग्रीन वेली सिटी, हाऊसिंग बोर्ड कालोनी, बोरियाकला, सेजबहार, रायपुर की ओर सूचनार्थ अग्रेषित।

  
वनमण्डलाधिकारी  
दन्तेवाड़ा वनमण्डल, दन्तेवाड़ा





**ENVIRONMENT MANAGEMENT DIVISION**

**Directorate of Extension**

**Indian Council of Forestry Research and Education**

*(An Autonomous Council of Ministry of Environment, Forest and Climate Change, GoI)*

**DEHRADUN – 248 006 (UTTARAKHAND) INDIA**

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