DRAFT

ENVIRONMENTAL IMPACT ASSESSMENT
AND
ENVIRONMENTAL MANAGEMENT PLAN
OF

PROPOSED EXPANSION OF FERRO ALLOYS PLANT
(0.055 to 0.293 MTPA FERRO ALLOYS ALONG WITH 150 MW CPP)
AT
VILLAGES: TULASIDIHA, CHARARHAGARHIA & KANGELAPAL
DISTRICT DHENKANAL, ODISHA
(AREA: EXISTING 52.525 ACRES [21.257 HA.],
ADDITIONAL PROPOSED 93.575 ACRE [37.869 HA.],
TOTAL 146.10 ACRE [59.126 HA.])

Project Proponent:

RUNGTA MINES LIMITED
Registered Office: "Rungta House", Chaibasa-833201, Jharkhand
Tel: +91-06582-256861, 256761, 256661; Fax: 6582-256442
E-mail: csp@ungtamines.com, Website: www.rungtamines.com

ToR granted: Letter no. IA. J-11011/515/2022-IA-II(IND-I) dated 01.12.2022

Project as per Schedule of EIA Notification 2006 : 3(a), 2(a) and 1(d)

BASELINE DATA PERIOD: 1ST MARCH 2022 TO 31st MAY 2022
COLLECTED BY: MIN MEC R & D LABORATORY, NEW DELHI
(NABL Certificate No. TC-6337 and
MOEF&CC Recognition vide Gazette No. SO 3744(E) at Sl. No. 97)

ISSUE 1 REV. 0 APRIL 2023, (UID No. 202304005)

Prepared by:

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Email: minmec@gmail.com
Estb. 1983
An ISO 9001:2015 approved company

Accredited by NABET, QCI vide Certificate No. NABET/ EIA/2225/IA 0096 (Rev.01) valid till 29.03.2025

Rungta Mines Limited

(FERRO ALLOYS DIVISION)

Works : Vill :- Tulasidiha, P.O. :- Meramandali, Dist. :- Dhenkanal - 759121, ODISHA, INDIA
Phone : (06732) 258171, Fax : (06732) 258171 Email : fad@rungtamines.co.in

UNDERTAKING

I, Pradeep Kumar Chaturvedi, hereby undertake that prescribed Terms of Reference with respect to the EIA/EMP "Proposed expansion of Ferro Alloys Plant from 0.055 MTPA to 0.293 MTPA (Ferro manganese - 0.055 MTPA to 0.293 MTPA, Silico Manganese -0.0399 MTPA to 0.230 MTPA, Ferro Chrome- 0.230 MTPA, Ferro Silicon- 0.1024 MTPA, Pig Iron- 0.369 MTPA, Metal Recovery Plant- 0.0198 MTPA to 0.115 MTPA, Sinter Plant- 0.0432 MTPA to 0.5616 MTPA, Chrome Ore Beneficiation Plant- 0.66 MTPA and Power Plant 150 MW) at villages Tulasidiha, Chararhagarhia and Kangelpapal, District Dhenkanal, Odisha in an area expansion from 21.257 to 59.126 ha" has been complied while conducting the EIA studies. The contents (information and data) as given by our consultant in the EIA/EMP report are factually correct, with full knowledge of the undersigned.

For Rungta Mines Ltd.

29/4/2023

P K Chaturvedi
(Director)
Date : 29 April 2023
Place : Chaibasa

QUALITY COUNCIL® OF INDIA
Creating an Ecosystem for Quality

National Accreditation Board for Education and Training

Certificate of Accreditation

Min Mec Consultancy Private Limited

A 121, Paryavaran Complex, IGNOU Road, New Delhi-110030

*The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organizations, Version 3: for preparing EIA-EMP reports in the following Sectors –*

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals including opencast/underground mining	1	1 (a) (i)	A
2	Coal washeries	6	2 (a)	A
3	Mineral beneficiation	7	2 (b)	A
4	Metallurgical industries (ferrous only)	8	3 (a)	A
5	Cement plants	9	3 (b)	A
6	Coke oven plants	11	4 (b)	A
7	Integrated paint industry	23	5 (h)	B
8	Aerial ropeways	35	7 (g)	B
9	Building and construction projects	38	8 (a)	B
10	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in IA AC minutes dated April 29, 2022 and Supplementary Assessment minutes dated March 3, 2023 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/22/2419 dated July 12, 2022. The accreditation needs to be renewed before the expiry date by Min Mec Consultancy Private Limited, Delhi following due process of assessment.

Sr. Director, NABET
Dated: April 10, 2023

Certificate No.
NABET/EIA/2225/IA 0096 (Rev.01)

Valid up to
March 29, 2025

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website

DECLARATION BY EXPERTS CONTRIBUTING TO THE "EIA FOR PROPOSED EXPANSION OF FERRO ALLOYS PLANT FROM 0.055 MTPA TO 0.293 MTPA (FERRO MANGANESE - 0.055 MTPA TO 0.293 MTPA, SILICO MANGANESE- 0.0399 MTPA TO 0.230 MTPA, FERRO CHROME-0.230 MTPA, FERRO SILICON- 0.1024 MTPA, PIG IRON- 0.369 MTPA, METAL RECOVERY PLANT- 0.0198 MTPA TO 0.115 MTPA, SINTER PLANT -0.0432 MTPA TO 0.5616 MTPA, CHROME ORE BENEFICIATION PLANT- 0.66 MTPA AND POWER PLANT 150 MW) AT VILLAGES TULASIDIHA, CHARADAGADA AND KANGELPAPAL, DISTRICT DHENKANAL, ODISHA

I, hereby, certify that I was a part of the team in the following capacity that developed the above EIA.

EIA coordinator

Name: Marisha Sharma
Signature and Date: 29.04.2023
Period of involvement: From March 2022 till date (intermittently)
Contact information: Ph- 011-29532236, Email id: minmec@ gmail.com

Functional Area Experts:

Sl. No.	Functional Area	Name of the expert/s	Involvement (period and task)		Signature and date
1.	Air pollution monitoring, prevention and control (AP)	Rashmi Gupta	**Period:**	March 2022 till date (intermittently)	
			Task:	Interpretation of baseline air environment and preparation of sections of air environment.	
2.	Water pollution monitoring, prevention and control (WP)	Gaurav Yadav	**Period:**	March 2022 till date (intermittently)	
			Task:	Interpretation of baseline water environment and preparation of sections of water environment.	
3.	Solid and hazardous waste management (SHW)	Dr. Marisha Sharma	**Period:**	March 2022 till date (intermittently)	
			Task:	Identification of different sources & types, quantity, handling mechanism and proposed management measures of all types of solid wastes and checking of related sections in the report.	
4.	Socio-economics (SE)	Dr. Marisha Sharma	**Period:**	March 2022 till date (intermittently)	
			Task:	Analysis of socio-economic status of the area, proposed	

Sl. No.	Functional Area	Name of the expert/s	Involvement (period and task)		Signature and date
				social welfare, socio-economic impact & management	
5.	Ecology and biodiversity (EB)	Rashmi Gupta	**Period:**	March 2022 till date (intermittently)	
			Task:	Overall responsibility of ecological surveys, information/ data interpretation and preparation of ecology section in EIA/EMP report.	
6.	Hydro-geology (HG)	B. D. Sharma	**Period:**	March 2022 till date (intermittently)	
			Task:	Preparation of hydrology & hydro-geology section for baseline environment, assessment of hydrogeological impact due to project along with mitigation measures.	
7.	Geology (Geo)	B. D. Sharma	**Period:**	March 2022 till date (intermittently)	
			Task:	Give geological input for the report.	
8.	Soil conservation (SC)	Rashmi Gupta	**Period:**	March 2022 till date (intermittently)	
			Task:	Interpretation of soil analysis results for writing in present baseline scenario.	
9.	Meteorology, air quality modeling and Prediction (AQ)	M.S. Yadav	**Period:**	March 2022 till date (intermittently)	
			Task:	Processing of micro meteorological data, air quality prediction planning (sources, emission, receptor, etc.), developing micro-meteorological input file and emissions input file for air modelling, model run, collating outputs into Annexure, plotting GLC contours.	
10.	Noise (NV)	M.S. Yadav	**Period:**	March 2022 till date (intermittently)	
			Task:	Interpretation of baseline noise level environment and preparation of sections of noise impact & mitigation.	

Sl. No.	Functional Area	Name of the expert/s	Involvement (period and task)		Signature and date
11.	Land use (LU)	Dr. Marisha Sharma	**Period:**	March 2022 till date (intermittently)	
			Task:	Satellite image interpretation and preparation of land use map of study area, prediction of impact on land use pattern, suggest mitigation measures.	
12.	Risk Assessment and hazard management (RH)	Pinaki Dasgupta	**Period:**	April 2022	
			Task:	Assess risk due to project and prepare chapter on disaster management plan.	

Declaration by the Head of the accredited consultant organization/ authorized person

I, Dr. Marisha Sharma, hereby, confirm that the above-mentioned experts prepared the **"Proposed expansion of Ferro Alloys Plant from 0.055 MTPA to 0.293 MTPA (Ferro manganese - 0.055 MTPA to 0.293 MTPA, Silico Manganese - 0.0399 MTPA to 0.230 MTPA, Ferro Chrome- 0.230 MTPA, Ferro Silicon- 0.1024 MTPA, Pig Iron- 0.369 MTPA, Metal Recovery Plant- 0.0198 MTPA to 0.115 MTPA, Sinter Plant- 0.0432 MTPA to 0.5616 MTPA, Chrome Ore Beneficiation Plant- 0.66 MTPA and Power Plant 150 MW) at villages Tulasidiha, Chararhagarhia and Kangelpapal, District Dhenkanal, Odisha in an area expansion from 21.257 to 59.126 ha"**. I also confirm that the consultant organization shall be fully accountable for any misleading information mentioned in this statement.

No plagiarism undertaking: It is certified that no unethical practice like 'copy and paste', and use of external data / text without proper acknowledgement has been done, while preparing this EIA report.

ToR compliance undertaking: The prescribed ToRs have been complied with and the data submitted is factually correct.

Signature: 

Name: Dr. Marisha Sharma
Designation: Director (Technical)
Name of the consultant organization: Min Mec Consultancy Pvt. Ltd.
NABET Certificate No.: NABET/ EIA/2225/IA 0096
Validity: 29.03.2025

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LIST OF ABBREVIATIONS

AFBC	-	Atmospheric Fluidised Bed Combustion
AMSL	-	Above mean sea level
BDL	-	Below Detectable Limit
BGL	-	Below Ground Level
CFBC	-	Circulating Fluidized Bed Combustion
CGWB	-	Central Ground Water Board
CHC	-	Community Health Centres
cm	-	Centi meter
CPCB	-	Central Pollution Control Board
CPP	-	Captive power plant
CSR	-	Corporate Social Responsibility
CTE	-	Consent to establish
CTO	-	Consent to Operate
Cum/day	-	Cubic metres per day
Cum/hr	-	Cubic metres per hour
D	-	Dispensary
DCAS	-	Degree College Arts & Science only
DG	-	Diesel Generator
Dia	-	Diameter
DM	-	Demineralisation
E	-	East
EC	-	Environmental clearance/ Engineering College
EIA	-	Environmental Impact Assessment
EMD	-	Environment Management Department
EMP	-	Environmental Management Plan
EO	-	Others
ETP	-	Effluent Treatment Plant
FAD	-	Ferro Alloys Division
FES	-	Fume Extraction System
FGD	-	Flue Gas desulpherisation
FWC	-	Family Welfare Centre
g	-	Gram
Ha	-	Hectare
HA	-	Hospital Allopathic
HAM	-	Hospital Alternative Medicine
Kcal	-	Kilo calorie
Kg	-	Kilogram
KL	-	Kilo litre
KLD	-	Kilo litre/day

KLH	-	Kilo litres per hour
KVA	-	Kilo Volt Ampere
KW	-	Kilo Watt
KWH	-	Kilo Watt Hour
l	-	Litres
Lpd	-	Litres per day
M	-	Meter
m^2	-	Square meter
m^3	-	Cubic meter
MC	-	Medicine College
MCM	-	Million Cubic Meter
MCWC	-	Maternity and Child Welfare Centre
MHC	-	Mobile Health Clinic
MI	-	Management Institute
MoEF&CC	-	Ministry of Environment, Forests and Climate Change
MOU	-	Memorandum of Understanding
MS	-	Middle school
MT	-	Million Tonnes
MTPA	-	Million Tonnes Per Annum
MVA	-	Mega Volt Ampere
MW	-	Mega watt
N	-	North
NFTC	-	Non Formal Training Centre
NGMF-C	-	Non Govt. Medical Facilities: Charitable
NGMF-IOP	-	Non Govt. Medical Facilities: In&Out patient
NGMF-MBBS	-	Non Govt. Medical Facilities: Medical practitioner with MBBS degree
NGMF-MS	-	Non Govt. Medical Facilities: Medicine shop
NGMF-ND	-	Non Govt. Medical Facilities: Medical practitioner with no degree
NGMF-O	-	Non Govt. Medical Facilities: Others
NGMF-OD	-	Non Govt. Medical Facilities: Medical practitioner with other degree
NGMF-OP	-	Non Govt. Medical Facilities: Out Patient
NGMF-TPFH	-	Non Govt. Medical Facilities: Traditional practitioner and faith healer
NH	-	National Highway
NOC	-	No objection certificate
Nos.	-	Numbers
OSPCB	-	Odisha State Pollution Control Board
P	-	Polytechnic
PFBC	-	Pressurised Fluidised Bed Combustion

PGP	-	Producer gas plant
PHC	-	Primary Health Centre
PHSC	-	Primary Health Sub-Centre
PPS	-	Pre-Primary School
PS	-	Primary school
RML	-	Rungta Mines Limited
RPM	-	Respirable Particulate Matter
S	-	South
SCR	-	Selective Catalytic Reduction
SFD	-	School For Disabled
SNCR	-	Selective Non-Catalytic Reduction
SPM	-	Suspended Particulate Matter
Sq.m.	-	Square metre
SS	-	Secondary school
SSS	-	Senior Secondary School
T	-	Tonnes
TBC	-	TB Clinic
TOR	-	Terms of Reference
TPA	-	Tonnes Per Annum
TPD	-	Tonnes Per Day
TPM	-	Tonnes Per Month
TPY	-	Tonnes Per Year
VH	-	Veterinary Hospital
VTS/ITI	-	Vocational Training School / Industrial Training Institute
W	-	West
WHR	-	Waste Heat Recovery
WHRB	-	Waste Heat Recovery Boiler

COMPLIANCE OF TERMS OF REFERENCE (TOR)

MoEF&CC issued the Standard Terms of Reference vide letter no. IA-J-11011/515/2022-IA.II(IND-I) dated 01.12.2022. **Table 1** gives the compliance to Standard Terms of Reference (TOR) for conducting environment impact assessment study for metallurgical industry (ferrous and non-ferrous), **Table 2** for Thermal Power Plant projects and **Table 3** for Mineral Beneficiation projects respectively.

TABLE 1: COMPLIANCE OF STANDARD TERMS OF REFERENCE FOR METALLURGICAL INDUSTRY (FERROUS AND NON-FERROUS)

ToR No.	TOR Point	Compliance
A. General Condition		
1.	**Introduction**	
i.	Background about the project	Refer section 1. 2, Chapter 1
ii.	Need of the project	Refer section 1.1, Chapter 1
iii.	Purpose of the EIA study	Refer section 1. 1, Chapter 1
iv.	Scope of the EIA study	Refer section 1. 6, Chapter 1
2.	**Project Description**	
A.	**Site details**	
1.	Location of the project site covering village, Taluka/Tehsil, District and State.	Refer section 1. 4.3, Chapter 1
2.	Site accessibility	Refer section 1. 4.4, Chapter 1
3.	A digital toposheet in pdf or shape file compatible to google earth of the study area of radius of 10km and site location preferably on 1:50,000 scale. (including all eco-sensitive areas and environmentally sensitive places).	Refer Fig. 3.2, Chapter 3
4.	Latest High-resolution satellite image data having 1m-5m spatial resolution like quick bird, Ikonos, IRS P-6 pan sharpened etc., along with delineation of plant boundary co-ordinates. Area must include at least 100m all around the project location.	Refer Fig. 3.18, Chapter 3
5.	Environment settings of the site and its surrounding along with map.	Refer Fig. 3.2, Chapter 3
6.	A list of major industries with name, products and distance from plant site within study area (10km radius) and the location of the industries shall be depicted in the study area map.	Refer Table 3.26 and Fig 3.28, chapter 3
7.	In case if the project site is in vicinity of the water body, 50 meters from the edge of the water body towards the site shall be treated as no development/construction zone. If it's near the wetland, Guidelines for implementing Wetlands (Conservation and Management) Rules, 2017 may be followed.	Project site is located adjacent to Nigra or Lingara nadi Safety distance shall be maintained from the river in form of minimum 50 m green belt.
8.	In case if the project site is in vicinity of the river, the industry shall not be located within the river flood plain corresponding to one in 25 years flood, as	Project site is located adjacent to Nigra or Lingara River. Safety distance shall be maintained from

ToR No.	TOR Point	Compliance
	certified by concerned District Magistrate/ Executive Engineer from State Water Resources Department (or) any other officer authorized by the State Government for this purpose as per the provisions contained in the MoEF&CC Office Memorandum dated 14/02/2022.	the river in form of minimum 50 m green belt. The information on the flood level data has been sought from Executive Engineer, Rengali, Right Canal Division No. II, Dhankanal, Odisha vide letter dated 05.01.2023 and Executive Engineer, Flood Cell, Kamakhyanagar, District Dhenkanal on 28.02.2023, copies of which are given in **Annexure XXVIII**.
9.	Type of land, land use of the project site.	The land use of the existing area is industrial. The land use of the proposed expansion area is private land (33.062 ha) and government land (4.808 ha). For further detailed break up, refer Table 3.14, Chapter 3.
10.	Status of acquisition of land. If acquisition is not complete, stage of the acquisition process as per the MoEF&CC O.M. dated 7/10/2014 shall be furnished.	**Existing:** 100% i.e. 52.5250 acres land is purchased and is in possession of the company. **Proposed additional:** required land is 93.575 acres which consists of 81.695 acres private land and 11.880 acres government land. Out of this, 39.935 acres private land has been purchased and 41.760 acres private and 11.880 acres government land is to be purchased.
11.	Engineering layout of the area with dimensions depicting 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.	Refer Fig 2.1, Chapter 2 gives the plant layout with the land use break up in Table 2.1, Chapter 2. The project is not located in any Industrial area/ Estate/ Complex.
B.	**Forest and wildlife related issues (if applicable):**	
i.	Status of Forest Clearance for the use of forest land shall be submitted.	No forest Land is involved in existing nor proposed expansion area.
ii	Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972, to the Standing Committee of the National Board for Wildlife if the project site located within notified Eco-Sensitive Zone, 10 km radius of national park/sanctuary wherein final ESZ notification is not in place as per MoEF&CC Office Memorandum dated 8/8/2019.	Not Applicable
Iii	The projects to be located within 10 km of the	There is no National Parks,

ToR No.	TOR Point	Compliance
	National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, Eco-sensitive Zone and Eco-sensitive areas, the project proponent shall submit the map duly authenticated by Divisional Forest Officer showing the distance between the project site and the said areas.	Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, Eco-sensitive Zone and Eco-sensitive areas within 10 km radius of the project. Map showing distance of project from National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, Eco-sensitive Zone and Eco-sensitive areas has been submitted to Divisional Forest Office, Dhenkanal Forest Division for Authentication. Application letter copy is given in **Annexure XXX**.
iv	Wildlife Conservation Plan duly authenticated by the Competent Authority of the State Government for conservation of Schedule I fauna, if any exists in the study area.	Preparation and approval of Wildlife Conservation Plan by Divisional Forest Officer, Dhenkanal Forest Division is underway. The letter requesting the preparation and approval of wildlife conservation plan is given in **Annexure XXV**.
C.	**Salient features of the project**	
i.	Products with capacities in Tons per Annum for the proposed project.	Refer Table 2.2, Chapter 2
ii.	If expansion project, status of implementation of existing project, details of existing/proposed products with production capacities in Tons per Annum.	Refer Table 2.2, Chapter 2
iii.	Site preparatory activities.	Site preparatory activities shall be carried out after receipt of EC from MoEF&CC for proposed expansion area
iv	List of raw materials required and their source along with mode of transportation.	Refer Table 2.24 unit wise raw material and 2.25 consolidated raw material , Chapter 2
v	Other than raw materials, other chemicals and materials required with quantities and storage capacities.	Refer Table 2.25, Chapter 2
vi	Manufacturing process details along with process flow diagram of proposed units.	Refer Section 2.4, Chapter 2
vii.	Consolidated materials and energy balance for the project.	Refer Table 2.25 & 2.27 , Chapter 2
viii.	Total requirement of surface/ ground water and power with their respective sources, status of approval.	Refer Section 2.7, Chapter 2 for water requirement and **Annexure XXIII and XXIV** for the copy of permissions.
ix	Water balance diagram	Refer Fig 2.13, Chapter 2
x	Details of Emission, effluents, hazardous waste generation and mode of disposal during construction	Refer various sections of Chapter 4 Emissions: Section 4.4.1

ToR No.	TOR Point	Compliance
	as well as operation phase.	Effluents: Section 4.6.2 Hazardous waste: Section 4.7
	Man-power requirement.	Refer Section 2.8, Chapter 2
xii	Cost of project and scheduled time of completion.	Refer section 2.9, Chapter 2
xiii.	Brief on present status of compliance	The existing project was established vide Consent to Operate granted by Odisha State Pollution Control Board (copy given in **Annexure XXI**) and is operational based on the Consent to Operate. The compliance to the Consent to Operate is given in **Annexure XXII**.
a	Cumulative Environment Impact Assessment for the existing as well as the proposed expansion/modernization shall be carried out.	The cumulative assessment of the entire plant (existing and proposed) becoming operational has been carried out and given n Section 4.4.1.4, Chapter 4 for impact on air. The incremental impact due to other parameters such as water, land, traffic, manpower, etc have been covered in respective sections of Chapter 4.
b	In case of ground water drawl for the existing unit, action plan for phasing out of ground water abstraction in next three years except for domestic purposes and shall switch over to 100% use of surface water from nearby source.	Water withdrawal permission for 733.972 KLD from surface water has been obtained from Office of Superitending Engineer, Rengali Right Canal Division No. II, Dhenkanal vide letter dated 14.02.2023. Balance shall be applied for prior to expansion. Water permission for withdrawl of 30 KLD from borewell, has been taken from CGWA, vide NOC no. CGWA/NOC/IND/REN/1/2021/5971. This is valid from 08/05/2021 to 07/05/2024. Refer **Annexure XXIII** and Annexure **XXIV** for copies of the permissions.
c	Copy of all the Environment 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 and Forests as per circular dated 30th May, 2012 on the status of compliance of conditions stipulated in all the existing environment clearances including amendments shall be provided.	The existing project was established prior to the EIA Notification 2006 and no environmental clearance was required at time of establishment.
d	In case the existing project has not obtained Environment Clearance, reasons for not taking EC	The existing project was established prior to the EIA

<table>
<tr><th>ToR No.</th><th>TOR Point</th><th>Compliance</th></tr>
<tr><td></td><td>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 Regional Office of the SPCB shall be submitted.</td><td>Notification 2006 and no environmental clearance was required because the project cost was below Rs. 50 crores, which did not require environmental clearance under EIA Notification 1994. Consent to Establish (NOC) for the existing project was obtained on 22.11.2005, copy of which is given in Annexure XX. The NOC was granted before 14.09.2006 and as per MOEF&CC's OM no. F. No. J-11013/41/20060IA.II dated 21.11.2006, clause ii, projects which were issued NOC before 14.09.2006 will not be required to take environmental clearance under EIA Notification 2006. This clause applies on those projects which did not require EIA clearance under EIA Notification 1994 and now require the same under EIA Notification 2006.

The first and latest CTO for the existing project is given in Annexure XXI

The compliance to the CTO is given in Annexure XXII.</td></tr>
<tr><td>3.</td><td>Description of the environment</td><td></td></tr>
<tr><td>i.</td><td>Study Period</td><td>March – May 2022 Summer Season.</td></tr>
<tr><td>ii.</td><td>Approach and methodology for data collection as furnished below:</td><td>Approach and methodology for data collection are given in respective sections in Chapter 3</td></tr>
<tr><td></td><td>
<table>
<tr><th>Attributes</th><th colspan="2">Sampling</th><th>Remarks</th></tr>
<tr><td></td><td>Network</td><td>Frequency</td><td></td></tr>
<tr><td colspan="4">A. Air Environment</td></tr>
<tr><td>Micro-Meteorological
Wind speed (Hourly)
Wind direction
Dry bulb temperature</td><td>Minimum 1 site in the project impact area</td><td>1 hourly continuous</td><td>• IS 5182 Part 1-20
• Site specific primary data is essential</td></tr>
</table>
</td><td>Refer Chapter 3
Micro-meteorology - Section 3.4
Air- Section 3.5
Noise - Section 3.7
Water Environment- Section 3.6
Traffic - Section 3.8
Soil- Section 3.10
Land environment- Section 3.9
Biological environment- Section 3.11
Socio economics- Section 3.12</td></tr>
</table>

ToR No.	TOR Point				Compliance
	Wet bulb Temperature Relative humidity Rainfall Solar radiation Cloud cover Environmental Lapse Rate			• Secondary data from • IMD, New Delhi • CPCB guidelines to be considered.	
	Pollutants PM2.5 PM10 SO2 NOx CO HC Other parameters relevant to the project and topography of the area	At least 8-12 locations	As per National Ambient Air Quality Standards, CPCB Notification	• Sampling as per CPCB guidelines • Collection of AAQ data (except in monsoon season) • Locations of various stations for different parameters should be related to the characteristic properties of the parameters. • The monitoring stations shall be based on the NAAQM standards as per GSR 826(E) dated 16/11/2009 and take into account	

ToR No.	TOR Point				Compliance
				the predominant wind direction, population zone and sensitive receptors including reserved forests, • Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAAQM Notification of 16/11/2009 along with min., max., average 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.	
	B. Noise				
	Hourly equivalent noise levels	At least 8-12 locations	As per CPCB norms		
	C. Water				
	Parameters for water quality	Samples for water quality should be collected and analyzed as per:			

<table>
<tr><th>ToR No.</th><th colspan="3">TOR Point</th><th>Compliance</th></tr>
<tr><td></td><td>• pH, temp, turbidity, magnesium hardness, total alkalinity, chloride, sulphate, nitrate, fluoride, sodium, potassium, salinity
• Total nitrogen, total phosphorus, DO, BOD, COD, Phenol
• Heavy metals
• Total coliforms, faecal coliforms Phyto plankton
• Zoo plankton</td><td colspan="2">• IS: 2488 (Part 1-5) methods for sampling and testing of Industrial effluents
• Standard methods for examination of water and wastewater analysis published by American Public Health Association.</td><td></td></tr>
<tr><td></td><td>For River Bodies
Total Carbon
pH
Dissolved Oxygen
Biological Oxygen Demand
Free NH4
Boron
Sodium Absorption Ratio
Electrical Conductivity</td><td>Surface water quality of the nearest River (60m upstream and downstream) and other surface water bodies</td><td>Yield of water sources to be measured during critical season
Standard methodology for collection of surface water (BIS standards)</td><td></td></tr>
<tr><td></td><td>For Ground Water</td><td colspan="2">Ground water monitoring data should be collected at minimum of 8 locations (from existing wells /tube wells/existing current records) from the study area and</td><td></td></tr>
</table>

ToR No.	TOR Point		Compliance
		shall be included.	
	D. Traffic Study		
	• Type of vehicles • Frequency of vehicles for transportation of materials • Additional traffic due to proposed project • Parking arrangement		
	E. Land Environment		
	Soil • Particle size distribution • Texture • pH • Electrical conductivity • Cation exchange capacity • Alkali metals • Sodium Absorption • Ratio (SAR) • Permeability • Water holding • capacity • Porosity	Soil samples be collected as per BIS specifications	
	Land use/Landscape • Location code • Total project area • Topography • Drainage (natural) • Cultivated, forest, plantations, water bodies, roads		

<table>
<tr><th>ToR No.</th><th colspan="2">TOR Point</th><th>Compliance</th></tr>
<tr><td></td><td colspan="2">F. Biological Environment</td><td></td></tr>
<tr><td></td><td>Aquatic
• Primary productivity Aquatic weeds
• Enumeration of phyto plankton, zoo plankton and benthos
• Fisheries
• Diversity indices
• Trophic levels
• Rare and endangered species
• Marine Parks/ Sanctuaries/ closed areas /coastal regulation zone (CRZ)
Terrestrial
• Vegetation- species list, economic importance, forest produce, medicinal value
• Importance value index (IVI) of trees
• Fauna
• Avi fauna
• Rare and endangered species
• Sanctuaries / National park /Biosphere reserve
• Migratory routes</td><td>• 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. Indicator species which indicate ecological and environment degradation should be identified and included to clearly state whether the proposed project would result in to any adverse effect on any species.
• Samples to collect from upstream and downstream of discharge point, nearby tributaries at downstream, and also from dug wells close to activity site.
• For forest studies, direction of wind should be considered while selecting forests.
• Secondary data to collect from Government offices, NGOs, published literature.</td><td></td></tr>
<tr><td></td><td colspan="2">G. Socio-economic</td><td></td></tr>
<tr><td></td><td>• Demographic structure</td><td>• Socio-economic survey is based on proportionate,</td><td></td></tr>
</table>

<table>
<tr><th>ToR No.</th><th>TOR Point</th><th>Compliance</th></tr>
<tr><td></td><td><table><tr><td>• Infrastructure resource base
• Economic resource Base
• Health status: Morbidity pattern
• Cultural and aesthetic attributes
• Education</td><td>stratified and random sampling method.
• Primary data collection through questionnaire
• Secondary data from census records, statistical hard books, topo sheets, health records and relevant official records available with Govt. agencies.</td></tr></table></td><td></td></tr>
<tr><td>iii.</td><td>Interpretation of each environment attribute shall be enumerated and summarized as given below:</td><td>Refer Chapter 3</td></tr>
<tr><td>●</td><td>Ambient air quality</td><td>Refer Section 3.5</td></tr>
<tr><td>●</td><td>Ambient noise quality</td><td>Refer Section 3.7</td></tr>
<tr><td>●</td><td>Surface water quality</td><td>Refer Section 3.6.1</td></tr>
<tr><td>●</td><td>Ground water quality</td><td>Refer Section 3.6.2</td></tr>
<tr><td>●</td><td>Soil quality</td><td>Refer Section 3.10</td></tr>
<tr><td>●</td><td>Biological Environment</td><td>Refer Section 3.11</td></tr>
<tr><td>●</td><td>Land use</td><td>Refer Section 3.9</td></tr>
<tr><td>●</td><td>Socio-economic environment</td><td>Refer Section 3.12</td></tr>
<tr><td>4.</td><td>Anticipated Environment Impacts and mitigation measures (In case of expansion, cumulative impact assessment shall be carried out)</td><td>Refer Chapter 4 and Chapter-10.</td></tr>
<tr><td>i.</td><td>Identification of potential impacts in the form of a matrix for the construction and operation phase for all the environment components.
<table><tr><th>Activity</th><th>Environment</th><th>Ecological</th><th>Socio-economic</th></tr><tr><td>Construction phase</td><td></td><td></td><td></td></tr><tr><td>Operation phase</td><td></td><td></td><td></td></tr></table></td><td>Refer Table 10.2, Chapter-10.</td></tr>
<tr><td>ii.</td><td>Impact on ambient air quality (Sources; Embedded control measures; Assessment; Mitigation measures; Residual impact)</td><td>Refer Section 4.4.1, Chapter 4</td></tr>
<tr><td>a.</td><td>Construction phase</td><td>Refer Section 4.4.1.A, Chapter 4</td></tr>
<tr><td>b.</td><td>Operation phase</td><td>Refer Section 4.4.1.B, Chapter 4</td></tr>
<tr><td>●</td><td>Details of stack emissions from the existing as well</td><td>Refer Section 4.4.1.1, Chapter 4</td></tr>
</table>

ToR No.	TOR Point	Compliance
	as proposed activity.	
●	Assessment of ground level concentration of pollutants from the stack emission based on AQIP Modelling. The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any along with wind rose map for respective period	Refer Section 4.4.1.2, Chapter 4 and **Annexure XVII.**
●	Impact on ground level concentration, under normal, abnormal and emergency conditions. Measures to handle emergency situations in the event of uncontrolled release of emissions	Refer Section 4.4.1.2, Chapter 4 and **Annexure XVII**
iii.	Impact on ambient noise quality (Sources; Embedded control measures; Assessment; Mitigation measures; Residual impact)	Refer Section 4.8.1, Chapter 4
a.	Construction phase	Refer Section 4.8.1, Chapter 4
b.	Operation phase	Refer Section 4.8.1, Chapter 4
iv.	Impact on traffic (Sources; Embedded control measures; Assessment; Mitigation measures; Residual impact)	Refer Section 4.9.1, Chapter 4
a.	Construction phase	Refer Section 4.9.1, Chapter 4
b.	Operation phase	Refer Section 4.9.1, Chapter 4
v.	Impact on soil quality (Sources; Embedded control measures; Assessment; Mitigation measures; Residual impact)	Refer Section 4.5.2, Chapter 4
a.	Construction phase	Refer Section 4.5.2, Chapter 4
b.	Operation phase	Refer Section 4.5.2, Chapter 4
vi	Impact on land use (Sources; Embedded control measures; Assessment; Mitigation measures; Residual impact)	Refer Section 4.5.1, Chapter 4
a.	Construction phase	Refer Section 4.5.1.1, Chapter 4
b.	Operation phase	Refer Section 4.5.1.2, Chapter 4
vii	Impact on surface water resource and quality (Sources; Embedded control measures; Assessment; Mitigation measures; Residual impact)	Refer Section 4.6, Chapter 4
a.	Construction phase	Refer Section 4.6, Chapter 4
b.	Operation phase	Refer Section 4.6, Chapter 4
viii	Impact on ground water resource and quality (Sources; Embedded control measures; Assessment; Mitigation measures; Residual impact)	Refer Section 4.6.4, Chapter 4
a.	Construction phase	Refer Section 4.6.4, Chapter 4
b.	Operation phase	Refer Section 4.6.4, Chapter 4
ix	Impact on terrestrial and aquatic habitat (Sources; Embedded control measures; Assessment; Mitigation measures; Residual impact)	Refer Section 4.10.1 Chapter 4
a.	Construction phase	Refer Section 4.10.1 Chapter 4

<table>
<tr><th>ToR No.</th><th>TOR Point</th><th>Compliance</th></tr>
<tr><td>b.</td><td>Operation phase</td><td>Refer Section 4.10.1 Chapter 4</td></tr>
<tr><td>x</td><td>Impact on socio-economic environment (Sources; Embedded control measures; Assessment; Mitigation measures; Residual impact)</td><td>Refer Section 4.11, Chapter 4</td></tr>
<tr><td>a.</td><td>Construction phase</td><td>Refer Section 4.11, Chapter 4</td></tr>
<tr><td>b.</td><td>Operation phase</td><td>Refer Section 4.11, Chapter 4</td></tr>
<tr><td>xi</td><td>Impact on occupational health and safety (Sources; Embedded control measures; Assessment; Mitigation measures; Residual impact)</td><td>Refer Section 4.12, Chapter 4</td></tr>
<tr><td>a.</td><td>Construction phase</td><td>Refer Section 4.12, Chapter 4</td></tr>
<tr><td>b.</td><td>Operation phase</td><td>Refer Section 4.12, Chapter 4</td></tr>
<tr><td>5.</td><td>Analysis of Alternatives (Technology & Site)</td><td>Refer Chapter 5</td></tr>
<tr><td>i.</td><td>No project scenario</td><td>Refer Section 5.1, Chapter 5</td></tr>
<tr><td>ii</td><td>Site alternative</td><td>Refer Section 5.2, Chapter 5</td></tr>
<tr><td>iii</td><td>Technical and social concerns</td><td>Refer Section 5.4, Chapter 5</td></tr>
<tr><td>iv</td><td>Conclusions</td><td>Refer Section 5.5, Chapter 5</td></tr>
<tr><td>6.</td><td>Environment Monitoring Program</td><td>Refer Chapter 6</td></tr>
<tr><td>i.</td><td>Details of the Environment Management Cell</td><td>Refer Section 6.2, Chapter 6</td></tr>
<tr><td>ii</td><td>Performance monitoring schedule for all pollution control devices shall be furnished.</td><td>Refer Table 6.3, Chapter 6</td></tr>
<tr><td>iii.</td><td>Corporate Environment Policy</td><td>Refer Section 10.5, Chapter 10</td></tr>
<tr><td>a.</td><td>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.</td><td>Refer fig 10.3 , Chapter 10</td></tr>
<tr><td>b.</td><td>Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environment or forest norms / conditions? If so, it may be detailed in the EIA.</td><td>Refer Section 10.3, Chapter 10</td></tr>
<tr><td>c.</td><td>What is the hierarchical system or Administrative order of the company to deal with the environment issues and for ensuring compliance</td><td>Refer Section 10.3, Chapter 10</td></tr>
<tr><td>d.</td><td>Does the company have system of reporting of non compliances / violations of environment 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</td><td>Refer Section 10.3, Chapter 10</td></tr>
<tr><td>iv.</td><td>Action plan for <u>post-project environment monitoring matrix</u>:</td><td>Refer Table 6.1, Chapter 6</td></tr>
<tr><td></td><td>
<table>
<tr><th>Activity</th><th>Aspect</th><th>Monitoring Parameter</th><th>Location</th><th>Frequency</th><th>Respon si-bility</th></tr>
<tr><td colspan="6">Construction phase</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<table>
<tr><th>ToR No.</th><th>TOR Point</th><th>Compliance</th></tr>
<tr><td></td><td>Operation phase<table><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td><td></td></tr>
<tr><td>7.</td><td>Additional Studies</td><td>Refer Chapter 7</td></tr>
<tr><td>i.</td><td>Public consultation details (Entire proceedings as separate annexure along with authenticated English Translation of Public Consultation proceedings).</td><td>Public consultation is yet to be conducted and will be added in detail in Section 7.5, Chapter 7.</td></tr>
<tr><td>ii.</td><td>Summary of issues raised during public consultation along with action plan to address the same as per MoEF&CC O.M. dated 30/09/2020</td><td>Public hearing is yet to be held. Summary of issues raised during public consultation along with action plan shall be incorporated in Final EIA Report after it is held in Section 7.5, Chapter 7</td></tr>
<tr><td></td><td><table><tr><th rowspan="2">Sl. No.</th><th colspan="2" rowspan="2">Physical activity and action plan</th><th colspan="3">Year of implementation (Budget in INR)</th><th rowspan="2">Total Expenditure (Rs. in Crores)</th></tr><tr><th>Name of the Activity</th><th>Physical Targets</th><th>1st</th><th>2nd</th><th>3rd</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td><td></td></tr>
<tr><td>iii.</td><td>Risk assessment
Methodology
Hazard identification
Frequency analysis
Consequence analysis
Risk assessment outcome</td><td>Refer Section 7.1, Chapter 7</td></tr>
<tr><td>iv.</td><td>Emergency response and preparedness plan</td><td>Refer Section 7.2 and 7.3, Chapter 7</td></tr>
<tr><td>8.</td><td>Project Benefits</td><td>Refer Chapter 8</td></tr>
<tr><td></td><td>Environmental benefits</td><td>Refer Section 8.1uy</td></tr>
<tr><td></td><td>Social infrastructure</td><td>Refer Section 8.2</td></tr>
<tr><td></td><td>Employment and business opportunity</td><td>Refer Section 8.2</td></tr>
<tr><td></td><td>Other tangible benefits</td><td>Refer Section 8.2</td></tr>
<tr><td>9.</td><td>Environment Cost Benefit Analysis</td><td>Refer Chapter 9</td></tr>
<tr><td>i.</td><td>Net present value</td><td>Refer Section 9.1, Chapter 9</td></tr>
<tr><td>ii</td><td>Internal rate of return</td><td>Refer Section 9.2, Chapter 9</td></tr>
<tr><td>iii</td><td>Benefit cost ratio</td><td>Refer Section 9.3, Chapter 9</td></tr>
<tr><td>iv</td><td>Cost effectiveness analysis</td><td>Refer Section 9.4, Chapter 9</td></tr>
<tr><td>10.</td><td>Environment Management Plan (Construction and Operation phase)</td><td>Refer Chapter 10</td></tr>
<tr><td>i.</td><td>Air Quality plan</td><td>Refer Table 10.1, Chapter 10</td></tr>
<tr><td>ii</td><td>Noise quality management plan</td><td>Refer Table 10.1, Chapter 10</td></tr>
<tr><td>iii</td><td>Solid and hazardous waste management plan</td><td>Refer Table 10.1, Chapter 10</td></tr>
</table>

ToR No.	TOR Point	Compliance
iv	Effluent management plan	Refer Table 10.1, Chapter 10
v	Storm water management plan	Refer Table 10.1, Chapter 10
vi	Rain water harvesting plan	Refer Table 10.1, Chapter 10
vii	Occupational health and safety management plan	Refer Table 10.1, Chapter 10
viii	Green belt development plan	Refer Table 10.1, Chapter 10
ix	Socio-economic management plan	Refer Table 10.1, Chapter 10
x	Wildlife conservation plan (In case of presence of schedule I species)	Wildlife conservation plan is under preparation at the DFO, Forest Department based on our request submitted vide letter given in **Annexure XXV**
xi	Total capital cost and recurring cost/annum for environment pollution control measures shall be included.	Refer Table 10.3, Chapter 10
11.	**Conclusion of the EIA study**	Summary of EIA is given in Chapter 11
12.	In addition to the above, any litigation pending against the project and/or any direction/order passed by any Court of 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.	Nil as on 31.03.2023. Refer Section 1. 7, Chapter 1
	Special Conditions	
1.	For Large ISPs, a 3-D view i.e. DEM (Digital Elevation Model) for the area in 10 km radius from the proposal site. MRL details of project site and RL of nearby sources of water shall be indicated.	Refer Fig 3.3, Chapter 3 for DEM for the area in 10 km radius. The list of water bodies and their mRL based on google earth and/or toposheet is given in Table 3 .2, Chapter 3.
2.	Plan for the implementation of the recommendations made for the steel plants in the CREP guidelines.	Refer Table 10.2, Chapter 10 for for compliance to CREP
3.	Plan for solid wastes utilization	Refer section 4 of Chapter 4
4.	Plan for utilization of energy in off gases (coke oven, blast furnace)	Not applicable as no coke oven and blast furnace is proposed.
5.	System of coke quenching adopted with justification	Not applicable as no coke oven plant is not proposed
6.	Details on environmentally sound technologies for recycling of hazardous materials, as per CPCB Guidelines, may be mentioned in case of handling scrap and other recycled materials.	Refer Section 4.7, Chapter 4 for details on handling and management of wastes. Hazardous waste such as used oil which will be generated form plant process to be stored in containers over impervious floor under well ventilated covered shed followed by disposal through CPCB/ SPCB

ToR No.	TOR Point	Compliance
		authorised recyclers
7.	Details on toxic metal content in the waste material and its composition and end use (particularly of slag).	Refer Table 3.27, Chapter 3. Refer SectioN 4.7.2, Chapter 4 for end use of slag
8.	Details on toxic content (TCLP), composition and end use of slag.	Plan for 100% utilization of solid waste have been made. Refer section 4.7.2, Chapter 4. TCLP test results have been given in Section 3.28, Chapter 3.
9.	100% dolo char generated in the plant shall be used to generate power.	Not applicable as no dolo char will be generated throughout the production process in plant.
10	Fourth Hole fume extraction system shall be provided for SAF.WHR system shall be installed to recover sensible heat from flue gases of EAF. Provision for installation of jigging and briquetting plant to utilise the fines generated in the process.	The proposed project will have Submerged Arc Furnaces with open top with movable attachments to close the gap during operation temporarily. 4th hole extraction system apply on Electric Arc Furnaces which have closed hoods. Provision for installation of metal recovery plant, sinter plant and briquetting plant to utilise the fines generated in the process is proposed
11	No tailing pond is permitted for Iron ore slimes. Dewatering and filtration system shall be provided.	Dewatering and filtration systems shall be proposed with the chrome beneficiation plant.
12.	Emission/ Effluent norms as per GSR 496 (E) dated 9/5/2016	This GSR applied on cement plant and no cement plant is proposed in this proposal.

TABLE 2: COMPLIANCE OF STANDARD TERMS OF REFERENCE (TOR) FOR THERMAL POWER PLANT PROJECTS

ToR No.	TOR Point	Compliance
A.	**Statutory Compliances**	
1.	The proposed project shall be given a unique name in consonance with the name submitted to other Government Departments etc. for its better identification and reference.	The project name is “Proposed Expansion Of Ferro Alloys Plant” of Rungta Mines Limited (Ferro Alloys Division)
2.	Vision document specifying prospective long term plan of the project shall be formulated and submitted.	The plan of implementation of the power plant is its installation in expansion phase along with the ferro alloy units as given in Section 2.9, Chapter 2
3.	Latest compliance report duly certified by the Regional Office of MoEF&CC for the conditions stipulated in the environmental and CRZ clearances of the previous	Not applicable since no environmental clearance or CRZ clearance has been obtained

ToR No.	TOR Point	Compliance
	Phase (s) for the expansion projects shall be submitted.	previously.
B.	**Details of project and site**	
1	The project proponent needs to identify minimum three potential sites based on environmental, ecological and economic considerations, and choose one appropriate site having minimum impacts on ecology and environment. A detailed comparison of the sites in this regard shall be submitted.	Refer section 5.1, Chapter 5 for comparison of the alternative sites.
2	Executive summary of the project indicating relevant details along with recent photographs of the proposed site (s) shall be provided. Response to the issues raised during Public Hearing and the written representations (if any), along with a time bound Action Plan and budgetary allocations to address the same, shall be provided in a tabular form, against each action proposed.	Executive summary of the project is chapter 11 of this EIA report. Recent photographs of the site are given in Section 2--, Chapter 2. Public hearing Minutes of Meeting, Response to the issues raised during Public Hearing will be compiled after public hearing consultation
3	Harnessing solar power within the premises of the plant particularly at available roof tops and other available areas shall be formulated and for expansion projects, status of implementation shall also be submitted.	Details in respect of harnessing of Solar power within the project area is given in section 4.3 (c) ,chapter 4 of the EIA report.
4	The geographical coordinates (WGS 84) of the proposed site (plant boundary), including location of ash pond along with topo sheet (1:50,000 scale) and IRS satellite map of the area, shall be submitted. Elevation of plant site and ash pond with respect to HFL of water body/nallah/River and high tide level from the sea shall be specified, if the site is located in proximity to them.	The geographical coordinates of the site are given in section 1.4.3 of Chapter 1 of the EIA report. Elevation of plant site is given in Section 3.2 of Chapter 3. Application has been submitted to Executive Engineer, Flood Cell, Kamakhya Nagar, Dhenkanal for HFL of the Lingara Nadi (copy given in Annexure XXVIII).
5	Layout plan indicating break-up of plant area, ash pond, green belt, infrastructure, roads etc. shall be provided.	Refer Fig. 2.1 and Table 2.1, Chapter 2.
6	Land requirement for the project shall be optimized and in any case not more than what has been specified by CEA from time to time. Item wise break up of land requirement shall be provided.	Refer Table 2.1, Chapter 2 for land breakup of plant.
7	Present land use (including land class/kisam) as per the revenue records and State Govt. records of the proposed site shall be furnished. Information on land to be acquired including coal transportation system, laying of pipeline, ROW, transmission lines etc. shall be specifically submitted. Status of land acquisition and litigation, if any, should be provided.	Refer Table 3.15, Chapter 3 for existing land use. Refer section 3.9.1, Chapter 3 for information on land type to be acquired and its status. Land will be required for the plant area. No land is required separately for coal transportation system, laying of pipeline, ROW or transmission lines.
8	If the project involves forest land, details of application,	There is no forest land within

ToR No.	TOR Point	Compliance
	including date of application, area applied for, and application registration number, for diversion under FCA and its status should be provided along with copies of relevant documents.	project area
9	The land acquisition and R&R scheme with a time bound Action Plan should be formulated and addressed in the EIA report.	There is no land acquisition proposed for the project. The land will be purchased from the private land owners and they will be compensated as per government policy and IDCO terms. Hence, no R&R plan has been proposed separately.
10	Satellite imagery and authenticated topo sheet indicating drainage, cropping pattern, water bodies (wetland, river system, stream, nallahs, ponds etc.), location of nearest habitations (villages), creeks, mangroves, rivers, reservoirs etc. in the study area shall be provided.	Refer fig 3.2., Chapter 3, topography and drainage map of 10 km radius based on survey of India map and Fig 3.18, Chapter 3 for satellite imagery.
11	Topography of the study area supported by toposheet on 1:50,000 scale of Survey of India, along with a large scale map preferably of 1:25,000 scale and the specific information whether the site requires any filling shall be provided. In that case, details of filling, quantity of required fill material; its source, transportation etc. shall be submitted.	Refer Fig. 3.2, Chapter 3
C.	**Ecology, Biodiversity & Environment**	
1	A detailed study on land use pattern in the study area shall be carried out including identification of common property resources (such as grazing and community land, water resources etc.) available and Action Plan for its protection and management shall be formulated. If acquisition of grazing land is involved, it shall be ensured that an equal area of grazing land be acquired and developed and detailed plan submitted.	A detailed study on land use pattern in the study area is given in section 3.9 of chapter 3. Grazing land is required for the project to the tune of 2.651 ha and the company shall acquire and develop equal area of grazing land in consultation with villagers
2	Location of any National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes / wildlife corridor, if any, within 10 km of the project site shall be specified and marked on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.	Refer Section 3.11.1 Chapter 3. There are no national parks or wildlife sanctuaries within 10 km radius. Mahanadi Elephant Reserve is situated at 21.91 km in north east. The nearest National Park is Simlipal (proposed) at a distance of 136.27 km in north east direction. The nearest sanctuary is Satkosia Gorge sanctuary at a distance of 21.25 km in south west. Mahanadi Elephant Reserve (proposed) is at a distance of 21.91 km in south west and Kahneijena-Anantpur elephant corridor is at a distance of 25.49 km in north west.

ToR No.	TOR Point	Compliance
		The map for authentication is under process and application for authentication is submitted at **Annexure XXV**.
3	A mineralogical map of the proposed site (including soil type) and information (if available) that the site is not located on potentially mineable mineral deposit shall be submitted.	No mineral Zone certificate issued by Tahasildar Odapada vide letter no 41176 dated 09.03.2023 and is given as **Annexure XXIX.**
4	The water requirement shall be optimized (by adopting measures such as dry fly ash and dry bottom ash disposal system, air cooled condenser, concept of zero discharge) and in any case not more than that stipulated by CEA from time to time, to be submitted along with details of source of water and water balance diagram. Details of water balance calculated shall take into account reuse and re- circulation of effluents.	The water requirement is optimized by adopting the concept of zero discharge as per latest MOEF Norms. Details of source of water are given in Section 2.6 of chapter 2 and water balance diagram in Fig 2.8 of Chapter 2.
5	Water body/Nallah (if any) passing across the site should not be disturbed as far as possible. In case any Nallah / drain is proposed to be diverted, it shall be ensured that the diversion does not disturb the natural drainage pattern of the area. Details of proposed diversion shall be furnished duly approved by the concerned Department of the State.	One first order and one second order drain is visible on toposheet. However, on ground, these are low lying areas where villagers carry out agriculture also. Hence, well defined channel do not exist on ground. However, the runoff from these areas will have to be managed as detailed in Section 4.2.2.4, Chapter 4.
6	It shall also be ensured that a minimum of 500 m distance of plant boundary is kept from the HFL of river system/ streams etc. and the boundary of site should also be located 500 m away from railway track and National Highways.	Since it is an existing plant, which was established in 2005 and the expansion is occurring in the land adjoining to the existing plant, a minimum of 50 m distance of plant boundary is being kept from the HFL of Lingara nadi as per TOR point no. 2.A.vii of general conditions of Standard Terms of Reference for conducting EIA study for Metallurgical Industry (Ferrous & Non-ferrous). It is not possible to have 500 m distance from Lingra Nadi due the dimensions of the project expansion area being around 526 m in E-W axis. Boundary of site shall be located 500 m away from railway track and National Highways.
7	Hydro-geological study of the area shall be carried out through an institute/ organization of repute to assess the impact on ground and surface water regimes. Specific mitigation measures shall be spelt out and time bound Action Plan for its implementation shall be submitted.	No ground water is proposed to be withdrawn for industrial purpose. Only drinking water requirement shall be met through 30 KLD water withdrawal permission from Central

ToR No.	TOR Point	Compliance
		Ground Water Authority. As per the Notification no. S.O.3289(E) of 24.09.2020 of Central Ground Water Authority, Hydrogeological Report is not required for 30 KLD water for non-industrial use. However, rain water harvesting and recharge to ground water as a mitigation has been given in Section 4.6.5, Chapter 4.
8	Detailed Studies on the impacts of the ecology including fisheries of the River/Estuary/Sea due to the proposed withdrawal of water/ discharge of treated wastewater into the River/ Sea etc shall be carried out and submitted along with the EIA Report. In case of requirement of marine impact assessment study, the location of intake and outfall shall be clearly specified along with depth of water drawl and discharge into open sea.	The surface water allocation has been done by Office of the Executive Engineer, Rengali Right Canal Division No. II, Dhenkanal. No effluent discharge of treated wastewater into river will be there since the project will have a ETP, STP and tailing pond. Plant shall be zero discharge in non-monsoon period. During monsoon, excess rainwater shall be released to the natural drainage as discussed in Section 4.2.2, Chapter 4.
9	Source of water and its sustainability even in lean season shall be provided along with details of ecological impacts arising out of withdrawal of water and taking into account inter-state shares (if any). Information on other competing sources downstream of the proposed project and commitment regarding availability of requisite quantity of water from the Competent Authority shall be provided along with letter / document stating firm allocation of water.	The consumptive water requirement of the project shall be met from Lingra nadi/ Brahmani river. Necessary water source and requirement are given in section 2.8 of chapter 2 in the EIA report. Agreement with Supritending Engineer, Rengali Right Canal Division No. -II, Dhenkanal for supply of surface water has been executed and copy given in **Annexure XXIV**. The peak and lean season discharge and flood levels from Lingra Nadi have been requested from The Executive Engineer, Flood Cell, Kamakhyanagar, Dist. Dhenkanal (letter given in **Annexure XXVIII**). The details of Brahmani river are given in Section 4.2.2.2 Chapter 4
10	Detailed plan for rainwater harvesting and its proposed utilization in the plant shall be furnished. In addition, wherever ground water is drawn, PP shall submit detailed plan of Water charging activity to be undertaken.	Rainwater harvesting details are given in section 4.4. of chapter 4 in the EIA report
11	Feasibility of near zero discharge concept shall be	Water Balance enclosed Section 2--, Chapter 2 covers Zero Liquid

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	critically examined and its details submitted.	Discharge (ZLD) from the project for effluents. Only during monsoon, excess run off shall be released into natural drain.
12	Optimization of Cycles of Concentration (COC) along with other water conservation measures in the project shall be specified.	The consumptive water requirement meets the latest MoEF&CC norms. The details are given in section 2. of chapter 2 in the EIA report. Water requirement for the Project shall be optimized with designed COC of 5 for conservation of water. A closed cycle condenser cooling water system with cooling towers has been proposed for the project. The CW chemical treatment programme will include acid & Scale and /or corrosion inhibitors apart from chlorination.
13	Plan for recirculation of ash pond water and its implementation shall be submitted.	No ash pond is proposed
14	Detailed plan for conducting monitoring of water quality regularly with proper maintenance of records shall be formulated. Detail of methodology and identification of monitoring points (between the plant and drainage in the direction of flow of surface / ground water) shall be submitted. It shall be ensured that parameter to be monitored also include heavy metals. A provision for long-term monitoring of ground water table using Piezometer shall be incorporated in EIA, particularly from the study area.	Regular monitoring of water quality shall be carried out by MOEF&CC/ NABL accredited land. Detailed plan for conducting monitoring of water quality is given in Table 6.1 & 6.2 of chapter 6 in the EIA report
15	Hazards Characterization: Past incidents of hazard events within 10km radius of project area with detailed analysis of causes and probability of re-occurrence	Refer Chapter 7 for hazard characterization and past incidents of events within 10 km radius of the project area.
D	**Environment Baseline study and mitigation measures**	
1	One complete season (critical season) site specific meteorological and AAQ data (except monsoon season) as per latest MoEF&CC Notification shall be collected along with past three year's meteorological data for that particular season for wind speed analysis and the dates of monitoring shall be recorded. The parameters to be covered for AAQ shall include PM10, PM2.5, SO2, NOx, CO and Hg. The location of the monitoring stations should be so decided so as to take into consideration the upwind direction, pre-dominant downwind direction, other dominant directions, habitation and sensitive receptors. There should be at least one monitoring station each in the upwind and in the pre - dominant downwind direction at a location where maximum ground level concentration	AAQ data has been collected in summer season of 2022 (March to May) and given in Section 3.5, Chapter 3.

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	is likely to occur.	
2	In case of expansion project, air quality monitoring data of 104 observations a year for relevant parameters at air quality monitoring stations as identified/stipulated shall be submitted to assess for compliance of AAQ Standards (annual average as well as 24 hrs).	The expansion is pertaining to ferro alloy plant and not to power plant. The proposed power plant will be a totally new unit, hence, this TOR is not applicable in context of proposed power plant.
3	A list of industries existing and proposed in the study area shall be furnished.	Details of existing industries are given in section 3.13 of chapter 3
4	Cumulative impacts of all sources of emissions including handling and transportation of existing and proposed projects on the environment of the area shall be assessed in detail. Details of the Model used and the input data used for modelling shall also be provided. The air quality contours should be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The windrose and isopleths should also be shown on the location map. The cumulative study should also include impacts on water, soil and socio-economics.	Cumulative impact of all units within the project is given in section 4.4.1.6, Chapter 4 and **Annexure XVII** (with windrose and isopleths).
5	Radio activity and heavy metal contents of coal to be sourced shall be examined and submitted along with laboratory reports.	Coal analysis is given in Section 3.16, Chapter 3.
6	Fuel analysis shall be provided. Details of auxiliary fuel, if any, including its quantity, quality, storage etc should also be furnished.	Coal analysis is given in Section 3.17, Chapter 3. The quantity required is given in table 2.25 Chapter 2 and the storage areas can be seen in layout in Fig 2.1, Chapter 2.
7	Quantity of fuel required, its source and characteristics and documentary evidence to substantiate confirmed fuel linkage shall be furnished. The Ministry's Notification dated 02.01.2014 regarding ash content in coal shall be complied. For the expansion projects, the compliance of the existing units to the said Notification shall also be submitted	Coal analysis is given in Section 3.17, Chapter 3. Coal will be purchased from open market hence no specific coal linkage is there. The Ministry's Notification dated 02.01.2014 regarding ash content in coal shall be complied. There is no expansion of the power plant. The power plant is a new proposed unit in the expansion of ferro alloy plant.
8	Details of transportation of fuel from the source (including port handling) to the proposed plant and its impact on ambient AAQ shall be suitably assessed and submitted. If transportation entails a long distance it shall be ensured that rail transportation to the site shall be first assessed. Wagon loading at source shall preferably be through silo/conveyor belt.	The details of transportation of fuel to proposed plant are given in section 4.9 of chapter 2 in the EIA report. The impact on air quality is discussed in Section 4.4.1 of Chapter 4. Conveyor belt is the preferred mode of transportation of coal.
9	For proposals based on imported coal, inland	Not applicable since no coal is

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	transportation and port handling and rail movement shall be examined and details furnished. The approval of the Port and Rail Authorities shall be submitted.	proposed to be imported. It will be brought from Companys own mine within 10 km distance.
10	Details regarding infrastructure facilities such as sanitation, fuel, restrooms, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase should be adequately catered for and details furnished.	All necessary infrastructure facilities will be provided to the labour force during construction as well as operation phase of the project.
E.	**Environment Management Plan**	
1	EMP to mitigate the adverse impacts due to the project along with item - wise cost of its implementation in a time bound manner shall be specified.	EMP Details are given in chapter 4 and Chapter 10 in the EIA report.
2	A Disaster Management Plan (DMP) along with risk assessment study including fire and explosion issues due to storage and use of fuel should be prepared. It should take into account the maximum inventory of storage at site at any point of time. The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be invariably provided. Provision for mock drills shall be suitably incorporated to check the efficiency of the plans drawn.	Disaster Management Plan (DMP) along with risk assessment study is covered in chapter 7 including the mentioned points
3	The DMP so formulated shall include measures against likely Fires/Tsunami/Cyclones/Storm Surges/ Earthquakes etc, as applicable. It shall be ensured that DMP consists of both On-site and Off-site plans, complete with details of containing likely disaster and shall specifically mention personnel identified for the task. Smaller version of the plan for different possible disasters shall be prepared both in English and local languages and circulated widely.	Disaster Management Plan (DMP) along with risk assessment study is covered in chapter 7
4	Details of fly ash utilization plan as per the latest fly ash Utilization Notification of GOI along with firm agreements / MoU with contracting parties including other usages etc. shall be submitted. The plan shall also include disposal method /mechanism of bottom ash along with monitoring mechanism.	fly ash utilization plan as per the latest fly ash Utilization Notification of GOI
F.	**Green belt development**	
1	Detailed scheme for raising green belt of native species of appropriate width (50 to 100 m) and consisting of at least 3 tiers around plant boundary not less than 2000 tree per ha with survival rate of more than 85% shall be submitted. Photographic evidence must be created and submitted periodically including NRSA reports in case of expansion projects. A shrub layer beneath tree layer	Details of greenbelt proposed are given in section 4-- of chapter 4 in the EIA report. The green belt will consist of at least 3 tiers around plant boundary with 2500 trees/ ha. Photos of the existing green belt

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	would serve as an effective sieve for dust and sink for CO2 and other gaseous pollutants and hence a stratified green belt should be developed.	are given in Section 2.2, Chapter 2.
2	Over and above the green belt, as carbon sink, plan for additional plantation shall be drawn by identifying blocks of degraded forests, in close consultation with the District Forests Department. In pursuance to this the project proponent shall formulate time bound Action Plans along with financial allocation and shall submit status of implementation to the Ministry every six months.	Additional plantation in vacant space in the project area will be done. The Divisional Forest Officer is preparing the Wildlife Conservation Plan which will include the identification of locations outside plant area including blocks of degraded forests for plantation. The preparation of the plan in underway based on our request letter (copy given in is given in **Annexure XXV**)
G.	**Socio economic activities**	
1	Socio-economic study of the study area comprising of 10 km from the plant site shall be carried out through a reputed institute / agency which shall consist of detail assessment of the impact on livelihood of the local communities.	Socio-economic survey has been carried out through primary and secondary survey for need assessment (Section 8.3.3; Chapter 8) and the impact on livelihood of local communities is assessed in Section 4.11 , Chapter 4.
2	Action Plan for identification of local employable youth for training in skills, relevant to the project, for eventual employment in the project itself shall be formulated and numbers specified during construction & operation phases of the Project.	Action Plan for identification of local employable youth for training in skills, relevant to the project, for eventual employment in the project itself has been formulated and given in Section 4.11, Chapter 4.
3	If the area has tribal population, it shall be ensured that the rights of tribals are well protected. The project proponent shall accordingly identify tribal issues under various provisions of the law of the land.	No tribal population is there within the land losers for the project.
4	A detailed CER plan along with activities wise break up of financial commitment shall be prepared in terms of the provisions OM No. 22-65/2017-IA.III dated 30.09.2020. CER component shall be identified considering need based assessment study and Public Hearing issues. Sustainable income generating measures which can help in upliftment of affected section of society, which is consistent with the traditional skills of the people shall be identified.	Public hearing is yet to be held. Summary of issues raised during public consultation along with action plan shall be incorporated in final EIA Report after it is held
5	While formulating CER schemes it shall be ensured that an in-built monitoring mechanism for the schemes identified are in place and mechanism for conducting annual social audit from the nearest government institute of repute in the region shall be prepared. The project proponent shall also provide Action Plan for the status of	Public hearing is yet to be held. Summary of issues raised during public consultation along with action plan shall be incorporated in final EIA Report after it is held

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	implementation of the scheme from time to time and dovetail the same with any Govt. scheme(s). CER details done in the past should be clearly spelt out in case of expansion projects.	
6	R&R plan, as applicable, shall be formulated wherein mechanism for protecting the rights and livelihood of the people in the region who are likely to be impacted, is taken into consideration. R&R plan shall be formulated after a detailed census of population based on socio economic surveys who were dependent on land falling in the project, as well as, population who were dependent on land not owned by them.	Not applicable
7	Assessment of occupational health and endemic diseases of environmental origin in the study area shall be carried out and Action Plan to mitigate the same shall be prepared.	The study revealed that there are no endemic diseases in surrounding area. Existing health problems reported during the study were not showing any unusual pattern. The health related problems found during the study like General health related i.e, High blood pressure, filariasis , malaria and Refractive error is mainly due to life style related factors
8	Occupational health and safety measures for the workers including identification of work related health hazards shall be formulated. The company shall engage full time qualified doctors who are trained in occupational health. Health monitoring of the workers shall be conducted at periodic intervals and health records maintained. Awareness programme for workers due to likely adverse impact on their health due to working in non-conducive environment shall be carried out and precautionary measures like use of personal equipments etc. shall be provided. Review of impact of various health measures undertaken at intervals of two to three years shall be conducted with an excellent follow up plan of action wherever required.	Details on occupational health and safety measures are included in section 4.12 of Section 4.
H.	**Corporate Environment Policy**	
1	Does the company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.	Yes. Refer Section 10.3, Chapter 10
2	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.	Refer Section 10.5, Chapter 10
3	What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental	Refer Section 10.5, Chapter 10

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	clearance conditions. Details of this system may be given.	
4	Does the company has compliance management system in place wherein compliance status along with compliances / violations of environmental norms are reported to the CMD and the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.	Refer Section 10.5, Chapter 10
I	**Miscellaneous**	
1	All the above details should be adequately brought out in the EIA report and in the presentation to the Committee.	Will be complied
2	Details of litigation pending or otherwise with respect to project in any Court, Tribunal etc. shall invariably be furnished.	Nil. Refer Section 1.7, Chapter 1.
3	In case any dismantling of old plants are envisaged, the planned land use & land reclamation of dismantled area to be furnished.	Not applicable
J	**Additional TOR for Coastal Based Thermal Power Plants Projects (TPPs):**	Not applicable since plant is inland

TABLE 3: COMPLIANCE OF STANDARD TERMS OF REFERENCE (TOR) FOR MINERAL BENEFICIATION PROJECTS

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1.	The alternate sites considered, the relative merits and demerits and the reasons for selecting the proposed site for the Beneficiation Plant should be indicated.	It is an expansion project. Alernate sites considered is given in Section 5.2, Chapter 5
2.	Details of the technology and process involved for beneficiation should be given.	Technology selected after assessment the alternative is given in section 5.3.3, Chapter 5 for beneficiation plant.
3.	Location of the proposed Plant w.r.t. the source of raw material and mode of transportation of the ore from mines to the beneficiation plant should be justified.	Refer table No. 2-46 for source & mode of transportation of the raw materials. The project is located in iron ore rich state of Odisha and at a viable distance from the iron-ore mines in the Dhenkanal regions
4.	Treatment of run of mine (ROM) and or of the fines/waste dump should be spelt out.	Run of Mine ore shall be brought to the plant and beneficiated as described in Section 2.4.9 Chapter 2.
5.	Estimation of the fines going into the washings should be made and its management described.	Beneficiation of lump ore is envisaged in beneficiation plant. The fine contents going with the wash water is usually in the range of 1%, based on experience of the Company, and this too is recoverable, dewatered and re-

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		useable for pelletisation.
6.	Details of the equipment, settling pond etc. should be furnished.	Refer section 2.4.9, Chapter 2.
7.	Detailed material balance should be provided.	The material balance for the Beneficiation Plant is given in section 2.4 , Chapter 2.
8.	Sources of raw material and its transportation should be indicated. Steps proposed to be taken to protect the ore from getting air borne should be brought out.	Please refer Table No. 2.21, Chapter 2 for sources of raw material and its transportation mode. Refer section 4.4.2 of chapter 4 for air pollution control measures.
9.	Management and disposal of tailings and closure plan of the tailing pond, if any after the project is over, should be detailed in a quantified manner.	The project will have a tailing decantation tank attached to the beneficiation unit. The tailings will be temporarily collected in it, water recovered and reused. The solids from the tailing are reusable as sand substitute in infrastructure/ fine concrete aggregate/ cement manufacture as described in Section 4.7.2, Chapter 4.
10.	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 also be indicated.	Refer Section 2.7, Table No. 2.28, chapter 2. For water balance diagram refer Fig. No. 2.13, Chapter 2
11.	A copy of the document in support of the fact that the Proponent is the rightful lessee of the unit should be given.	There is no lease. Company has purchased (39.935 ha private land) and will purchase (41.760 acres private and 11.880 acres government land). The land ownership record is given in **Annexure XXXII.**
12.	All documents including EIA and public hearing should be compatible with one another in terms of the production levels, waste generation and its management and technology and should be in the name of the lessee.	All documents are compatible with one another as required.
13.	All corner coordinates of the Unit, superimposed on a High Resolution Imagery/Toposheet should be provided. Such an Imagery of the proposed Unit should clearly show the land use and other ecological features of the study area (core and buffer zone).	Please refer section 1.4.3 Chapter 1. The boundary is super imposed on google earth image and given in Fig. No.2.3, Chapter 2 and a satellite image in Fig. 3.18, Chapter 3.
14.	It should be clearly indicated 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	Please refer Section 10.5, Chapter 10 for Environment Policy and for infringement/ deviation/ violation reporting procedure with hierarchical system.

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	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 EIA Report.	
15.	Issues relating to Safety should be detailed. The proposed safeguard measures in each case should also be provided. Disaster management plan shall be prepared and included in the EIA/EMP Report.	Hazards and risks associated with the plant have been identified and given in section 7.1 of Chapter 7. Disaster management plan is given in section 7.1.3, Chapter 7. Occupational safety measures are given in Section 4.12 of Chapter 4.
16.	The study area will comprise of 10 km zone around the Plant.	Complied. EIA study has been done for the study area of 10 km zone around the plant. Study map shown in Fig. 3.2 , Chapter 3.
17.	Cumulative impact study of both Beneficiation Plant with suggested mitigation measures as per the study should be described.	Beneficiation plant is part of the expansion of Ferro alloys plant and has been considered for impact assessment with all the other sub-units.
18.	Location of Railway siding with its handling capacity and safety measures should be indicated.	The nearest Railway siding is Meramandali and the safety measures to be followed there are given in Section 4 .9, Chapter 4.
19.	Option to provide only silo for storage of minerals instead of open stacking to avoid fugitive dust should be explored and arrangements finalized justified.	There will be a mix of silo storage arrangement as well as open storage, the former being the preferable storage method.
20.	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 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.	Please refer section 3.11.2 and Fig. No. 3.21, Chapter 3 for pre operational land use and Section 3.9 Chapter 3 for land use of study area. Land use after expansion is given in Section 4.5.1, Chapter 4 along with the impact of land use change and its management.

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21.	Details of the land for any Over Burden Dumps outside the lease, such as extent of land area, distance from lease, its land use, R&R issues, if any, should be given.	No land is required for dumping outside the project. No R&R is required since no displacees are there. Approximately 500 land losers have been identified. All land looser will be compensated as per government policy and IDCO terms. Refer section 4.11 of Chapter 4.
22.	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.	No forest land is present in the plant area. This is evidenced from the land records available from the revenue department (**Annexure XXXII**).
23.	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.	Not Applicable since no forest land involved in existing and expansion area.
24.	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.	Not Applicable since no forest land involved.
25.	The vegetation in the RF / PF areas in the study area, with necessary details, should be given.	Please refer section 3.21 Chapter 3.
26.	A study shall be got done to ascertain the impact of the 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.	A “Site Specific Conservation Plan” is under preparation by DFO Dhenkanal. Wildlife management has been summarised in section 4.10.3, Chapter 4 along with the findings of the biological study in Section 3.11, Chapter 3.
27.	Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, 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	There are no National parks, Wildlife Sanctuary, Biospheres reserves and migratory corridor within 10 km radius. The nearest National Park is Simlipal (proposed) at a distance of 136.27 km in north east direction. The nearest sanctuary is Satkosia Gorge sanctuary at a distance of

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	mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished.	21.25 km in south west. Mahanadi Elephant Reserve (proposed) is at a distance of 21.91 km in south west and Kahneijena-Anantpur elephant corridor is at a distance of 25.49 km in north west. Permission from National Board of Wildlife is not required since the project is outside 10 km radius as well as outside eco-sensitive zones of the aforementioned protected areas.
28.	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 alongwith 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.	Refer Section 3.11, Chapter 3. In addition a site specific Conservation Plan is under preparation by DFO Dhenkanal.
29.	Proximity to Areas declared as 'Critically Polluted' shall also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB/CPCB shall be secured and furnished to the effect that the proposed activities could be considered.	The project area used to fall in Odapada Block of Dhenkanal District which is part of “Angul Talchar” declared as Critically Polluted Area at sl. no. 7 of MOEF&CC’s OM No. J-11013/5/2010-IA.II(I) dated 15.03.2010. It had a CEPI score of 82.09. However, the latest status as recorded in NGT order dated 14.11.2019 in the Original Application No. 1038/2018 is that CEPI score is 46.43 and is ranked at serial 94, and therefore, it is well below the rank of either critical (CEPI score >70) or severely (CEPI score 60-70) polluted area. Thus, the proposed activity can be considered with is CEPI score of 46.3.
30.	Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL. HTL, CRZ area, location of the unit w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Projects falling under CRZ would also need to obtain approval of the	Plant does not lie in coastal area

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	concerned Coastal Zone Management Authority).	
31.	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 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.	No R&R is required. Approximately 500 land losers have been identified. All land looser will be compensated as per government policy and IDCO terms. Refer section 4.11 of Chapter 4.
32.	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 unit in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given.	Monitoring period was from 1st March to 31st May 2022. The collected data is given in Chapter 3 as follows: ● Air sampling stations and justification for selecting the stations are given in Section 3.5 and tabulated in Table 3.5 of Chapter 3. ● Micro-meteorology- Section 3.4
33.	Air quality modeling 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 modeling 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.	The prediction modeling for Ground Level Concentration of pollutants from the stack emissions is given in section 4.4.1.1 to 4.4.1.6`, of Chapter 4 and the detailed study is given in Annexure XVII for stack and fugitive emissions and for GLCs due to traffic, refer Annexure XVIII The GLC contour maps are given in Annexure XVII along with windrose diagram.
34.	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.	Refer section 2.7, c1qahapter 2.
35.	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project	Please refer section 2.7, chapter 2 and **Annexure XXIII & XXIV**.

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	should be secured and copy furnished.	
36.	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.	Please refer section 4.6, Table 4.12, Chapter 4. For rainwater harvesting refer section 4.6.5
37.	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.	Please refer section 3.2.2, Chapter 3 for existing drainage features and section 4.2.2, Chapter 4 for impact and mitigation. Please refer section 4.10.2, Chapter 4
38.	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 brought out.	Please refer section 4.2.2, Chapter 4
39.	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. 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 the pollution.	Please refer section 4.10.2, Chapter 4
40.	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.	Please refer section 4.9, Chapter 4
41.	Details of the onsite shelter and facilities to be provided to the workers should be included in the EIA report.	Refer section 2.8 chapter 2
42.	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 should be detailed.	Please refer section 4.12, of chapter 4. OHS format is attached in Annexure XXVII. Health checkup report is attached in Annexure XXVII.
43.	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed	Public health remedial measure with budget is incorporated in Section 4.11, Chapter 4.

ToR No.	TOR Point	Compliance
	remedial measures should be detailed along with budgetary allocations.	
44.	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.	Please refer section 4.11, Chapter 4 and Chapter 8
45.	Public hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.	Public hearing is yet to be held. Will be incorporated after public hearing in the final EIA report.
46.	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the project should be given.	No litigation pending against the project till date on pollution control or environment related matters.
47.	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	Cost of project - Section 2.9, Chapter 2 EMP cost - section 10.6, Table 10.3 & 10.4 in Chapter 10.
48.	A brief background of the Project, its financial position, Group Companies and legal issues etc. should be provided with past and current important litigations if any.	Please refer Section 1.3, 1.4 and section 1.7, chapter 1
49.	Benefits of the Project, if the project is implemented should be outlined. The benefits of the projects shall clearly indicate environmental, social, economic, employment potential, etc.	Refer Chapter 8
50.	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.	All documents are properly referenced with index and page number.
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.	Complied
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	For test reports of Water (Annexure V), Air (Annexure III), Soil (Annexure XI), Noise (Annexure VII) etc. of this EIA report. Testing has been done by Min Mec R&D Laboratory, New Delhi (NABL accredited/ MoEF&CC Recognized Lab). Certificate of lab is given in Annexure XIX.
d	Where the documents provided are in a language other than English, an English translation should be provided.	Complied
e	The Questionnaire for environmental appraisal of project as devised earlier by the Ministry shall also be	Not applicable since as per latest MoEF&CC OM's Form 2 shall be

ToR No.	TOR Point	Compliance
	filled and submitted.	filled online when applying for EC.
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 4th August, 2009, which are available on the website of this Ministry, should also be followed.	Complied
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.	No changes proposed
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 by the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.	Not applicable since the project is going for EC first time.

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CHAPTER 1

INTRODUCTION

1.1 PURPOSE OF THE PROJECT

Environmental clearance is a statutory requirement as per EIA Notification dated 14th September 2006 and its amendments till date for projects that fall under its Schedule. The project falls in Category A under Schedule 3 (a), 2 (b) and 1(d). Category A project shall seek Environmental clearance from the Ministry of Environment, Forest & Climate Change (MoEF&CC), New Delhi. The procedure covers submission of application with Form-1 and Pre-feasibility report to Ministry of Environment, Forest & Climate Change (MoEF&CC), obtaining a Terms of Reference (ToR), preparation of draft EIA/ EMP in line with the Terms of Reference, applying to the State Pollution Control Board for public hearing/ consultation, recording of suggestions/ objections and statements of the public and finalizing the EIA/ EMP report after incorporating the responses and action plans to the points raised by the public. The final EIA/EMP report shall be submitted to the MoEF&CC which shall be appraised by the Expert Committee and thereafter only the Environmental Clearance can be granted.

Thus, this Environmental Impact Assessment (EIA) report has been prepared for the expansion of Ferro Alloys Plant from 0.055 to 0.293 MTPA along with 150 MW Captive Power Plant (CPP). As per procedure laid down in the EIA Notification dated 14th September 2006 and its amendments, Form-I, proposed Terms of References (TOR) for the EIA along with the pre-feasibility report was submitted to Ministry of Environment, Forest & Climate Change (MoEF&CC) vide online application no. IA/OR/IND1/403580/2022 dated 28th October 2022. After submission of TOR application, Essential Details Sought (EDS) were received from MoEF&CC raised online on 4.11.2022. Reply to this was made vide letter No. RML/FAD/MOEF/22-23/154 dated 25.11.2022, submitted 26.11.2022. In view of the reply submitted, Standard Auto ToR for the same was granted vide letter no.IA-J-11011/515/2022-IA-II(IND-I) dated 01.12.2022 (copy given in **Annexure I)**

To obtain the Environmental Clearance for the expansion project, environmental studies have been carried out and Draft Environmental Impact Assessment (EIA) / Environment Management Plan (EMP) has been prepared in line with Terms of References received. After conduct of public hearing, the Final EIA/EMP report shall be prepared.

1.2 BACKGROUND OF THE PROJECT

RML is operating a ferro alloys plant in village Tulasidiha in District Dhenkanal of Odisha for a capacity of 0.055 MTPA ferro alloys. Odisha State Pollution Control Board (OSPCB) granted Consent to Establish (CTE) vide letter no. 33614/IND-II-NOC/3916 dated 22.11.2005 and it amendment

vide letter no. 19793/IND-II-CTE-6752 dated 27.10.2022. OSPCB also granted CTE vide letter no. 11852/Ind-II-NOC-5244 dated 21.07.2014 and its amendment vide letter no. 19942/IND-II-CTE-6761 dated 28.10.2022 for installation of Sinter Plant (Manganese) of quantity 43200 TPA. Copies of CTE letters are given in **Annexure XX**. Details of Ferro Manganese and Silico Manganese production capacity as mentioned in CTE is given in **Table 1.1**.

TABLE 1.1: DETAILS OF PRODUCTION CAPACITY AS PER CTE

Sl. No.	Facilities	Production in Tonnes/ month	Production in TPA
1.	Ferro Manganese	4584	55008
2.	Silico Manganese	3330	39960
3.	Metal recovery plant	25 T/h	
4.	Manganese ore sinter plant	3600	43200

Now the company proposes the expansion of the ferro alloys plant.

Salient features of the proposed expansion project are given in **Table 1.2**.

TABLE 1.2: SALIENT FEATURES OF THE PROJECT

Project name	Expansion of Ferro Alloys Plant
Project proponent	Rungta Mines Limited
Location	Existing Village: Tulasidiha Proposed additional village: Chararhagarhia & Kangelapal District : Dhenkanal State : Odisha
Latitude and longitude (as per google earth as on 19.08.2022)	A. North most: 20°47'52.48"N, 85°17'24.94"E B. East most: 20°47'35.60"N, 85°17'51.21"E C. South most: 20°47'14.93"N, 85°17'26.27"E D. West most: 20°47'30.10"N, 85°17'14.82"E
Total Area	**Existing:** 52.5250 acres (21.257 ha) **Proposed additional:** 93.575 acres (37.869 ha) **Total:** 146.10 acres (59.126 ha)
Status of Land	**Existing:** 100% i.e. 52.5250 acres land is purchased and in possession of the company. **Proposed additional:** 93.575 acres which consists of 81.695 acres private land and 11.880 acres government land. Out of this, 39.935 acres private land has been purchased and 41.760 acres private and 11.880 acres government land is to be purchased.
Product	Ferro manganese, sinter and power
Rated capacity existing & Proposed	• Ferro manganese- 0.055 MTPA to 0.293 MTPA • Silico Manganese- 0.0399 MTPA to 0.230 MTPA • Ferro Chrome- 0.230 MTPA • Ferro Silicon- 0.1024 MTPA • Pig Iron- 0.369 MTPA

	• Metal Recovery Plant- 0.0198 MTPA to 0.115 MTPA • Sinter Plant- 0.0432 MTPA to 0.5616 MTPA • Chrome Ore Beneficiation Plant- 0.66 MTPA • Power Plant- 150 MW
Working days	**Existing :** 325 **Proposed**: 350
Manpower	**Existing** : 500 **Proposed Additional** : 1500 **Total** : 2000
Expected cost of the project	**Existing** : Rs. 25 Crores **Proposed Additional** : Rs. 950 Crores **Total** : Rs. 975 Crores
Water requirement	**Existing :** 9 KLH (216 KLD) **Additional :** 228 KLH (5467 KLD) **Total :** 237 KLH (5683 KLD)
Source of water	• Surface water withdrawal permission (Lingra nadi) for 733.972 KLD vide letter dt. 14.02.2023, available from Office of Supritending Engineer, Rengali Right Canal Division No. II, Dhenkanal • Balance surface water withdrawal (Lingra nadi/ Brahmani River) shall be applied for prior to expansion • Bore well (permission for 30 KLD from CGWA vide NOC no. CGWA/NOC/IND/REN/1/2021/5971 valid from 08/05/2021 to 07/05/2024) • Rain water harvesting within plant site
Waste water generation	**Existing :** 0.24 KLH (5.7 KLD) **Proposed additional :** 10.76 KLH (258.2 KLD) **Total :** 11 KLH (263.9 KLD)
Waste water disposal	**Existing :** Nil except excess runoff during monsoon after water harvesting **After expansion :** Nil except excess runoff during monsoon after water harvesting This is proposed to be a zero liquid effluent discharge plant.
Power requirement	**Existing** : 25 MW **Proposed Additional** : 125 MW Total : 150 MW
Power source	**Existing:** State electricity supply board **After expansion :** Captive Power Plant
Implementation Schedule	60 months from the date of EC

1.3 PROJECT PROPONENT

M/s Rungta Mines Limited (RML), is one of the leading and the oldest mining company of the mineral rich belt of Odisha and Jharkhand. The company is engaged in these activities for the past six decades. The

company's owns Iron and Manganese Ore mines, steel plants and power plants in Odisha and Jharkhand.

The Corporate office of Rungta Mines Limited is located at Chaibasa, Jharkhand. The company's vision and mission is to utilise its core values and strengths, complemented with the vast experience gained, to help it keep pace with the changing times and respond to domestic & international market forces by maintaining consistent quality and dispatch schedules, making RML synonymous with reliability.

1.4 BRIEF DESCRIPTION OF THE PROJECT

1.4.1 Nature of project

The nature of the project as per **Schedule to EIA Notification, 2006 & its amendments** is Item no. 3 (a) for metallurgical industries (ferrous & non - ferrous). This is a Category A project. The projects contains the following sub unit categories and Schedules:

Sub-Project	Schedule Item No.	Category
Ferro Alloys Plant	3(a)	A
Beneficiation Plant	2(b)	A
Captive Power Plant	1(d)	B

1.4.2 Size

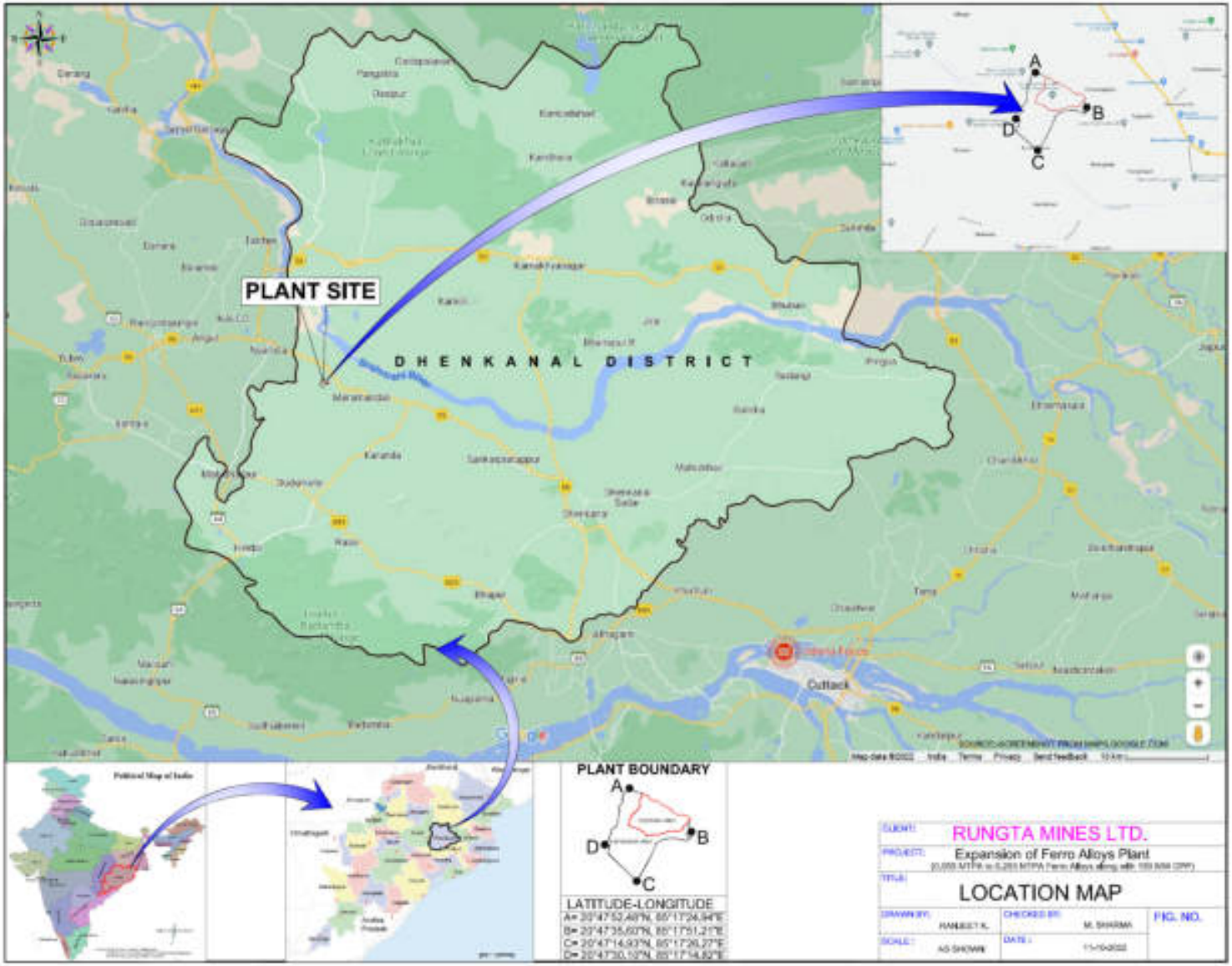
Expansion of Ferro Alloys Plant is proposed from 0.055 MTPA to 0.293 MTPA along with 150 MW CPP. There shall be expansion of land from 21.257 Ha to 59.126 Ha. Land of existing plant has been purchased. 37.869 ha (93.575 acres) is additionally required which consists of 33.061 ha (81.695 acres) private land and 4.808 ha (11.880 acres) is government land for the proposed expansion phase. Out of 37.869 ha (93.575 acres), 16.16 ha (39.935 acres) private land has been purchased and 16.90 ha (41.760 acres) private and 4.808 ha (11.880 acres) government land is yet to be purchased.

1.4.3 Location

The existing plant is located in village Tulasidiha & for proposed expansion phase land from two additional villages namely Chararhagarhia & Kangelapal shall be required in District Dhenkanal, Odisha. Location map is shown in **Fig 1.1.** The location of plant and study area can be seen in Survey of India Topo sheet No. 73 H/01, 02, 05 and 06. Plant will be established at following coordinates based on Google Earth:

	Latitude, N	Longitude, E
A. North most	20° 47' 52.48"	85° 17' 24.94"
B. East most	20° 47' 35.60"	85° 17' 51.21"
C. South most	20° 47' 14.93"	85° 17' 26.27"
D. West most	20° 47' 30.10"	85° 17' 14.82"

FIG 1.1: LOCATION MAP



1.4.4 Site Accessibility

Sl. No.	Nearest	Details
1.	Road	NH-55 at 0.85 km (aerially) and 1.05 km by road in north east direction
2.	City	Angul at a distance of 20.7 km aerially and 24.5 km by road in west north west direction.
3.	Railway station	Meramundali Railway Station at 1.1 km aerial distance in north east direction. It is 2.1 km by road.
4.	Airport	Bhubaneshwar, approximately 79 km aerially and 106 km by road in south east direction.

1.4.5 Importance to country & region

Importance in the country: As per the National Steel Policy, the objective is to build a globally competitive industry. It is anticipated that a crude steel capacity of 300 million tonnes will be required by 2030 based upon the demand projections. Thus, achieving crude steel capacity of up to 300 million tonnes will require extensive mobilization of natural resources, finances, manpower and infrastructure including land. Ferro Alloys are used as additives in steel making as de-oxidants and as alloying agent. These are added in steel production process not only for deoxidation but also for grain size control as well as for improvement in the mechanical properties of steel. Depending upon the process of steel making and the type of steel being made, the requirement of Ferro Alloys varies widely. The proposed project will assist in the endeavor to meet the projected demand of steel in the country by providing the necessary additives to the larger steel manufacturers.

As per the National Steel Policy, 2017, Ferro alloy industry is a power intensive industry. Hence, captive power generation in the ferroalloys plants will be extensively supported. Since the demand for ferro-alloys is likely to grow along with steel production in the country, the Industry would have to be encouraged to set up larger units to achieve adequate economies of scale. Efforts in the direction of providing necessary raw materials linkages and stable supply of power to the Ferroalloy units must be rendered priority.

Regional Importance: [1] The Ferro alloys Industry was established as an ancillary industry to cater to the growing needs of the domestic Steel Industry and is spread all over the country. Besides other parts of the country such as Andhra Pradesh, Chhattisgarh, Jharkhand, Odisha, etc., have ferro alloys units because of availability of the raw material as well as uninterrupted electricity supply.

The ferroalloys unit have incorporated the latest technology in order to use non-metallurgical grade ores, both lumps and fines, after necessary

[1] Source: Indian Minerals Yearbook 2019 (Part- II : Metals & Alloys) 58th Edition -FERROALLOYS, July 2020

beneficiation and agglomeration. The units have also incorporated an effective pollution control measures in the form of gas cleaning, deoxidising and waste heat recovery. Major Ferro Alloy Plants in Odisha are present in Keonjhar and Dhenkanal Districts.

Odisha has a pig iron manufacturing capaity of 190530 TPA while its annual hot metal production has been 15915000 TPA and hot metal production has been 497000 TPA in 2019-2020.

As discussed earlier that India is expected to become one of the leading steel consuming nations and the Ferroalloys Industry estimates that the consumption of ferroalloys will increase domestically and internationally in the coming years. This has led to the expansion and coming up of new industries which will significantly contribute to economic growth of the Nation as well as to the region as it generates employment both directly and also due to development of downstream industries. The infrastructural and other social amenities grow in the region leading to overall development of the region. The proposed project will also contribute in enhancement of the overall development of the region.

1.4.6 Demand-supply gap

[2]The product mix of the Ferro Alloy industry consists of Ferro manganese, Silico Manganese, Ferro Silicon, Ferro Chrome & Charge Chrome called Bulk Ferro Alloys. There is another group of ferro alloys called Noble Ferro alloys which consists of Ferro Molybdenum, Ferro Titanium, Ferro Tungsten, Ferro Vanadium, etc. As per Indian Ferroalloys Producers' Association (IFAPA), the total installed capacity of bulk Ferroalloys Industry in India is estimated at 5.10 million tonnes per annum and for noble ferroalloys it is 50,000 tonnes per annum. Owing to high cost of power, Ferroalloys Industry has not been operating to its full capacity in India.

Ferro alloys are used in production of mild steel, carbon steel, special alloy steel and stainless steel in the country. India’s steel production is increasing every year; thereby the consumption of ferro alloys is also increasing. The industry has enough capacity to produce ferro alloys required for domestic steel industry. However, certain basic raw materials, i.e., ores viz, manganese ore, chrome ore, roasted molybdenum ore and concentrate/ moly oxide, tungsten ore, wolframite ore, scheelite ore, nickel oxide, vanadium ore, vanadium pentoxide, etc need linkages and stable supplies.

The total production of ferromanganese in 2018-19 was about 5,18,000 tonnes while it was 47,406 tonnes in 2019-20 as per the annual return submitted to IBM in Form ‘O’. The estimated consumption of ferromanganese was 50,800 tonnes in 2017-18.

[2] Source: Indian Minerals Yearbook 2021 (part-II: metals & alloys), 60th Edition, Advance release, March 2023 of Indian Bureau of Mines available at https://ibm.gov.in/writereaddata/files/16821603416443bad57364cFerro_Alloys_2021.pdf accessed 25.04.2023

The production of silicomanganese (including medium-carbon & lowcarbon silicomanganese) which was about 3,42,591 tonnes in 2018-19 decreased to 3,20,594 tonnes in 2019-20. In 2017-18, the total consumption of silicomanganese by all industries has been estimated at 1,22,600 tonnes.

The production of ferrosilicon in 2018-19 was about 90,000 tonnes. The domestic consumption of ferrosilicon in the Organised Sector was estimated at 23,400 tonnes in 2017-18[3]. The production of ferrosilicon during 2019-20 and 2020-21 is not available.

The total production of ferrochrome/charge chrome in 2019-20 was about 9,21,000 tonnes which decreased to 8,68,000 in 2020-21.

Imports of ferroalloys (total) decreased marginally by 13% to 4,21,980 tonnes in 2020-21 from 4,83,127 tonnes in the previous year. In terms of value, the ferroalloys imports also decreased to ` 5,531 crore in 2020-21 from ` 6,343 crore in 2019-20. Out of total imports in terms of quantity, imports of ferrosilicon accounted for about 46% followed by ferromanganese (15%), ferronickel (18%), ferrochrome (9%) and chargechrome (3%). Other ferroalloys together accounted for the remaining 9% of the imports in 2020-21. Imports were mainly from Bhutan (25%) followed by Indonesia (14.1%), Malaysia (12%), China (11%) and South Africa (7%).

As per the steel world report, ferroalloys Industry is estimated to grow at a CAGR of 5.9% from 2017 to 2025 and is expected to reach a valuation of US$ 188.7 billion by 2025. India is expected to show strong growth in usage of steel in the coming years because of its robust economy, massive infrastructure needs and expansion of industrial production. India is expected to become one of the leading steel consuming nations in the next decade. In this scenario, the Ferroalloys Industry estimates that the consumption of ferroalloys will increase domestically and internationally in the coming years. Some of the Ferroalloy Producers have already gone for expansion and some new units are coming up.

Pig iron : forecast of Pig iron demand/ production by 2030-31 is estimated as 17 million tonnes. A status report on the performance of Indian Steel Industry during April-March 2020-21 shows Pig iron production was 4.88 million tonnes, down by 10 % in comparisons to same period of last year. Pig iron is a part of the Secondary Steel Sector. Domestic production of pig iron lags behind and is not in tandem with the demand. Efforts were, therefore, made to increase pig iron manufacturing facilities in the Secondary Sector. Production of pig iron in merchant units in the Secondary Sector got its first major boost in 1992. Thereafter, the growth of this Sector accelerated greatly as Foundry-grade pig iron fast became the preferred raw material for the quality conscious foundries.

[3] Source: Indian Minerals Yearbook 2020 (part-II: metals & alloys), 59th Edition, October 2021 of Indian Bureau of Mines available at https://ibm.gov.in/writereaddata/files/11292021123407Ferro%20Alloys_%202020.pdf accessed 25.04.2023

As a result of various policy initiatives taken by the Government, the Private Sector showed considerable interest in setting up new pig iron units, especially in the post-liberalised period. This has resulted in drastic change in the contribution of Private Sector producers. With 86 % share, the Private Sector (4.208 million tonnes, down by 12.4 % over 2019-20) led pig iron production in 2020-21, with the average share of the Sector at 91% in the last five years ending 2020-21.The share of Public Sector in 2020-21was about 9 % (0.67 million tonnes, up by 9 % over previous year). With a 71 % share, the Other Producers (3.464 million tonnes, down by 18% over 2019-20) led pig iron production in 2020-21 while the rest 29% was the share contributed by SAIL, RINL, TSL Group, AM/NS (Essar Steel), JSWL, JSPL taken together. In fact, the trend of last five years ending 2020-21 has been similar in this regard.

Export Possibility[4]

Owing to high cost of power, Ferroalloys Industry has not been operating to its full capacity in India. As per Indian Minerals Yearbook 2021 (part-II: metals & alloys), March 2023 of Indian Bureau of Mines, In 2020-21, exports of ferroalloys (total) increased by 7% to 18,43,322 tonnes in 2020-21 from 17,15,919 tonnes in the previous year. In terms of value, ferroalloys exports also increased to 12,773 crore in 2020-21 from 11,810 crore in 2019-20.

Out of total export, in terms of quantity, majority were exports of ferrochrome (39%) followed by ferro-silico-manganese (41%), ferromanganese (18%) and ferrosilicon (1%). The other ferroalloys together accounted for the remaining 1% of exports in 2020-21. Exports were mainly to China (19%), UAE (11%), Republic of Korea (9%) and Japan (7%).

The **Table 1.3** below shows the trend in production for sale, import, export and actual consumption of finished steel (alloy/ stainless + non-alloy) in the country for the last five years.

TABLE 1.3: TREND IN PRODUCTION IMPORT, EXPORT AND CONSUMPTION OF FERRO ALLOYS IN INDIA (IN TONNES)

Description	Fe-Mn	Si-Mn	Fe-Si	Fe-Cr
Production (year)	518000 (2018-19)	329295 (2020-21)	90000 (2018-19)	868000 (2020-21)
Imports (year)	66089 (2020-21)	-	194439 (2020-21)	39002 (2020-21)
Export (year)	720539 (2020-21)	-	11236 (2020-21)	720539 (2020-21)
Consumption (year)	50800 (2017-18)	23400 (2017-18)	23400 (2017-18)	14600 (2017-18)

Source: ***Indian Minerals Yearbook 2021 (part-II: metals & alloys), 60th Edition, Advance release, March 2023***

[4] Source: Indian Minerals Yearbook 2021 (part-II: metals & alloys), 60th Edition, Advance release, March 2023 of Indian Bureau of Mines available at https://ibm.gov.in/writereaddata/files/16821603416443bad57364cFerro_Alloys_2021.pdf accessed 25.04.2023

Domestic / Export markets

The ferro alloy can be sold both in domestic market as well as or exported.

1.5 LEGAL ASPECTS

The requisite Consent to Establish and Consent to Operate for the existing operational plant have been obtained from State Pollution Control Board. The Consent to Establish, Consent to Operate and Environment Clearance will be obtained for expansion phase. Company will adhere to the statutory provisions, as applicable, for the following:

1. The Factories Act, 1948
2. Indian Boiler Act, 1923 and its amendments till date, Indian Boiler Regulations 1950 and their amendments
3. The Air (Prevention and Control of Pollution) Act, 1981
4. The Water (Prevention and Control of Pollution) Act, 1974
5. Environment (Protection) Act, 1986 and Rules thereunder
6. Environmental (Protection) Rules,1986 (and its Amendments till date)
7. Environment Impact Assessment Notification 2006 and its amendments
8. Manufacture, Storage and Import of Hazardous Chemical Rules 1989 amended in 1994 and 2000.
9. Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and amendments 2016, 2017, 2018
10. Solid Waste Management Rules, 2016
11. Construction and Demolition Waste Management Rules 2016
12. Plastic Waste Management Rules 2016 and amendment 2018
13. Batteries Management Rules, 2022
14. E-Waste Management Rules, 2016 and amendment 2018
15. GSR 94(E): Mandatory Implementation of Dust Mitigation Measures for all Construction and Demolition Activities
16. Noise Pollution (Regulation and Control) Rules 2000 and amendment 2000, 2002, 2017
17. Wildlife Protection Act, 1972 and amendments
18. Wetland Rules, 2017
19. Forest (Conservation) Act, 1980
20. The Petroleum Act, 1934 and amendments thereunder
21. Motor Vehicles Act, 1988 and the amendments thereunder
22. Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996

23. Ozone Depleting Substances (Regulation and Control) Rules, 2000
24. Public Liability Insurance Act, 1991 and amendments till date
25. Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996

Compliance to State Rules and Notifications is and shall be ensured along with the environmental clearance being sought for expansion from 0.055 to 0.293 MTPA under EIA Notification 2006 from MOEF&CC, Government of India.

1.6 SCOPE OF STUDY- DETAILS OF REGULATORY SCOPING CARRIED OUT AS PER TERMS OF REFERENCE

The Environmental Impact Assessment and Environment Management Plan for the project addressing the environment related issues are prepared in accordance with the requirements of Terms of Reference prescribed by Ministry of Environment, Forest and Climate Change, Govt. of India vide letter No.IA-J-11011/515/2022-IA-II(IND-I) dated 01.12.2022. (copy given in **Annexure I**).

The study evaluates the prevailing environmental conditions. The adverse impacts have been identified and possible mitigation measures have been drawn in order to protect the environment. In order to carry out the study, the baseline environmental scenario has been established and the project activities superimposed on them to assess the impact and subsequent mitigation.

The main objectives of the present EIA study are briefly summarized below:

- To establish the baseline environmental scenario.
- To identify, predict and assess the impacts of proposed future project on the environment.
- To prepare a detailed action plan for implementation of mitigation measures.
- To suggest preventive measures to minimize adverse impacts and to maximize beneficial impacts.
- To suggest a monitoring programme to evaluate the effectiveness of mitigation measures.
- To suggest the formation of a core group responsible for implementation of the EMP.
- To prepare a capital cost estimate for environment management plan.
- To address the concerns of disaster management and social development.

The scope of the present study is to conduct EIA covering all the disciplines of environment and field monitoring in relevant disciplines over one full season of 3 (three) months (excluding monsoon months). The draft EIA report is prepared as per the MoEF&CC Notification dated 14.09.2006 and its amendments till date and in accordance with the Terms of Reference (TOR) issued by the MoEF&CC. After completion of the Public Consultation, all the environmental concerns expressed during the Public Consultation process will be addressed and appropriate changes in the “draft EIA Report” are made accordingly to formulate the “Final EIA Report”. The final EIA Report is then presented to the Expert Appraisal Committee (EAC) of MoEF&CC. Any queries raised will be clarified and replies will be submitted to them.

Study area:

The project area is termed as "core zone". The area within 10 km radius around the periphery of the project boundary has been considered as the “buffer zone” for identifying and assessing impact with respect to air, water, noise, land use, ecology and socio-economic environment. The core zone and buffer zone together comprise the "study area".

Data Generation:

The baseline environmental data was generated during summer season from 01.03.2022 to 31.05.2022 and some additional data collection was carried out after receipt of ToR. Monitoring has been carried out by Min Mec R&D Laboratory, (NABL accredited and MOEF&CC recognised, certificates given in **Annexure XIX**) in accordance with the requirement of statutory agencies as given in **Table 1.4**.

TABLE 1.4: BASELINE DATA GENERATED

Description	No. of locations	Total No. of samples
Air		
Ambient air monitoring (24 hourly samples), twice a week Parameters: PM 10, PM 2.5, SO2, NO2, CO, Benzene, BaP, Arsenic, Nickel and Lead	8 (1 in core zone and 7 in buffer zone)	192
NH3: twice a month for 3 months	8 (1 in core zone and 7 in buffer zone)	48
Meteorological parameters		
Measured at hourly duration simultaneously at core zone for 3 months for Wind speed (hourly), wind direction, relative humidity, rainfall	1 (Core Zone of existing plant)	90 days
solar radiation, cloud cover		11 days

Description	No. of locations	Total No. of samples
Water		
Water sample from various surface and ground water sources in core and buffer zone (10 km radius) and tested for physical, chemical & biological parameters	17 (Surface Water-9 and Ground water-8)	17 (Surface Water-9 and Ground water-8)
Soil		
Parameters: pH, EC, $CaCO_3$, Specific Gravity, Moisture, Alkali metals (Sodium and Potassium), Textural Classification, Grain Size analysis or Particle size distribution, Colour, Organic Carbon, Organic Matter, Phosphorous, Nitrate-Nitrogen, Cation exchange capacity, Sodium Absorption Ratio (SAR), Permeability, Water holding capacity, Porosity	4	4
Noise		
Hourly equivalent noise level readings taken for 24 hours (Leq)	8	8 sets
Traffic density		
Hourly for 24 hours	2	2 sets

Secondary and primary data collection was done comprising of, but not restricted to the following:

- Long Term Climatic data from Indian Meteorological Department (IMD)
- Geo-hydrological aspects based on available data from various secondary sources
- Identification of water bodies, hills, roads etc. within 10 km radius
- Details of fauna, flora, information in forests, major habitats, sanctuaries, sensitive places within a distance of 10 km from the project site
- Major industries within 10 km radius.
- Historical monuments and places of tourist/ religious importance within 10 km radius.
- Land use pattern within core zone and buffer zone (10 km radius around the core zone), Cropping pattern.
- Demography and Socio-economic based on last available Census data for entire study area

The preparation of the EIA/EMP has been done as per the generic structure prescribed in EIA Notification dated 14th September 2006 and its amendments, as follows:

- **Chapter 1: Introduction.** Covers purpose of the report, identification of project & project proponent, brief description of nature, size, location of the project and its importance to the country, region and Scope of the study – details of regulatory scoping carried out (As per Terms of Reference)

- **Chapter 2: Project Description.** (Based on study of the reports like Pre-feasibility Report or Techno-economic Feasibility Report). This includes condensed description of those aspects of the project (based on project feasibility study), likely to cause environmental effects. Details such as type of project, project boundary & project site layout, size or magnitude of operation (including associated activities required by or for the project), project implementation schedule, technology and process description.

- **Chapter 3: Present Baseline Scenario.** The base line data generated and collected has been used to establish the present environmental scenario. This covers the study area, period, components & methodology, establishment of baseline for valued environmental components, as identified in the scope and base maps of applicable environmental components.

- **Chapter 4: Environmental Impacts & Mitigation.** (Identification, prediction and evaluation of anticipated environmental impacts due to the proposed expansion plant). The impact assessment and mitigation is proposed for:

  - Topography and drainage
  - Climate
  - Air environment
  - Noise environment
  - Traffic density
  - Water environment
  - Land environment & soil
  - Soil quality
  - Ecology
  - Socio-economic conditions
  - Occupational health and safety

Environmental Management plan suggesting the environmental safeguards, abatement technology and pollution control measures include the following:

- Air, water, noise pollution control measures
- Solid waste management
- Traffic management
- Land use changes and mitigation

- Pronounce the improvement in socio-economic conditions and benefits the people will get on implementation of the project. Outlining corporate social responsibility.
- Green belt development plan & reclamation plan.
- Environmental monitoring, implementation organization and feedback mechanism to effect mid course corrections.

❖ **Chapter 5: Analysis of Alternatives (Technology & Site).** In case, the scoping exercise results in need for alternatives then description of each alternative, summary of adverse impacts of each alternative, mitigation measures proposed for each alternative and selection of alternative is carried out.

❖ **Chapter 6: Environmental Monitoring Program.** Technical aspects of monitoring, the effectiveness of mitigation measures including measurement methodologies, frequency, location, data analysis, reporting schedules, detailed budget & procurement schedules.

❖ **Chapter 7: Additional Studies.** This shall comprise of public consultation, risk assessment, social impact assessment and R&R action plans or any other studies specified by MoEF&CC.

❖ **Chapter 8: Project benefits.** This comprises of the improvements in the physical infrastructure, improvements in the social infrastructure, employment potential–skilled, semi-skilled and unskilled and other tangible benefits.

❖ **Chapter 9: Environmental Cost Benefit Analysis.** If recommended at the Scoping stage. In this case, it has been prescribed.

❖ **Chapter 10: Environmental Management Plan.** Description of the administrative aspects for ensuring that mitigation measures are implemented and their effectiveness monitored, feedback mechanism to effect mid course corrections after approval of the EIA.

❖ **Chapter 11: Summary and Conclusion of EIA/EMP.** This constitutes the summary of the EIA Report.

❖ **Chapter 12: Disclosure of Consultants engaged,** The names of the Consultants engaged with their brief resume and nature of Consultancy rendered.

1.7 STATUS OF LITIGATIONS

There are no litigations/ court cases pending against the project as on 31.03.2023.

1.8 STATUS OF STATUTORY CLEARANCES

List of all the previous Consents obtained for the project relevant to environmental clearance are given below:

1. NOC's:

   a) Consent to establish for Ferro Manganese and Silico Manganese from Odisha State Pollution Control Board, vide letter no. 33614/IND-II-NOC dated 22.11.2005 and its amendment vide letter no 19793/IND-II-CTE-6752 dated 27.10.2022.

   b) Consent to establish for manganese ore sinter plant from Odisha State Pollution Control Board, vide letter no. 11852/IND-II-NOC dated 21.07.2014 and its amendment vide letter no 19942/IND-II-CTE-6761 dated 28.10.2022.

2. Consent to operate:

   a) Consent to operate for Ferro Manganese and Silico Manganese

Year	Date of Consent	Consent No.	Capacity as per CTO, TPA		Actual Achieved, TPA	
			Ferro manganese	Silico manganese	Ferro manganese	Silico manganese
2006-07	14.03.2007	5719/SPCB/BBSR-I-IND(CON)-5718	55,008	39,960	0	0
2007-08	06.08.2007	18931/IND-I-CON-5718	55,008	39,960	4,517.6	0
2008-09	28.08.2008	20056/IND-I-CON-5718	55,008	39,960	7,422.43	4,563.0
2009-10	12.06.2009	9324/IND-I-CON-5718	55,008	39,960	0	18,370.139
2010-11	24.04.2010	6914/IND-I-CON-5718	55,008	39,960	0	34,910.821
2011-12	11.05.2011	7994/IND-I-CON-5718	55,008	39,960	0	13,004.0 upto Sep 2012
2012-13	18.05.2012	9766/IND-I-CON-5718	55,008	39,960	Plant not in operation	
2013-14	12.04.2013	1714/IND-I-CON-5718	55,008	39,960	Plant not in operation	
2014-15	31.03.2014	5390/IND-I-CON-5718	55,008	39,960	Plant not in operation	
2015-16	30.03.2015	5634/IND-I-CON-5718	55,008	39,960	Plant not in operation	
2016-17	22.03.2016	5043/IND-I-CON-5718	55,008	39,960	Plant not in operation	
2017-18	09.03.2017	3334/IND-I-CON-5718	55,008	39,960	Plant not in operation	
2018-19	27.03.2018	3704/IND-I-CON-5718	55,008	39,960	Plant not in operation	
2019-20	02.03.2019	2291/IND-I-CON-5718	55,008	39,960	Plant not in operation	
2020-21	20.02.2020	2055/IND-I-CON-5718	55,008	39,960	Plant not in operation	
2021-22	27.03.2021	5373/IND-I-CON-5718	55,008	39,960	0	19906.545
2022-23	25.03.2022	4716/IND-I-CON-5718 Valid upto 31.03.2027	55,008	39,960	0	16,193.0

Note: ***In CTO's from 2007 till 2022, the capacity has been mentioned as tonnes per month. Ferro Manganese sanctioned is 4584 TPM and silico manganese sanctioned is 3330 TPM which is equivalent to 55,008 TPA & 39,960 TPA, respectively. Hence above table mentions all values in TPA.***

b) Consent to operate for Manganese Ore Sinter Plant

Year	Date of Consent	Consent No.	Capacity as per CTO, TPA	Actual Achieved
2014-2022	Nil	Nil	Nil	Plant not operational
2022-2023	28.03.2022	4878/IND-I-CON-6825	3600 TPM	728.53
2023-24	23.02.2023	2750/IND-I-COM-6825	43,200 TPA	Ongoing

3. NOC from Flood and Irrigation Dept. - Not applicable as there is no nala diversion proposed.

4. Surface water withdrawal permission (Lingra nadi) for 733.972 KLD vide letter dt. 14.02.2023, available from Office of Superintending Engineer, Rengali Right Canal Division No. II, Dhenkanal

5. Bore well (permission for 30 KLD from CGWA vide NOC no. CGWA/NOC/IND/REN/1/2021/5971 valid from 08/05/2021 to 07/05/2024).

CHAPTER 2

PROJECT DESCRIPTION

2.1 PRODUCTS AND CAPACITY

Rungta Mines Limited proposes expansion of ferro alloys plant from 0.055 MTPA to 0.293 MTPA in District Dhenkanal of Odisha. This will be done by enhancing capacities of existing facilities and adding new facilities as follows:

1. Expansion:
   - Ferro manganese- 0.055 MTPA to 0.293 MTPA
   - Silico Manganese- 0.0399 MTPA to 0.230 MTPA
   - Metal Recovery Plant- 0.0198 MTPA to 0.115 MTPA
   - Sinter Plant- 0.0432 MTPA to 0.5616 MTPA

2. New:
   - Ferro Chrome- 0.230 MTPA
   - Ferro Silicon- 0.1024 MTPA
   - Pig Iron- 0.369 MTPA
   - Chrome Ore Beneficiation Plant- 0.66 MTPA
   - Power Plant- 150 MW

2.2 PLANT LAYOUT

Existing plant premises area is 52.525 acres. Additional land required for expansion will be 93.575 acres. The total plot area after expansion shall be 146.10 acres. Break-up of land utilization of existing and proposed expansion plant is given in **Table 2.1**. For storage, there will be a mix of silo storage arrangement as well as open/ covered storage in stock yards, the former being the preferable storage method.

TABLE 2.1: BREAK UP OF PLOT AREA

Sl. No.	Description	Existing			Proposed Additional		Total After Expansion		
		Area in acres	Area in ha	%	Area in acres	Area in ha	Area in acres	Area in ha	%
1.	Plants, facilities & tailing management	20.888	8.453	39.77	49.525	20.042	70.413	28.496	48.20
2.	Stock yards	3.5	1.416	6.66	2.5	1.012	6	2.428	4.11
3.	Area for solid waste management	1.5	0.607	2.86	5	2.023	6.5	2.631	4.45
4.	Green belt & plantation	17.5	7.082	33.32	30.88	12.497	48.38	19.579	33.11
5.	Administration buildings	0.5	0.202	0.95	1	0.405	1.5	0.607	1.03
6.	Water reservoir	6.04	2.444	11.50	0	0.000	6.04	2.444	4.13
7.	Roads	2.597	1.051	4.94	4.67	1.890	7.267	2.941	4.97
	Total	**52.525**	**21.257**	**100.00**	**93.575**	**37.869**	**146.100**	**59.126**	**100.00**

Source: Rungta Mines Ltd.

2.3 EXISTING AND PROPOSED PRODUCTION CAPACITY

The existing and proposed expansion plant configuration and production capacities are given in **Table 2.2**.

TABLE 2.2: EXISTING & PROPOSED PRODUCTION & CONFIGURATION

Sl. No.	Plant Equipment/ facility	Existing facilities as per CTE dated 22.11.2005, and 21.07.2014		Current status as on April 2023						Proposed Additional Units		Final (Existing + Proposed)	
		Total (A+B)		Implemented(A)		Un-implemented (B)		As per CTO					
		Configu-ration	Capacity TPA	Configuration	Capacity TPA	Configu-ration	Capacity TPA	Configuration	Capacity TPA	Configuration	Capacity TPA	Configuration	Capacity TPA
1	**Ferro Alloy Plant**												
	Ferro Manganese OR	1X9 MVA 1X18 MVA	1X 9 MVA= 18,336 1X18 MVA=36,672	9 MVA= 18,336 18 MVA=36,672	55,008	-	-	9 MVA= 18,336 18 MVA= 36,672	55,008	7 nos. X 9 MVA= 128,352 3 nos. X 18 MVA=110,016	238,368	8 nos. X 9 MVA= 146,688 4 nos. X18 MVA=146,688	293,376
	Silico Manganese OR	1X9 MVA 1X18 MVA	9 MVA= 13,320 18 MVA=26,640	9 MVA= 13,320 18 MVA=26,640	39,960	-	-	9 MVA= 13320 18 MVA=26640	39,960	7nos. X 9 MVA =102080 3 nos. X 18 MVA =88,760	190,840	8 nos. X 9 MVA =115,400 4 nos. X 18 MVA =115,400	230,800
	Ferro Chrome OR	Nil	Nil	Nil	Nil	-	-	-	-	8 nos. X 9 MVA= 115,200 TPA 4 nos. X 18 MVA= 115,200 TPA	230,400	8 nos. X 9 MVA= 115,200 TPA 4 nos. X18 MVA= 115,200 TPA	230,400
	Ferro Silicon	Nil	Nil	Nil	Nil	-	-	-		8 nos. X 9 MVA= 51200 TPA 4 nos. X 18 MVA= 51200 TPA	102,400	8 nos. X 9 MVA= 51200 TPA 4 nos. X 18 MVA= 51200 TPA	102,400
2	Pig Iron	Nil	Nil	Nil	Nil	-	-	-		8 nos. X 9 MVA= 184800 TPA 4 nos. X 18 MVA=	369,600	8 nos. X 9 MVA= 184800 TPA 4 nos. X 18 MVA= 184800	369,600

Sl. No.	Plant Equipment/ facility	Existing facilities as per CTE dated 22.11.2005, and 21.07.2014		Current status as on April 2023						Proposed Additional Units		Final (Existing + Proposed)	
		Total (A+B)		Implemented(A)		Un-implemented (B)		As per CTO					
		Configu-ration	Capacity TPA	Configuration	Capacity TPA	Configu-ration	Capacity TPA	Configuration	Capacity TPA	Configuration	Capacity TPA	Configuration	Capacity TPA
										184800 TPA		TPA	
3	Metal Recovery plant	1X 5TPH	19,980	1X 5TPH	19980			1X 5TPH	19,980	2 nos. X 10 TPH +1X5 TPH	95,420	2 nos. X 10 TPH + 2 nos. X 5 TPH	115,400
4	Briquette Plant for Ferro chrome	Nil	Nil	Nil	Nil	-	-	-	-	4 nos. X 10 TPH 8 nos. X 5 TPH	461,127	4 nos. X 10 TPH 8 nos. X 5 TPH	461,127
5	Briquette Plant for Ferro manganese	Nil	Nil	Nil	Nil	-	-	-	-	7 nos. X 10 TPH 7 nos. X 5 TPH	476,738	4 nos. X 10 TPH 8 nos. X 5 TPH	586,754
6	Sinter plant	1 no. X 150 TPD	43,200	1 nos. X 150 TPD	43,200	-	-	1X150 TPD	43,200	3 nos. X 600 TPD or 15 nos. X 120 TPD	518,400	1 X 150 TPD 3 X 600 TPD	561,600
7	Chrome ore Beneficiation	Nil	Nil	Nil	Nil	-	-			4 nos. X 500 TPD or 5 nos. X 400 TPD	660,000	4 nos. X 500 TPD or 5 nos. X 400 TPD	660,000
8	Power plant	Nil	Nil	Nil	Nil	-	-			2 nos. X 25 MW + 5 nos. X 20 MW	150 MW	2 nos. X 25 MW + 5 nos. X 20 MW	150 MW

The integrated plant layout with existing and proposed units, greenbelt, utilities, etc. is shown in **Fig 2.1**.

There will be construction of buildings, sheds, roads, storage etc. within the plot. Site Photographs showing the existing plant buildings, green belt and the proposed expansion area are given in **Fig 2.2**. A distance of 50 m has been maintained from the edge of the Lingra Nadi for any construction and the no-construction zone will be used for green belt.
The Google Image of project site is shown in **Fig 2.3**.

2.4 PROCESS DESCRIPTION

Capacity of Ferro Alloys Plant will be expanded from 0.055 MTPA to 0.293 MTPA along with 150 MW capacity CPP and 0.369 MTPA pig iron. Manufacturing process for each individual production unit is described in subsequent paragraphs along with their configuration, material balance and process flow sheets. Due to rounding off in excel (where the calculation were carried out), there may be variation in total by +/- 1 in material balances given in this section.

2.4.1 Ferro Alloys Plant (8 nos. X 9 MVA+ 4 nos. X 18 MVA)

Submerged arc furnaces (SAF) produce a wide range of metal products by smelting various minerals to metal products. In some processes a valuable slag or vapor product arise as well as metal.

In the submerged arc furnace, electric power heats the raw materials and provides the energy to reduce the ore to a metallic state. Generally carbon serves as the reducing agent and fluxes are often added to facilitate the process. The common practice is to mix the ore materials, the reducing agent, and any fluxes outside of the furnace and then to periodically charge this mixture (often called charge mix) into the furnace. Although the charge mix is added periodically, the reduction reactions and metal production proceed continuously. The metal is usually allowed to accumulate until tapping occurs at appropriate intervals; however continuous tapping is not uncommon.

The term “Submerged Arc” is used because the electrodes are usually buried deep in the furnace burden and the reduction reaction takes place near the tip of the electrodes. At the top of the burden little current flows between the electrodes because of the high resistivity of the un-melted charge. As the burden descends in the furnace the non-carbon portion of the charge begins to melt. As the carbon heats, its resistance decreases providing a conductivity path between the electrodes.

This current flow creates the intense heat needed for the high temperature and energy required for the reduction reactions. Due to the relatively low resistivity of most smelting process charge mixture, submerged arc furnaces generally operate at lower secondary voltages and higher currents than steel making furnaces. Depending on the size of the furnace and the resistivity of the charge mix, the secondary voltage will typically range between 160 to 280 volts in modern furnaces. The current can reach 200,000 amperes in the largest furnaces. Since changes in the resistance are very slow in submerged arc furnaces and the process are continuous, electric control is much simpler, and any disturbance to the electrical distribution network is much less severe than is the case with typical electric arc furnace steel production.

FIG 2.1: PLANT LAYOUT MAP

FIG 2.2: PHOTOGRAPHS OF EXISTING PLANT

Existing plant

Greenbelt development

Expansion plant area

FIG 2.3: PLAN SHOWING EXISTING AND PROPOSED AREA ON GOOGLE EARTH IMAGE

In this ferro alloys plant, submerged arc furnace with slag operation will be adopted. The products to be made will be:

- Ferro-Manganese
- Silico-Manganese
- Ferro-Chromium
- Ferro-Silicon
- Pig iron

2.4.2 Ferro Manganese (8 nos. X 9 MVA + 4 nos. X 18 MVA) after expansion

Submerged arc furnace produce high-carbon or “standard” ferro-manganese (typically 79% Mn and 7%C). High-carbon ferro-manganese can be refined to medium-carbon or low carbon ferro- manganese in post tapping processes.

Manganese ores, which usually contain iron oxide, are mixed with coal or coke reductant and usually a small quantity of fluxes from the charge mix.

The submerged arc furnaces have a open or closed top design. In closed top, ambient air can be prevented from mixing with the processes off- gas,

then the off-gas contains 65 to 70% CO and can be used as fuel for other plant processes such as raw material drying.

However, the existing units as well as proposed units shall have furnaces with be open top with movable attachments to close the furnace top during operation. The hood shall have an exhaust system connected to the fume extraction system leading to the bag filter for removal of particulate matter prior to release to atmosphere.

The raw material are premixed and then transported to overhead mix bins. From the overhead mix bin the mix drop through chutes which distribute the mix around the electrodes. In current practice, entire charge is not put completely into the furnace but also kept on the sides of the mouth of the furnace and pushed laterally into the furnace with a pusher, as the charge in the furnace melts and settles and creates space on the top.

Partially the CO gas produced in the reaction zone pre-reduces the higher manganese oxide forms to MnO; however, gas reduction of MnO is impossible. The electric current passes through the coke bed and the slag layer and a reaction between the solid carbon reductant and the MnO occurs in the slag the coke layer minimizing arcing between the electrodes and the slag bath.

Ferro-manganese producers operate at as low a temperature as possible while still keeping the slag fluid. The lower temperature limits the amount of MnO reduction; therefore the slag may contain upto 45% MnO and can be used as a raw material for the production of silico-manganese, manganese chemicals or electrolytic manganese.

The electric resistance of the ferro-manganese mix is lower than it is for silicon alloys. Therefore ferro-manganese furnace operates at lower voltage and higher currents.

Table 2.3 gives the configuration of ferro manganese plant, both existing and expansion. **Table 2.4** gives the material balance of the ferro manganese plant, both existing and expansion. **Table 2.5** gives the proposed briquette plant configuration for ferro manganese and **Table 2.6** gives the material balance of proposed briquette plant for ferro manganese. The flow sheet of production is given in **Fig 2.4**.

TABLE 2.3: CONFIGURATION OF FERRO MANGANESE PLANT (EXISTING AND PROPOSED)

Sl. No.	Description	Unit	Existing Furnace Type 1	Existing Furnace Type 2	Total Existing	Additional	Total Furnace Type 1	Total Furnace Type 2	Grand Total
1	Furnace Capacity	MVA	18	9	18 + 9	18 + 9	18	9	18 + 9
2	Numbers	nos.	1	1	2	10	4	8	12
3	Working Hours in a Day	Hours	24	24	24		24	24	24

Sl. No.	Description	Unit	Existing Furnace Type 1	Existing Furnace Type 2	Total Existing	Additional	Total Furnace Type 1	Total Furnace Type 2	Grand Total
4	Working Day in a Year	Days	325	325	325		325	325	325
5	Daily Production	TPD	112.8	56.4	169.25593	733.44	451.3	451.3	902.6983
6	Annual Production	TPA	36,672	18,336	55,008	2,38,369	1,46,688	1,46,688	2,93,377
	Say	TPA	36,672	18,336	55,008	2,38,368	1,46,688	1,46,688	2,93,376

TABLE 2.4: MATERIAL BALANCE FOR FERRO MANGANESE (EXISTING AND PROPOSED)

Sl. No.	Raw Material	Specific consumption (T/T)	Existing, TPA			Additional Proposed, TPA	Total after expansion, TPA		
			Furnace Type 1	Furnace Type 2	Total		Furnace Type 1	Furnace Type 2	Grand Total
1	Mn Briquettes	2.06	75,544	37,772	1,13,316	4,91,038	3,02,177	3,02,177	6,04,355
2	Manganese Ore Lump	0.2	7,334	3,667	11,002	47,674	29,338	29,338	58,675
3	Coke	0.057	2,090	1,045	3,135	13,587	8,361	8,361	16,722
4	Quartz	0.061	2,237	1,118	3,355	14,540	8,948	8,948	17,896
5	Electrode Paste	0.022	807	403	1,210	5,244	3,227	3,227	6,454
	Sub total	**2.4**	**88,013**	**44,006**	**1,32,019**	**5,72,083**	**3,52,051**	**3,52,051**	**7,04,102**
	Product & By-Products	**Specific generation (T/T)**	**Furnace Type 1**	**Furnace Type 2**	**Total (Existing)**	**Additional proposed**	**Furnace Type 1**	**Furnace Type 2**	**Grand Total**
1	Ferro-Manganese (High Carbon Ferro-Manganese at 75 to 80% Mn)	1	36,672	18,336	55,008	2,38,368	1,46,688	1,46,688	2,93,376
2	Fe-Mn Slag	1.2	44,006	22,003	66,010	2,86,042	1,76,026	1,76,026	3,52,051
3	Bag Filter Fines (Fe-Mn)	0.2	7,334	3,667	11,002	47,674	29,338	29,338	58,675
	Sub total	**2.4**	**88,013**	**44,006**	**1,32,019**	**5,72,083**	**3,52,051**	**3,52,051**	**7,04,102**

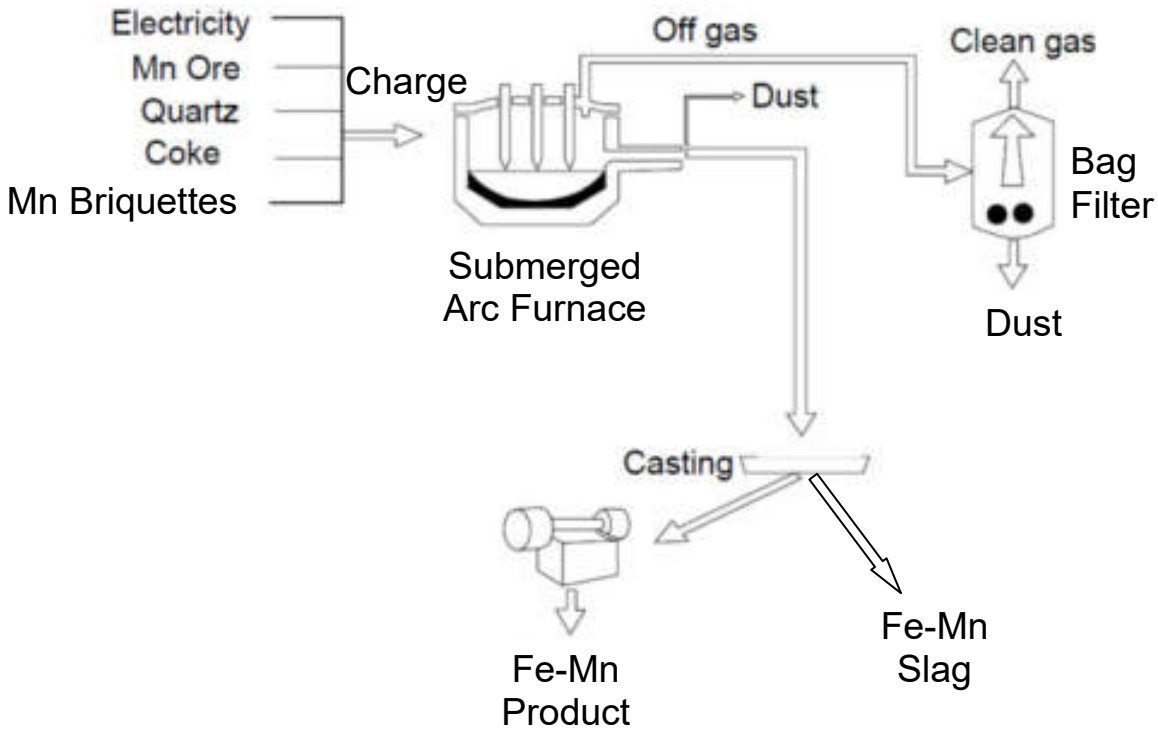
TABLE 2.5: CONFIGURATION OF PROPOSED FERRO-MANGANESE BRIQUETTE PLANT

Sl. No.	Description	Unit	For Existing Furnace Type 1	For Existing Furnace Type 2	Total for Existing	For Additional Furnaces	Total for Furnace Type 1	Total for Furnace Type 2	Grand Total
1	Briquette Required for 1T Production	T/T	2	2	2		2	2	2
2	Briquette required per Day	TPD	225.7	112.8	338.5	1466.88	902.7	902.7	1805.4
3	Capacity of Briquette Plant	TPH	9.4	4.7	14.1	61.12	37.6	37.6	75.2
4	**Briquette Plant to be installed**	**TPH**	10	5	15	65	40 (4 nos. X 10 TPH)	40 (8 nos. X 5 TPH)	80

TABLE 2.6: MATERIAL BALANCE OF PROPOSED FERRO-MANGANESE BRIQUETTE PLANT

Sl. No.	Raw Material	Specific consumption (T/T)	For Furnace Type 1	For Furnace Type 2	For Total (Existing)	For Additional	For Total Furnace Type 1	For Total Furnace Type 2	Grand Total
			Quantity required, TPA						
1	Manganese Ore Concentrate	1.059	77,672	38,836	1,16,507	5,04,865	3,10,686	3,10,686	6,21,372
2	Lime	0.047	3,447	1,724	5,171	22,407	13,789	13,789	27,577
3	Molasses	0.07	5,134	2,567	7,701	33,372	20,536	20,536	41,073
C	**Product & By-Products**	**Specific generation (T/T)**	**Quantity generated, TPA**						
1	Briquette	1	73,344	36,672	1,10,016	4,76,738	2,93,377	2,93,377	5,86,754
2	Reused Briquette Fines	0.176	12,909	6,454	19,363	83,906	51,634	51,634	1,03,269

FIG 2.4: FLOW CHART OF FERRO MANGANESE PRODUCTION



2.4.3 Silico manganese (8 nos. X 9 MVA + 4 nos. X 18 MVA) after expansion

Submerged arc furnace produce a silicon-manganese-iron alloy commonly referred to as silico-manganese. Silico-manganese typically contains 68 to 72% Mn, 15 to 23% Si, and 1 to 2% C.

Silico-manganese is produce by reprocessing high carbon ferro-manganese by-product slag and smelting cheaper high silicon-manganese ores. The manufacturing process in the submerged arc furnace is similar to as

discussed for ferro manganese production. The electric resistance of the silicon alloys is higher than ferro-manganese.

Table 2.7 gives the configuration of ferro manganese plant, both existing and expansion. **Table 2.8** gives the material balance of the ferro manganese plant, both existing and expansion.

TABLE 2.7: CONFIGURATION OF SILICO-MANGANESE PLANT (EXISTING AND PROPOSED)

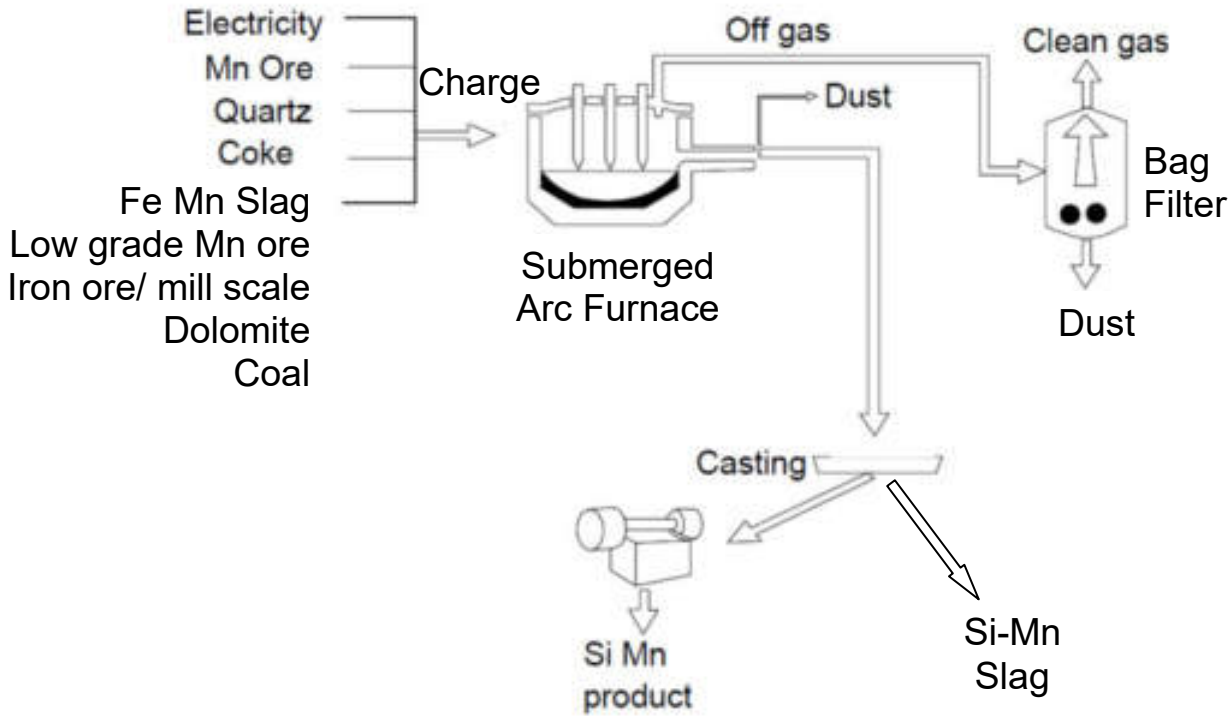
Sl. No.	Description	Unit	Furnace Type 1 (existing)	Furnace Type 2 (existing)	Total (Existing)	Additional Proposed	Furnace Type 1 (Total)	Furnace Type 2 (Total)	Grand Total
1	Furnace Capacity	MVA	18	9	18 + 9	18 + 9	18	9	18 + 9
2	Furnace numbers	nos.	1	1	2	10	4	8	12
3	Working Hours in a Day	Hours	24	24	24		24	24	24
4	Working Days in a Year	Days	300	300	300	25	325	325	325
5	Daily Production	TPD	88.80	44.40	133.20	577.23	355.22	355.22	710.43
6	**Annual Production**	**TPA**	**26,640**	**13,320**	**39,960**	**1,90,931**	**1,15,445**	**1,15,445**	**2,30,890**
	Say	**TPA**	**26,640**	**13,320**	**39,960**	**1,90,840**	**1,15,400**	**1,15,400**	**2,30,800**

TABLE 2.8: MATERIAL BALANCE FOR SILICO MANGANESE (EXISTING AND PROPOSED)

Sl. No.	Raw Material	Specific consumption (T/T)	Furnace Type 1 (Existing)	Furnace Type 2 (Existing)	Total (Existing)	Additional Proposed	Furnace Type 1 (Total)	Furnace Type 2 (Total)	Grand Total
			Quantity required, TPA						
1	Quartz (94%-95%)	0.15	3,996	1,998	5,994	28,626	17,310	17,310	34,620
2	Charcoal / Coke	0.48	12,787	6,394	19,181	91,603	55,392	55,392	1,10,784
3	Iron Ore / Mill Scale	0.0125	333	166	499	2,386	1,443	1,443	2,885
4	Electrode Paste	0.025	666	333	999	4,771	2,885	2,885	5,770
5	Manganese Ore (38%-40%)	0.72	19,181	9,590	28,771	1,37,405	83,088	83,088	1,66,176
6	Low-Grade High Silicon Ore from MOIL	0.865	23,043	11,522	34,565	1,65,077	99,821	99,821	1,99,642
7	Fe-Mn Slag	0.72	19,181	9,590	28,771	1,37,405	83,088	83,088	1,66,176
8	Dolomite	0.1	2,664	1,332	3,996	19,084	11,540	11,540	23,080
9	Coal	0.23	6,127	3,064	9,191	43,893	26,542	26,542	53,084
	Sub total	**3.3025**	**87,978**	**43,989**	**1,31,966**	**6,30,251**	**3,81,109**	**3,81,109**	**7,62,217**

	Product & By-Products	Specific generation (T/T)	Furnace Type 1 (Existing)	Furnace Type 2 (Existing)	Total (Existing)	Additional Proposed	Furnace Type 1 (Total)	Furnace Type 2 (Total)	Grand Total
			Quantity generated, TPA						
1	Silico-Manganese	1	26,640	13,320	39,960	1,90,840	1,15,400	1,15,400	2,30,800
2	Slag (Si-Mn)	0.5	13,320	6,660	19,980	95,420	57,700	57,700	1,15,400
3	Bag Filter Fines (Si-Mn)	0.02	533	266	799	3,817	2,308	2,308	4,616
4	Losses	1.7825	47,485	23,743	71,228	34,0173	2,05,701	2,05,701	4,11,401
	Sub total	**3.3025**	**87,978**	**43,989**	**1,31,966**	**6,30,251**	**3,81,109**	**3,81,109**	**7,62,217**

FIG 2.5: FLOW CHART OF SILICO MANGANESE PRODUCTION



2.4.4 Ferro chrome plant (8 nos. X 9 MVA+ 4 nos. X 18 MVA)

When ferro chrome is produced by the reduction of chromite with carbon (coke) in submerged arc furnace, the product ferro chrome so obtained is basically carbon saturated iron-chromium alloy with typically 6-8 wt % C. In solid ferro chrome, carbon forms solid chromium carbide and complex iron-chromium carbides. The configuration of Ferro Chrome plant is given in **Table 2.9** and and the material balance is given in **Table 2.10.** The configuration of proposed ferro chrome briquette plant shall be 60 TPH and material balance of the proposed ferro chrome briquette plant is given in **Table 2.11**.

TABLE 2.9: CONFIGURATION OF PROPOSED FERRO CHROME PLANT

Sl. No.	Description	Unit	Furnace Type-1	Furnace Type-2	Total
1	Furnace Capacity	MVA	18	9	18 + 9
2	Numbers	Nos.	4	8	12
3	Working Hours in a Day	Hours	24	24	24
4	Working Days in a Year	Days	320	310	320
5	Daily Production	TPD	360.26	360.26	720.51
6	**Annual Production**	**TPA**	**1,15,282**	**1,11,679**	**2,26,961**
7	**Say**	**TPA**	**1,15,200**	**1,15,200**	**230400**

TABLE 2.10: MATERIAL BALANCE OF PROPOSED FERRO CHROME PLANT

Sl. No.	Description	Specific consumption (T/T)	Quantity for Furnace Type-1, TPA	Quantity for Furnace Type-2, TPA	Total Quantity, TPA
	Raw material				
1	Cr Briquettes	2.043	2,35,354	2,35,354	4,70,707
2	Chrome Ore Lump	0.2	23,040	23,040	46,080
3	Coke	0.056	6,451	6,451	12,902
4	Quartz	0.061	7,027	7,027	14,054
5	Electrode Paste	0.022	2,534	2,534	5,069
	Sub-Total	**2.382**	**2,74,406**	**2,74,406**	**5,48,813**
	Product & By-Products	**Specific generation (T/T)**	**Quantity, TPA**	**Quantity, TPA**	**Total Quantity, TPA**
1	Ferro-Chrome	1	1,15,200	1,15,200	2,30,400
2	Slag (Fe-Cr)	1.19	1,37,088	1,37,088	2,74,176
3	Bag Filter Fines (Fe-Cr)	0.192	22,118	22,118	44,237
	Sub-Total	**2.382**	**2,74,406**	**2,74,406**	**5,48,813**

Flow sheet of Ferro Chrome is given in **Fig 2.6.**

FIG 2.6: FERRO CHROME

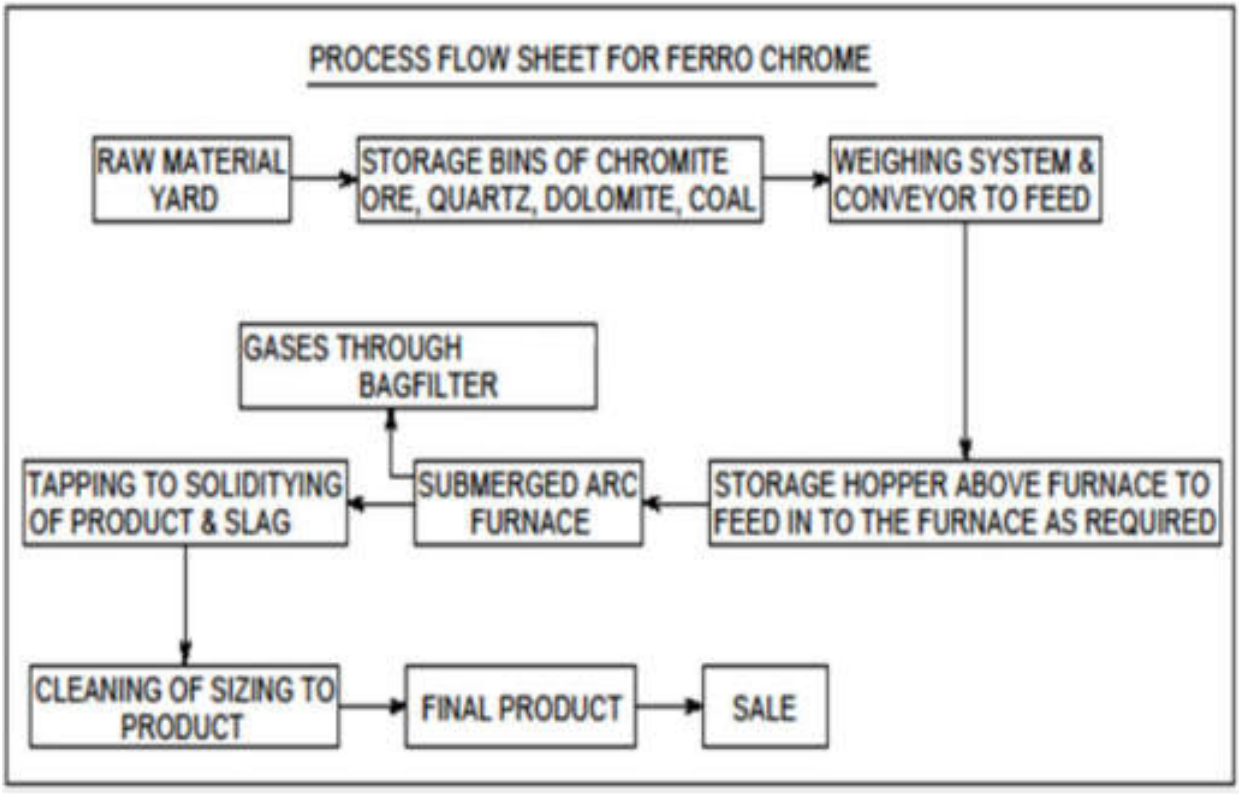
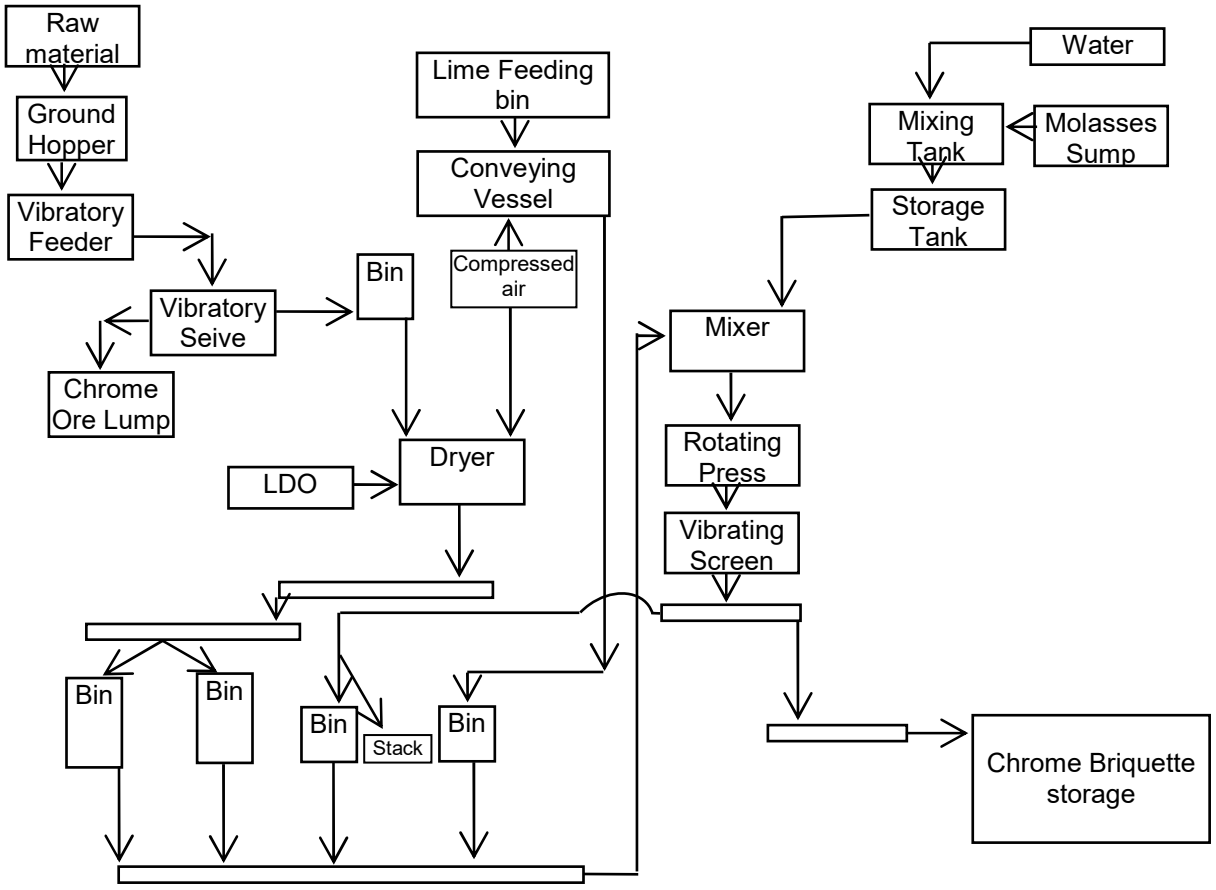


TABLE 2.11: MATERIAL BALANCE OF PROPOSED FERRO-CHROME BRIQUETTE PLANT OF 60 TPH

Sl. No.	Description	Specific consumption (T/T)	Total Quantity, T
1	Chome-ore concentrate	1.059	4,88,333
2	Lime	0.047	21,673
3	Molasses	0.071	32,740
	Total		**5,42,746**
	Product & By-Products	**Specific generation (T/T)**	**Quantity, T**
1	Briquette	1	4,61,127
2	Reused Briquette Fines	0.177	81,619
	Total		**5,42,746**

The manufacturing process of the chrome ore briquette can be seen in **Fig 2.7.**

FIG 2.7: PROCESS FLOW SHEET FOR THE MANUFACTURING OF CHROME BRIQUETTES



2.4.5 Ferro-Silicon

Ferro-Silicon is widely used as a deoxidizer and alloying element in the iron and steel industry. Most grades of ferro-silicon contain either 50% or 75% silicon by weight, commonly referred to as 50% FeSi and 75% FeSi. Silicon (usually > 99% Si purity) is primarily used as an alloying element in aluminum products and as a feedstock for the production of silicones.

A mixture of silica (usually quartz or quartzite), coke or coal makeup the charge mix. The coal or coke acts as the reducing agents. Iron usually in the form of light steel scrap, is added for ferrosilicon production.

The reaction to produce silicon based metal is $SiO_2+2C \rightarrow Si+2CO$.

However, there are complex side reactions that generate SiO gas and which burn to SiO and CO as they escape the burden. Successful operations keep the electrodes deeply buried so that the evolving SiO fume which is aerosol in nature exits the furnace through a hood system and collects in baghouse filters. The collected fume is very light (9 to 12 lbs/ft^3). If the fume is pure enough and handled correctly, it can be resold as an additive to cement, ceramic, and refractory products.

Configuration of ferro silicon is given in **Table 2.12** and material balance for proposed Ferro Silicon plant is given in **Table 2.13.** The production flow sheet is given in **Fig 2.7.**

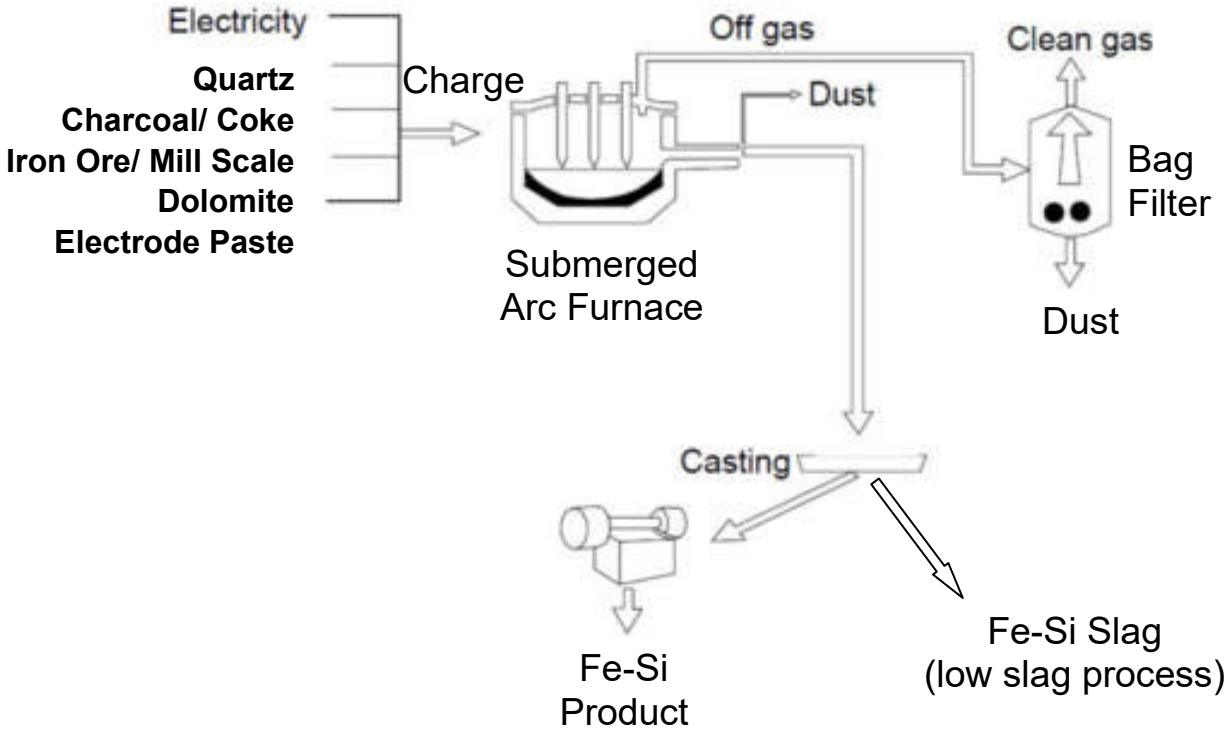
TABLE 2.12: CONFIGURATION OF PROPOSED FERRO-SILICON PLANT

Sl. No.	Description	Unit	Furnace Type-1	Furnace Type-2	Total
1	Furnace Capacity	MVA	18	9	18 + 9
2	Numbers	Nos.	4	8	12
3	Working Hours in a Day	Hours	24	24	24
4	Working days in a Year	Days	320	320	320
5	Day Production	TPD	160.09	160.09	320.19
6	Annual Production	TPA	51,230	51,230	1,02,460
7	Say	TPA	**51,200**	**51,200**	**1,02,400**

TABLE 2.13: MATERIAL BALANCE OF PROPOSED FERRO-SILICON

Sl. No.	Raw Material	Specific consumption (T/T)	Quantity for Furnace Type-1, TPA	Quantity for Furnace Type-2, TPA	Total Quantity, TPA
1	Quartz (94%-95%)	1.95	99,840	99,840	1,99,680
2	Charcoal/ Coke	1.3	66,560	66,560	1,33,120
3	Iron Ore/ Mill Scale	0.25	12,800	12,800	25,600
4	Electrode Paste	0.07	3,584	3,584	7,168
5	Dolomite	0.07	3,584	3,584	7,168
	Sub-total	3.64	1,86,368	1,86,368	3,72,736
	Product & By-Products	**Specific generation (T/T)**	**Quantity for Furnace Type-1, TPA**	**Quantity for Furnace Type-2, TPA**	**Total Quantity, TPA**
1	Ferro-Silicon	1	51,200	51,200	1,02,400
2	Bag Filter Fines (Fe-Si)	0.2	10,240	10,240	20,480
3	Slag (Fe-Si)	0.055	2,816	2,816	5,632
4	Losses	2.385	1,22,112	1,22,112	2,44,224
	Sub-total	3.64	1,86,368	1,86,368	3,72,736

FIG 2.8: FLOW CHART OF FERRO SILICON PRODUCTION



2.4.6 Pig Iron

Pig iron is a product in solid (lumpy) form obtained upon solidification of Hot Metal in Pig Casting Machine. It is called Pig or Pig Iron because of its typical humpy shape. It is a basic input for making iron casting, which finds application in industrial and other sectors of economy. Pig iron is one of the basic raw materials required by the Foundry & Casting Industry for manufacturing various types of castings for the engineering section. In advanced countries pig iron is also used as a partial substitute of melting scrap in the charge mix of Electric Arc Furnaces. Pig Iron is mainly classified into two grades, 'Basic Grade' used for making steel and 'Foundry Grade' used for manufacturing iron castings[1].

Configuration of proposed pig iron plant is given in **Table 2.14** and material balance is given in **Table 2.15**.

TABLE 2.14: CONFIGURATION OF PROPOSED PIG IRON

Sl. No.	Description	Unit	Furnace Type-1	Furnace Type-2	Total
1	Furnace Capacity	MVA	18	9	18 + 9
2	Furnace numbers	nos.	4	8	12
3	Working Hours in a Day	Hours	24	24	24
4	Working Days in a Year	Days	325	325	325

[1] Source : Indian Minerals Handbook 2021 (Part II-Metals & Alloys), Indian Bureau of Mines, available at https://ibm.gov.in/writereaddata/files/16821553356443a74707e96Iron_Steel_Scrap_2021.pdf accessed 24.04.2023

Sl. No.	Description	Unit	Furnace Type-1	Furnace Type-2	Total
5	Daily Production	TPD	568.98	568.98	1137.95
6	**Annual Production**	**TPA**	**1,84,917**	**1,84,917**	**3,69,834**
	Say	**TPA**	**1,84,800**	**1,84,800**	**3,69,600**

TABLE 2.15: MATERIAL BALANCE FOR PROPOSED PIG IRON

Sl. No.	Raw Material	Specific consumption (T/T)	Furnace Type 1 Quantity, TPA	Furnace Type 2 Quantity, TPA	Grand Total, TPA
1	Iron Ore/ sinter	**1**	1,15,400	1,15,400	2,30,800
2	Metallurgical/ Pearl Coke	**0.23**	26,542	26,542	53,084
3	Quartz	**0.03**	3,462	3,462	6,924
4	Electrode Paste	**0.015**	1,731	1,731	3,462
5	Flourspar	**0.04**	4,616	4,616	9,232
6	Mill scale	**0.1**	11,540	11,540	23,080
7	Dolomite/ Limestone	**0.35**	40,390	40,390	80,780
8	Coal	**0.52**	60,008	60,008	1,20,016
	Sub total	**2.285**	**2,63,689**	**2,63,689**	**5,27,378**
	Product & By-Products	**Specific generation (T/T)**	**Quantity, TPA**	**Quantity, TPA**	**Grand Total, TPA**
1	Pig Iron	**1**	1,84,800	1,84,800	3,69,600
2	Slag (Pig Iron)	**0.384**	44,314	44,314	88,627
3	Bag Filter Fines (Pig Iron)	**0.02**	2,308	2,308	4,616
4	Losses	**0.881**	1,01,667	1,01,667	2,03,335
	Sub total	**2.285**	**3,33,089**	**3,33,089**	**6,66,178**

2.4.7 Sinter Plant

Sinter Plant plays a very important role in increasing the productivity. 1 X 150 TPD sinter plant is under operation. Three new sinter machines are proposed of 3 X 600 TPD or 15x120 TPD, to produce 5,18,400 TPA sinter. The configuration of sinter plant is as given in **Table 2.16**.

TABLE 2.16: CONFIGURATION OF SINTER PLANT (EXISTING AND PROPOSED)

Sl. No.	Description	Unit	Quantity
1	Sinter Plant (existing)	Nos.	**1**
	Capacity	TPD	**150**
	No. of working days	Days/ annum	**288**
	1X150 TPD Sinter Plant	TPA	43200
2	Sinter Plant (Proposed-alternate 1)	Nos.	**3**
	Capacity	TPD	**600**

Sl. No.	Description	Unit	Quantity
	No. of working days	Days/ annum	**288**
	3X600 TPD Sinter Plant (Proposed Alternate 1)	TPA	5,18,400
3	Sinter Plant (Proposed-Alternate 2)	Nos.	**15**
	Capacity	TPD	**120**
	No. of working days	Days/ annum	**288**
	15X120 TPD Sinter Plant (Proposed Alternate 2)	TPA	5,18,400

Process: Manganese ore fines and coke fines of -4 mm shall be fed to ground hopper. This material shall be discharged through Vibrating feeder in a controlled rate on to feed conveyor BC-1. This material shall be fed to vibrating screen having opening 4 Sq mm. The -4 mm will pass through and fall on respective bunkers separately. Above 4 mm will pass through and discharge on extra bunker & shall be fed to furnace directly.

Then Mn Ore fines and coke fines will pass through belt scale or weigh hopper separately. After weighing by weighing hopper at ratio 84:16 percentage Mn. Ore fines and Coke fines will discharge to a mixture machine. These fines will be mixed inside the mixture by adding proper amount of water for 9 to 10 minutes, which shall be ready for preparation of sinter.

This mixed paste will be discharged to BC-2 conveyor by discharge chute from mixture machine and will pass through shuttle conveyor to drop in the 15 nos. Cast Iron pans. At the bottom end of each 3 nos. of pans, one blower will fixed to extract the fumes and discharge in the chimney. Each batch of Sinter shall take 2 hr 30 min.

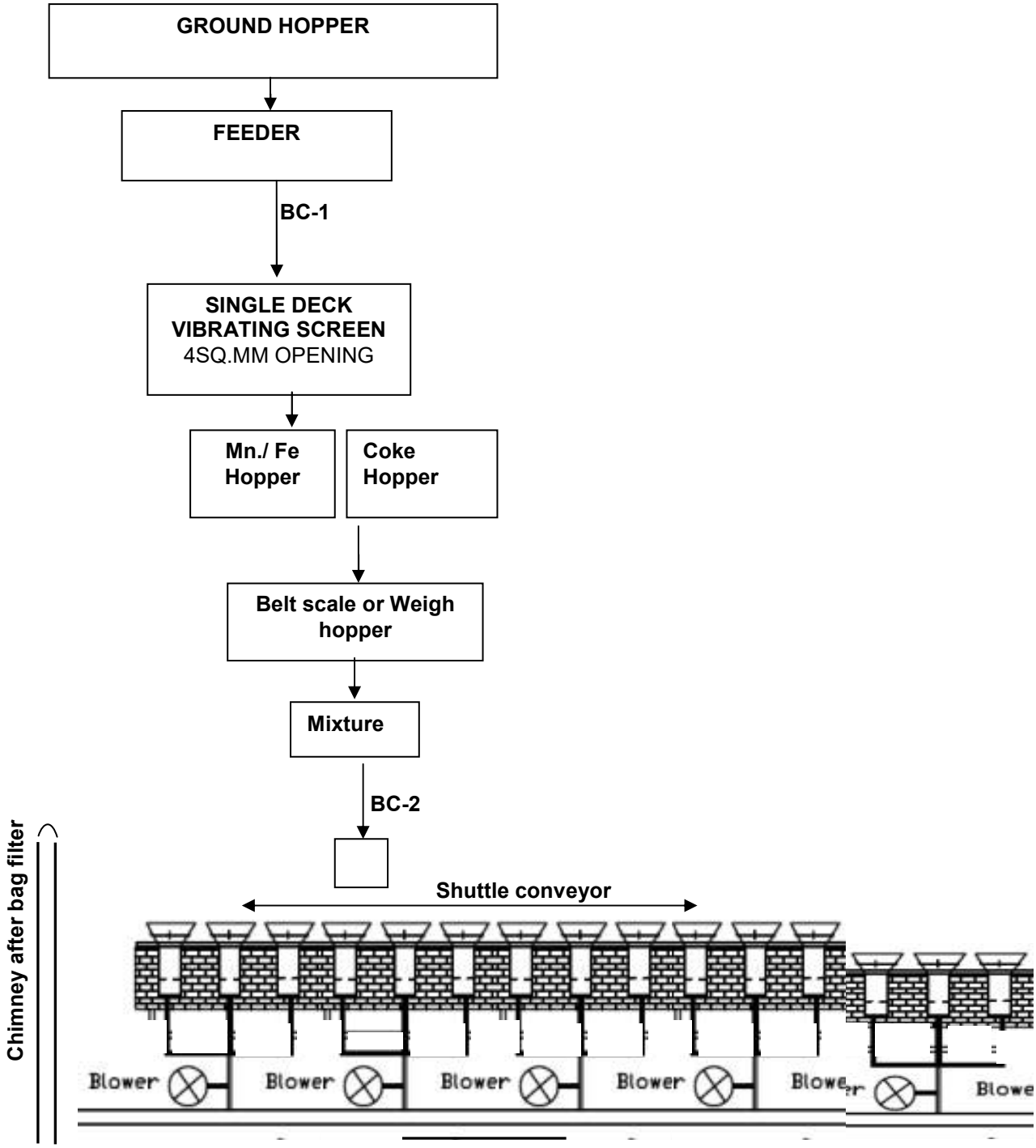
Material Balance is given in **Table 2.17**. Flow sheet of sinter plant is given in **Fig 2.9**.

TABLE 2.17: MATERIAL BALANCE FOR SINTER PLANT AFTER EXPANSION

Raw Material Inputs	Specific Consumption T/T of Product	Quantity (TPA)	% Charge Mix
Iron Ore Fines	**0.950**	5,33,520	62.52%
Coke Fines	**0.035**	19,656	2.30%
Lime Stone	**0.130**	73,008	8.56%
Dolomite	**0.130**	73,008	8.56%
Bag Filter dust from Ferro Alloy Plant	**0.104**	58,675	6.88%
Bag filter (sinter plant)	**0.020**	11,232	1.32%
Sinter Return Fines	**0.150**	84,240	9.87%
Total	**1.519**	**8,53,339**	**100.00%**

Outputs	Specific generation T/T of Product	Quantity (TPA)	%
Sinter	**1.000**	5,61,600	65.81%
Sinter Return Fines	**0.150**	84,240	9.87%
Bag filter (sinter plant)	**0.020**	11,232	1.32%
LOI & losses	**0.349**	1,96,267	23.00%
Total	**1.519**	**8,53,339**	**100.00%**

FIG 2.9: FLOW SHEET OF SINTER PLANT



2.4.8 Metal Recovery Plant

Process: The ferro alloys slag consist some portion of valuable ferro alloys material which can be obtained in a directly saleable condition and can be sold at reasonably good market rates as compared to the main ferro alloys product. It can also be reused in the process.

The existing Metal Recovery Plant is being used to recover this portion of metal from slag. Certain portion of slag is conveyed to Metal Recovery Plant (MRP) wherein it is crushed as to extract good quality Ferro chrome from the slag waste. This process involves the following three steps;

- Crushing and screening of metal containing slag
- Separation of metal from slag
- Re-crushing of middling to realize additional metal

Crushing and Screening: This circuit produces a crushed slag having a narrow size distribution, which would aid the metal liberation in further stages. Cone crushers are used to maximize shear at metal-slag interfaces. Wherever possible, the multiple cycles of crushing are maintained in a close circuit so that the minimum crushed size is achieved. To minimize fines, the reduction ratios are maintained as low as possible.

Separation of Metal from Slag: This involves two stage recovery jigging process known as the “Coarse Jigging‟ and “Fine Jigging‟. During the coarse jigging stage, the cut density is set with an aim to recover clean metal and not with a focus on recovery. The coarse fraction is crushed to have an output in the form of saleable coarse alloy. An under-bed air pulsated jig with a float control system is on the discharge gates. A hydro dynamically stable float is positioned in the jigging bed.

Later during the Fine Jigging, the cut density is lowered to focus on recovery. Since the material is fine, a strongly pulsed Jig is not required here. Only a single stage is required to utilize “through the bed‟ Jigging as the material quantity reaching this stage is only about 5% of the total feed. The output of this stage is in form of fine tailings and slimes.

The final disposed middling from coarse jigging and very fine metal from fine jigging are used for furnace feed.

Configuration of metal recovery Plant is given in **Table 2.18**.

TABLE 2.18: CONFIGURATION OF METAL RECOVERY PLANT (EXISTING AND PROPOSED)

Description	Unit	Existing Sanctioned capacity as per CTO	Proposed Additional	Total
Metal recovery plant	TPH	1 X 5	2 nos. X 10 + 1 no. X 5	2 nos. X 10 + 2 X 5 TPH

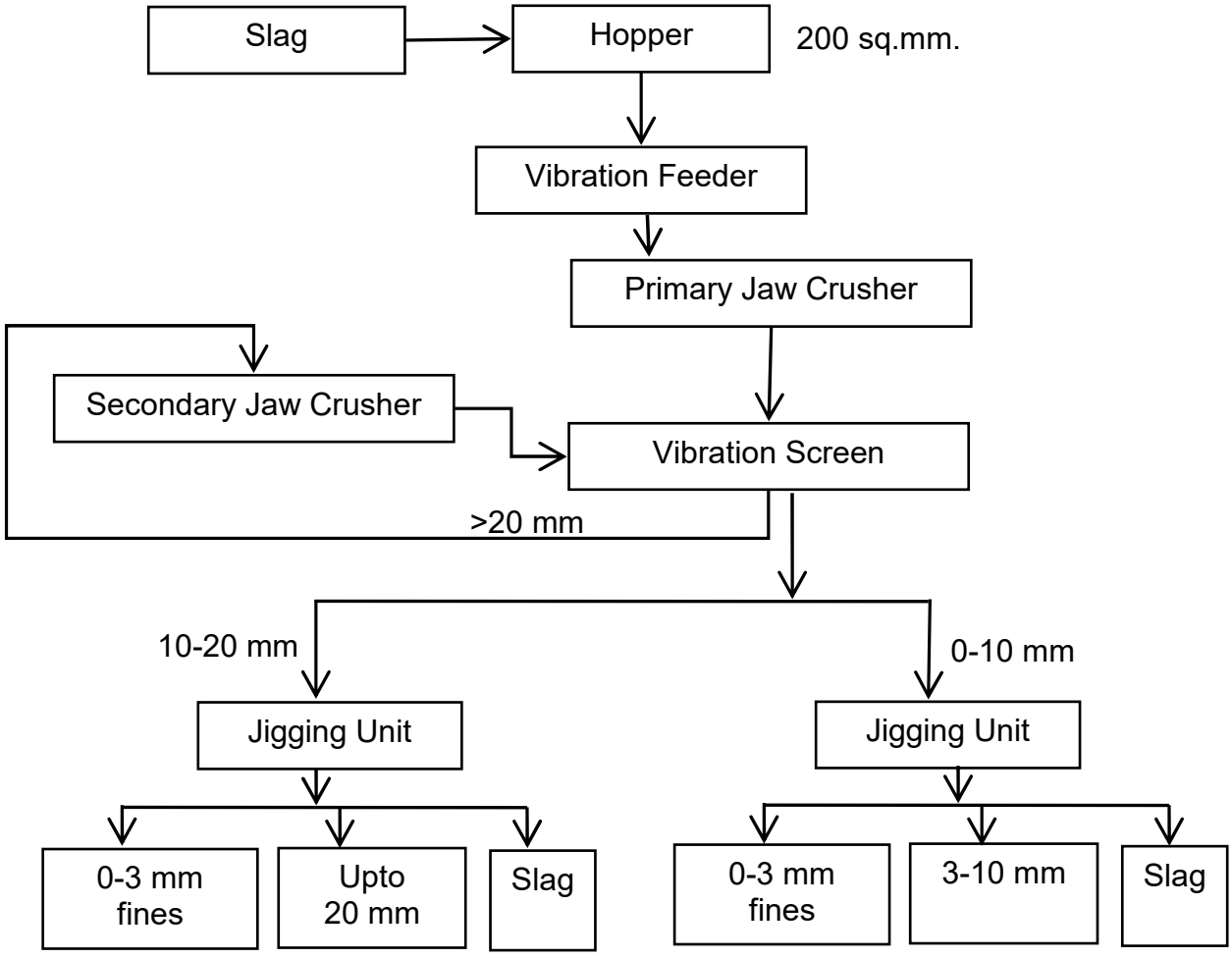
Description	Unit	Existing Sanctioned capacity as per CTO	Proposed Additional	Total
No. of working days	Days/ Annum	335	335	335
No. of working hours	Hours/ Day	24	24	24
Total Production	**TPA**	**19,980**	**95,420**	**1,15,400**

Material Balance of Metal Recovery Unit is given in **Table 2.19.**

TABLE 2.19: MATERIAL BALANCE OF METAL RECOVERY UNIT (EXISTING AND PROPOSED)

Input		**Quantity for Existing, TPA**			**Quantity for Proposed, TPA**		**Total, TPA**
Si-Mn Slag	100%	13,320	6,660	19,980	57,700	57,700	1,15,400
Output							
Mn concentrate	5%	666	333	999	2,885	2,885	5,770
Rejects	95%	12,654	6,327	18,981	54,815	54,815	1,09,630

FIG 2.10: PROCESS FLOW SHEET FOR METAL RECOVERY PLANT



2.4.9 Chrome Ore Beneficiation

Technology for the chrome ore beneficiation will be dry crushing and seiving followed by wet beneficiation.

Process: Chromite ore fines from mines will be fed into Chrome ore Beneficiation plant. The raw material is low grade friable chrome ore of 0-250 mm size [0-20 mm about 80% and 20-100 mm about 15% and 100-250 mm about 5%. After sizing in Jaw Crusher entire process will be carried out in wet process. Hence, there will be no source of fugitive emissions. During crushing and screening, dry fog dust suppression systems will be adopted to control fugitive emissions. Crushing size is controlled to avoid loss of Cr_2O_3 in micro fines.

Blended low grade chrome ore will be fed to a Feed Hopper through Dumper. The feed will be fed to the Jaw Crusher for crushing the ore to below 50 mm. The crushed material from Jaw crusher will be further fed into Roll Crusher for crushing the materials to -20 mm size which will be separated in Double Deck Vibrating Screens. The separated material will be conveyed to Wet Vibrating Screen through Belt Conveyor. The materials greater than 1 mm size will be fed to Rod Mill for wet grinding in a closed circuit back to Wet Vibrating screen. The slurry with <1 mm material from Wet Vibrating screen will be collected in a sump and sufficient water will be added. The same will be fed to two Hydro Cyclones, two number of 2X2 Top Feed Gravity Distributor Spirals. The feed grade is crushed to below 1 mm size to maximize the liberation of SiO_2, Al_2O_3, free Fe, etc. Primary Separation of SiO_2, MgO, Al_2O_3 and other floating material occurs in Hydro-cyclones and goes to tailing along with water. The gravity separation occurs in spiral bank to achieve better Cr Fe, low SiO_2.

The configuration of chrome ore beneficiation plant is given in **Table 2.20** and Material balance is given in **Table 2.21**.

TABLE 2.20: CONFIGURATION OF PROPOSED CHROME ORE BENEFICIATION PLANT

Description	Unit	Proposed
Chrome Ore Beneficiation plant	Nos.	5
Configuration	TPD	4X500 or 5X400
Working days	Per/ Annum	350
Working hours	Hours /Day	24
Total Production Capacity	**TPA**	**6,60,000**
Belt feeder	1 no.	
Belt conveyors	Several as required	
Jaw Crusher	1	
Roll Crusher	1	

Description	Unit	Proposed
Double Deck vibrating screen	1	
Wet Vibrating screen	1	
Rod Mill	1	
Hydro Cyclone	2	
Spirals	2 no. X 6	
Filter press	2 nos.	

TABLE 2.21: MATERIAL BALANCE OF PROPOSED CHROME ORE BENEFICIATION PLANT

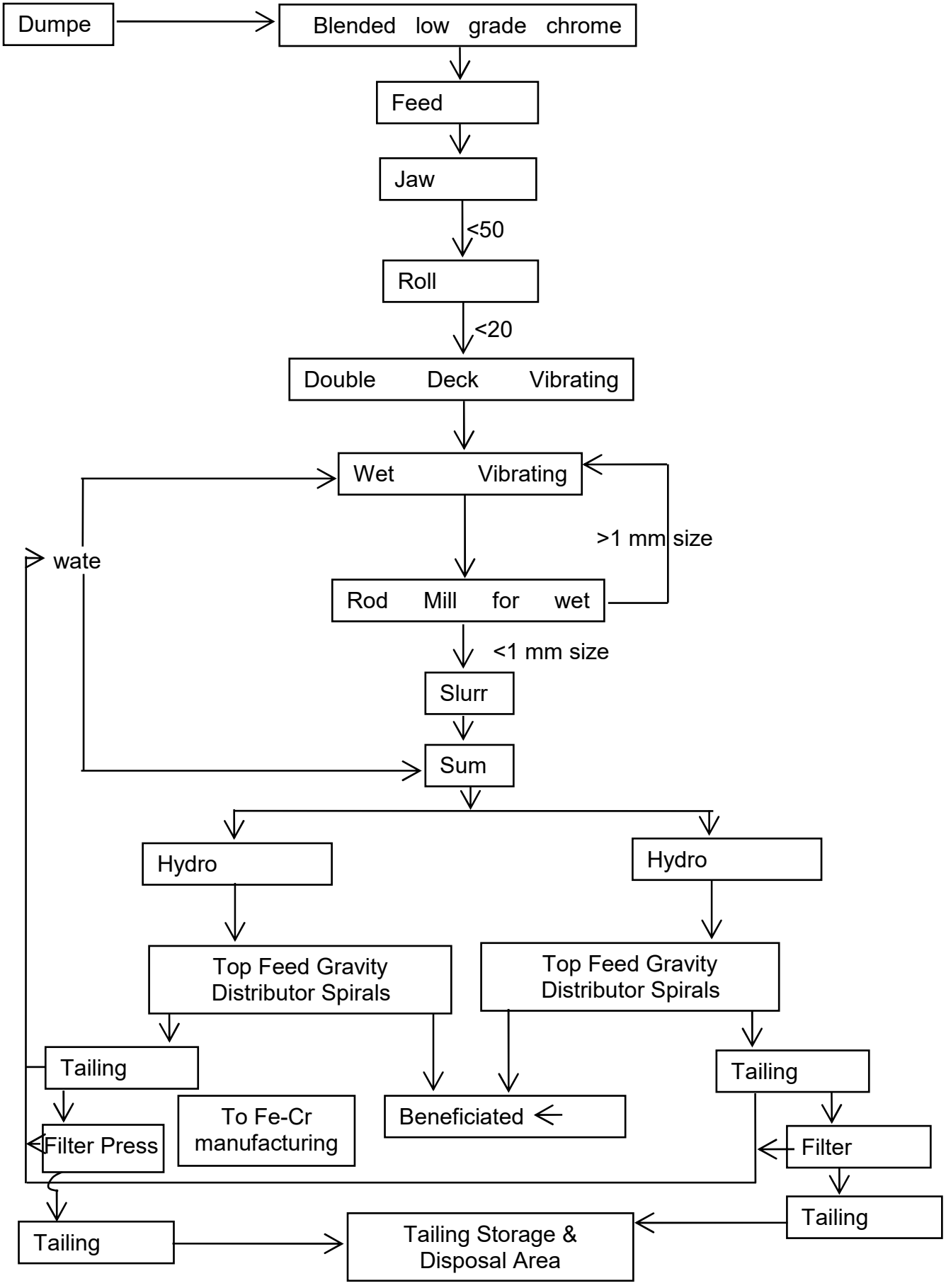
Inputs	**Quantity, T**	**Percentage**
Low grade Chrome ore	3,85,824	58%
Slag (Fe-Cr)	2,74,176	42%
Total	**660000**	**100%**
Output	**Quantity, T**	
Beneficiated chrome	4,62,000	70%
Rejects	1,98,000	30%
Total	**6,60,000**	**100%**

After the beneficiation process, tailing will be collected in a tailing tank where decanted water will be recycled back into the beneficiation process. The water will not be allowed to leave the beneficiation cycle. The dewatered tailing shall passed through filter press and converted to cakes. The cake will be stored in a tailing dump, which will be lined with the HDPE lining. After TCLP test on the cakes, it can be used as landfill/ base material in roads (when Cr is within permissible limits), else it will be sent to the nearest TSDF facility at Jajpur, Odisha.

Area required for tailing management

Density of Chrome ore Tailings	2.50 T/m^3
Quantity of Tailings	1,98,000 TPA / 2.5 = 79,200 m^3 per annum
Tailing tanks (1 nos.) (of 1 week capacity, assuming 20% concentrate)	7,920 m^3
Tank size	1600 m^2 X 5 m depth
Area required for Tailing cake storage	3500 m^2 for 17,100 m3 dried tailing cake for 90 days with height 5-6 m.

FIG 2.11: PROCESS FLOW SHEET FOR CHROME BENEFICIATION



2.4.10 AFBC/ CFBC Power generation unit (150 MW)

150 MW AFBC/ CFBC based captive power plant has been proposed. Configuration of AFBC/ CFBC based power plant is given in **Table 2.22** and material balance for proposed CPP is given in **Table 2.23**.

TABLE 2.22: CONFIGURATION OF PROPOSED CPP

Description	Unit	Quantity
AFBC/ CFBC	Nos.	**2**
Capacity	MW	**25**
AFBC/ CFBC	Nos.	**5**
Capacity	TPH	**20**
No. of working days	Days/Annum	**350**
No. of working hours	Hours /Day	**24**
Power generation	MW/ TPH	**0.241**
Plant	**Unit**	**Production**
2 X 25 MW CFBC	MWh	**50**
5 X 20 MW CFBC	MWh	**100**

TABLE 2.23: MATERIAL BALANCE OF CPP

Raw Material Inputs	Specific Consumption T/MWh	Quantity (TPA)
Coal required for Power Generation	0.565	7,12,174
Limestone	0.020	24,728
Total	**0.585**	**7,36,902**
Outputs		**Quantity (TPA)**
Material combusted in CFBC (FC, VM, etc)		3,82,793
Fly ash from Coal (45% Ash)		3,20,478
Ash contributed by limestone		33,630
Total		**7,36,902**

The components of the power plant will be:

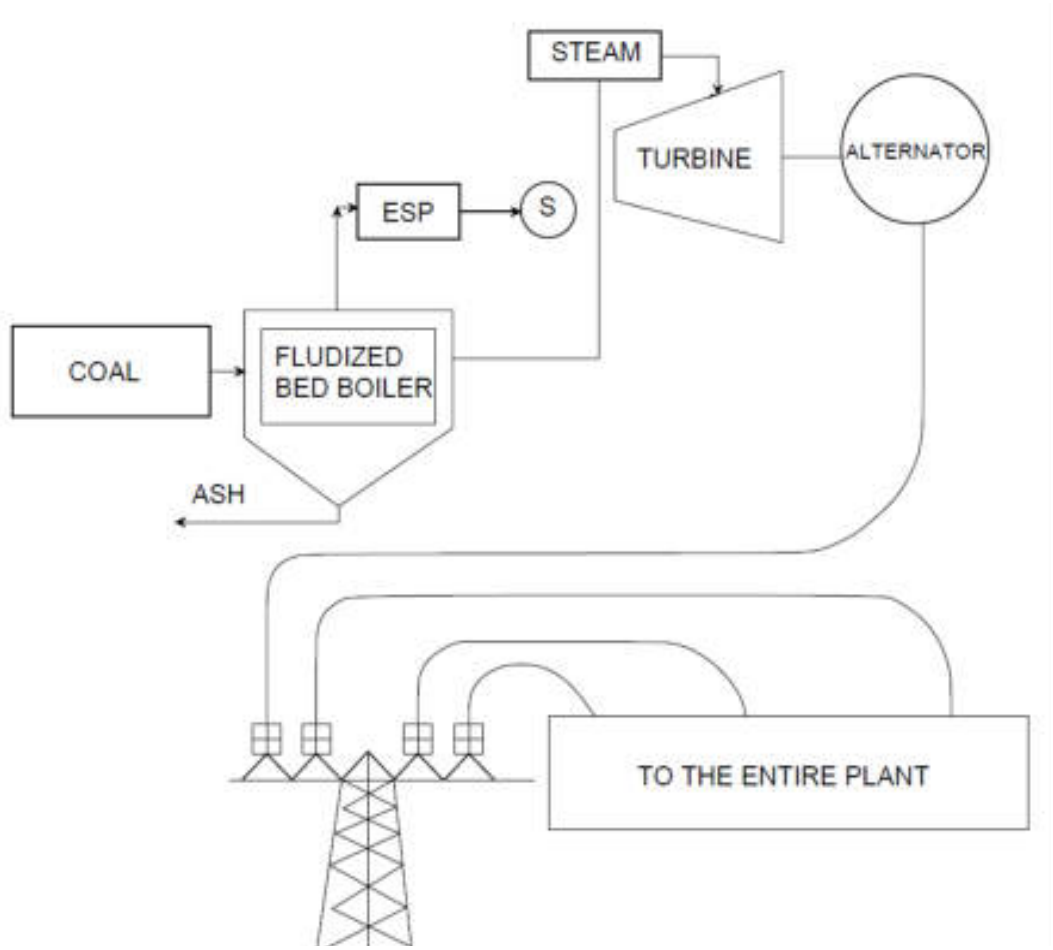
Coal Handling System: The coal received will be crushed and screened at plant for power generation.

Ash handling system: For handling of fly ash of the steam generator, dense phase, pneumatic conveying system will be provided. The ash collected in the hoppers located in economizer, air pre-heated sections of ESP hoppers will be pneumatically conveyed and collected. Ash will be utilized in brick manufacturing, road making, low lying area levelling and other permitted uses as per the Fly Ash Notification.

Cooling water system : Cooling water system is the main consumer of water in a thermal power plant. Cooling water is required for condenser and auxiliary cooling. The water required for condenser cooling should be soft water, free from suspended solids. A circulating water system with a cooling tower, make-up water system and blow down system shall be provided.

Flow sheet of CPP is given in **Fig 2.12**.

FIG 2.12: TYPICAL FLOW DIAGRAM OF POWER PLANT



Abbreviation: S- Stack
Note: Provision for FGD shall be Kept

Action plan for complying with the coal consumption norms published by Central Electricity Authority vide letter dated 27th March 2019 is as follows:

- The heat rate shall comply to the maximum permissible heat rate for calculation of annual coal consumption
- The coal requirement shall be met through grades G13-14 for the plant

Thus, the average annual coal consumption shall not exceed the permissible limit as shown below:

	Grade of coal	GCV of coal (kcal/kg)	CERC allowed storage loss (kcal/kg)	GCV considered (kcal/kg)	Unit heat rate (kcal/kWh)	Annual coal consumption at 85% PLF (T/MW per annum)
CEA	G13	3400	85	3315	2600	5840
CEA	G14	3100	85	3015	2600	6421
Proposed plant	G13-14			Average 3200	2600	Average 6208

Source: Rungta Mines Ltd.

Furthermore, provision of space for flue gas desulpherisation (FGD) unit shall be made so that the same can be established in the future in order to meet stringent statutory norms.

2.5 RAW MATERIALS AND FINISHED PRODUCT

The unit wise detail of raw material is given in **Table 2.24** and consolidated list of raw material with their sources are given in **Table 2.25.** The finished product details are given in **Table 2.26.**

Mode of transport of Raw material

Raw material will be transport through road and rail-road combination. Presently also raw material is being transport by road and rail-road combination.

TABLE 2.24: UNIT WISE DETAILS OF RAW MATERIAL REQUIREMENT

Sl. No.	Facility	Raw Material	Existing			Additional proposed	Total Proposed		
			Required, TPA	Own source, TPA	From outside (purchase), TPA	From outside (purchase), TPA	Required, TPA	Own source, TPA	From outside (purchase), TPA
1	Sinter Plant	Iron Ore Fines	41,040		41,040	4,92,480	5,33,520	0	5,33,520
		Coke Fines	1,512		1,512	18,144	19,656	0	19,656
		Lime Stone	5,616		5,616	67,392	73,008	0	73,008
		Dolomite	5,616		5,616	67,392	73,008	0	73,008
		BF dust from Ferro Alloy Plant	4,513	4,513	0	0	58,675	58,675	0
		Bag filter (sinter plant)	864	864	0	0	11,232	11,232	0
		Sinter Return Fines	6,480	6,480	0	0	84,240	84,240	0
2	Ferro Alloy	Quartz (94%-95%)	5,994		5,994	1,93,686	1,99,680	0	1,99,680
		Charcoal / Coke	22,316		22,316	1,10,804	1,33,120	0	1,33,120
		Iron Ore / Mill Scale/ Sinter	499	499	0	23,080	2,53,880	2,30,800	23,080
		Electrode Paste	1,210		1,210	5,958	7,168	0	7,168
		Manganese Ore (38%-40%)	28,771		28,771	1,37,405	1,66,176	0	1,66,176
		Low-Grade High Silicon Moil Ore	34,565		34,565	1,65,077	1,99,642	0	1,99,642
		Fe-Mn Slag	28,771	28,771	0	0	1,66,176	1,66,176	0
		Dolomite	3,996		3,996	19,084	23,080	0	23,080
		Coal	9,191		9,191	1,10,825	1,20,016	0	1,20,016
		Mn Briquettes	1,13,316		1,13,316	-1,13,316	6,04,355	6,04,355	0
		Cr Briquettes				0	4,70,707	4,70,707	0
		Chrome Ore Lump				46,080	46,080	0	46,080
		Manganese Ore Concentrate				6,15,602	6,21,372	5,770	6,15,602
		Lime				0	27,577	27,577	0

Sl. No.	Facility	Raw Material	Existing			Additional proposed	Total Proposed		
			Required, TPA	Own source, TPA	From outside (purchase), TPA	From outside (purchase), TPA	Required, TPA	Own source, TPA	From outside (purchase), TPA
		Molasses				41,073	41,073	0	41,073
		Chome-ore concentrate				26,333	4,88,333	4,62,000	26,333
		Flourspar				9,232	9,232	0	9,232
3	Chrome Ore Beneficiation Plant	Low grade Chrome ore				3,85,824	3,85,824	0	3,85,824
		Slag (Fe-Cr)				0	2,74,176	2,74,176	0
4	Metal recovery plant (MRP) from Si-Mn Slag	Si-Mn Slag	19,980	19,980	0	0	1,15,400	1,15,400	0
5	Metal recovery plant (MRP) from Pig Iron Slag	Slag (Pig Iron)				0	88,627	88,627	0
6	CFBC	Coal required for Power Generation				7,12,174	7,12,174	0	7,12,174
		Limestone				24,728	24,728	0	24,728
	Total		**3,34,251**	**61,108**	**2,73,143**	**31,59,057**	**60,31,936**	**25,99,736**	**34,32,200**

TABLE 2.25: CONSOLIDATED RAW MATERIAL REQUIREMENT REQUIRED FROM OUTSIDE AND THEIR SOURCES

Sl. No.	Raw Material	Existing purchase from outside, TPA	Additional purchase from outside, TPA	Total purchase from outside, TPA	Source	Mode	Distance, km
1	Iron Ore Fines	41,040	492,480	533,520	OMC/ other mines, Odisha	Road/ Rail	240
2	Coke Fines	1,512	18,144	19,656	Talcher, Odisha	Road	30
3	Lime Stone	5,616	92,120	97,736	Sundergarh, Odisha	Road/ Rail	270
4	Dolomite	9,612	86,476	96,088	Sundergarh, Odisha	Road/ Rail	270
5	Quartz (94%-95%)	5,994	193,686	199,680	Raigarh, Chhattisgarh	Road/ Rail	375
6	Charcoal / Coke	22,316	110,804	133,120	Open market	Road	upto 300
7	Iron Ore / Mill Scale/ Sinter	-	23,080	23,080	OMC/ other mines or plants, Odisha	Road/ Rail	240
8	Electrode Paste	1,210	5,958	7,168	Bhubaneswar, Odisha	Road/ Rail	62
9	Manganese Ore (38%-40%)	28,771	137,405	166,176	Koira, Odisha	Road/ Rail	240
10	Low-Grade High Silicon Mn Ore	34,565	165,077	199,642	MOIL's Mines in Maharashtra	Road/ Rail	1622
11	Coal	9,191	822,999	832,190	Talcher, Odisha	Road/ Rail	30
12	Chrome Ore Lump	-	46,080	46,080	Sukinda Valley, Odisha	Road	upto 300
13	Manganese Ore Concentrate	-	615,602	615,602	OMC/ other mines, Odisha	Road/ Rail	240
14	Molasses	-	41,073	41,073	Open market in Odisha	Road	upto 100
15	Chome-ore concentrate	-	26,333	26,333	Open market in Odisha	Road/ Rail	upto 100
16	Flourspar	-	9,232	9,232	Open market in Odisha	Roadl	upto 100
17	Low grade Chrome ore	-	385,824	385,824	Sukinda Valley, Odisha	Road/ Rail	upto 300
18	Mn Briquettes	113316.48	-	-			
	TOTAL	**273,143**	**3,159,057**	**3,432,200**			

TABLE 2.26: FINISHED PRODUCT DETAILS FOR ENTIRE PLANT (TPA)

Sl. No.	Name of Product	Production	In house consumption	Sale to outside
1.	Ferro Alloys Plant			
	Ferro Manganese Plant OR	2,93,376	0	2,93,376
	Silico-Manganese OR	2,30,800	0	2,30,800
	Ferro-Silicon OR	1,02,400	0	1,02,400
	Ferro-Chrome OR	2,30,400	0	2,30,400
	Pig Iron	3,69,600	0	3,69,600
2.	Sinter	5,61,600	2,30,800	3,30,800
	Total			**7,00,400**

2.6 POWER REQUIREMENT

The plant will generate 150 MW energy in form of electricity from its captive power plant and will utilize the total power generated in proposed expansion plant. Energy consumption is given in **Table 2.27.**

TABLE 2.27: ENERGY CONSUMPTION FOR ENTIRE PLANT

Sl. No.	Description	No. of Days	No. of Hours	Specific KWH Req	Production Capacity	Production Units	Power Required MW
	Existing Plant						
1	Ferro Alloy Plant						
	Ferro-Manganese or	325	24	3100	55008	TPA	21.86
	Silico-Manganese	300	24	3950	39960	TPA	21.92
	Briquetting (Fe-Mn)	325	24	22	110016	TPA	0.31
2	Metal recovery Plant	300	24	25	19980	TPA	0.07
3	Sinter	288	24	45	43200	TPA	0.28
4	Lighting, common areas, services & miscellaneous	365	24	LS			2
	Total Existing						25
	After Expansion						
1	Ferro Alloy Plant						
1.1	Ferro-Chrome or	320	24	3950	230400	TPA	118.50
1.2	Ferro-Manganese or	325	24	3100	293376	TPA	116.60
1.3	Ferro-Silicon or	320	24	8500	102400	TPA	113.33
1.4	Silico-Manganese	325	24	3950	230800	TPA	116.88
1.5	Pig Iron	325	24	2460	369600	TPA	116.57
1.6	Briquetting (Fe-Mn)	325	24	22	586754	TPA	1.65
1.7	Briquetting (Fe-Cr)	320	24	22	461127	TPA	1.32
2	Metal recovery Plant	325	24	25	115400	TPA	0.37
3	Chrome beneficiation plant	320	24	60	660000	TPA	5.16
4	Sinter	288	24	45	561600	TPA	3.66
5	Captive Power Plant	350	24	10.0%	150		15.00
6	Lighting, common areas, services & miscellaneous	365	24	LS	6		6.00
	Total Requirement						150

2.7 WATER REQUIREMENT

The total fresh water requirement for the entire project will be 237 KLH after expansion. The present fresh water requirement is 9 KLD.

Fresh water will be stored in a raw water reservoir. Water from the reservoir will be subjected to clari-flocculation, sludge settling and gravity filtration.

Clear water will be utilized for cooling water make up and as service water. For potable water system, the filtered water will be subjected to chlorination. For make up to the steam-condensate cycle (boiler feed water), demineralization of the filtered water by cation and anion exchange resins is envisaged. Consumption of industrial water in different operations can be broadly classified under the following heads:

- Evaporation losses in raw water reservoir
- Losses in water treatment
- Make up to cooling water systems
- Boiler feed water
- Dust suppression
- Horticulture and green belt
- Service water, e.g., make-up to fire water system, etc.

Existig and proposed daily make up water requirement has been given in **Table 2.28 and Table 2.29.**

TABLE 2.28: WATER REQUIREMENT FOR EXISTING PLANT

Sl. No.	Description	No. of days	No. of hours	Req. cum per unit	Unit	Capacity	Make-up water, KLH	Waste water discharge, KLH
1	Ferro Alloy Plant							
1.1	Submerged Arc furnaces	325	24	0.71 KLH/T	TPA	55,008 ha	5.00	0.10
1.2	Briquetting	325	24	0.01 KLH/T	TPA	1,10,016 ha	0.14	0.01
2	Metal Recovery Plant	300	24	0.3 KLH/T	TPA	19,980 ha	0.83	0.00
3	Sinter	288	24	0.3 KLH/T	TPA	43,200 ha	1.88	0.13
	Sub Total						8	
4	Drinking Water and Sanitary	325	24	45 lpcd	lpcd (3 shifts)	500 nos.	0.9	0.00
5	Sprinkling	325	24	20 KLD/ha		3.07 ha	0.11	0.00
6	Green belt	325	24	10 KLD/ha	KLD/ha	7.082 ha	0.12	0.00
	Total Water consumption						9.0	0.24
	In KLD						**216**	**5.76**

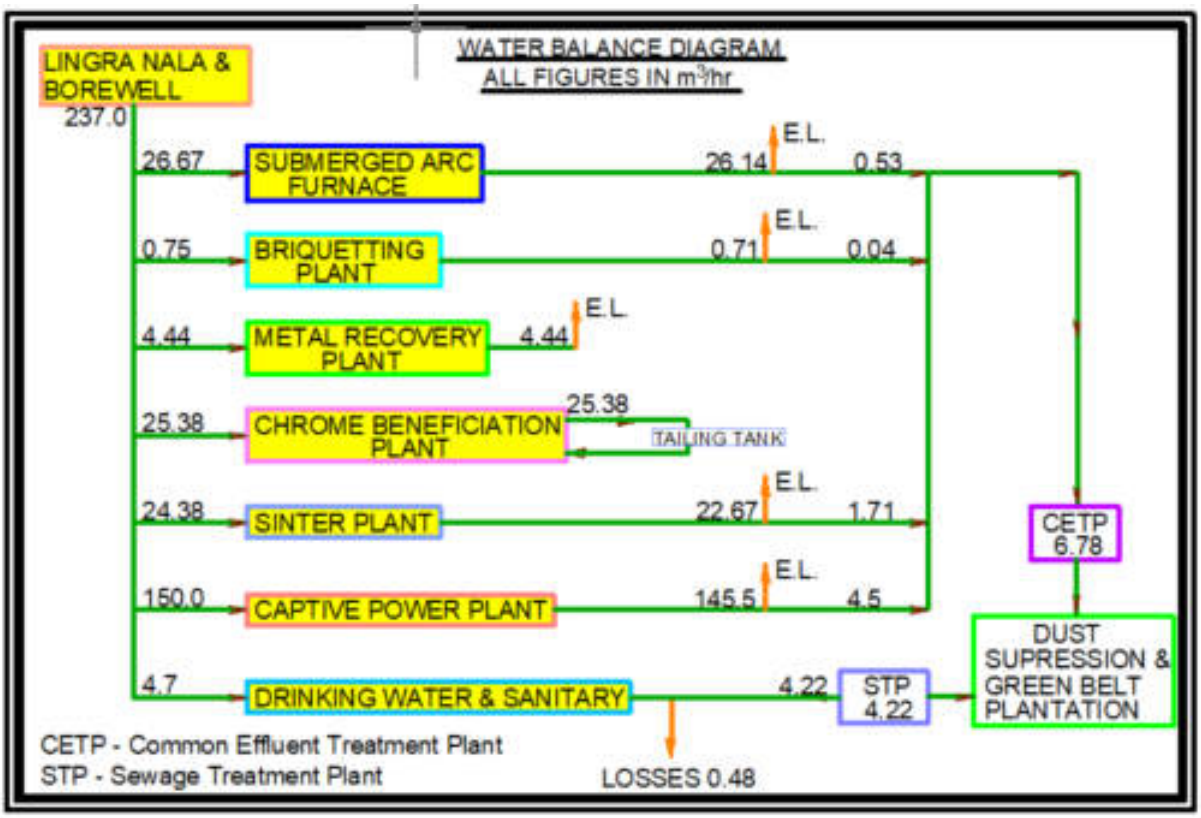
TABLE 2.29: WATER REQUIREMENT FOR ENTIRE PLANT AFTER EXPANSION

Sl. No.	Description	No. of Days	No. of Hours	Require-ment per unit	Capacity of unit	Make-up Water, KLD	Waste water discharge, KLH
1.0	**Ferro Alloy Plant**						
1.1	Submerged Arc furnaces	325	24	0.56 KLH/T	3,69,600 TPA	26.67	0.53
1.2	Briquetting	325	24	0.01 KLH/T	5,86,754 TPA	0.75	0.04
2	Metal Recovery Plant	325	24	0.30 KLH/T	1,15,400 TPA	4.44	0.00
3	Chrome Beneficiation Plant	325	24	0.30 KLH/T	6,60,000 TPA	25.38	0.00
4	Sinter	288	24	0.30 KLH/T	5,61,600 TPA	24.38	1.71
5	CPP	350	24	1.000 KLH/MW	150 MW	150	4.50
	Sub Total			**-**		**232**	
6	Drinking Water and Sanitary (2000 employees + 25% visitors, drivers & transport helpers)	350	24	45.00	2,500 nos.	4.7	4.22
7	Sprinkling	365	24	10.00 KLD/ha	8.0 ha	0.14	0.00
8	Green belt	365	24	10.00 KLD/ha	19.60 ha	0.34	0.00
	Total Water consumption					**237**	**11**
	In KLD					**5688**	**264**

100% of the waste water generated shall be utilized for green belt watering, sprinkling on roads, stock yards & solid waste disposal areas, ash conditioning as well as back in the process. The plant will maintain zero effluent discharge system during non monsoon since the treated waste water shall be reused within the premises.

Water withdrawal permission for 733.972 KLD from surface water has been obtained from Office of Superintending Engineer, Rengali Right Canal Division No. II, Dhenkanal vide letter dated 14.02.2023. The water is being withdrawn from Lingara Nala for the existing project. Balance shall be applied for prior to expansion. Water permission for withdrawal of 30 KLD from borewell, has been taken from CGWA, vide NOC no. CGWA/NOC/IND/REN/1/2021/5971. This is valid from 08/05/2021 to 07/05/2024. Refer **Annexure XXIII** and Annexure **XXIV** for copies of the permissions. Rain water shall also be collected and reused within plant site. Water balance diagram is shown in **Fig 2.13.**

FIG 2.13: DAILY MAKEUP WATER BALANCE DIAGRAM FOR 0.293 MTPA FERRO ALLOY PLANT AFTER EXPANSION



Fire water system: Water requirement for fire protection system shall be met from the raw water reservoir and separate fire fighting tank and pumps shall be provided for emergency use.

2.8 MANPOWER

The manpower in existing plant is 500 and an equal number in indirect employment. The additional manpower required will be 1500. The total manpower after the expansion of the project will be 2000. Many more persons will also get employment in the ancillary & other services connected with this project.

Supporting infrastructure shall be upgraded like office building, canteen, roads etc. Rest shelters for workers are established at the site and shall be augmented.

2.9 PROJECT IMPLEMENTATION SCHEDULE AND PROJECT COST

The tentative project implementation schedule is 84 months from date of receipt of Environmental clearance and other statuary clearances. The implementation shall be phase wise with approximately half the plant envisaged to be established earlier, made operational and then followed by the remaining half of the plant. However, the phasing is only indicative and

tentative and subject to change on detailed engineering. The phases proposed is as follows:

- **Phase 1 -** Submerged Arc Furnace 3 nos. X 9 MVA + 2 nos. X 18 MVA; Metal recovery plant 1 nos. X 10 TPH + 1 no. X 5 TPH; Briquette Plant for Ferro chrome 2 nos. X 10 TPH + 4 nos. X 5 TPH; Briquette Plant for Ferro manganese 4 nos. X 10 TPH + 3 nos. X 5 TPH; sinter plant 2 nos. X 600 TPH or 7 nos. X 120 TPH; Chrome ore Beneficiation 2 nos. X 500 TPD or 3 nos. X 400 TPD; Power plant 2 nos. X 25 MW + 1 nos. X 20 MW.

- **Phase 2 -** Submerged Arc Furnace 4 nos. X 9 MVA + 1 nos. X 18 MVA; Metal recovery plant 1 nos. X 10 TPH; Briquette Plant for Ferro chrome 2 nos. X 10 TPH + 4 nos. X 5 TPH; Briquette Plant for Ferro manganese 3 nos. X 10 TPH + 4 nos. X 5 TPH; sinter plant 1 nos. X 600 TPH or 8 nos. X 120 TPH; Chrome Ore Beneficiation 2 nos. X 500 TPD or 2 nos. X 400 TPD; Power plant 4 nos. X 20 MW.

The tentative implementation program of the project shall be given in Table 2.30.

TABLE 2.30: TENTATIVE PROJECT SCHEDULE

Sl. No.	Plant Facilities	12	24	36	48	60	72	84
		Phase 1				Phase 2		
1.1	Ferro Manganese OR	■	■	■		■	■	■
1.2	Silico Manganese OR							
1.3	Ferro Chrome OR							
1.4	Ferro Silicon							
2	Pig Iron							
3	Metal Recovery plant			■				■
4	Briquette Plant for Ferro chrome			■				■
5	Briquette Plant for Ferro manganese			■				■
6	Sinter plant		■	■			■	■
7	Chrome ore Beneficiation			■				■
8	Power plant	■	■	■		■	■	■

The cost of the project shall be as follows:

Existing	:	Rs. 25 Crores
Proposed Additional	:	Rs. 950 Crores
Total	:	Rs. 975 Crores

CHAPTER 3

DESCRIPTION OF THE ENVIRONMENT

3.1 GENERAL

As per the procedure laid down in the EIA Notification dated 14th September 2006, Form-I, proposed Terms of Reference (TOR) for the EIA along with the pre-feasibility report was submitted to MOEF&CC vide online application no. IA/OR/IND1/403580/2022 dated 28.10.2022. The information of the environmental data that had been generated during the preceding summer season i.e. from 01.03.2022 to 31.05.2022 was also submitted. After submission of TOR application Essential Details Sought (EDS) was raised online on 04.11.2022. The reply to EDS was uploaded on 25.11.2022. Thereafter, MoEF&CC issued the TOR vide letter no. J-11011/515/2022-IA-II(IND-I) dated 01.12.2022 for Expansion of Ferro Alloy plant from 0.055 to 0.293 MTPA along with 150 MW CPP (copy given in **Annexure I**).

3.1.1 Sources of Environmental Data

The baseline information on micro-meteorological data, ambient air quality, water quality, soil quality and noise levels have been recorded at site by M/s Min Mec R&D Laboratory, New Delhi (NABL certificate no. TC 6337 valid upto 16/03/2024 and MoEF&CC Notification no. SO 3744(E) at Sl. No. 97 valid upto 16/10/2024). Certificates are given in **Annexure XIX**. Long term meteorological data was collected from the nearest IMD station, Angul (20 km, WNW). Micro-meteorological data was collected at the site using an automatic weather monitoring station during the monitoring period. Data on water quality, soil quality, air quality, noise levels, flora, fauna, traffic volumes, etc. have been monitored/ measured/ collected during field visits. Apart from these, secondary data have been collected from Census Handbook, Revenue Records, Forest Working Plan, Forest Department, etc.

3.1.2 Study area

For the description of baseline environmental scenario, the plant area (existing plus proposed) has been considered as the “core zone”. The area falling within a distance of 10 km from the boundary of the core zone has been considered as the “buffer zone”. The core zone and the buffer zone together form the “study area”. Baseline status and impact assessment has been done for the study area as shown in **Fig 3.2**.

3.2 TOPOGRAPHY AND DRAINAGE

3.2.1 Topography

Core zone: The core zone represents nearly flat land but gently sloping land having elevation from 61 m – 73 m above mean sea level (amsl), as

per google earth of the existing and expansion plant area. The overall slope is towards the south eastern side towards Nigra Nadi (also known as Lingara Nadi).

Buffer zone: The study area (10 km radius around project) is sloping from the southern side towards Brahmani river in the north east. There are few hills in the southern portion with a maximum elevation of 312 m above mean sea level (amsl) at Nimidha RF. The other notable hill is Jharbandh Reserve Forest with a peak at 229 m in SSE. The lowest elevation of around 56 m amsl near Rorha is observed in study area. Open scrub patches are scattered in the buffer area. Most of the buffer area is agricultural private land with a few large industries.

A digital elevation map of the study area has been prepared and is given in **Fig 3.3.** The highest elevations of the hills have been coloured in red and lowest elevation, around the Brahmani rover, are shown in blue. The southern side is higher than the northen side.

3.2.2 Drainage

Core zone: There is no perennial river or water body present in the project area. The existing and proposed expansion project site is located adjoining to Nigra (Lingara) Nadi and 3.8 km south/ south west of Brahmani River. A seasonal nala flows from west to east across the expansion area and joins Lingara Nadi. There is a pond as well as the Rengali Right Main Canal outside the southern boundary of the project area. As per toposheet, water from seasonal nala from the pond outside southern boundary flows northwards and joins the above mentioned west-east seasonal nala before joining Lingara Nadi. A perusal of the google earth image of 2022 shows that the west-east seasonal drain mentioned above is not well defined but rather a broad low lying zone, which is water logged in patches but where local people have fields with well defined boundaries. The path of the south-north seasonal stream is also a series of well defined agricultural fields are given in **Fig 3.1a** and **3.1b**.

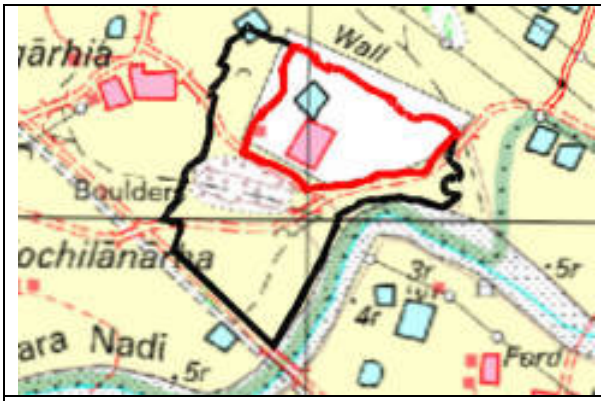
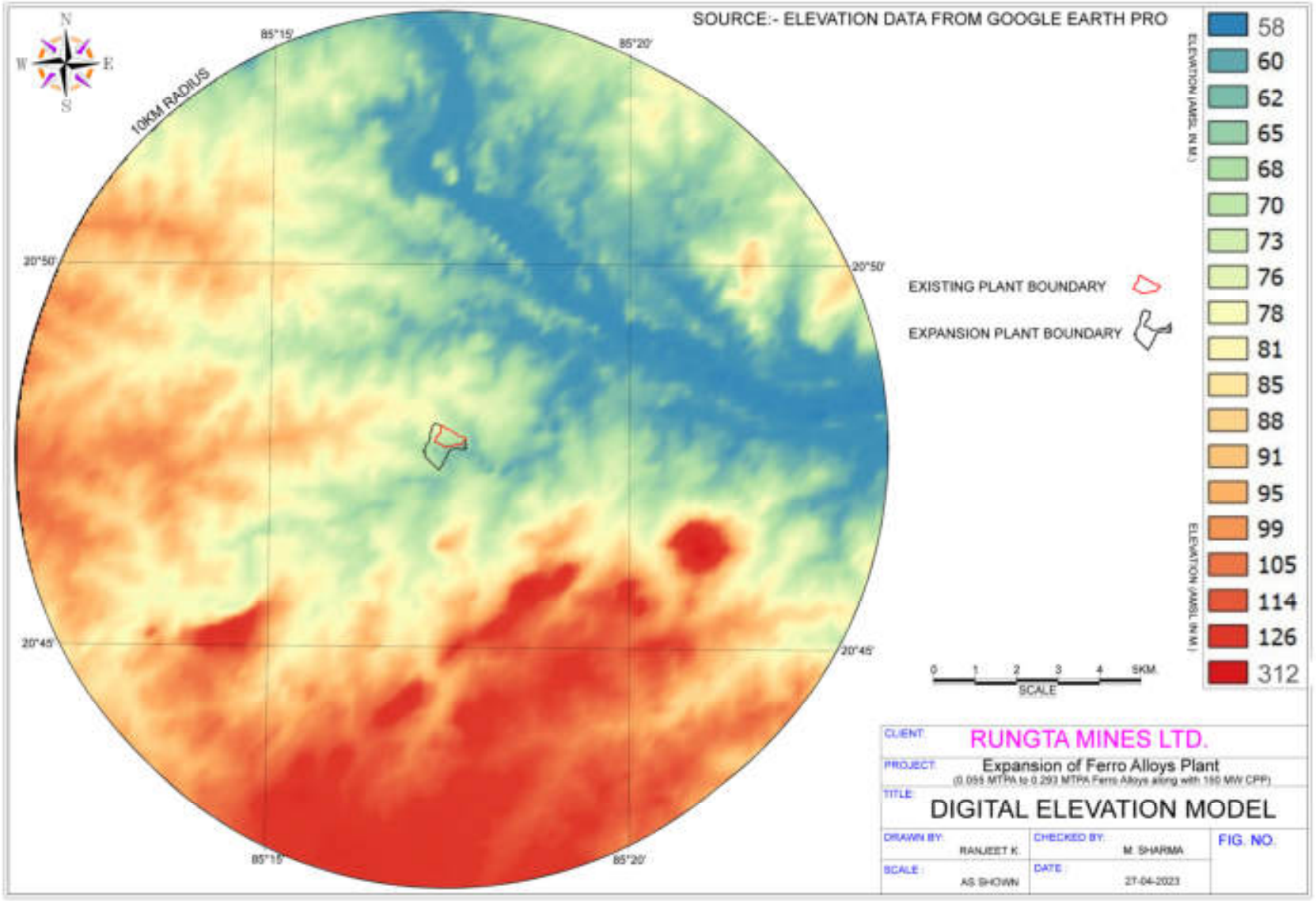


FIG 3.1A: SEASONAL DRAINS AS PER TOPOSHEET

FIG 3.1B: GROUND SITUATION OF SEASONAL DRAINS SHOWN ON TOPOSHEETS IS THAT ITS UNDER AGRICULTURE NOW

FIG 3.2: TOPOGRAPHY AND DRAINAGE MAP OF THE STUDY AREA

FIG 3.3: DIGITAL ELEVATION MODEL OF 10 KM RADIUS



Buffer zone: The drainage of the study area is controlled mainly by the Brahmani river flowing 3.8 km north east of the project. Its tributaries are Nigra or Lingara Nadi (adjoining to plant), Kisinda Jor (2.1, N), Kusumdor Jor (7.0, SSE) and Ria Jor (5.9, NE). These form the main drainage in the study area with seasonal surface flow. The drainage network in study area is dendritic in nature. Topography and drainage map of the study area is shown in **Fig 3.2**. Rivers/ water bodies present in 10 km radius are given in **Table 3.1**. It may be noted that, although there are many small ponds in the buffer zone, the ponds having significant area/ size have been considered and mentioned in the table.

TABLE 3.1: RIVER/ NALA/ WATER BODIES PRESENT IN 10 KM RADIUS

Sl. No.	Name of River/ nala	Distance (km) and direction with respect to plant
1.	Nigra or Lingara Nadi	Adjoining, SE
2.	Kisinda Jor	2.1, N
3.	Brahmani River	3.8, NE
4.	Rangali Right Main Canal	0.01, SW
5.	Ria Jor	5.9, NE
6.	Kusumdor Jor	7.0, SSE
7.	Sarapa Canal	7.7, SE
8.	Kantei Nala	8.5, SW
9.	Parjang Branch Canal	7.9, NE
10.	Baulamala Jharana	9.2, NNE
11.	Reservoir Near Nua	7.5, SE
12.	Reservoir Near Kadala	3.0, S
13.	Pond in Sanamunda Village	6.7, SW
14.	Pond in Garha Santri Village	9.0, WNW
15.	Reservoir Near Mendhapada village	8.3, NE
16.	Pond In Jharbandh Village	2.9, SE
17.	Pond In Meramandali Village	3.6, ESE
18.	Pond In Kumusi Village	9.8, NE
19.	Pond In Brundabanpur Village	7.6, NW
20.	Pond In Jhanjiribahal Village	9.7, WNW
21.	Pond In Barhamunda Village	4.7, SSW
22.	Pond In Chintapokhari Village	4.7, E

3.3 CLIMATE

The climate of the region is sub-tropical, being characterized by hot and dry summer, a monsoon and a cold winter. The winter season extends from November to end of February, which is followed by summer season from March to the middle of June and rainy season from middle of June to middle of October. The nearest meteorological station of India Meteorological Department (IMD) is Angul, which is approximately 20 km to the WNW of the project area. Meteorological parameters of Angul station have been collected from Climatological normals for the period 1981-2010 & 1991-2020, for the study of long-term meteorology of the study area and have been represented subsequently.

3.3.1 Temperature, Relative Humidity and Rainfall

The month wise average maximum and minimum temperature, average monthly relative humidity at 08:30 hrs & 17:30 hrs and yearly total rainfall (mm), recorded at IMD station Angul, have been furnished in **Table 3.2.**

TABLE 3.2: CLIMATE DATA OF IMD STATION ANGUL (PERIOD 1981- 2020 & 1991-2020)

Month	Mean Temperature (°C)				Relative Humidity (%)				Mean Rainfall			
	Daily Min		Daily Max		08:30 hrs		17:30 hrs		Rain (mm)		Rainy days	
	1981-2010	1991-2020	1981-2010	1991-2020	1981-2010	1991-2020	1981-2010	1991-2020	1981-2010	1991-2020	1981-2010	1991-2020
Jan	14.2	14.1	28.7	28.7	73	74	55	58	8.5	10.4	0.7	1.0
Feb	16.8	16.6	32	32.1	69	69	49	51	16	14.4	1.1	1.2
Mar	19.9	19.7	36.1	36.6	69	68	47	46	28.4	22.9	1.7	1.4
Apr	24.2	24.3	39.6	39.8	67	67	45	46	35.4	38.0	2.3	2.9
May	25.5	25.6	39.9	40.2	66	66	48	48	81.8	81.2	4.1	4.7
Jun	25.1	25.1	36.7	36.8	71	71	63	63	194.6	172.6	8.6	9.0
Jul	24	23.8	32.7	32.5	80	81	74	74	282.6	301.7	12.2	13.8
Aug	23.6	23.3	31.8	32.0	81	80	77	77	303.5	285.5	13	14.2
Sep	23.5	23.2	32.4	32.5	79	79	76	76	205.4	214.2	10.6	11.2
Oct	21.4	21.2	32.7	32.7	74	75	67	69	93.4	105.2	4.8	4.9
Nov	17.4	17.4	30.6	30.6	70	72	59	63	23.4	17.4	1.1	1.1
Dec	13.8	13.6	28.6	28.7	70	71	57	60	4.6	9.1	0.2	0.6
Annual	**20.8**	**20.6**	**33.5**	**33.7**	**72**	**72.7**	**60**	**60.9**	**1277.5**	**1272.6**	**60.4**	**66.1**

(Source: Climatological Normals, IMD Angul, Odisha)

From **Table 3.2**, the following conclusions can be drawn for the period 1991-2020:

1. **Temperature:** The mean minimum temperature ranges from 13.6°C in December to 25.6°C in May, while maximum temperature ranges from 28.7°C in December & January to 40.2°C in May.

2. **Relative Humidity:** The relative humidity is higher in the morning hours averaging 72.7% compared to night hours which is averaging 60.9%. During July to October, it is observed higher than other months.

3. **Rainfall:** It can be seen that, June to September are the months of heaviest rainfall compared to the other months. The annual rainfall varies from the lowest value of 9.1 mm in December to 301.7 mm in July. The annual average rainfall is 1272.6 mm.

3.3.2 Wind speed and direction

The wind roses as per Climatological normals, IMD for Angul are given in **Fig 3.4** and **Fig 3.5** for 08:30 Hrs and 17:30 hrs for the period 1981-2010 & 1991-2020, respectively. In 1981-2010, it can been seen that in the morning wind flow is predominantly from north-east or north-west throughout the year while in evening, wind is predominantly it has been from north east (Nov-Jan), north west (Feb-Mar, Aug-Nov), south east (April-May) & south west (June-July). In 1991-2020, it can been seen that in the morning, wind flows predominantly from the north-west during January to March and June to December and from north-east during only two months i.e. April to May. In the evening, wind flows from north-east during January and October to December, from north-west during February to March and August to September, from south-east for two months during April & May and during June and July wind flows predominantly from south-west.

FIG 3.4: WINDROSE DIAGRAM OF IMD DATA OF ANGUL AT 08:30 HRS

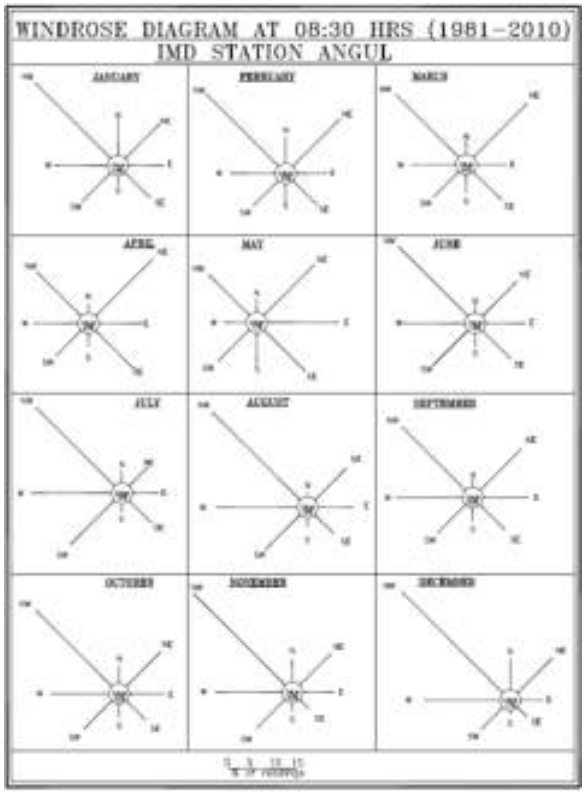
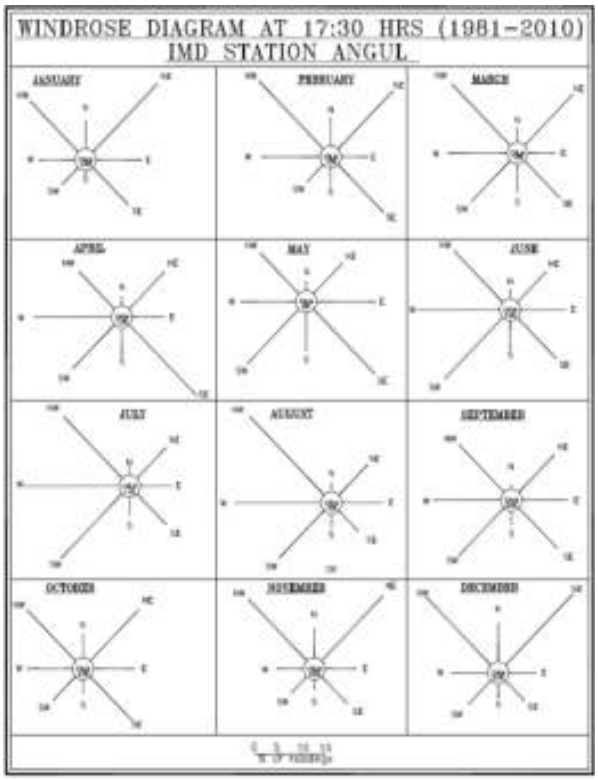
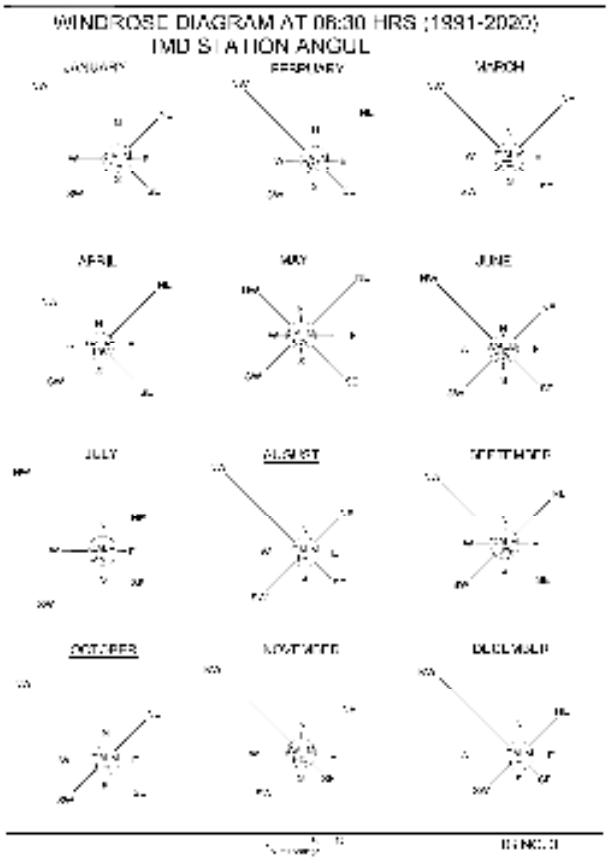
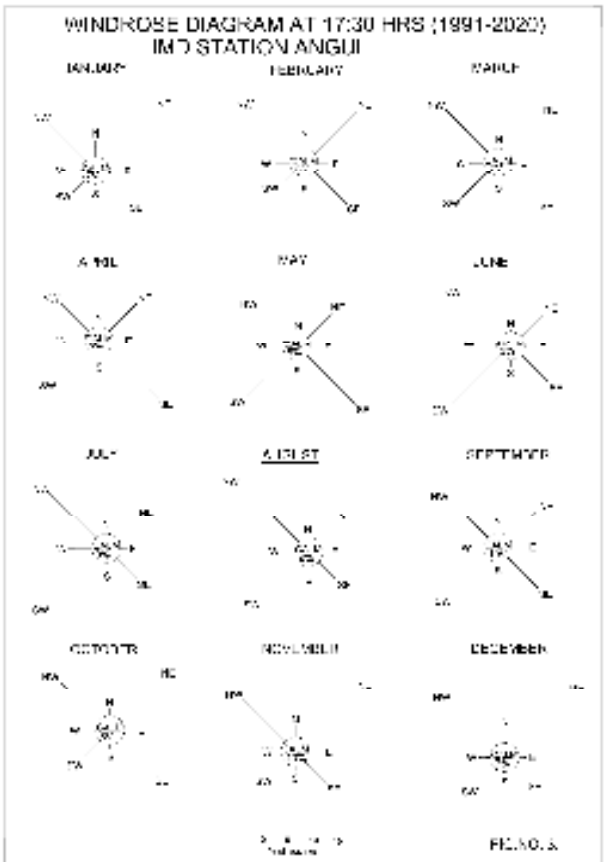


FIG 3.5: WINDROSE DIAGRAM OF IMD DATA OF ANGUL AT 17:30 HRS

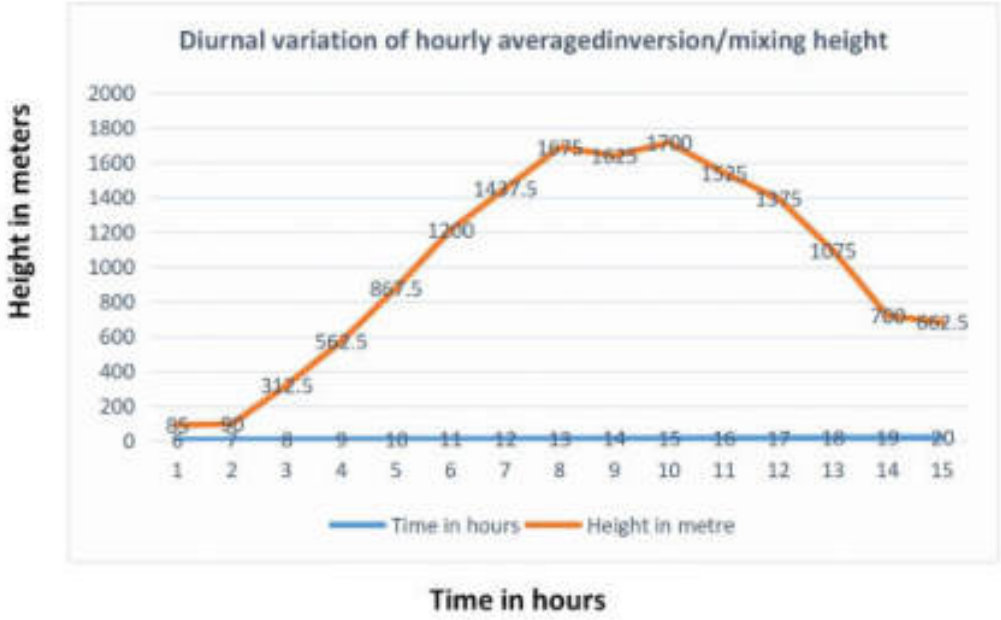






3.3.3 Inversion and mixing height

The hourly variation of inversion against monthly average mixing height data at plant site has been assessed as below:



3.4 MICRO-METEOROLOGY

The micro-meteorological data of the study area have been recorded continuously by Min Mec R&D Laboratory, New Delhi with an automatic weather station at the operating Rungta Mines Limited (Ferro Alloys Division) area from 1st March to 31st May 2022. The daily average of the monitored micro-meteorological data is given in **Annexure II** and summarized in **Table 3.3**. The various parameters are summarised in **Table 3.3**.

TABLE 3.3: SUMMARY OF MONITORED MICRO-METEOROLOGICAL DATA (MARCH TO MAY 2022)

Particulars	Maximum	Minimum	Average
Temperature (°C)	43.74	20.22	32.51
Relative humidity (%)	86.40	36.60	57.27
Wind speed (km/hr)	19.84	0.07	6.68
Predominant wind direction	NW (12.45% occurences excluding calm) SE (14.5% of occurrences including calm)		

Calm is <1.8 kmph

The above table shows that temperature was recorded as a minimum of 20.22°C and maximum of 43.74°C, relative humidity as a minimum of 36.60% and maximum of 86.40% during the monitoring period. The wind speed varies between 0.07 km/hr to 19.84 km/hr and the predominant wind

direction was observed from NW (12.45% occurences excluding calm) and SE with 14.5% of occurrences including calm. The wind frequency table is given in **Table 3.4** and the corresponding wind rose diagram is shown in **Fig 3.6**.

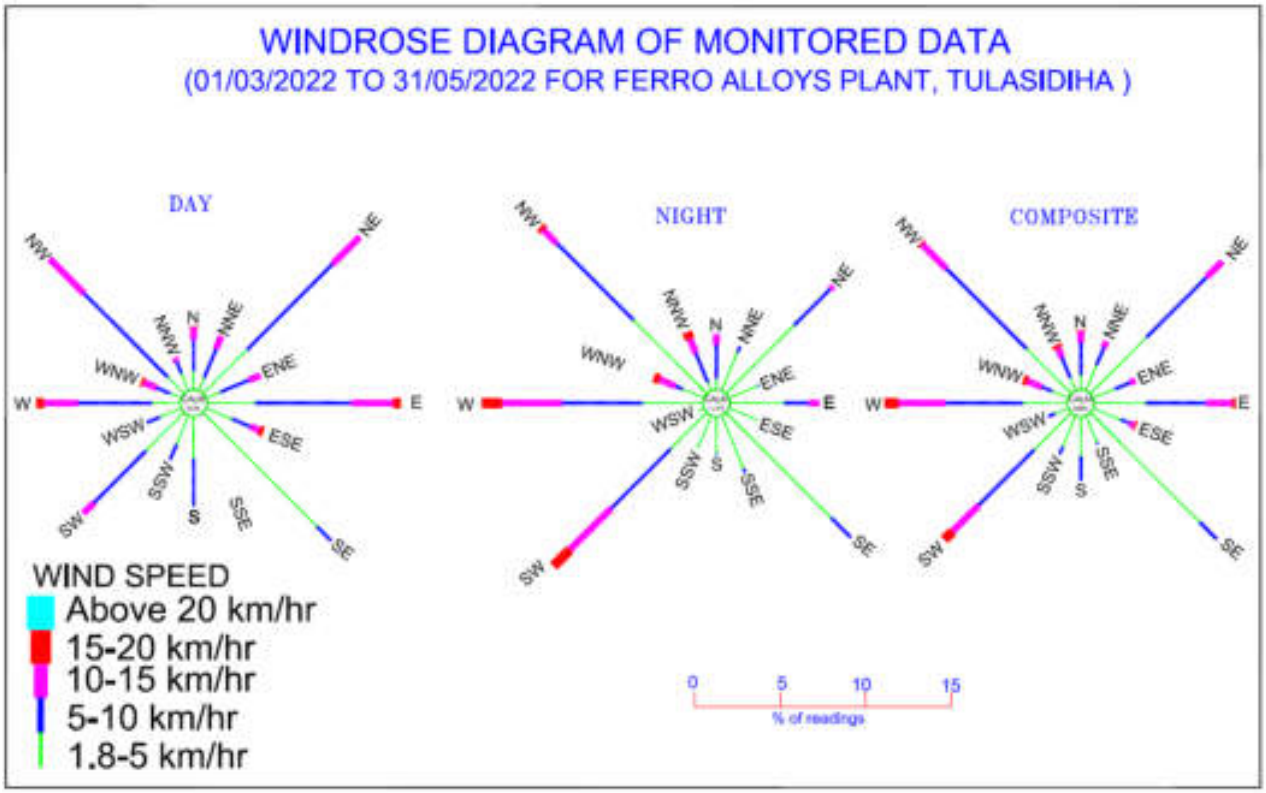
TABLE 3.4: WIND FREQUENCY TABLE OF MONITORED DATA (01/03/2022 TO 31/05/2022)

Direction from	% of readings in different ranges of wind speed (km/hr)							
	Calm	1.8 - 5	5 - 10	10-15	15-20	> 20	Total	Ex-Calm
	DAY TIME (6 HRS TO 17 HRS)							
E	0.27	2.81	5.62	2.45	0.45	0.00	11.6	11.33
ENE	0.18	0.91	1.81	0.72	0.00	0.00	3.62	3.44
NE	0.18	3.62	7.07	2.26	0.00	0.00	13.13	12.95
NNE	0.09	0.82	1.81	0.82	0.00	0.00	3.54	3.45
N	0.63	1.09	1.81	0.72	0.09	0.00	4.34	3.71
NNW	0.18	1.09	0.72	0.27	0.00	0.00	2.26	2.08
NW	0.18	1.36	6.88	2.90	0.00	0.00	11.32	11.14
WNW	0.36	0.72	0.82	0.82	0.18	0.00	2.9	2.54
W	0.27	1.63	4.35	1.99	0.45	0.00	8.69	8.42
WSW	0.27	1.36	0.82	0.00	0.00	0.00	2.45	2.18
SW	0.18	3.17	4.26	0.91	0.00	0.00	8.52	8.34
SSW	0.27	1.81	1.00	0.00	0.00	0.00	3.08	2.81
S	0.45	2.45	2.81	0.00	0.00	0.00	5.71	5.26
SSE	0.18	0.00	0.00	0.00	0.00	0.00	0.18	0.00
SE	4.26	9.42	1.18	0.00	0.00	0.00	14.86	10.60
ESE	0.18	1.63	1.18	0.54	0.27	0.00	3.8	3.62
TOTAL	**4.14**	**28.46**	**48.12**	**17.21**	**2.07**	**0.00**	**100**	**95.86**
	NIGHT TIME (18 HRS TO 5 HRS)							
E	0.63	3.17	1.45	0.63	0.00	0.00	5.88	5.25
ENE	0.36	1.81	0.09	0.00	0.00	0.00	2.26	1.90
NE	0.45	5.62	2.99	0.27	0.00	0.00	9.33	8.88
NNE	0.18	2.45	0.36	0.00	0.00	0.00	2.99	2.81
N	0.54	0.63	1.99	0.63	0.00	0.00	3.79	3.25
NNW	1.00	0.54	1.81	0.91	0.45	0.00	4.71	3.71
NW	0.54	6.07	6.34	1.09	0.27	0.00	14.31	13.77
WNW	0.27	1.36	0.45	1.00	0.36	0.00	3.44	3.17
W	0.18	3.53	4.71	3.53	1.18	0.00	13.13	12.95
WSW	0.09	0.36	0.00	0.00	0.00	0.00	0.45	0.36
SW	0.54	2.99	4.89	3.44	1.36	0.00	13.22	12.68
SSW	0.45	2.08	0.00	0.00	0.00	0.00	2.53	2.08
S	1.00	2.17	0.09	0.00	0.00	0.00	3.26	2.26
SSE	0.63	3.35	0.27	0.00	0.00	0.00	4.25	3.62
SE	3.80	8.70	1.63	0.00	0.00	0.00	14.13	10.33
ESE	0.45	1.81	0.00	0.00	0.00	0.00	2.26	1.81
TOTAL	**7.85**	**41.29**	**30.6**	**15.3**	**4.89**	**0.00**	**99.93**	**92.08**

Direction from	% of readings in different ranges of wind speed (km/hr)							
	Calm	1.8 - 5	5 - 10	10-15	15-20	> 20	Total	Ex-Calm
	COMPOSITE (DAY+ NIGHT)							
E	0.45	2.99	3.53	1.54	0.23	0.00	8.74	8.29
ENE	0.27	1.36	0.95	0.36	0.00	0.00	2.94	2.67
NE	0.32	4.62	5.03	1.27	0.00	0.00	11.24	10.92
NNE	0.14	1.63	1.09	0.41	0.00	0.00	3.27	3.13
N	0.59	0.86	1.90	0.68	0.05	0.00	4.08	3.49
NNW	0.59	0.82	1.27	0.59	0.23	0.00	3.50	2.91
NW	0.36	3.71	6.61	1.99	0.14	0.00	12.81	12.45
WNW	0.32	1.04	0.63	0.91	0.27	0.00	3.17	2.85
W	0.23	2.58	4.53	2.76	0.82	0.00	10.92	10.69
WSW	0.18	0.86	0.41	0.00	0.00	0.00	1.45	1.27
SW	0.36	3.08	4.57	2.17	0.68	0.00	10.86	10.50
SSW	0.36	1.95	0.50	0.00	0.00	0.00	2.81	2.45
S	0.72	2.31	1.45	0.00	0.00	0.00	4.48	3.76
SSE	0.41	1.68	0.14	0.00	0.00	0.00	2.23	1.82
SE	4.03	9.06	1.40	0.00	0.00	0.00	14.5	10.46
ESE	0.32	1.72	0.59	0.27	0.14	0.00	3.04	2.72
TOTAL	**6.03**	**34.88**	**39.36**	**16.26**	**3.51**	**0.00**	**100.04**	**94.01**

Note: Calm is cut off at wind speed <1.8 km/hr as per CPCB

FIG 3.6: WIND ROSE DIAGRAM OF MONITORED DATA



It is submitted that the south east direction in composite windrose was erroneously drawn short while submitting windrose diagram with monitoring

station map in TOR online application no. IA/OR/IND1/403580/2022. The error has been rectified in the EIA. After the receipt of Terms of Reference vide letter no. J-11011/515/2022-IA-II(IND-I) dated 01.12.2022, additional monitoring has been carried out related to collection of data for solar radiation and cloud cover. The monitoring data has been given in **Annexure II**. Hourly average solar radiation was found using a pyranometer attachment to the automatic weather station which gave the daily average of the global solar irradiance of 6620.47 W/m^2 for daylight hours. Hourly cloud cover observed ranged between 0 to 5 octas.

3.5 AMBIENT AIR QUALITY

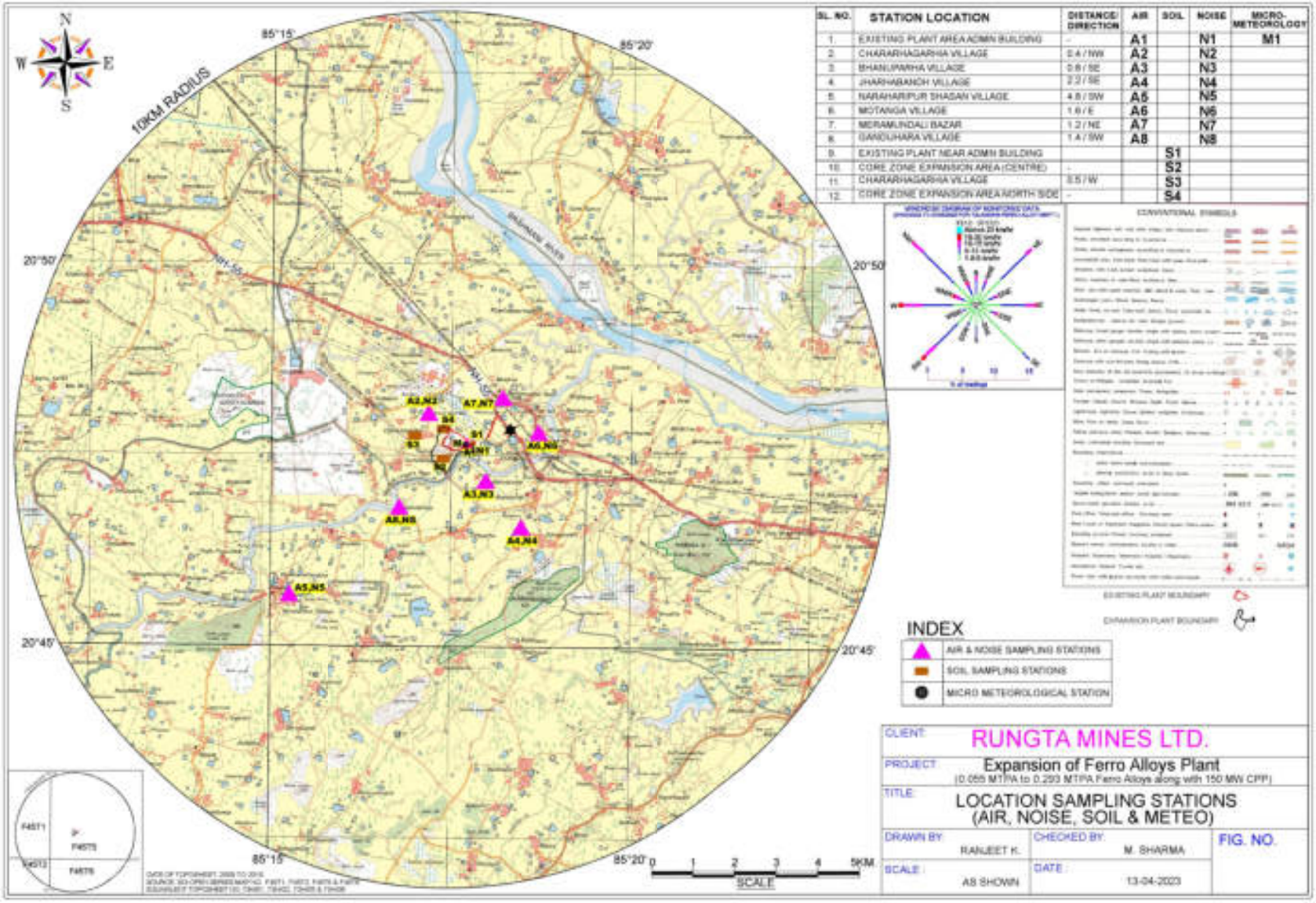
3.5.1 Location of sampling stations

Ambient air quality monitoring was undertaken at 8 different stations during the summer season 2022 in the core and buffer zone to study the present ambient air quality. The sampling station locations are given in **Table 3.5** and the same are marked in **Fig 3.7**.

TABLE 3.5: LOCATION OF AIR SAMPLING STATIONS

Station No. (Refer Fig 3.7)	Name of Location	Distance & direction from plant boundary	Justification for location with respect to plant area
1	Existing Plant area (Admin Building)	Within	Plant site where industrial activities will take place
2	Chararhagarhia village	0.4 km, NW	First predominant upwind direction, fifth predominant downwind direction & nearby village
3	Bhanuparha village	0.8 km, SE	One station in first predominant downwind direction w.r.t. plant and nearest downwind village
4	Jharhabandh village	2.2 km, SE	Second station in first predominant downwind direction w.r.t. plant
5	Naraharipur Shasan village	4.8 km, SW	Second station in second predominant downwind direction w.r.t. plant
6	Motanga village	1.6 km, E	Third predominant downwind direction w.r.t. Plant area
7	Meramundali Bazar	1.2 km, NE	Second predominant upwind direction, fourth predominant downwind direction, major human activity hub
8	Gandijhara village	1.4 km, SW	Second station in second predominant downwind direction w.r.t. plant

FIG 3.7: LOCATIONS OF SAMPLING STATIONS- AIR, NOISE, SOIL & METEO



SL. NO.	STATION LOCATION	DISTANCE/ DIRECTION	AIR	SOIL	NOISE	MICRO-METEOROLOGY
1.	EXISTING PLANT AREA ADMIN BUILDING	-	A1		N1	M1
2.	CHARARHAGARHA VILLAGE	0.4 / NW	A2		N2	
3.	BHANUPARHA VILLAGE	0.8 / SE	A3		N3	
4.	JHARHABANDH VILLAGE	2.2 / SE	A4		N4	
5.	NARAHARIPUR SHASAN VILLAGE	4.8 / SW	A5		N5	
6.	MOTANGA VILLAGE	1.6 / E	A6		N6	
7.	MERAMUNDALI BAZAR	1.2 / NE	A7		N7	
8.	GANDUHARA VILLAGE	1.4 / SW	A8		N8	
9.	EXISTING PLANT NEAR ADMIN BUILDING			S1		
10.	CORE ZONE EXPANSION AREA (CENTRE)	-		S2		
11.	CHARARHAGARHA VILLAGE	0.5 / W		S3		
12.	CORE ZONE EXPANSION AREA NORTH SIDE	-		S4		

3.5.2 Sampling schedule and parameters

The study was undertaken for 3 months with frequency of twice a week at each site. 24-hour average samples were collected from each station for Respirable particulate matter (RPM or PM_{10}), Fine particulate matter ($PM_{2.5}$), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Carbon monoxide (CO) B(a)P, Ammonia and Benzene was measured. Nickel, Arsenic and Lead were monitored once in 15 days at all locations during the monitoring period. These samples were analysed in laboratory by adopting the methods specified in National Ambient Air Quality Standard.

3.5.3 Methodology

Respirable Particulate Matter (PM_{10})

The sampling of ambient air was performed with respirable dust sampler, which is primarily a high volume sampler fitted with a cyclone separator for pre-separation of particles larger than 10 microns diameter. Air exiting from the separator is drawn at a measured rate through the separator followed by a pre-weighed glass fibre sheet of 20 x 25 cm sizes (Whatman, EPM-2000 or equivalent). The PM_{10} concentrations are determined gravimetrically from the average airflow rate, sampling period and the mass of particulate matter collected over the GF filter surface.

Fine Particulate Matter ($PM_{2.5}$)

The sampling of ambient air was performed with fine particulate sampler for particles less than 2.5 microns diameter.

The PM concentrations are determined gravimetrically from the average airflow rate, sampling period and the mass of particulate matter collected over the PTFE filter surface.

Sulphur Dioxide

The sampling of ambient air for evaluating SO_2 concentrations was performed with a multigas sampler, using the vacuum created by the respirable dust sampler for drawing the air samples through the impingers. Air is drawn at a measured and controlled rate of 300 ml/min through a solution of sodium tetra-chloromercurate.

After completion of the sampling, the used absorbing reagent is treated with dilute solutions of sulfamic acid, formaldehyde and para rosaniline hydrochloride. The absorbance of the intensely coloured para rosaniline methyl sulphonic acid is measured and the amount of SO_2 in the sample is computed from graphs prepared with standard solutions.

The ambient SO_2 concentrations were computed from the amount of SO_2 collected and the volume of air sampled.

Nitrogen dioxide

The sampling of ambient air for evaluating NO_2 concentrations was performed with a multigas sampler, using the vacuum created by the respirable dust sampler for drawing the air samples through the impingers. Air is drawn at a measured and controlled rate of about 300 ml/minute through an orifice-tipped impinger containing solutions of sodium hydroxide and sodium arsenite. After completion of the sampling, an aliquot of the used absorbing solution was treated with solutions of H_2O_2, sulphanilamide and NEDA.

The nitrite ion present in the impinger was calculated from the absorbance of the resulting solution and from the graphs prepared with standard solutions. The ambient NO_2 concentrations were computed from the total nitrite ion present in the impingers, overall efficiency of the impinger and the procedure, and the volume of air sampled.

Carbon monoxide

The method of determining carbon monoxide is by portable CO detector Model no. gaZguard Tx of Pollution Protection Systems which works on the principle of electrochemical detection of pollutant at any instant.

Benzene

The sampling of ambient air for evaluating benzene concentrations is performed by VOC Analyser by opening a tube at two ends, connecting it to a sample pump, and pulling air through the tube with the pump. Airborne chemicals are trapped onto the surface of the sorbent with sampling flow rate in the range of 20-100 ml/min. The tube is then sealed with push-on caps. The sample is re-extracted or desorbed by conventional solvent (generally 1-5 ml of carbon disulphide) using ultra sonication for 15 min to remove analyte from the sorbent material. Desorbed samples are analyzed using gas chromatograph (GC) fitted with capillary column and flame ionization detector (FID).

NH_3

The sampling of ambient air for evaluating NH_3 concentrations was performed by placing 10 ml of absorbing solution of 0.1 N H_2SO_4 in an impinger and sample for one hour at the flow rate of 1 to 2 L/min. After sampling, the volume of sample is measured and transferred to a sample storage bottle. The contents of the sample bottle are transferred to a 25 ml glass stopper graduated cylinder. All the solutions and sample are maintained at 25° C. 2 ml buffer and 5 ml working phenol solution is added, mixed, and filled to about 22 ml. 2.5 ml of working hypochlorite solution is added and rapidly mixed. It is then diluted to 25 ml, mixed and stored in the dark for 30 minutes to develop colour. The absorbance of the solution is measured at 630 nm on a spectrophotometer using 1 cm cells. The concentration of NH_3 in $\mu g/m^3$ is calculated from standard graph.

Benzo (a) pyrene

The sampling of ambient air is carried out using respirable dust sampler using EPM- 2000 glass fibre or equivalent filter. Filter paper is divided in two equal parts. Half portion of filter paper is used for the measurement of B(a)P. For extracting the sample, the collected filter papers are cut into strips using scissors and transferred to 250 ml beaker. These samples are extracted with about 50ml of toluene using ultra sonic bath for about 30 minutes. The procedure is repeated twice (50ml x 2 times) for complete extraction. The extracts are filtered into evaporative flask of 250 ml with the help of Whatman filter paper No. 20 or filter-disc. The extraction process is repeated twice and extractants combined. The toluene extract is evaporated using rotary evaporator with water bath as cool as possible (temperature not exceeding 40°C) taking care that it is not evaporated upto total dryness. It should be stopped at near dryness (less than 1 ml, visible). Then 2.0 ml of toluene is added to rinse the wall of evaporation flask and extract transferred into a beaker of 5 ml capacity. The extracted residue is diluted and made up to 0.5 ml or 1 ml. 1µl or 2 µl is injected into GC-FID for analysis. The resulting concentration is recorded.

Heavy metals (nickel, lead, arsenic)

The sampling of ambient air for evaluating lead, nickel and arsenic is done by collect the particulate matter on glass fibre filter (EPM 2000 or equivalent) using PM 10 sampler. Filter paper is divided in two equal parts. Half portion of filter paper is used for the measurement of lead, nickel and arsenic. The sample is extracted by hot plate procedure and the digested sample is analysed using ICP. The concentration is calculated using calibration graph.

A summary of the methodology is given in **Table 3.6.**

TABLE 3.6: SUMMARY OF PROCEDURES FOR DETERMINING VARIOUS AIR QUALITY PARAMETERS

Parameters	Testing Procedure
PM_{10}	IS:5182 (Part 23) using respirable dust sampler (RDS), gravimeteric analysis
$PM_{2.5}$	Adapted from CPCB guidelines using fine particulate sampler, gravimeteric analysis
SO_2	Absorption in sodium tetra chloro-mercurate followed by colorimetric estimation using P-rosaniline hydrochloride and formaldehyde (IS : 5182 Part. II. 1969)
NO_2	Absorption in dil. NaOH and then estimated through spectrophotometer with sulphanilamide and N(I-Nepthyle) Ethylene diamine Dihydrochloride and Hydrogen Peroxide (IS:5182 1975, Part VI)
CO	Electrochemical detection by portable CO detector

Parameters	Testing Procedure
Benzene	Collection by organic vapour sampler followed by solvent extraction and GC analysis (IS:5182 (Part 11))
NH_3	CPCB Guidelines- Absorption in 0.1 N H_2SO_4 followed by reaction with phenol and hypochlorite solution for colour development and spectrophotometric concentration determination
BaP	Collection on filter paper using respirable dust sampler followed by solvent extraction and GC analysis (IS:5182 (Part 12))
Arsenic, Nickel, Lead	Collection on filter paper using respirable dust sampler followed by digestion and ICP analysis (IS 3025 (Part 2))

3.5.4 Results

Analysis results with respect to $PM_{2.5,}$ $PM_{10,}$ SO_2 and NO_2 are presented in **Annexure III** and summarized in **Table 3.7**. The National Ambient Air Quality Standards dated 18th November 2009, give the limits for Industrial as well as Residential & Rural area is attached in **Annexure IV**.

TABLE 3.7: SUMMARY OF AMBIENT AIR QUALITY MONITORING RESULTS 24 HOURLY AVERAGE CONCENTRATION IN µg/m³

		24 hourly average concentration in µg/m³ except CO in mg/m³								
Pollutant		Existing Plant area (Admin building)	Bhanup-arha village	Gandijhara village	Chararhag arhia village	Jharha-bandh village	Narahari-pur Shasan village	Meram-undali Bazar	Motanga village	Permissible Limits, NAAQS 2009
PM10	Min.	60.4	50.2	55.2	48.2	45.1	38.2	53.3	48.3	100
	Max	67.9	62.0	64.0	60.2	62.7	54.8	62.0	60.0	
	Avg	64.3	56.6	58.9	53.8	54.2	46.1	57.9	53.4	
	98th %tile	67.9	61.9	63.7	59.1	62.5	53.7	61.8	59.5	
PM2.5	Min.	33.3	27.5	29.7	26.7	25.0	22.8	28.7	26.3	60
	Max	41.6	37.2	37.6	32.9	37.2	32.2	36.3	35.1	
	Avg	36.2	31.8	33.3	30.2	30.8	27.0	32.7	30.6	
	98th %tile	40.5	36.6	37.4	32.7	36.2	32.0	35.7	35.1	
SO_2	Min.	9.2	BDL	8.3	7.4	6.9	BDL	9.7	6.4	80
	Max	16.2	12.3	14.0	13.5	12.6	8.5	15.5	14.4	
	Avg	12.6	8.2	11.4	10.4	9.6	7.0	12.5	10.7	
	98th %tile	16.0	12.2	13.8	13.4	12.5	8.4	15.5	14.3	
NO_2	Min.	14.3	10.6	8.4	9.1	8.6	7.6	15.6	9.4	80
	Max	20.2	18.4	15.7	15.3	13.0	10.3	22.1	18.3	
	Avg	17.0	14.9	13.3	13.0	11.7	9.1	19.0	14.7	
	98th %tile	19.9	18.4	15.7	15.1	12.9	10.3	21.7	18.2	
CO	Min.	0.344	0.115	0.344	0.229	0.229	0.115	0.344	0.229	2 (8 hourly)
	Max	0.802	0.458	0.573	0.687	0.573	0.344	0.802	0.687	
	Avg	0.612	0.287	0.455	0.486	0.407	0.229	0.571	0.477	
	98th %tile	0.799	0.445	0.571	0.687	0.573	0.344	0.802	0.664	

Note: ***BDL: Below Detection Limit of SO_2<6.0; NH_3<1.0; Pb<0.07 µg/m³; As<0.6 ng/m³; Ni<0.6 ng/m³***

Source: ***Test report no. MMA/06-22/15 & MMA/06-22/16 dated 06.06.2022 by Min Mec R&D Laboratory.***

Twenty four hour average PM_{10} level was found to range from 38.2 to 67.9 µg/m^3, $PM_{2.5}$ was found to vary from 22.8 to 41.6 µg/m^3, SO_2 from BDL to 16.2 µg/m^3 and NO_2 from 7.6 to 22.1 µg/m^3. All the values are on the lower side at all the locations. The concentrations of SO_2 and NO_2 are considerably low compared to the 80 µg/m^3 NAAQS permissible limit for residential, rural and other areas. The concentrations of PM_{10} & $PM_{2.5}$ are also within limits of 100 & 60 µg/m^3 respectively, as per National Ambient Air Quality Standard 2009.

The CO level was observed between 0.115 to 0.802 mg/m^3 while the limits are 2 mg/m^3.

NH_3 level was observed BDL (<20 µg/m^3) in all the locations. The permissible limits for NH_3 are prescribed as 400 µg/m^3.

BaP and C_6H_6 level were not detected in any locations in the study area.

Pb, As and Ni were also observed below detectable limits of 0.07µg/m^3, 0.4 ng/m^3, and 0.6 ng/m^3, respectively, which are much below the permissible limits of 1 µg/m^3, 6 ng/m^3 and 20 ng/m^3, respectively.

3.6 WATER ENVIRONMENT

3.6.1 Surface water resources

The river Brahmani controls the drainage of the district and it's tributaries. Brahmani is the second longest river in Odisha and flows through the district in a general east-west direction. It divides the district into two halves. Initially, the river flows in a north-south direction, then follows a northwest-southeast course and subsequently changes to northeast-southwest direction. Finally, it changes to a northwest-southeast course near the eastern border of the district. Most part of the district falls within it's basin.

The Brahmani is perennial in nature with a nominal flow during the summer season. It's important tributaries are Ramiala Nadi, Nigre Nadi, Purajhor Nadi etc. The smaller streams show dendritic pattern while the major river and it's tributaries show sub-parallel drainage, indicating structural control.
(Source: Ground water information booklet of Dhenkanal district, CGWB, South Eastern Region, Bhubaneswar, May, 2013.)

In the buffer zone, there are several water bodies created due to the man made embankments and canals. The nearest such water body (Rangali Right Main Canal) at 0.01 km along the south west side of the project boundary of proposed expansion plant area. Other tanks and reservoirs are clearly visible in **Fig 3.2** and are present in almost all villages. Some of the reservoirs have water distribution networks such as canals and aqueducts. Section 3.2.2 has discussed the surface water bodies of the study area in detail.

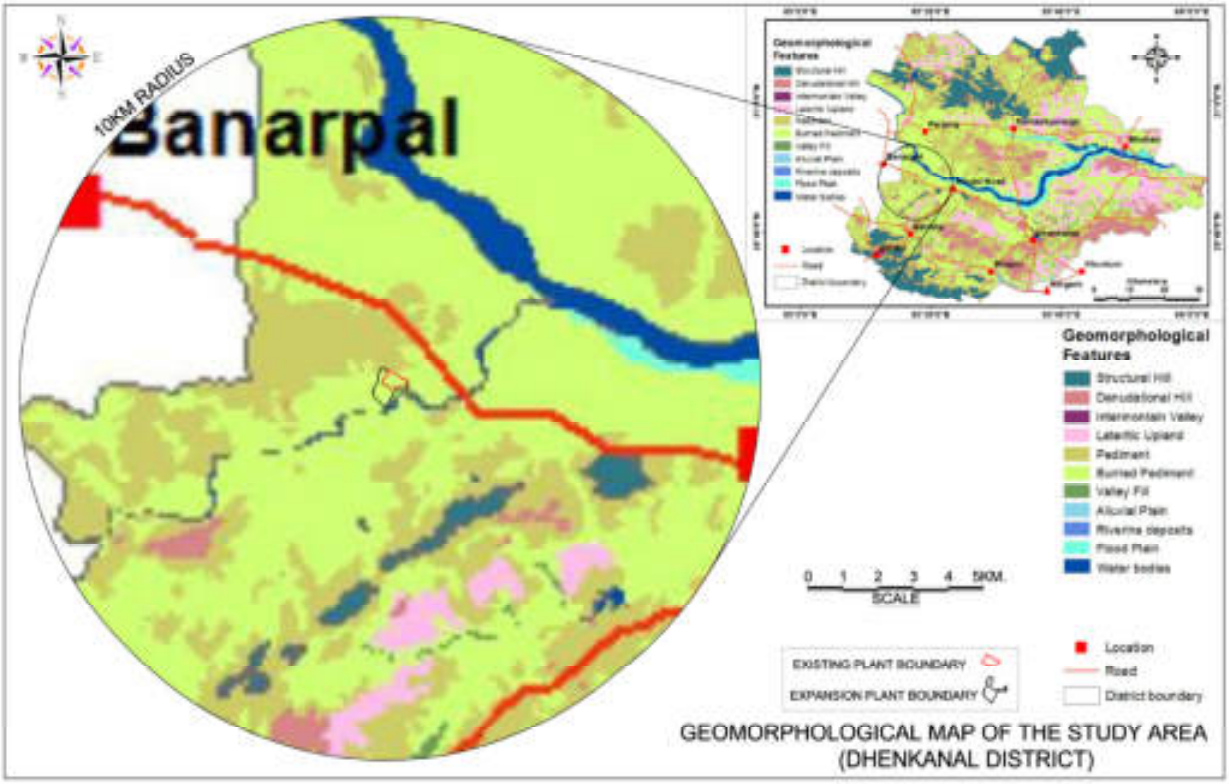
3.6.2 Ground water resources

3.6.2.1 Geology

The information from this section is sourced from "Aquifer Mapping and Management of Ground Water Resources, Dhenkanal District, Odisha" by Central Ground Water Board, South Eastern Region, Bhubaneswar, May 2022.

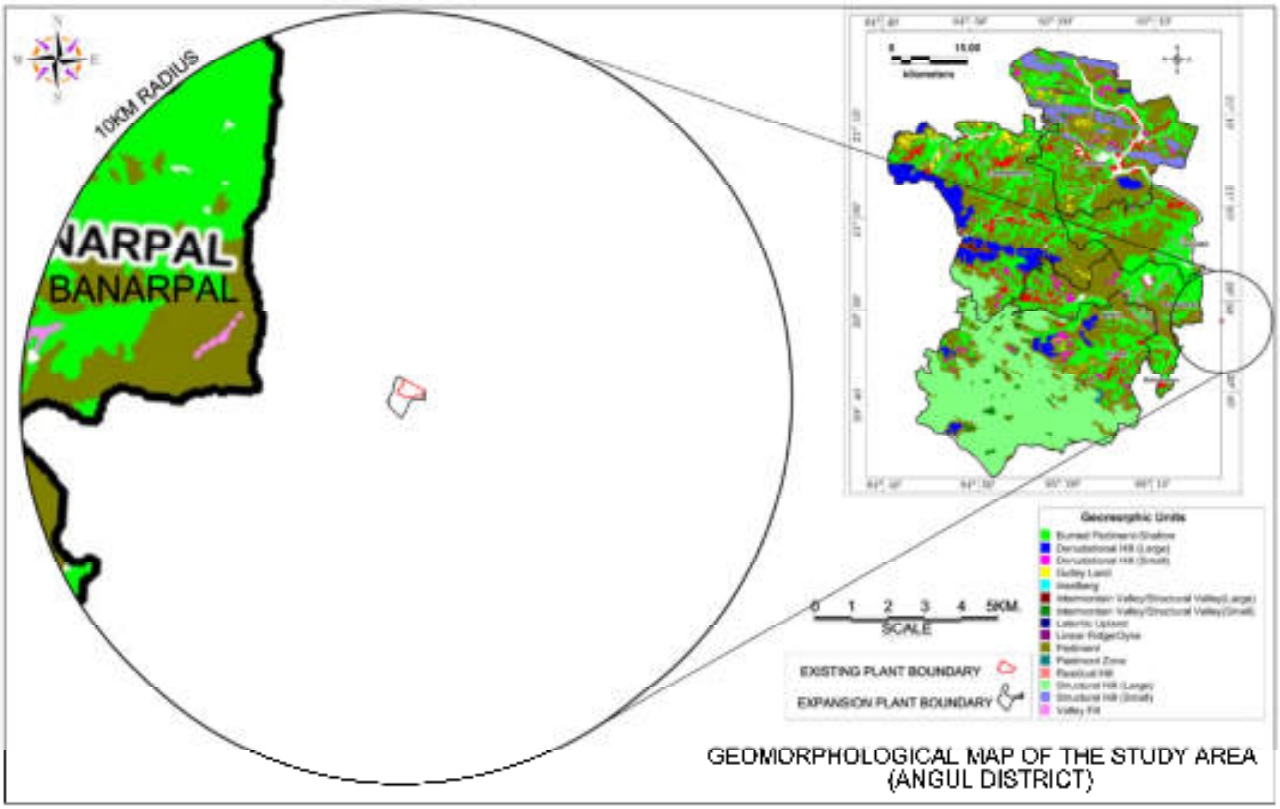
The district can be broadly divided into four natural physiographic units- Southern Mountainous Region, Eastern Valley and Plain, Central Undulating Plain and Northern Mountainous Region. The district is characterized by rugged forest cladded mountainous terrain with narrow intermontane valleys. The details of the geomorphology identified in the study area of the Ferro Alloys Plant can be seen in **Fig 3.8**.

FIG 3.8: GEOMORPHOLOGY OF STUDY AREA (DHENKANAL DISTRICT)



Source: ***Fig 1.5 of "Aquifer Mapping and Management of Ground Water Resources, Dhenkanal District, Odisha" by CGWA, Bhubaneswar, May 2022.***

FIG 3.9: GEOMORPHOLOGY OF STUDY AREA (ANGUL DISTRICT)



Source: ***Fig 3.2 of "National Aquifer Mapping and Management of Plan, parts of Angul District, Odisha" by CGWA, Bhubaneswar, July 2016***

It can be seen in **Fig 3.10** that the project area lies over buried pediment, which is also a dominant geomorphological feature of the 10 km radius. In addition, 10 km radius has pediments,structural hills (in south west), lateritic upland (in south west), water body & flood plain under Brahmani River and occassional denudational hill in south and south west of the project.

The major parts of the district are underlain by Archean crystalline of the Eastern ghat group, Precambrian metasedimentaries, Gondwana sedimentaries and recent alluvium. The Archean occurring in the major parts of the district include granite, granite gneisses and khondalites. The Precambrian occur in small patches as phyllites and micaschist. The Gondwana occupy the northwestern parts of the district and comprise a sequence of sandstone, shale and carbonaceous shale. The recent alluvium occurs in limited patches along the river courses. The generalized stratigraphic sequence is given in **Table 3.8** and the geological map of the study area is shown in **Fig 3.11**.

TABLE 3.8: GENERALIZED STRATIGRAPHIC SEQUENCE IN DHENKANAL DISTRICT

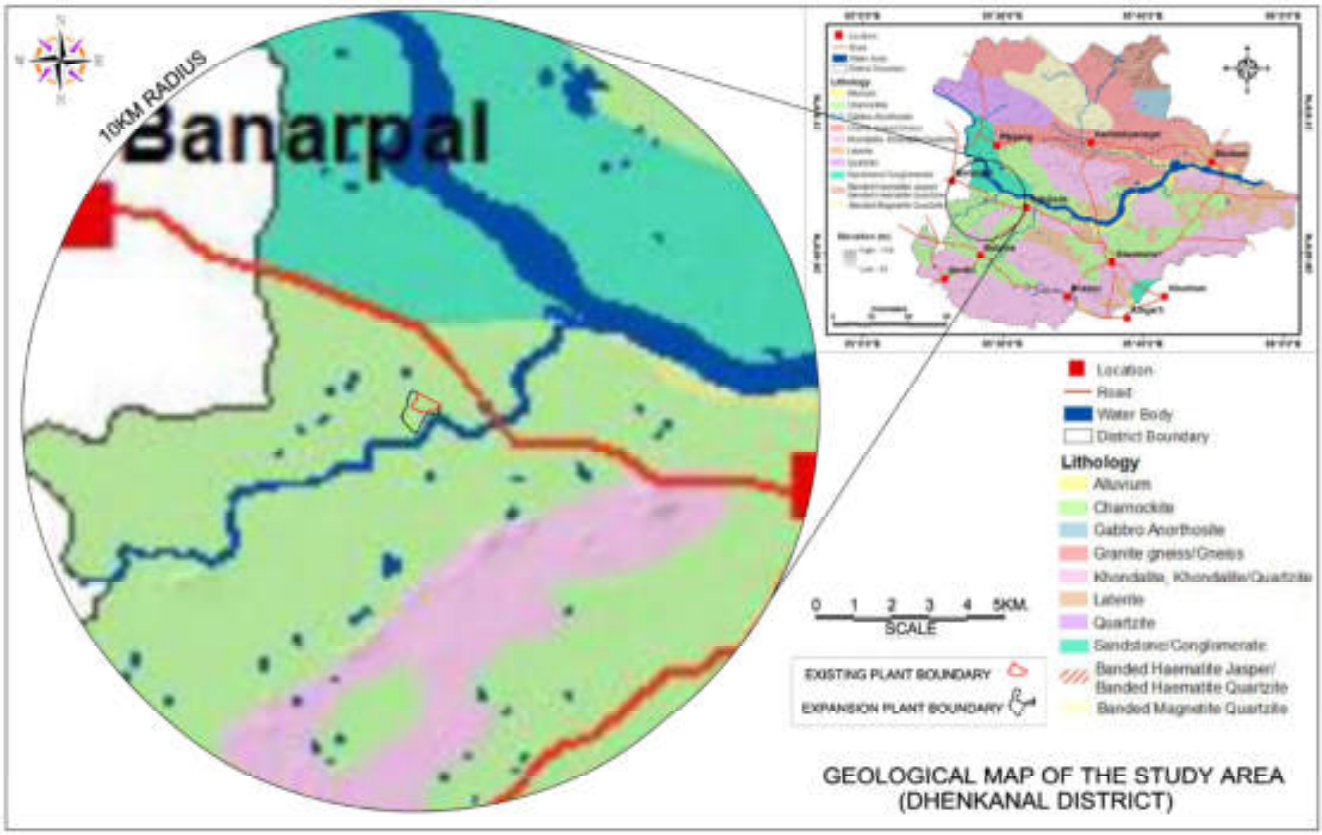
Era	Group/ Super Group	Lithology
Quaternary Recent to sub-recent		Alluvium Sand, silt and clay in varying proportions

Era	Group/ Super Group	Lithology
		Laterites and lateritic gravels
------	**Unconformity**	-------
Upper Paleozoic to Mesozoic		Sandstone, shale, carbonaceous shale
------	**Unconformity**	------
Precambrian	Precambrian	Phyllite, Mica schist
Archean		Granite, granite gneisses, Khondalite

Source: Table 2.1 of "Aquifer Mapping and Management of Ground Water Resources, Dhenkanal District, Odisha" by CGWA, Bhubaneswar, May 2022.

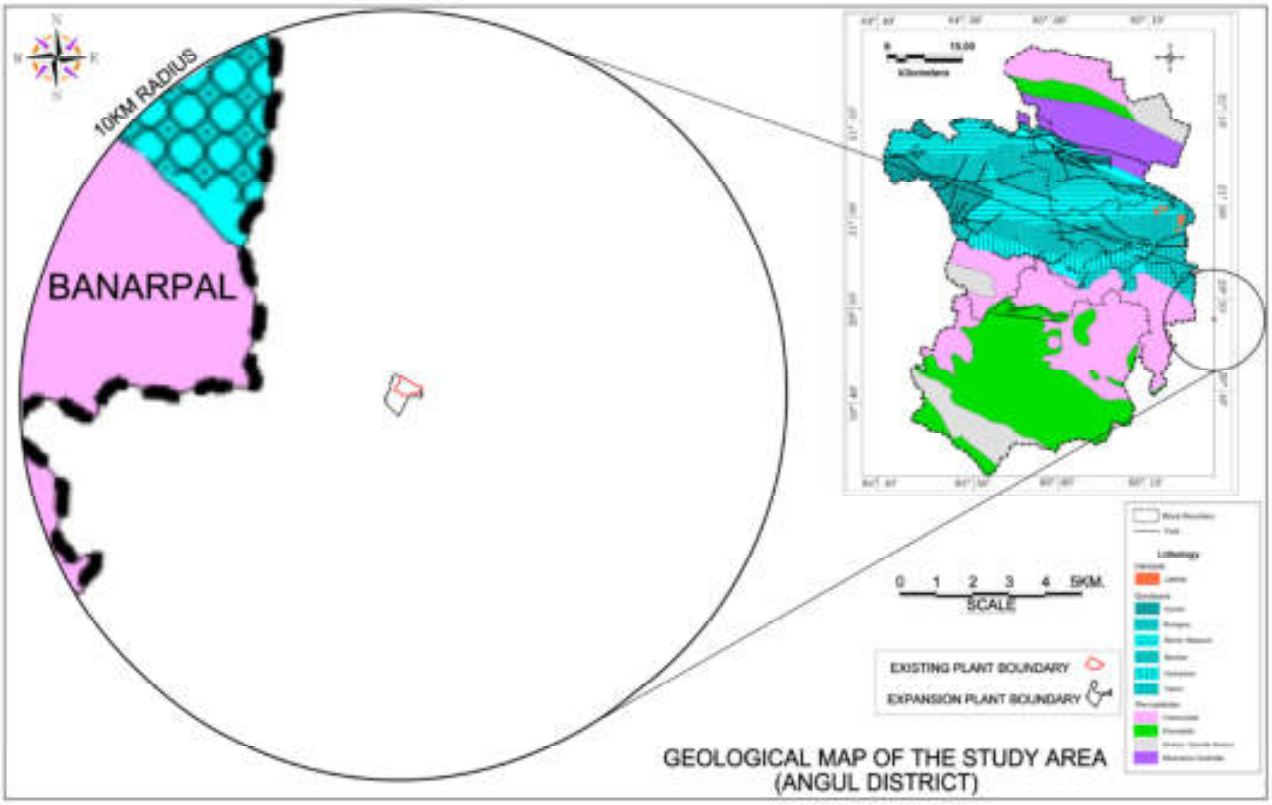
The details of the geology identified in the study area of the Ferro Alloys Plant can be seen in **Fig 3.10**.

FIG 3.10: GEOLOGY OF STUDY AREA (DHENKANAL DISTRICT)



Source: Fig 2.1 of "Aquifer Mapping and Management of Ground Water Resources, Dhenkanal District, Odisha" by CGWA, Bhubaneswar, May 2022

FIG 3.11: GEOLOGY OF STUDY AREA (ANGUL DISTRICT)



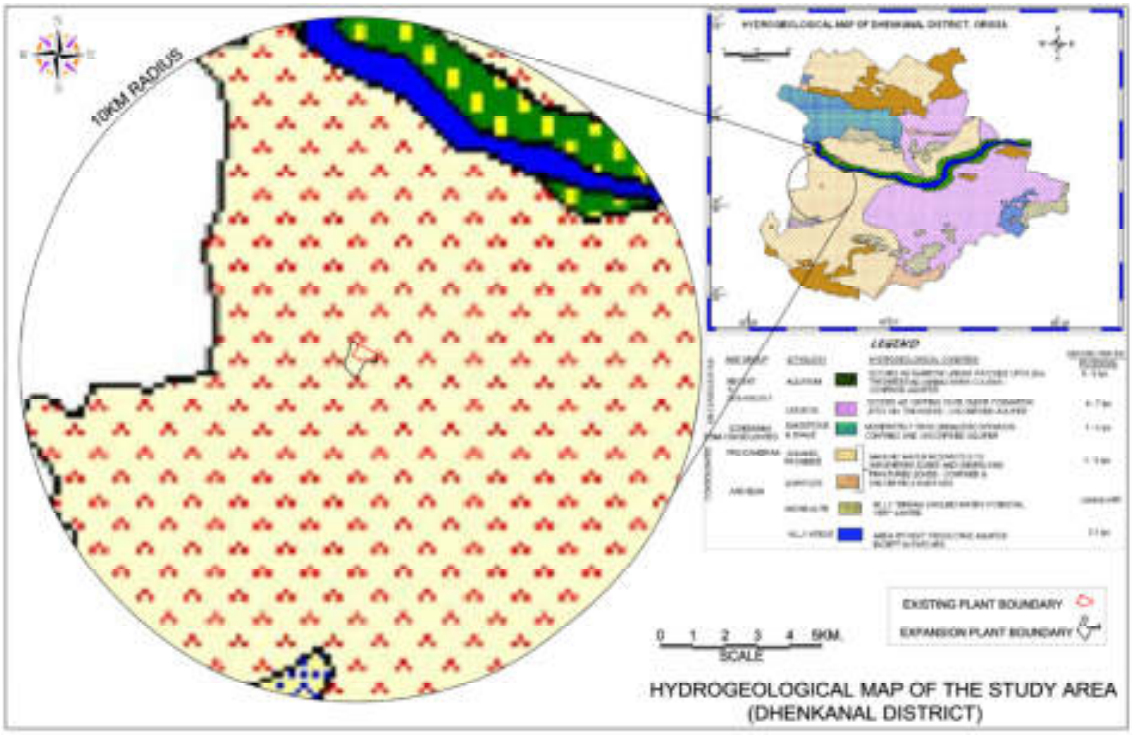
Source: Fig 4.1 of "National Aquifer Mapping and Management of Plan, parts of Angul District, Odisha" by CGWA, Bhubaneswar, July 2016

It can be seen that the rock below the plant area comprises of Charnockite. In the study area, the central and south eastern portion comprises of Charnockite and in north side sandstone/ conglomerate are present. Khondalite/ Quartzite are present in the southern side.

3.6.2.2 Hydrogeology

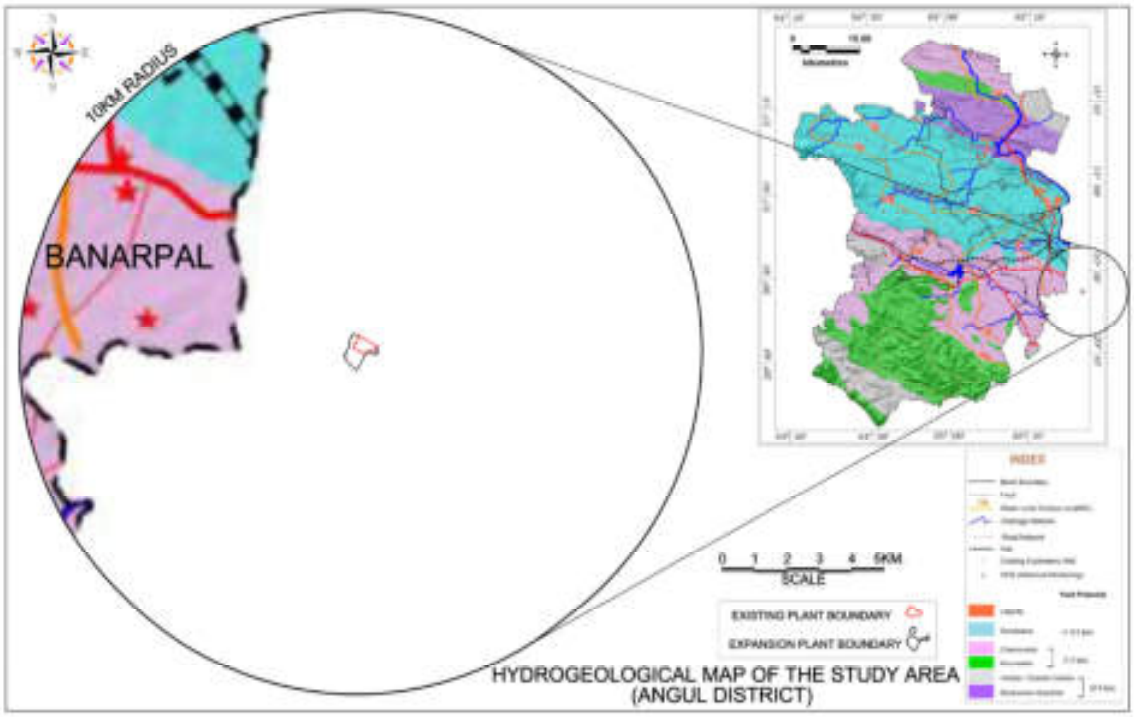
The information from this section is sourced from Ground water information booklet of Dhenkanal District, CGWB, South Eastern Region, Bhubaneswar, May, 2013. The major part of the district is underlain by hard crystalline rocks and is devoid of any primary porosity and hence when weathered and fractured, secondary porosity is developed. The semi-consolidated Gondwana sandstone forms moderately good aquifer, when weathered and fractured. The recent alluvium, which occurs in limited patches, sustains very good yield. Since major part of the district is underlain by hard rocks of diverse lithological compositions and structures, the water-bearing properties of the formations vary widely. The hydro-geological map of Dhenkenal district is given in **Fig 3.12**.

FIG 3.12: HYDROGEOLOGICAL MAP OF DHENKANAL DISTRICT



Source: Ground water information booklet of Dhenkanal District, CGWB, South Eastern Region, Bhubaneswar, May, 2013

FIG 3.13: HYDROGEOLOGICAL MAP OF ANGUL DISTRICT



Source: Fig 4.2 of "National Aquifer Mapping and Management of Plan, parts of Angul District, Odisha" by CGWA, Bhubaneswar, July 2016

It can be seen from the figure that the project area as well as majority of the study area is comprising precambrian gneiss or precambrian granitic gneiss. Here ground water is restricted to weathered zones and underlying

fractured zones -confined and unconfined aquifers. It has a ground water potential of 1-5 lps. The area adjoining the Brahmani river in the north side is recent to sub-recent alluvium. It occurs as narrow linear patches upto 25 m thickness adjoining river course with confined aquifers. It has a ground water potential of 5-6 lps.

As per the Ground water information booklet of Dhenkanal District, the pre-monsoon, 2011 water level data varies 3.34 to 10.99 meter below ground level.The post monsoon, 2011 water level data varies 1.08 to 8.0 meter below ground level. The net annual replenishable ground water resources in the district has been computed as 44264 Ha m, out of which the Ground Water Draft for irrigation is 2745 Ha m. The stage of ground water development varies from 13.55% to 39.55% in different blocks. The overall stage of ground water development of the district is 16.82%. Hence, there is ample scope for stepping up ground water development in the district.

The ground water level observed at the monitoring station Motanga (latitude 20.8014, longitude 85.3119) during the season April- June 2020 is 3.34 m(bgl) situated at 1.7 km, NE from the project boundary and the ground water level observed at the monitoring station Motanga-II (latitude 20.7978, longitude 85.3139) during the season April - June 2020 is 1.170 m(bgl) situated at 1.75 km, NE from the project boundary. The season wise ground water trend for Groundwater monitoring stations Motanga & Motanga-II are below given in **Fig 3.14**.

FIG 3.14: SEASON WISE GROUND WATER TREND FOR MOTANGA

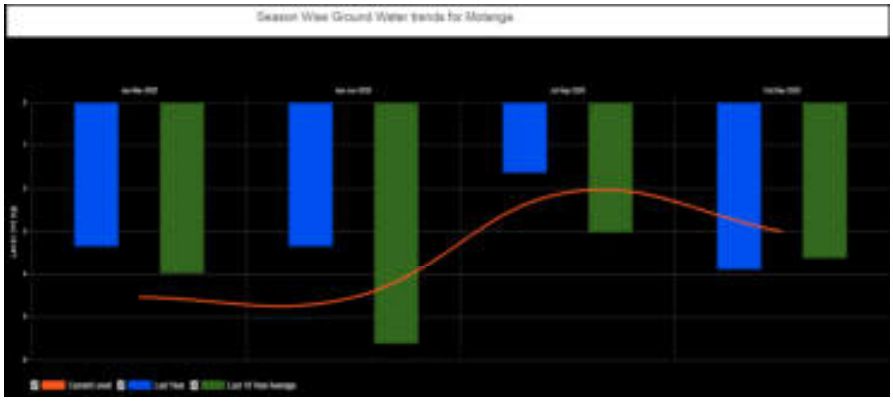
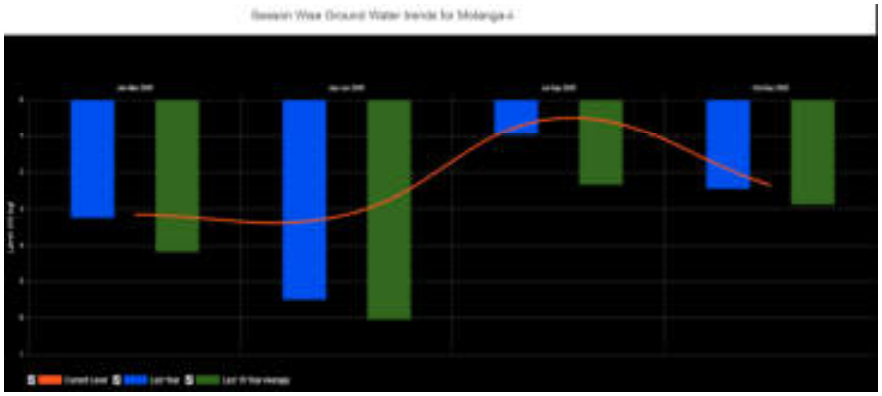


FIG 3.15: SEASON WISE GROUND WATER TREND FOR MOTANGA-II



Source: https://indiawris.gov.in/wris/#/groundWater accessed 24.04.20223

3.6.2.3 Annual ground water resource

The groundwater resource potential and the utilization for the study area has been worked out as per the methodology suggested by Groundwater Estimation Committee (GEC-2015) which has been briefly discussed in following paragraphs.

The monsoon rainfall (June-September) as per long term IMD Angul records from 1981-2010 works out as 974 mm. The annual rainfall is 1272.6 mm. The non monsoon rainfall works out to be 298.6 mm, which is 23.7% of the annual rainfall. As per the GEC report, the recharge from rainfall during the non-monsoon season may be estimated provided the normal rainfall in the non-monsoon season is greater than 10% of the normal annual rainfall. Hence, the recharge is being estimated for both monsoon & non- monsoon season i.e. using total annual rainfall. The entire study area is suitable for groundwater recharge. The recharge works out as under.

A. By rainfall infiltration method

Total study area (as per Census 2011)	-	374.54 sq.km
Area suitable for ground water recharge (as per Census 2011 all areas except Area under Non-Agricultural Uses)	-	296.72 sq.km
Annual average rainfall (IMD Angul 1981-2010, as per Climatological Normals	-	1272.6 mm
Rainfall infiltration index (avg.) as per GEC-2015 recommendation for highly Weathered Granite gneiss	-	11%
Annual groundwater recharge	**-**	**41.537 MCM**

B. By water table fluctuation method

Total study area (as per Census 2011)	-	374.54 Sq.km
Area suitable for ground water recharge (as per Census 2011)	-	296.72 Sq.km
Average seasonal change of water table of study area	-	4.4 m
Specific yield as per GEC-2015 recommendation for Weathered Weathered Granite gneiss	-	3.0%
Annual groundwater recharge	**-**	**39.167 MCM**

The difference between the two expressed as a percentage of the rainfall infiltration method is (-) 6.07%, thus, the rainfall recharge for normal monsoon is to be taken as equal to value estimated by the water table fluctuation method as per the recommendations on ground water resource

estimation methodology. Thus, **39.167** MCM per annum is the estimated annual ground water resource.

C. Return flow from surface irrigation

Total irrigated area (as per Census 2011)	-	2685.81 Ha
Surface water irrigated area (as per Census 2011)	-	2274.8 Ha
Applied water / Ha.	-	0.5 m/Ha
Total applied water	-	11.37 MCM
Return seepage, Average 30%	**-**	**3.411 MCM**

Thus, annual ground recharge

39.167 + 3.411= 42.578 MCM

D. Ground Water Use

There are three major consumer of ground water in the area (i) Domestic (ii) Irrigation (iii) Livestock. There are several industries and mines in the study area which will also have drinking water requirement. It is assumed that the industrial requirement shall be met through surface water sources. Hence, the drinking water of industries has been considered as a part of domestic subheading, since majority of the employees live locally.

D.1 Domestic

Total population as per Census 2011	-	170881
Decadal growth rate (Dhenkanal District)	-	11.8 %
Present population (2023) estimated on basis of decadal growth rate	-	195078
Population dependent on Ground water	-	110630
Per capita domestic need	-	70 LPD
Total annual ground water use	**-**	**2.827 MCM**

D.2 Irrigation

As per Census 2011, the total irrigated area is 2653.97 ha. The major part of irrigation is done by surface water (canal- 1935.02 ha, tanks/ lakes- 307.30 ha) and by others - 10.60 ha. Ground water is used for 401.06 ha.

Total area irrigated by ground water	-	2685.81 Ha
Gross irrigation need	-	0.5 m/ha/annum
Return seepage, average 30%	-	61.652 ha m= 0.61 MCM
Annual Net withdrawal	**-**	**1.439 MCM**

D.3 Livestock

The water consumption for livestock has been empirically considered as 5% of human consumption, which comes to 0.141 MCM.

D.4 Industries

It is being assumed that there are about 9 working Industries/mines present in 10 km radius using ground water, rest industries use surface/ harvested water @ 50 cum/day which comes out to 0.149 MCM.

D.5. Annual ground water use

2.827 + 0.141 + 1.439+ 0.149= 4.556 MCM

E. Ground water balance

Sl. No.	Particulars	Million Cubic Meter (MCM)
1.	Total annual replenishable recharge • By rainfall infiltration factor method (million m^3/year) • By groundwater table fluctuation method (million m^3/year)	 41.537 (to consider) 39.167
2.	Estimated annual ground water recharge including return seepage (million m^3/year)	42.578
3.	Estimate Annual draft (million m^3/year)	4.556
4.	Net annual ground water availability (million m^3/year)	38.022
5.	Stage of ground water development in %	10.7 %
6.	Category as per GEC	Safe

3.6.3 Water quality

To establish the base line status of water quality in the study area, physico-chemical characteristics of water samples from important surface water bodies and representative ground water sources were determined. Water quality sampling and analysis was undertaken during the monitoring season.

Location of Sampling Stations

The location of ground and surface water sample sources (**Fig 3.16**) is as given in **Table 3.9**.

TABLE 3.9: LOCATION OF WATER SAMPLING STATIONS

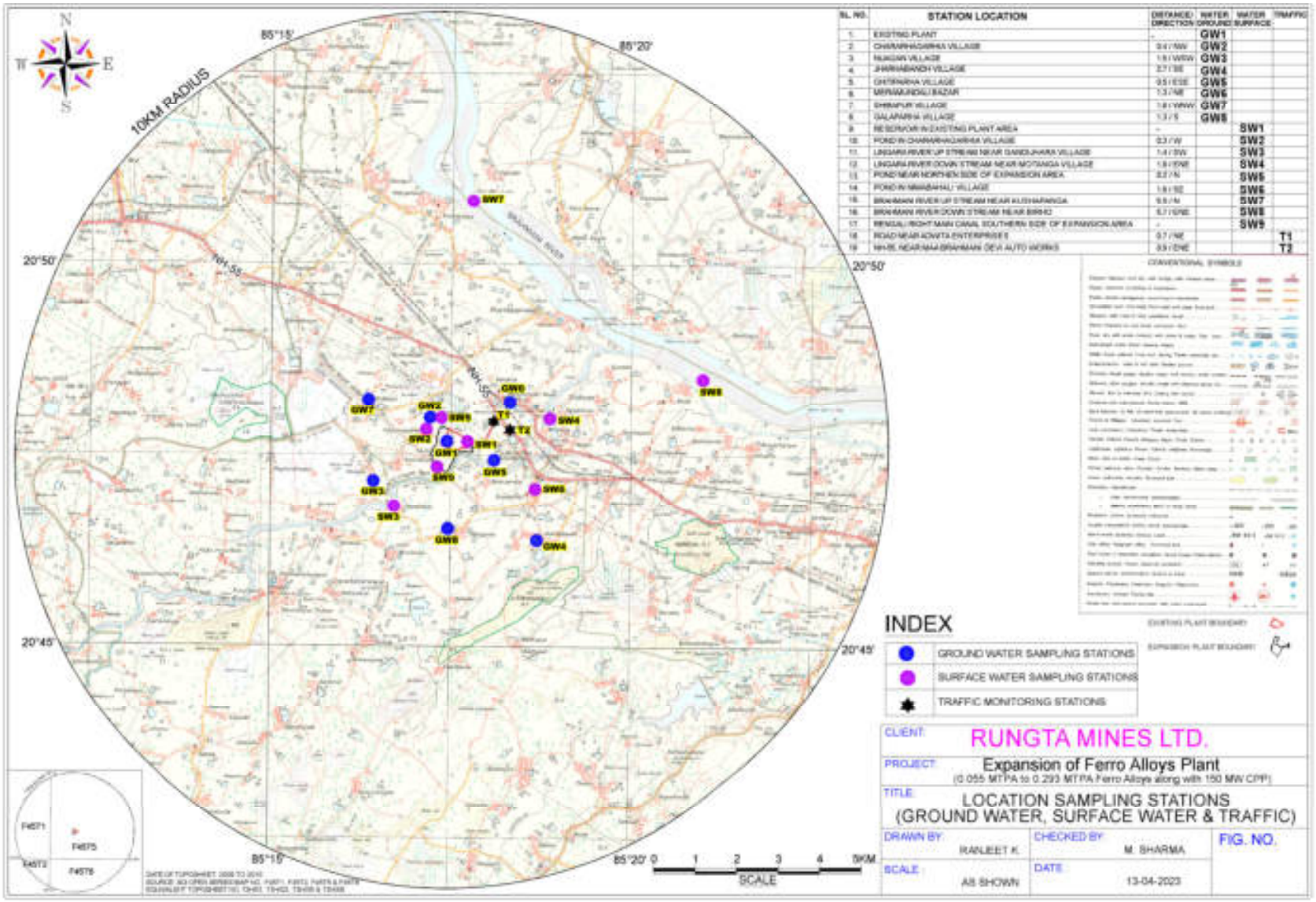
Station No. (Ref. Fig 3.16)	Source	Location	Distance and direction from Plant
I.		**Surface Water**	
SW1	Reservoir	Existing Plant area	Within
SW2	Pond	Chararhagarhia village	0.3, W
SW3	River	Lingara River up stream near Gandhijhara village	1.4/ SW
SW4	River	Lingara River down stream near Motanga village	1.9, ENE
SW5	Pond	Near northern side of expansion area	Adjoining
SW6	Pond	Pond in Nimabahali village	1.8 km, SE
SW7	River	Brahamani River up stream near Kushapanga village	5.5 km, N
SW8	River	Brahamani River down stream near Birho village	5.7 km, ENE
SW9	Canal	Rengali Right Main Canal southern side of expansion area	Adjoining. N
II.		**Ground Water**	
GW1.	Borewell	Existing Plant area	Within
GW2	Handpump	Chararhagarhia village	0.4 km, NW
GW3	Handpump	Nuagan village	1.5 km, WSW
GW4	Hand pump	Jharhabandh village	2.7 km, SE
GW5	Hand pump	Chitiparha village	0.5 km, ESE
GW6	Hand pump	Meramundali Bazar village	1.3 km, NE
GW7	Hand pump	Shibapur Village	1.8 km, WNW
GW8	Hand pump	Galaparha village	1.3, S

Methodology

Samples from surface and ground water sources were collected by adopting grab sampling method. The samples were collected in polyethylene sampling bottles. In case of surface water, sample was collected from a point 12" below the surface.

The physico-chemical quality of water samples were characterized by adopting the relevant parts of IS:3025 "Standard Methods for Water Analysis", APHA 23rd Edition and other standard methods for select parameters prescribed in IS 10500:2012, Schedule VI of Environment Protection Rules and the 'Water Quality Standards for Surface Water Sources' by CPCB. For analysis, the samples were brought to Min Mec R&D Laboratory, New Delhi, after proper preservation.

FIG 3.16: LOCATION OF SAMPLING STATION (WATER, SOIL AND TRAFFIC)



SL. NO.	STATION LOCATION	DISTANCE/ DIRECTION	WATER GROUND	WATER SURFACE	TRAFFIC
1.	EXISTING PLANT	-	GW1		
2	CHARARHAGARHA VILLAGE	0.4 / NW	GW2		
3	NUAGAN VILLAGE	1.6 / WNW	GW3		
4.	JHARKABANDH VILLAGE	2.7 / SE	GW4		
5.	GHITARARHA VILLAGE	0.5 / ESE	GW5		
6.	MPRAKURDA(L) BAZAR	1.3 / NE	GW6		
7.	DHIMAPUR VILLAGE	1.6 / WNW	GW7		
8.	GALAPARHA VILLAGE	1.3 / S	GW8		
9.	RESERVOIR IN EXISTING PLANT AREA	-		SW1	
10.	POND IN CHARARHAGARHA VILLAGE	0.3 / W		SW2	
11.	LINGARA RIVER UP STREAM NEAR GANDUHARA VILLAGE	1.4 / SW		SW3	
12.	LINGARA RIVER DOWN STREAM NEAR MOTANGA VILLAGE	1.8 / ENE		SW4	
13.	POND NEAR NORTHEN SIDE OF EXPANSION AREA	0.2 / N		SW5	
14.	POND IN MAHABHALI VILLAGE	1.8 / SE		SW6	
15.	BRAHMANI RIVER UP STREAM NEAR KUSHAPANGA	9.6 / N		SW7	
16.	BRAHMANI RIVER DOWN STREAM NEAR BIRMO	5.7 / ENE		SW8	
17.	RENGALI RIGHT MAIN CANAL SOUTHERN SIDE OF EXPANSION AREA	-		SW9	
18	ROAD NEAR ADVITA ENTERPRISES	0.7 / NE			T1
19	NH-55, NEAR MAA BRAHMANI DEVI AUTO WORKS	0.5 / ENE			T2

Analytical Results

The physico-chemical characteristics of ground and surface water samples are presented in **Annexure V**. To facilitate comparison with drinking water standards, Characteristics for Drinking Water as per IS 10500: 2012, has been included in the **Annexure VI.** Surface and ground water test results are given in **Table 3.10**.

TABLE 3.10: WATER TEST RESULTS

Sl. No.	Parameters	As per IS 10500:2012 Requirement		Test Results (range)	
		Acceptable Limits	Permissible Limit	Surface Water	Ground water
1.	Turbidity	1	5	0.448- 4.659	BDL-2.415
2.	pH value	6.5 to 8.5	No Relaxation	7.7-8.3	6.7-7.6
3.	Specific Conductance, µmhos	-	-	191.3- 975	1055- 2291
4.	Total Dissolved solids	500	2000	124-564	644- 1482
5.	Total Suspended Solids, mg/l	-	-	BDL-8	BDL-8
6.	Total hardness (as $CaCO_3$) mg/l	200	600	204-268	328- 892
7.	Total Alkalinity, mg/l	200	600	84-252	183- 614
8.	Acidity, mg/l	-	-	BDL- 10 at pH 8.3	5- 32.5 at pH 8.3
9.	Chlorides (as Cl), mg/l	250	1000	10- 159	51- 327
10.	Sodium as Na, mg/l	-	-	7.2- 102.5	45.5- 166.78
11.	Potassium as K, mg/l	-	-	2.4- 38	2- 5.7
12.	Iron (as Fe), mg/l	1.0	No Relaxation	BDL-0.14	BDL-0.370
13.	Fluoride (as F), mg/l	1.0	1.5	0.32-1.39	0.47- 0.91
14.	Phosphorus, mg/l	-	-	BDL- 0.011	-
15.	Hexavalent Chromium, mg/l	-	-	BDL	BDL
16.	Sulphate (as SO_4), mg/l	200	400	7- 94	64- 131
17.	Nitrate (as NO_3), mg/l	45	No Relaxation	BDL-17.69	2.29- 42.44
18.	Calcium (as Ca), mg/l	75	200	16-58	95- 183
19.	Magnesium (as Mg), mg/l	30	100	9 - 34	22- 117
20.	Copper (as Cu), mg/l	0.05	1.5	BDL	BDL
21.	Manganese (as Mn), mg/l	0.1	0.3	BDL-0.082	BDL-0.272
22.	Selenium (as Se), mg/l	0.01	No Relaxation	BDL	BDL
23.	Arsenic (as As), mg/l	0.05	No Relaxation	BDL	BDL
24.	Zinc (as Zn), mg/l	5	15	BDL-0.029	BDL-0.648
25.	Nickel as Ni, mg/l	0.02	No Relaxation	BDL	BDL
26.	Cadmium (as Cd), mg/l	0.003	No Relaxation	BDL	BDL
27.	Chromium (as Cr), mg/l	0.05	-	BDL	BDL
28.	Boron (as B), mg/l	0.5	1.0	0.033- 0.099	0.015- 0.082
29.	Lead (as Pb), mg/l	0.01	No Relaxation	BDL	BDL
30.	Barium (as Ba), mg/l	0.7	No Relaxation	0.019- 0.150	0.048- 0.248
31.	Silver as Ag, mg/l	0.1	No Relaxation	BDL	BDL
32.	Cobalt (Co), mg/l	-	-	BDL	BDL
33.	Bismuth (Bi), mg/l	-	-	BDL	-
34.	Dissolved Oxygen, mg/l	-	-	6.4-7.1	-

Sl. No.	Parameters	As per IS 10500:2012 Requirement		Test Results (range)	
		Acceptable Limits	Permissible Limit	Surface Water	Ground water
35.	Biochemical Oxygen Demand, mg/l	-	-	1.5-18	-
36.	Chemical Oxygen Demand, mg/l	-	-	BDL- 43	-
37.	Oil & Grease, mg/l	-	-	BDL	-
38.	Total Coliform (MPN/100ml)	-	-	1.8- 3.6	-
39.	E. Coli	-	-	Absent	-
40.	Temperature °C	-	-	26-29	25-26
41.	Phosphorus as P, mg/l	-	-	-	BDL
42.	Ammonical Nitrogen as NH_3, mg/l	-	-	BDL-3.36	N. D.
43.	Phenol, mg/l	0.001	0.002	-	N. D.
44.	Total Kjeldahl Nitrogen, mg/l	-	-	BDL-26.88	-
45.	Sodium Adsorption Ratio (SAR) mg/l	-	-	0.35-2.93	-
46.	Faecal Coliform	-	-	Absent	-

Source: Min Mec R&D Laboratory Report No. MMW/05-22/60, MMW/05-22/61, MMW/05-22/62 and MMW/05-22/63 dated 31.05.2022, MMW/04-23/15, MMW/04-23/16, MMW/04-23/17 and MMW/04-23/18 dated 28.04.2023

Note: BDL (Below Detection Limit) of Turbidity(NTU)<1, TSS<2, Fe<0.1, Ag<0.01, Bi<0.02, Co<0.01 F<0.1, P<0.003, COD<5, Cr^{6+}<0.1, NO_3<0.5 Cu<0.01, Mn<0.01, Se<0.01, As<0.01, Zn<0.01, Ni<0.01, Cd<0.002, Cr<0.01, Pb<0.01, O&G<2 mg/l, P<0.003 mg/l, NH3<0.56 mg/l, Total Kjeldahl Nitrogen<1 mg/l

N.D.- Not detected

It is observed that the surface water and ground water quality is within the permissible limits as specified by IS: 10500 - 2012 for drinking purposes except Total hardness, Total Alkalinity and Magnesium in Chararhagarhia village (handpump) water.

3.7 NOISE LEVEL

3.7.1 Monitoring Locations

Eight monitoring locations, were selected so as to represent the entire study area. The location of monitoring stations are indicated in **Fig 3.7** and given in **Table 3.11**.

TABLE 3.11: LOCATION OF NOISE MONITORING STATIONS

Station No. (Ref Fig 3.7)	Name of Monitoring Station	Distance (km) and Direction from the Plant
1	Existing Plant area	Within
2	Chararhagarhia village	0.4 km, NW
3	Bhanuparha village	0.8 km, SE
4	Jharhabandh village	2.2 km, SE

Station No. (Ref Fig 3.7)	Name of Monitoring Station	Distance (km) and Direction from the Plant
5	Narharipur Shasan village	4.8 km, SW
6	Motanga village	1.6 km, E
7	Meramundali Bazar	1.2 km, NE
8	Gandijhara village	1.4 km, SW

3.7.2 Methodology

For measurement of ambient noise level, a Digital Sound Level Meter was used. The meter was calibrated with a calibrated sound level meter before using in the field. The measurements were carried out continuously for the 24-hour period to obtain hourly equivalent sound pressure level. From these values, day and night time as well as 24-hour Leq values were also calculated. The Leq is the equivalent continuous sound level, which is equivalent to the same sound energy as the fluctuating sound measured during observation period.

3.7.3 Observations

Results of ambient noise measurements are presented in **Annexure VII**, and summarized in **Table 3.12**. The Ambient Air Quality Standards in respect of Noise and permissible exposure in cases of continuous/ impact noise and thresholds for vibration is given in **Annexure VIII**.

TABLE 3.12: AMBIENT NOISE LEVELS IN dB(A) (ALL VALUES IN Leq)

Location	Noise levels in dB(A)		Permissible limits	
	Day	Night	Day	Night
Existing Plant area	65.18	57.20	75	70
Chararhagarhia village	52.06	42.16	55	45
Bhanuparha village	51.12	40.59	55	45
Jharhabandh village	51.74	41.53	55	45
Narharipur Shasan village	50.14	39.55	55	45
Motanga village	50.04	41.24	55	45
Meramundali Bazar	61.12	50.06	55	45
Gandijhara village	53.01	42.49	55	45

Source: Min Mec R&D Laboratory Report No. MMN/06-22/17 dated 06.06.2022

Leq values observed during day time varies from 50.04 to 65.18 dB (A) and at night time varies from 39.55 to 57.20 dB (A). The day and night time Leq values noted from the eight noise monitoring stations in the study area indicate that the noise levels are well within the limits prescribed for the noise level in the residential and industrial zone.

3.8 TRAFFIC VOLUME

3.8.1 Monitoring Locations

The traffic density survey was conducted at 2 locations namely NH-55, Angul to Dhenkenal near Nimabahali Bazar Village, Near Mahaveer Dhaba (0.7, NE) and at NH-55 to Plant, Near Adwita Enterprise (0.9, ENE).The traffic monitoring stations are shown in **Fig 3.16**.

3.8.2 Methodology

Traffic count were made continuously for 24 hours by visual observation and counting of vehicles under seven categories, viz. Cycles, 2 wheelers, LMVs, Buses, Trucks, Animal drawn vehicles and others. The counting has been summarised for each hour and given in **Annexure IX**. The count of the vehicles is then converted into equivalent passenger car units (PCUs) but multiplying by equivalency factor. The equivalency factor is then used for calculation of maximum carrying capacity of the roads based on the standards of Indian Road Congress (IRC).

3.8.3 Observations

A summary of the traffic volume monitored during survey period is given in **Table 3.13** and details are given in **Annexure IX**.

TABLE 3.13: TRAFFIC VOLUME MONITORING DATA AND CARRYING CAPACITY OF THE ROAD

Code		**T-2**		**T-1**	
Location		**NH-55, Angul to Dhenknal (Near Mahaveer Dhaba)**		**NH-55 to Plant (Near Adwita Enterprises)**	
Road		**Angul to Dhenknal**		**NH-to Plant**	
Type of vehicle	**Equivalency Factor**	**Observed count (up + down)**	**Equivalent PCU**	**Observed count (up + down)**	**Equivalent PCU**
Cycles	0.5	455	228	457	229
Motor Cycles and Scooters	0.5	4752	2376	529	265
LMV	1	3354	3354	30	30
Buses	3	255	765	0	0
HMV (Trucks)	3	7225	21675	16	48
Others (Tractor)	1.5	177	266	15	23
Total		**16218**	**28665**	**1047**	**595**
Width of Road in m		18		7	
DSV in PCU/DAY		-		2000	
Maximum Capacity	In PCU/day	35000		4000	
	%Utilization	81.9		14.83	

Note: All volumes are total of two directions,
#Table 1 of IRC: 64-1990 for conversion factor into equivalent passenger car unit (PCU)
****Design Service Volume (DSV) in PCU/day as per Table 2,3,&5 of IRC:64-1990***
*****Maximum capacity as per IRC 64-1990, section 6.1 = DSV/0.5, in PCU/day for Rural area***

From perusal of above table it is clear that the current traffic volume utilization is within the maximum capacity of the road.

The width of the NH-55 from Angul to Dhenkenal is approximately 9 m for each side of two lane road. It is a black topped, well maintained road. The width of the village road from Plant joining to NH-55 is approximately 7 m. Large number of trucks ply on the national highway. The movement of light motor vehicles is uniform during the daytime and low during the night hours.

3.9 LAND ENVIRONMENT

3.9.1 Core zone

Existing plant area of 21.257 ha land has been purchased and is in possession of the company. For the expansion, additional 37.869 ha land will be required which consists of 33.06 ha private land and 4.81 ha government land. Out of this, 16.16 ha private land has been purchased and 16.9 ha private and 4.81 ha government land is to be purchased. Total area after expansion will be 59.126 ha. There is no forest land within the project area. Landuse of expansion area is given in **Table 3.14** and pre project landuse details of existing & expansion area is given in **Table 3.15**.

TABLE 3.14: VILLAGE WISE LAND USE DETAILS OF THE EXPANSION AREA (IN HA)

Sl. No.	Name of the Village	Private Land	Government Land					Grand Total
			Leasable	Communal	Gochar	Forest	Total Govt.	
1	Tulasidiha	8.928	1.064	0.380	1.688	0.000	3.132	12.060
2	Charhagarhia	4.656	0.146	0.000	0.000	0	0.146	4.802
3	Kangelapal	19.478	0.000	0.567	0.963	0	1.530	21.008
	Total	**33.062**	**1.210**	**0.947**	**2.651**	**0**	**4.808**	**37.869**

TABLE 3.15: PRE-PROJECT LAND USE DETAILS OF EXISTING AND PROPOSED PLANT

Current land use	Area in Ha
Forest land	0
Agriculture land	17.718
Grazing land	2.651
Barren land	0
Waste land	0.149
Surface water bodies	3.501
Marshy land	0
Mangroves	0
Settlements	0
Roads / Other infrastructure	1.638

Current land use	Area in Ha
Plantation / Green belt	7.082
Industrial use	26.331
Pits	0.0
Debasthali	0.057
Total	**59.126**

3.9.2 Study area

Land use pattern of study area has been studied on the basis of 2011 Census data. The number of villages/ census towns/ municipalities falling in different tehsils and the corresponding areas are given in **Table 3.16.**

TABLE 3.16: DISTRICTS/TALUK WISE VILLAGES, CENSUS TOWNS & MUNICIPALITIES IN STUDY AREA (AS PER CENSUS 2011)

District	Tehsils	No. of villages/ CT/ municipality	Area (ha)
Dhenkanal	Parajang	11	2820.00
	Odapada	40	10291.00
	Gondia	1	1952.00
	Hindol	62	14317.00
Angul	Talcher	1	202.00
	Banarpal	32	7872.65
Total		**147**	**37454.65**

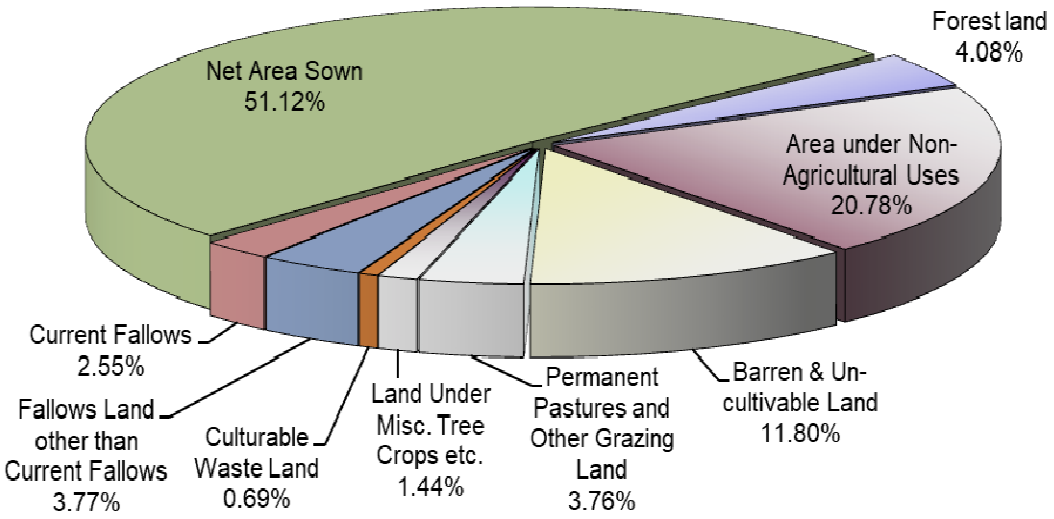
Detailed break up of land use pattern within study area is given in **Annexure X** and summarised in **Table 3.17**. The land use pattern in graphical present in **Fig 3.17**.

TABLE 3.17: LAND USE DETAILS OF STUDY AREA (AS PER CENSUS 2011)

Land use	Area (Ha.)	% of Total Area
Net area sown	19148.18	51.12
Current fallows	955.47	2.55
Fallows land other than current fallows	1412.54	3.77
Culturable waste	257.31	0.69
Land under miscellaneous tree crops	540.65	1.44
Permanent pastures and other grazing land	1409.35	3.76

Land use	Area (Ha.)	% of Total Area
Barren land and uncultivable land	4418.25	11.80
Area under non agricultural uses	7783.12	20.78
Forest land	1529.78	4.08
Total	**37454.65**	**100.00**

FIG 3.17: LAND USE PATTERN IN THE STUDY AREA (CENSUS 2011)



A perusal of above table shows that 51.12% is net area sown, 20.78% is area under non-agricultural uses, 11.80% is barren and un-cultivable land, 4.08% of total area is forest land, 3.77% is fallows land other than current fallows, 3.76% is permanent pastures and other grazing land, 2.55% is current fallows, 1.44% land under miscellaneous tree crops and 0.69% is culturable waste land.

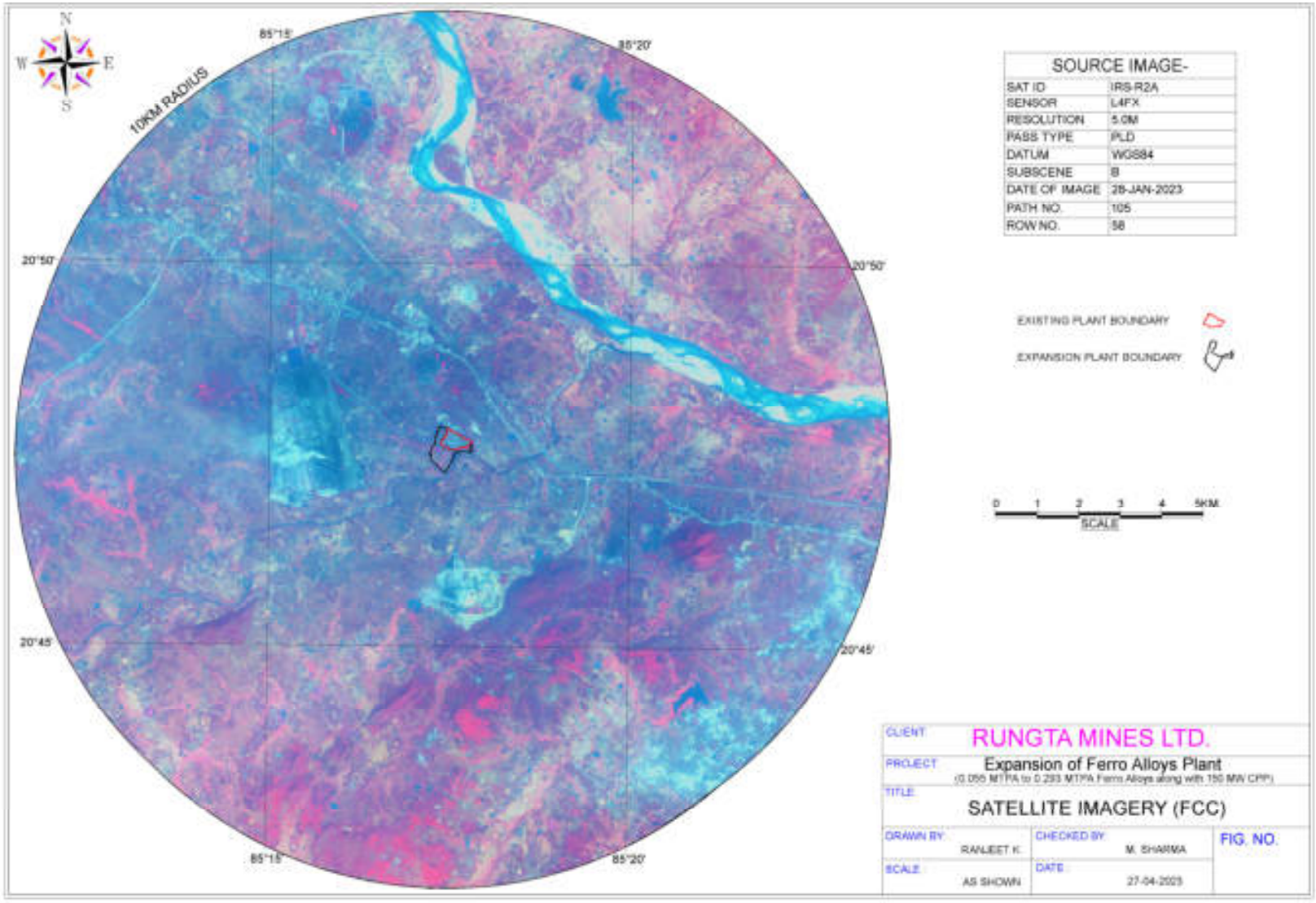
3.9.3 Land use based on satellite imagery

Land use / land cover information relates to the status, spatial distribution & area extent of different land use categories. The satellite image of the study area is given in **Fig 3.18.**

Data Inputs: Satellite-IRS-R2A, Sensor- L4FX, path- 105, Row-058, Date of Pass- 28.01.2023

Collateral Data: Survey of India Open Source map

FIG 3.18: 10 KM RADIUS LAND USE MAP BASED ON SATELLITE IMAGERY



3.10 SOIL QUALITY

Core Zone: Top soil samples were collected from the four locations. Top soil samples were collected from four locations. One from existing core zone of the project site, two from expansion plant area in south direction and north direction and one from Chararhagarhia village at 0.5 km in west direction. The location of soil sampling stations are given in **Table 3.18** and shown in **Fig 3.16**.

TABLE 3.18: SOIL SAMPLING STATIONS

Station no. (Ref Fig 3.16)	Location	Distance (in km) & Direction	Type of land
1	Existing plant area	Within	Plant area
2	Expansion plant area south side	Within	Agricultural land
4	Chardagarhia	0.5 km, W	Agricultural land
6	Expansion Plant near north side	Within	Uncultivated/ wasteland

Summary of soil test are given in **Table 3.19** and details given in **Annexure XI**.

TABLE 3.19: SOIL TEST RESULT (SUMMER 2022)

Parameters	Protocol	Range
Textural Classification#	IS 1498:1970	Medium grained sand
Colour#	-	Dark Brown- Medium Brown
pH	IS 2720 (P26)	6.7- 7.9
E.C. (mS/cm)	IS 14767:2000	0.1118- 0.4960
$CaCO_3$ (%by mass)	IS 2720 (P23)	4- 11
Specific Gravity	IS : 2720 (P 3/Sec 1) -1980	2.2- 2.51
Moisture (%by mass)	IS 2720 (P 2)	5.706- 12.813
Organic Carbon (%by mass)	Method no. 9, STI Manual*	0.48- 0.75
Organic Matter (%by mass)	Method no. 9, STI Manual*	0.83-1.30
Phosphorous (mg/kg)	Method no. 13, STI Manual*	6.81- 8.75
Nitrate-Nitrogen (mg/kg)#	Method no. 12, STI Manual*	0.53- 2.55

Parameters	Protocol	Range
Sodium (Kg/ha)	Method no. 14, STI Manual*	203.84- 445.76
Potassium (Kg/ha)	Method no. 14, STI Manual*	63.0- 206.0
Calcium^{2+} me/100 gram Soil	Method no. 16.a, STI Manual*	15.7- 21.1
Magnesium^{2+} me/100 gram Soil	Method no. 16.b, STI Manual*	4.4- 8.2
Cation exchange capacity, meq/100gram soil	Method no. 3 1.33, STI Manual*	1.31-1.42
Water Holding Capacity, %	IS 14765 : 2000	25.31-31.18
SAR, (meq/l)	By Calculation**	1.24-2.24
Porosity, %	SMF$^{\#}$	40-48
Permeability, cm/sec.	IS 2720 (P 17): 1986, RA 2021	$2.3x10^{-3}$ - $2.6x10^{-3}$

Note:– * Methods Manual, Soil Testing in India, Department of Agriculture & Cooperation, Ministry of Agriculture (MOA), Government of India

***** Concentration in a Saturated Soil Paste***

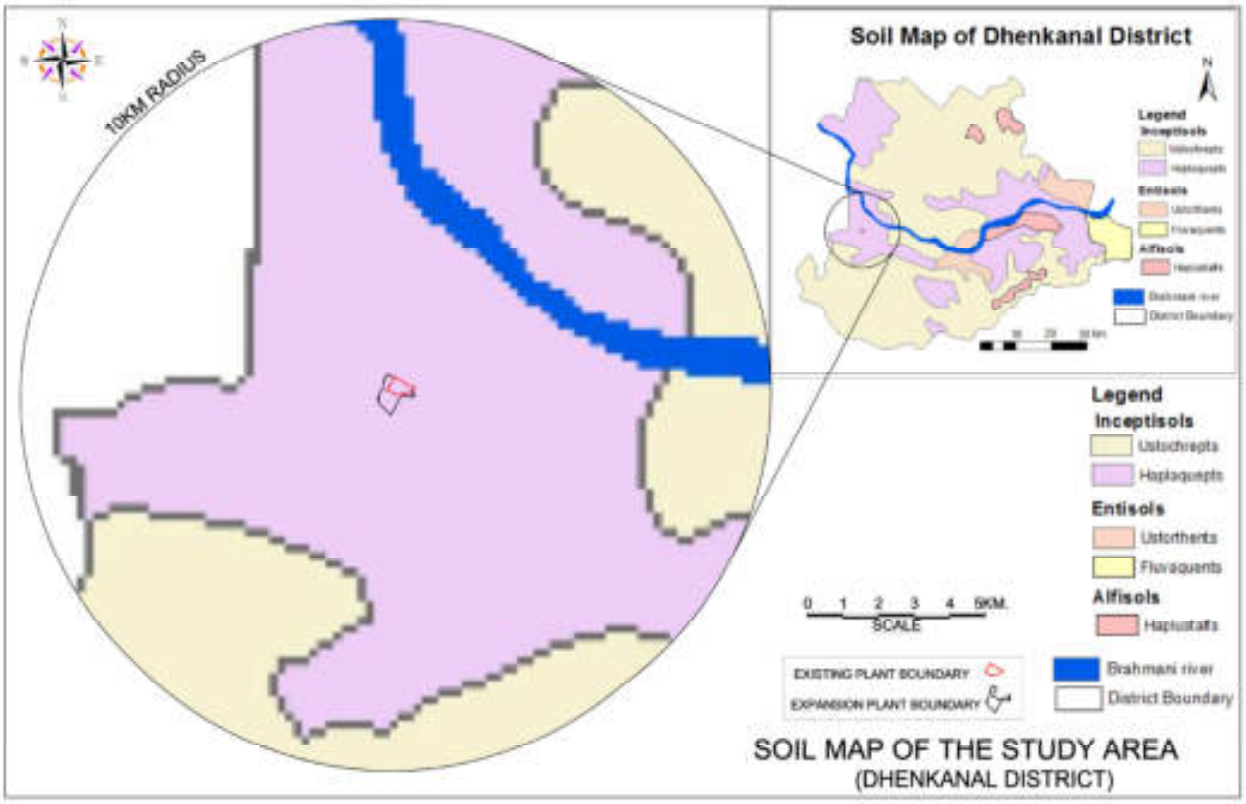
 # Section 2.4, Soil Mechanics and Foundations by B. C. Punmia

Source: Test report no. MMS/05-22/64 & MMS/05-22/65 dated 31/05/2022 and MMS/04-23/19 dated 28.04.2023 by Min Mec R&D Laboratory

Texture of soil is medium grained sand and dark brown to medium brown in colour. The soil is slightly acidic to moderately alkaline in nature. Conductivity of soil shows it is salt free. Organic carbon in two soil samples is deficient and optimum in other two. Soil is deficient in nitrogen, phosphorous and potassium.

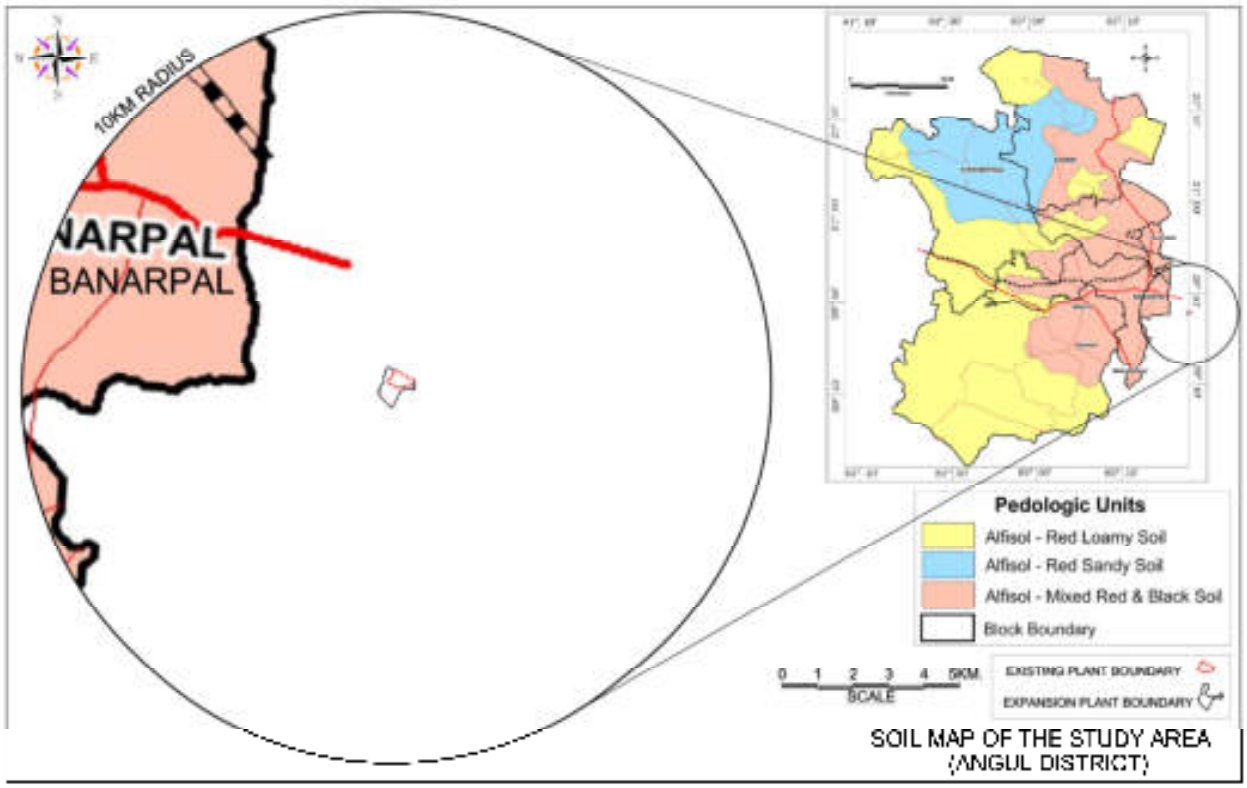
Study area: Based on the physical and chemical characteristics, mode of original occurrence, soils of the district are classified into three types, namely Alfisols, Ultisols and Entisols. The soil map of the study area (**Fig 3.19**) shows that Inceptisols (type of entisols) are the dominant soil types with sub-type Ustochrepts and Haplaquepts. Inceptisols are usually Mixed Grey Soil. Entisols are younger alluvial soils occurring along the Brahmani river. The soils are deficient in nitrogen, phosphoric acid and humus but are not generally in potassium and lime. The pH of the soil is alkaline. The texture varies from sandy and loamy sand. The soils are most fertile and are suitable for variety of crops like paddy, wheat, sugarcane, cotton, banana and tobacco.

FIG 3.19: SOIL MAP OF STUDY AREA (DHENKANAL DISTRICT)



Source : Fig 1.5 of "Aquifer Mapping and Management of Ground Water Resources, Dhenkanal District, Odisha" by CGWA, Bhubaneswar, May 2022.

FIG 3.20: SOIL MAP OF STUDY AREA (ANGUL DISTRICT)



Source: Fig 3.4 of "National Aquifer Mapping and Management of Plan, parts of Angul District, Odisha" by CGWA, Bhubaneswar, July 2016

3.11 ECOLOGY

A strategic balance between physical and biological environment is vital for human survival. Abiotic factors as air, water, soil, climate needs to be maintained for having a vibrant environment. Imparity in any aspects of sustainable environment can lead to long term damages to the environment.

3.11.1 Forests

There is no forest present within existing and proposed expansion plant area. Total forest land in the study area as per Census 2011 is 1529.78 ha (4.08%). As per Champion and Seth's classification of the revised forest types of India, the forests of Dhenkanal District is Northern Tropical Moist Deciduous Forest (3C).

There are no national parks or wildlife sanctuaries within 10 km radius. The nearest National Park is Simlipal (proposed) at a distance of 136.27 km in north east direction. The nearest sanctuary is Satkosia Gorge sanctuary at a distance of 21.25 km in south west. Mahanadi Elephant Reserve (proposed) is at a distance of 21.91 km in south west and Kahneijena-Anantpur elephant corridor is at a distance of 25.49 km in north west.

There are three protected and reserve forest present within 10 km of the study area of the project. The distance to these are given in **Table 3.20** and their location are shown in **Fig 3.21**.

TABLE 3.20: LIST OF FORESTS IN 10 KM RADIUS OF THE PROJECT

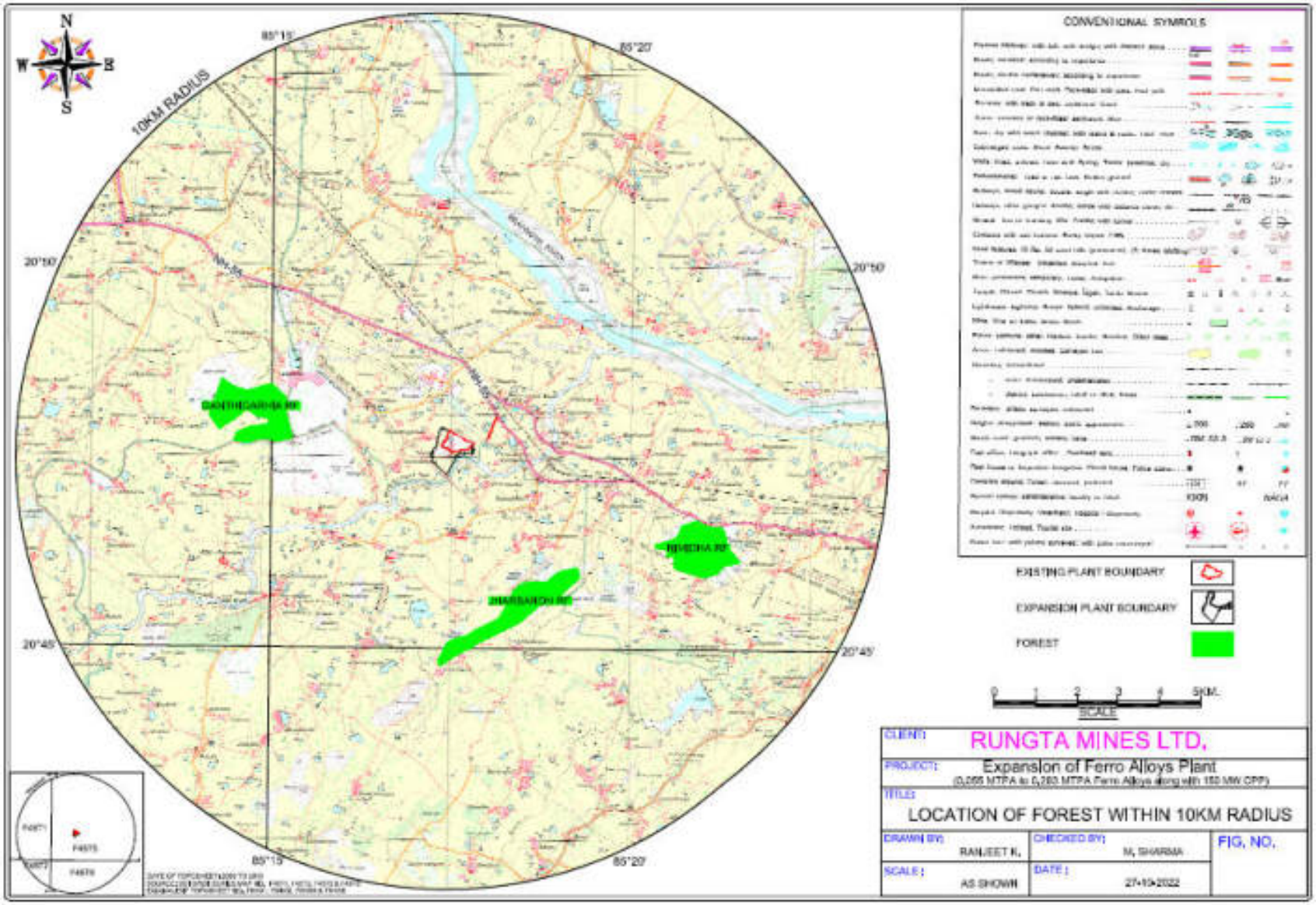
Sl. No.	Name of forest	Distance (km)	Direction
1.	Ganthigarhia Protected Forest	3.4	W
2.	Jharbandh Reserve Forest	3.2	SSE
3.	Nimidha Reserve Forest	4.9	SE

3.11.2 Flora

Core Zone: Trees, herbs, shrubs & climbers are found in the expansion area. About 300 number of trees are estimated to exist within the expansion plant area. Some of the trees found in the expansion area are Babul, Kaju, Neem, Palas etc. while herbs, shrubs and grasses are Arakha, Chauli, Tulsi, Duba, Sinkula etc. Detailed list of flora found in core zone has been submitted for authentication vide letter no. RML/FAD/WLCP/22-23/181 dated 16.01.2023 at the office of DFO, Dhenkenal Forest Division.

Buffer Zone: There are 41 species of trees, 2 species of bamboo, 15 species of shrubs, 8 species of herbs, 11 species of climbers and 4 species of grasses in buffer zone. The list of plant species submitted at the office of the DFO, Dhenkenal Forest Division for authentication has been given in **Annexure XII.** Some of the species of trees are Amba, Bel, Kendu, Kadamba, Mahul, Neem, Siris, Sissu, Teak etc. Herbs, shrubs, grasses and climbers found in study area include Arakha, Candle-stick tree, Lajwanti, Tulsi, Makai, Duba etc.

FIG 3.21: LOCATION OF FORESTS



Cropping pattern: Due to semi-humid climate, the rainfall is moderate. The agriculture is dependent on monsoon but irrigation facilities in form of ponds/tubewells are available in the study area. The main crop of the area is paddy. The area under major field crops and horticulture is given in **Table 3.21.**

TABLE 3.21: AREA UNDER MAJOR FIELD CROP & HORTICULTURE IN DHENKENAL DISTRICT

Sl. No.	Major Field Crop Cultivated	Total Area (Ha)
1.	Paddy	112.0
2.	Horsegram	7.63
3.	Greengram	22.2
4.	Blackgram	25.8
5.	Groundnut	12.0
6.	Mustard	2.48
Horticulture Crops - Fruits		
1.	Mango	8.4
2.	Citrus	0.9
3.	Cashew nut	1.7
4.	Coconut	1.1
5.	Banana	0.5
Horticulture Crops - Vegetables		
1.	Potato	0.2
2.	Onion	0.8
3.	Sweet potato	3.4
4.	Vegetables	25.4
Plantation Crops		
1.	Eucalyptus	2.0
2.	Teak	0.5

(Source: Agriculture Contingency Plan for District, Dhenkenal, Odisha (2011) State: agricoop.gov.in accessed 24.04.2022)

Plantation along roads: Plantation of species along the roadside can be see. The species seen are *Azardirachta indica* (Neem)*, Butea monospperma* (Palas)*, Cassia fistula* (Sunari)*, Dalbergia sisoo* (Sissu)*, Diospyros melanoxylon* (Kendu)*, Ficus benghalensis* (Bara)*, Mangifera indica* (Amba)*, Syyzygium cumini* (Jamun)*, etc.*

Vegetation in the Hamlets: The species composition near the hamlets is different from those found in the natural environmental conditions. The vegetation structure surrounding the hamlets reflects a typical character of habitation. The trees in the settlement area are catering to the needs of

local population such as fodder, fuel-wood, fruit, and timber and for religious purposes. Some of the common species found in the hamlets comprise *Mangifera indica, Syzygium cumini, Madhuca indica, Tamarindus indica, etc.*

Medicinal plant species: The study area is also endowed with several medicinal plants. Medicinal plants found in the study area are used by the people of villages for their daily use and minor ailments. The common medicinal plants of the region are *Azadirachta indica, Butea monosperma, Cassia fistula, Ficus benghalensis, Madhuca indica, Mangifera indica, Syzygium cuminii, etc. and Ocimum sanctum, in houses as well.*

Fuel wood plant species: Villagers collect dry leaves, stems and log to fulfill their daily need for fuel wood requirement. *Syzygium cumini (Jamun), Mangifera indica* (*Mango)* etc. are the species, used for fuel wood.

3.11.3 Fauna

The request letter has been submitted at the office of the DFO, Dhenkenal Forest Division for the preparation of Site Specific Conservation Plan in compliance to the conditions of Terms of reference. The list of fauna found in the core zone and study area was has been submitted at the office of the DFO, Dhenkenal Forest Division for authentication vide letter no. RML/FAD/WLCP/22-23/181 dated 16.01.2023 as given in **Annexure XIII.**

Core zone: 13 avian species, 8 reptilian, 2 amphibians and 9 species of mammals are found in the expansion area. Fauna in the expansion plant area is less as compared to buffer area. Avifauna includes House Crow, Common Mynah, Cattle Egret, Pond Heron, Black Drongo, Red Vented Bulbul, Blue Rock Pigeon etc.; Mammals are Common House Rat, Five Stripped Palm Squirrel, Indian Hare, Jackal etc. and reptiles are Common Rat Snake, Indian Chameleon, etc.

Buffer zone: A total of 43 faunal species were recorded, comprising 11 species of mammals, 11 species of reptiles, 2 species of amphibians, and 19 avifaunal species. The mammalian species observed in the study area are Common Mongoose, Indian Hare, Common House Rat, etc.; bird species are Jungle Crow, Black Drongo, Common Pigeon, etc. and reptiles are Common Rat Snake, Common Indian Krait, Common Garden Lizard etc.

Endangered species : There are no endangered species found in core zone. The endangered species found in the buffer zone as per Schedule I of Wildlife (Protection) Act 1972, Amendment 2022 are given below:

- Jackal *(Canis aureus)*
- Indian Elephant (*Elephas maximus*)
- Sloth bear (Melursus ursinus)

- Indian grey mongoose *(Urva edwardsi)*
- Common rat snake *(Ptyas mucosus)*
- Indian Chameleon (*Chamaeleon zeylanicus*)
- Indian cobra (*Naja naja*)
- Checkered Keelback (*Fowlea piscator*)
- Indian Rock Python *(Python molurus*)
- Eurasian eagle *(Bubo bubo)*

Endemic species: There are no endemic species of mammals or reptiles in core zone or buffer zone based on "A checklist of Mammals of India with their distribution and conservation status", July 2015[1] and "A Checklist of Reptiles of India", May 2018[2] by scientists of Zoological Survey of India.

Livestock: Livestock occupies an important place in the rural economy of Dhenkanal district. It provides them with the draught power required for cultivation and an additional means of supplementing their income. The live-stock plays a vital role in the agricultural economy of the district, because it not only supplies milk, meat, manure, bones, hides and skins, hoofs and horns but also serves as draught cattle for drawing carts, ploughs and is also used for drawing water. Villagers keep Cow, Goat, Buffalo, Sheep, Hen etc. for poultry, milk, eggs etc.

3.11.4 Aquatic Ecology

The biological organisms are the best indicators of environmental quality. The abundance or absence of certain organisms thus often serves as indicators of a healthy or polluted aquatic environment. Information about the impact (environmental stress) on the community structure serves as inexpensive and efficient "early warning and control system" to check the effectiveness of control measures to prevent damage to a particular ecosystem (e.g. adjustments of emission norms, management of installations and sanitation etc.).The nature and quality of such biological species in a particular environment depend on various physico-chemical characteristics of water such as pH, conductivity, nutrients, BOD etc.

Ecology of river includes different biological species, such as Plankton (both phyto and zoo), different species of Algae, Aquatic Macrophytes, Aquatic Insect and Fishes.

Based on primary and secondary survey, fish found in Lingra nala and Brahmani river have been identified. Some of these fishes are also source of food of local people. Common fishes found are rohi (*Labeo rohita*), carp

[1] Source : https://zsi.gov.in/WriteReadData/userfiles/file/Checklist/Checklist%20of%20Mammals%20of%20India-Gaurav%20Sharma,%20M_%20Kamalakannan%20and%20K_%20Venkataraman-01-07-2015.pdf
[2] Source : https://zsi.gov.in/WriteReadData/userfiles/file/Checklist/Reptile%20Checklist%20(May%202018).pdf

(*Labeo catla*),barred baril (*Barilius barila*), mrigal (*Cirrihinus mrigala*), glass perchlet (*Chanda nama*), karandi (*Puntius conchonius*), etc. as given in **Annexure XIII.**

Perusal of various secondary sources show that the most common phytoplankton are diatoms, photosynthesizing dinoflagellates, and blue-green algae. Zooplankton include protozoans such as foraminiferans, radiolarians and non-photosynthesizing dinoflagellates as well as animals like tiny fish and crustaceans. Common phytoplanktons found in rivers of study area include species of *Cymbella, Diatoma,Chlamydomonas, Closterium, Oedogonium, Anabaena, Euglena etc.* and zooplanktons include species of *Cyclops, Rotarias, Brachionus, Amoebas, Parameciums etc.*

3.12 SOCIO-ECONOMIC CONDITIONS

The socio-economic conditions of the area are described in the following paragraphs.

3.12.1 Demographic profile

There is no habitation within the project area. There are 145 inhabited villages/ census towns in the study area. The total population within the study area is 170881. The district and tehsil wise population as per Census 2011 records is given in **Table 3.22**.

TABLE 3.22: DISTRICT & SUB DISTRICT WISE POPULATION (CENSUS 2011)

District	Tehsil	No. of villages	No of households	Total population	Males	Females
Dhenkanal	Parajang	11	3494	13547	6903	6644
	Odapada	40	11874	50765	27249	23516
	Hindol	62	13830	55081	28274	26807
	Gondia	1	1568	6778	3504	3274
Angul	Talcher	1	262	1278	695	583
	Banarpal	32	9777	43432	22573	20859
Total		**147**	**40805**	**170881**	**89198**	**81683**

The village wise demographic details including population of males, females, schedule cast, schedule tribe, literacy level are given in **Annexure XIV** and summarised in **Table 3.23**. The sex wise break-up of literacy levels and population of SC & ST are shown in **Fig 3.22** and **3.23** respectively.

FIG 3.22: LITERACY LEVEL IN THE STUDY AREA (CENSUS 2011)

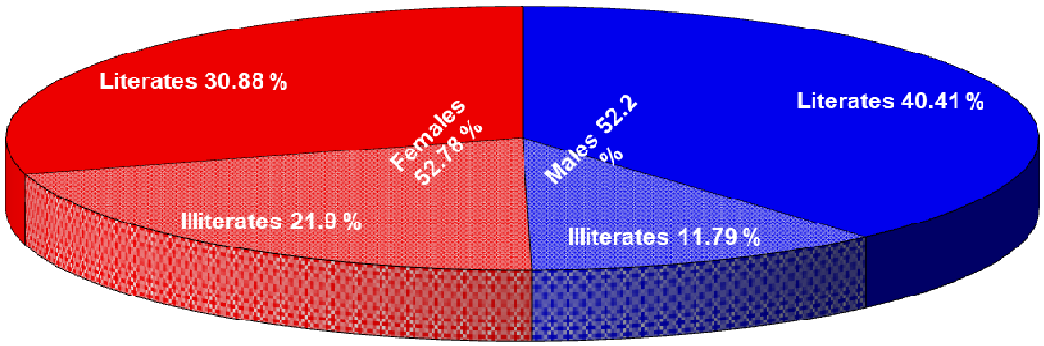


FIG 3.23: BREAK UP OF SC & ST IN THE STUDY AREA (CENSUS 2011)

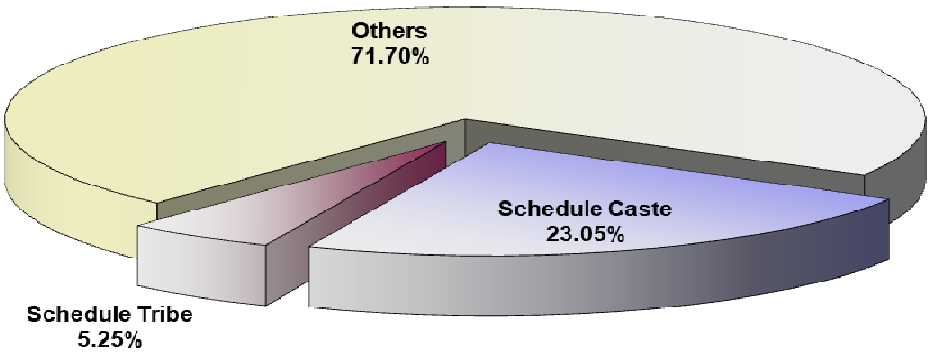


TABLE 3.23: DEMOGRAPHIC DETAILS OF THE STUDY AREA (AS PER CENSUS 2011)

Description	Population	Percentage
Total Population	170881	100.00
Male Population	89198	52.20
Female Population	81683	47.80
Females/1000 males	915	-
No. of households	40805	-
Family size, persons/family	4-5	-
Schedule caste	39383	23.05
Schedule Tribe	8977	5.25
Total literates	121819	71.29
Male literates	69052	40.41
Female literates	52767	30.88

Mostly the population is rural and the percentage of Scheduled Tribes is 5.27% and Schedule Castes is 22.83% of the total population. The male population exceeds female population. The average family size is 4-5 persons per family. The literacy level is approximately 71.26 % and it is lower among females (30.85 %). There are 915 women against every 1000 men in the study area.

3.12.2 Employment and occupation

Employment pattern and occupation are the two main indicators of the economic profile, and the same for the individual villages, based on 2011 census data, are presented in **Annexure XV.** A summary of employment pattern and occupation for the study area is presented in **Table 3.24.**

TABLE 3.24: SUMMARY OF EMPLOYMENT & OCCUPATION IN THE STUDY AREA

Description	Numbers	%
Main workers	41018	24.00
Marginal workers	17980	10.52
Non workers	111884	65.47
Break-up of main workers		
Cultivators (%)	6509	15.87
Agricultural labours (%)	4846	11.81
Household industries (%)	2036	4.96
Other workers (%)	27627	67.35
Total	**41018**	**100**
Break-up of marginal workers		
Cultivators (%)	1691	9.40
Agricultural labours (%)	8279	46.05
Household industries (%)	995	5.53
Other workers (%)	7017	39.03
Total	**17980**	**100**

3.12.3 Employment pattern

The village wise employment pattern within the study area including their break-up is given in **Annexure XV**. The employment pattern, break-up of main workers and break-up of marginal workers are graphically depicted in **Fig 3.24**, **3.25, 3.26** and **3.27,** respectively.

FIG 3.24: EMPLOYMENT PATTERN IN THE STUDY AREA (CENSUS 2011)

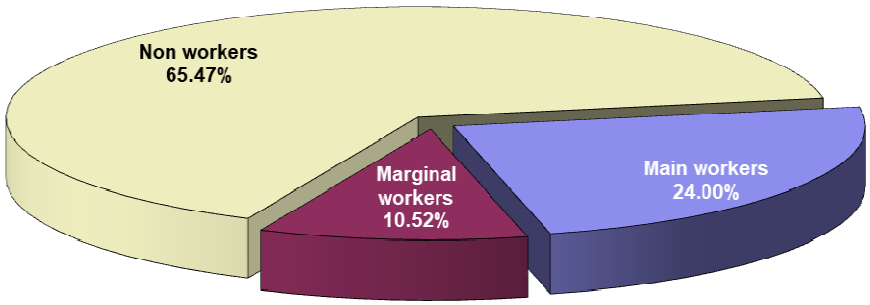


FIG 3.25: BREAK UP OF MAIN WORKERS IN THE STUDY AREA (CENSUS 2011)

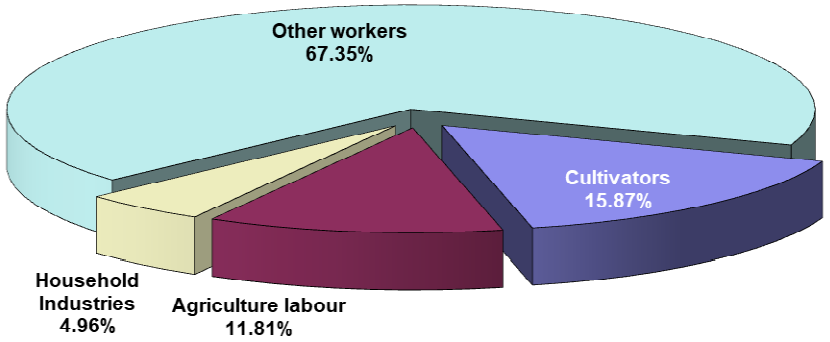


FIG 3.26: BREAK UP OF MARGINAL WORKERS IN THE STUDY AREA (CENSUS 2011)

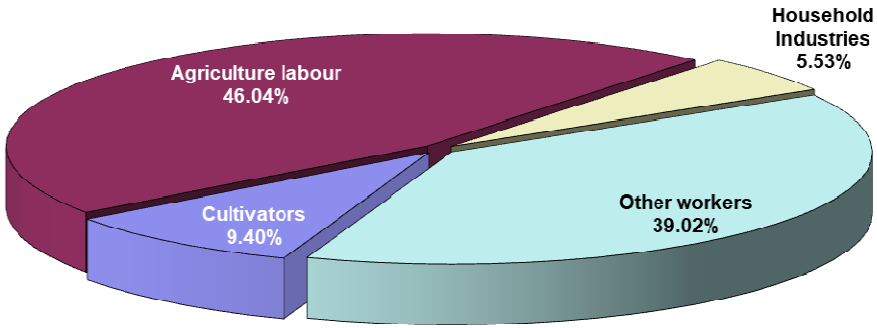
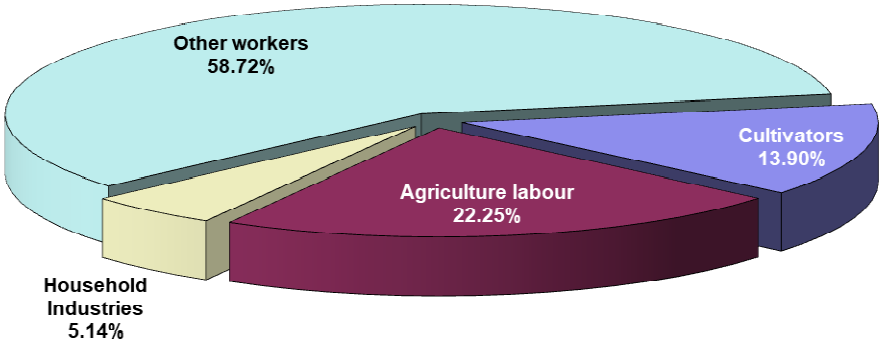


FIG 3.27: BREAK UP OF TOTAL WORKERS (MAIN & MARGINAL) IN THE STUDY AREA (CENSUS 2011)



3.12.4 Amenities

Details of amenities available in individual villages are given in **Annexure XVI**. A summary of the same is given in **Table 3.25**.

TABLE 3.25: AMENITIES AS PER CENSUS 2011

Education	Towns	Govt. Primary School (Nos.)	4
		Govt. Middle School (Nos.)	3
		Govt. Secondary School (Nos.)	3
		Govt.-Non Formal Education (Nos.))	13
	Villages	Pre-Primary school	4
		Primary school	180
		Middle school	97
		Secondary school	46
		Senior.Secondary school	16
		Degree College Arts & Science only	7
		Engineering. College	3
		Medicine College	2
		Management Institute	3
		Polytechnic	4
		Vocational Training School/ITI	9
Medical and health care	Towns	Dispensary/Health Centre (Nos.)	3
		Maternity Home Nearest facility Distance (in kms.)	7
		Nursing Home (Nos.)	1
		Non-Government Medicine Shop (Nos.)	4
	Villages	Primary Health Centre	1
		Primary Health Sub-Centre	18
		Maternity And Child Welfare Centre	4
		TB Clinic	1
		Hospital Allopathic	3
		Hospiltal Alternative Medicine	1
		Dispensary	6
		Veterinary Hospital	5
		Family Welfare Centre	4
		Non Govt. Med.Facilities: Medical Practitioner with MBBS degree	6
		Non Govt. Med.Facilities: Medical Practitioner with other degree	1
		Non Govt. Med.Facilities: Medicine shop	52
Power Supply	Towns	Electricity-Domestic Connection (Nos.)	946
		Electricity-Industrial Connection (Nos.)	5
		Electricity-Commercial Connection (Nos.)	33
		Electricity-Road Lighting Connection (Nos.)	13
		Electricity-Others Connection (Nos.)	13
	Villages	Power Supply For Domestic Use	132

		Power Supply For Agriculture Use	44
		Power Supply For All Users	39
Communication System	Villages	Post Office	21
		Sub Post Office	9
		Post & Telegraph office	7
		Village PIN code)	144
		Telephone (landline)	92
		Public Call Office/ Mobile PCO	31
		Mobile phone coverage	133
		Internet Cafes/Common Service Centre	3
		Private Courier Facility	19
Transport System and Approach	Towns	Pucca Road Length (in kms.)	12.6
		Kutcha Road Length (in kms.)	11.3
	Villages	Public Bus Service	22
		Private Bus Service	39
		Railway station	10
		Auto/Modified Autos	67
		Taxi	38
		Vans	9
		Tractors	70
		Cycle-pulled Rickshaws (manual driven)	143
		Cycle-pulled Rickshaws (machine driven)	0
		Carts Drivens by Animals)	128
		Sea/River/Ferry Service)	22
		Number of villages connected to:	
		National Highway	22
		State Highway	7
		Major District Road	29
		Other District Road	66
		Black Topped (pucca) Road	86
		Gravel (kuchha) Roads	133
		Water Bounded Macadam	19
		All Weather Road	103
		Navigable waterways:river/canal	28
		Foot Path	144
	Towns	Latrines-Pit (Nos.)	1134
		Latrines-Flush/Pour Flush (Nos.)	1076
		Latrines-Others (Nos.)	9.65
Water supply and Sanitation	Villages	Tap Water Untreated	17
		Covered Well	1
		Uncovered Well	132
		Hand Pump	143
		Tube Wells/Borehole	7

		Spring	24
		River/Canal	61
		Tank/Pond/Lake	135
		Others	9
Banks and Commercial Societies	Towns	Nationalised Bank (Nos.)	1
		Agricultural Credit Society (Nos.)	3
	Villages	ATM	1
		Commercial bank	1
		Co-operative bank	2
		Agricultural Credit Societies	3
		Self-Help Group	136
		Public Distribution System	96
		Mandis/Regular Market)	20
		Weekly Haat	25
		Agricultural Marketing Society	11
		Nutritional Centres-ICDS	32
		Nutritional Centres: Anganwadi	124
		Nutritional Centres-Others	3
		ASHA	134
		Community centre with/without TV	51
Sports and Entertain-ment	Towns	Govt.-Stadium (Nos.))	0
		Private-Stadium (Nos.)	0
		Govt.-Cinema Theatre (Nos.))	0
	Villages	Sports Field	70
		Sports Club/Recreation Centre	53
		Cinema/Video Hall	1
		Public Library	13
		Public Reading Room	13
		Daily Newspaper Supply	133
		Assembly Polling Station	103
		Birth and Death Registration Office	4
Fire Fighting	Towns	Fire Fighting Service (Status A(1)/NA(2))	6

3.13 INDUSTRIES & CRITICALLY POLLUTED AREAS

The list of industries present in the study area is given below in **Table 3.26** and shown in **Fig 3.28.**

TABLE 3.26: LIST OF INDUSTRIES WITHIN STUDY AREA

Sl. No.	Industries Name	Distance & Direction	Product	Production
1.	Tata Steel Ltd (formerly known as Bhushan Power & Steel Ltd.)	1.6, W	(Operational) DRI, Power Plant, Sinter Plant, Coal washery, Coke Oven, Oxygen Plant, Bar Mill, Lime and dolo plant	5.6 MTPA
2.	Navbharat Ventures Ltd.	0.9, N	(Operational) High Carbon Ferro Chrome & Power Plant	0.075

Sl. No.	Industries Name	Distance & Direction	Product	Production
3.	BRG Iron & Steel Company Pvt. Ltd. (formerly known as Bhuvee Profile and Stainless Pvt. Ltd.)	2.4, NNW	Not Operational	-
4.	Lanco Power Plant	2.4, N	Not Operational	-
5.	Rabirun Vinimay Pvt. Ltd.	3.8, NW	Not Operational	-
6.	GMR Kamalanga Energy Ltd.	6.7, NNW	(Operational) Power Plant	3X350 MW
7.	MGM Mineral's Ltd. (Steel Division)	4.4, SE	(Operational) DRI, SMS, Power	250000 TPA DRI along with SMS, Power and pellet, Plant,
8.	Maa Tarini Stone Crusher	8.5, SE	(Operational) Stone Crusher	
9.	Kanak Durga Stone Crusher	9.3, SE	(Operational) Stone Crusher	
10.	Crusher-1	6.8, ESE	Operational Stone Crusher	
11.	Sri Jagannath Stone Crusher-Crusher-2	9.3, ESE	(Not Operational) Stone Crusher	-
12.	Crusher 3	9.0, SE	(Operational) Stone Crusher	
13.	Crusher-4	9.3, SE	(Operational) Stone Crusher	
14.	Crusher-5	8.7, SSE	(Operational) Stone Crusher	
15.	Tulshi Ricetech Private Ltd	9.6, W	Rice Mill	
16.	Shalivahana Green Energy Ltd.	3.8, SE	Power Plant	20 MW Biomass Based TPP -
17.	Rungta Mines Ltd's Dhenkanal Steel Plant	3.4, SE	(Operational) Power Plant, DRI, SMS, Pellet Plant, TMT-Bar	7.53 MTPA Steel
18.	Brick kiln	2.2, NE	Brick	
19.	Brick kiln	3.4, NE	Brick	
20.	Brick kiln	3.1, NE	Brick	
21.	Brick kiln	3.7, NE	Brick	
22.	Brick kiln	3.8, NE	Brick	
23.	Maa Santoshi Fly Ash Bricks	8.2, WNW	Brick	

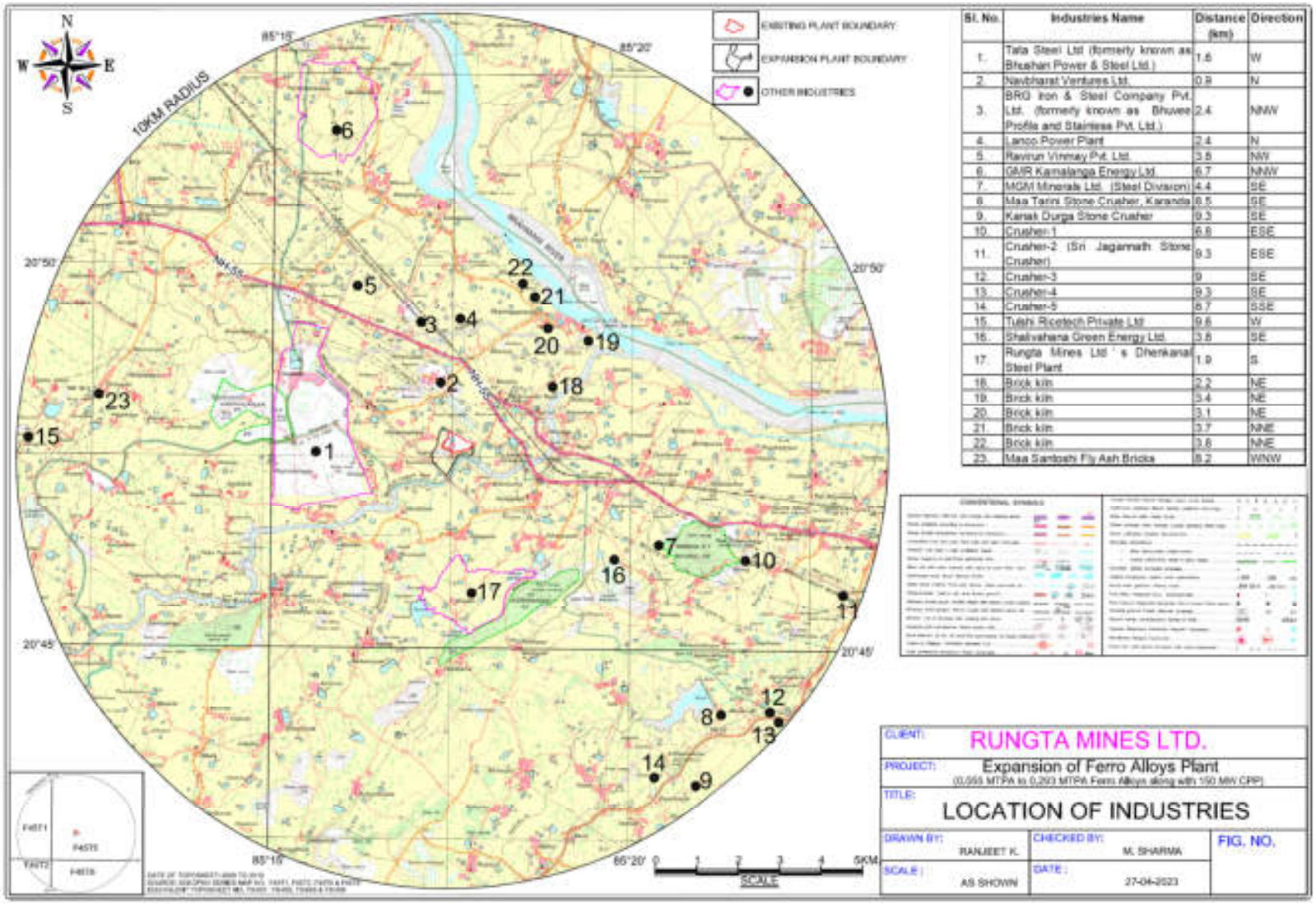
Critically polluted area: The project area used to fall in Odapada Block of Dhenkanal District which is part of "Angul Talchar" declared as Critically Polluted Area at sl. no. 7 of MOEF&CC's OM No. J-11013/5/2010-IA.II(I) dated 15.03.2010. It had a CEPI score of 82.09.

However, the latest status as recorded in NGT order dated 14.11.2019 in the Original Application No. 1038/2018 is that CEPI score is 46.43 and is ranked at serial 94, and therefore, it is well below the rank of either critical (CEPI score >70) or severely (CEPI score 60-70) polluted area. Thus, the proposed activity can be considered with is CEPI score of 46.3.

3.14 PLACES OF TOURISM/RELIGIOUS/HISTORICAL INTEREST

No specific place of tourist importance falls within the study area. No places of historical importance are present in the study area.

FIG 3.28: LOCATION OF INDUSTRIES



Sl. No.	Industries Name	Distance (km)	Direction
1.	Tata Steel Ltd (formerly known as Bhushan Power & Steel Ltd.)	1.6	W
2.	Navbharat Ventures Ltd.	0.9	N
3.	BRG Iron & Steel Company Pvt. Ltd. (formerly known as Bhuvee Profile and Stainless Pvt. Ltd.)	2.4	NNW
4.	Lanco Power Plant	2.4	N
5.	Ravirun Vinmay Pvt. Ltd.	3.8	NW
6.	GMR Kamalanga Energy Ltd.	6.7	NNW
7.	MGM Minerals Ltd. (Steel Division)	4.4	SE
8.	Maa Tarini Stone Crusher, Karanda	6.5	SE
9.	Kanak Durga Stone Crusher	9.3	SE
10.	Crusher-1	6.8	ESE
11.	Crusher-2 (Sri Jagannath Stone Crusher)	9.3	ESE
12.	Crusher-3	9	SE
13.	Crusher-4	9.3	SE
14.	Crusher-5	8.7	SSE
15.	Tulshi Ricetech Private Ltd	9.6	W
16.	Shalivahana Green Energy Ltd.	3.8	SE
17.	Rungta Mines Ltd ' s Dhenkanal Steel Plant	1.9	S
18.	Brick kiln	2.2	NE
19.	Brick kiln	3.4	NE
20.	Brick kiln	3.1	NE
21.	Brick kiln	3.7	NNE
22.	Brick kiln	3.8	NNE
23.	Maa Santoshi Fly Ash Bricks	8.2	WNW

3.15 SEISMICITY

The Plant area falls in seismic Zone –III, which is a moderate risk zone.

3.16 SLAG AND TCLP CHARACTERISATION

The concentration of Mn, Fe, Zn, Cu, Pb, Ni, Cd, Co, Cr,Hg & As in Silico-manganese slag sample is given in **Table 3.27**. TCLP study of slag is given in **Table 3.28**.

TABLE 3.27: CONCENTRATION OF TOXIC & HEAVY METALS IN SILICO-MANGANESE SLAG SAMPLE.

Sl. No.	Parameter	Unit	Concentration in Slag Sample
1.	Mn	%	13.71
2.	Fe	%	0.202
3.	Zn	mg/Kg	26.81
4.	Cu	mg/Kg	23.28
5.	Pb	mg/Kg	5.69
6.	Ni	mg/Kg	3.49
7.	Cd	mg/Kg	BDL
8.	Co	mg/Kg	11.01
9.	Cr	mg/Kg	46.16
10.	Hg	mg/Kg	7.62
11.	AS	mg/Kg	63.44

Source: Report no. LT02-CCD/22/79 dated 24.01.2023 of IMMT (CSIR) Laboratory, Bhubaneswar

TABLE 3.28: SLAG ANALYSIS REPORT (MG/L)

Sl. No.	Metals	Concentration in TCLP or WET* leaching solutions of slag test sample,	Waste constituents concentration limits based on TCLP or STLC. Gazette of India, Extraordinary, Schedule-II
1	Hg	0.002	0.2
2	As	0.014	5.0
3	Total Cr	0.065	5.0
4	Cr VD	0.037	5.0
5	Cd	BDL	1.0
6	Pb	BDL	5.0
7	Mn	45.65	10.0
8	Ba	0.98	100
9	Se	0.009	1.0

Sl. No.	Metals	Concentration in TCLP or WET* leaching solutions of slag test sample,	Waste constituents concentration limits based on TCLP or STLC. Gazette of India, Extraordinary, Schedule-II
10	Ag	0.006	5.0
11	Co	0.038	80.0
12	Cu	0.0035	25.0
13	Ni	0.024	20.0
14	Zn	0.11	250
15	Sb	0.036	15.0
16	Mo	0.008	350
17	V	0.030	24.0

Source: Report no. LT02-CCD/22/79 dated 24.01.2023 of IMMT (CSIR) Laboratory, Bhubaneswar

3.17 COAL ANALYSIS

Coal for power plant shall be sourced from coal mines in Odisha. Coal analysis of Lingraj and Kaniha mines is given in **Table 3.29**.

TABLE 3.29: COAL ANALYSIS OF LINGRAJ AND KANIHA MINES

Parameters	Lingraj	Kaniha
Total Moisture (As received)	5.84%	5.80%
Surface Moisture	4.18%	4.16%
Inherent Moisture	1.66%	1.64%
Ash (Air dried)	44.28%	44.16%
Ash (As received)	42.40%	42.29%
Volatile Matter	26.42%	26.48%
Fixed Carbon	27.64%	27.72%
Gross Calorific Value (Air dried)	3658 k.cal/kg	3670 k.cal/kg
Gross Calorific Value (As received)	3503 k.cal/kg	3515 k.cal/kg

Source: Rungta Mines Ltd.

CHAPTER 4

ENVIRONMENTAL IMPACTS & MITIGATION

4.1 GENERAL ASPECTS

Rungta Mines Limited proposes to enhance production capacity of Expansion of Ferro Alloys Plant from 0.055 to 0.293 MTPA Ferro Alloys alongwith 150 MW CPP. The proposed units will be established within the existing plant as well as on additional land. The expansion plant will have an impact on land, air, water, noise, soil, ecology, socio-economics, etc. and measures shall be taken to minimize the impact.

The environment management plan includes the evaluation of total impacts after superimposing the predicted impacts over baseline data. This helps in incorporating proper mitigation measures wherever necessary for preventing deterioration in environmental quality. Keeping in mind the environmental baseline scenario as detailed in Chapter 3 and the proposed project activity described in Chapter 2, it is attempted to assess the likely impact and its extent on various environmental parameters in this chapter.

The important environmental parameters associated with such a project are as follows:

- Topography and drainage
- Climate
- Air environment
- Land environment
- Water environment
- Solid waste
- Noise environment
- Traffic density
- Ecology
- Socio-economic environment
- Occupational health and safety
- Historical Monuments

The beneficial impacts anticipated from an industrial project, irrespective of their relevance to the proposed project, would be the employment opportunity available.

4.2 TOPOGRAPHY AND DRAINAGE

4.2.1 Topography

4.2.1.1 Impact during construction phase

The core zone represents flat land having the ground elevation of the project area from 61 – 73 m above mean sea level, as per google earth elevation accessed on 24.03.2023. The existing plant area is devoid of any natural drainage or topographical features. The existing plant is already constructed and operational on 52.525 acres.

Change in topography shall occur in the expansion area of 93.575 acres as well as part of the existing area due to the construction of the additional buildings, sheds, additional boundary walls, stock yards, etc. in the expansion phase. Prior to the construction, leveling activities shall be carried out to raise plinth of some buildings or fill low lying portions within the plant area. This will be a permanent change in the topography since construction once achieved will not be reversed. There will be no impact on topography of the buffer zone since all construction activities are restricted within the project site.

4.2.1.2 Impact during operation phase

Once the construction has been completed, the topographical changes are permanent and irreversible. The handling of raw material in stock yards and solid waste in the solid waste yards will cause creation of upto 10 m high stacks in the designated stack areas. The height of these stacks will be dynamic in nature and will be reducing or decreasing as the stocks increase or decrease or solid waste is reused or disposed.

4.2.1.3 Management during construction

During construction, the management of the cutting and filling material has to be carried out so that the cutting is utilised to the extent possible for filling and requirement for disposal is not there. Similarly, the leveling shall be planned during detailed engineering and carried out in such a manner that minimum filling is there. The excavated material shall be used in landscaping and filling low lying areas within and around the project site. Thus, the intention is to balance the digging & filling so that no extra earth is left or required. As soon as the material is dug, it will be simultaneously utilised. Planning shall be done in advance, during detailed engineering, for the location and quantity of utilisation of the dug out material. The change in topography in the core zone will lead to changes in the sheet flow pattern of rain water within the core zone. For that provision of storm water drains shall be made.

4.2.1.4 Management during operation

The stacks of raw material and solid waste will have dynamic height depending on the quantity of material. The height of the stacks will be

governed by the angle of repose of the material, such that the stacks do not slide and spill over into adjoining area. Similarly, the height of inflammable materials like coke, coal etc shall be restricted to prevent natural build up of heat and prevent auto-ignition.

4.2.2 Drainage

4.2.2.1 Impact during construction phase

The impact on drainage in expansion area will be as a consequence of changes in topography. A perusal of the toposheet, google earth image and site visit showed there is no perennial river or water body in the project area. There are low lying areas where the agricultural fields have been made even though they fall in the path of the seasonal drains shown on toposheet.

As discussed in the section related to topography, the sheet flow of rain water shall get affected within the core zone due to construction of buildings. There will be collection of rain water in excavated areas and obstruction due to dumped material. There may occur water logging and slippery & hazardous conditions, in absence of mitigation measures.

Impact on the drainage in the buffer zone is not anticipated as no construction will be taking place outside plant boundary.

4.2.2.2 Impact during operation phase

As the sheet flow runoff from plant site pre-construction was going into natural drain, there will be marginal change in the volume of flow into the natural drain after construction since run off water from the plant area will get captured and harvested in surface water reservoir or recharged to ground.

The plant area after expansion shall be 59.126 ha. Annual rainfall as per Climatological normals for the period 1991-2020 is 1272.6 mm. Thus, maximum possible runoff volume that can be harvested has been calculated in section 4.6.5 related to rain water harvesting as getting affected can be 0.259 MCM/ annum of which 76.5% will occur in June-September. This run off water would have otherwise flown into Lingara Nadi, which joins Brahamani river in the north east of the project, within the study area.

Brahmani river flow was estimated as 10149 cum on 20.02.2010 as per “Piping Corridor Survey And Bathymetric Survey For Dhenkanal Steel Plant In And Around Dhenkanal, Odisha” by Geosolution Proservices Pvt. Ltd., Kolkata. As per the “Hydrological Data (Unclassified)” of Central Water Commission, December 2018, the nearest hydrological observation site on Brahmani river is at Jenapur. The maximum discharge observed was 10372.06 cumecs (26/09/2011) and minimum observed was 4.88 cumecs (10/05/1980) based on data of 1979-2015. The annual 50%

dependable flow has been identified as 15847.41 MCM/annum for the period 2005 to 2015. The runoff from plant can atmost reduce by 0.259 MCM/annum, which is 0.0016% of the likely flow in Brahmani river with 50% dependability. Thus, the impact shall be negligible on the flow of Brahmani river.

Buffer zone: Impact on the drainage in the buffer zone is not anticipated on any drainage features as none will be disturbed due to operation of project outside core zone. Only the volume of flow into Brahmani river via Lingara nala will reduce by 0.0016% of the likely flow in Brahmani river with 50% dependability.

4.2.2.3 Management during construction

- Detailed engineering planning of storm water drains has to be carried out prior to the commencement of construction of plant based on contour plan (tentative plan given in **Fig 4.1**).

- The planning has to be carried out in such a manner that water from the west side of the plant has to be evacuated to the east side of the plant.

- Construction of storm water drains has to take into account the design rainfall as per PWD norms to ensure adequate cross section

- The sections of the drains has to be designed as per the PWD norms

- The design after review and approval of the civil engineering team has to be followed while construction is ongoing

- The construction of the storm water drains has to be completed along with the construction of the buildings

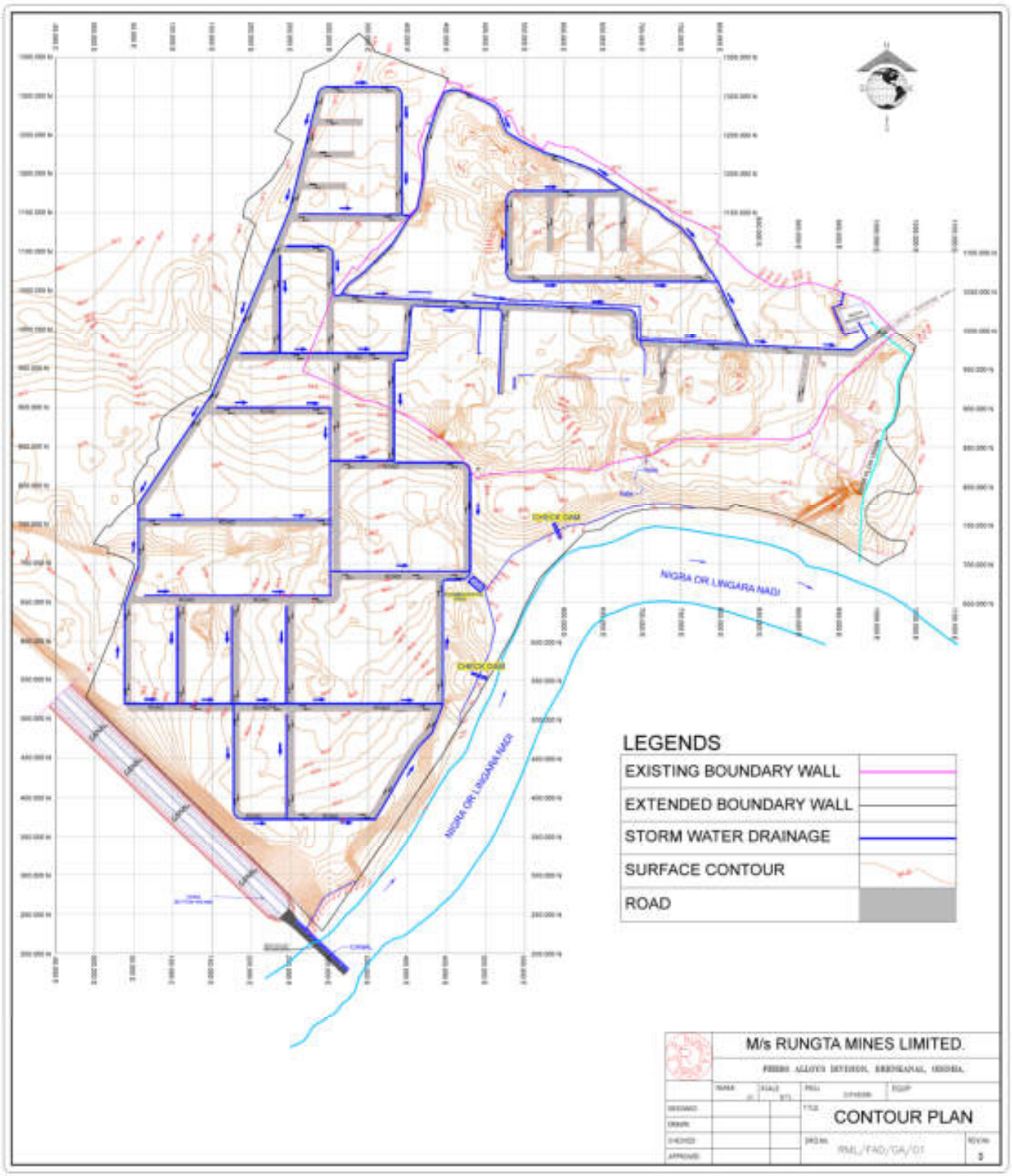
- The drains have to be made pucca, connected to the desilting chamber prior to raw water reservoir

- The roof top water has to be connected to rain water harvesting structures to collect the runoff and recharge to ground

4.2.2.4 Management during operation

During operation, repair and maintenance has to be carried out periodically for all storm water drains. It has to be ensured that solid waste or raw material falls into the storm water drains and blocks them. The free flow of water has to be ensure at all times during rains as per the contour map indicating road details and drainage details given in **Fig 4.1**.

FIG 4.1: CONTOUR MAP



4.3 CLIMATE AND METEOROLOGY- IMPACT AND MITIGATION

a) Construction phase - impact & mitigation

The plant and colony construction will have marginal impact on climate or meteorology during construction phase as mostly civil/ mechanical work concerning erection of plant will be carried out. There will be use of fossil fuel in the vehicles bringing raw material, DG sets used during construction or any specific diesel based machinery such as JCB, dozer, etc. The emissions will be insignificant and temporary to have any impact on the long term climate of the region. The construction of buildings permanently will cause localised changes in micro-climate due to the urban heat island effect due to which the buildings gain heat more than the surroundings and radiate back to the environment for a longer time.

b) Operation phase- impact & mitigation

The project envisages installation of several units within the ferro alloys plant, many of which will require cooling. This will add substantial heat and increase the ambient temperature locally. The project envisages installation of power generating units based on Fluidized Bed Combustion (AFBC or CFBC). Char generated from the sponge iron kiln will also be utilized as source of fuel for the power plant. However, the gases get discharged at about 150°C. Thus, during operational phase, slight variation in temperature is likely on account of heat generation from various units and their cooling requirement.

Due to concrete buildings heat island phenomenon will continue to occur, which will be localized and manifest itself in the premises of the plant. Therefore impact on climate will be small and insignificant.

The other activity, which can be considered in this context is the stack emissions and thermal pollution. The thermal pollution will be restricted to the plant site while the stack emissions will contribute incremental values of pollutants and a thermal plume near the emission point till natural dispersion equalises the temperature. The climate is controlled by the pressure depression in the Bay of Bengal and is not anticipated to be affected by local activities under discussion. Therefore no mitigation measures are need to be taken.

Further, carbon dioxide (green house gas) contributing fossil fuels will be in the form of diesel and furnace oil used to operate the trucks, vehicles and rolling mill, which will be a necessity. In order to sequester CO_2, plantation is a suitable method. Hence, 33% of the plant area shall be under greenbelt.

In coal/ middling/ fines based power plants, the carbon dioxide emissions are a global concern since it is a green house gas (GHG). In addition to power plants, combustion or loss of Fixed carbon from coal will take place in other units to a limited extent. The CO_2 emissions have been calculated

on the basis of the likely fixed carbon content of the various fuels that will be consumed in the plant will be follows:

TABLE 4.1: LIKELY CARBON DIOXIDE EMISSION FROM PLANT

Raw material	Quantity, TPA	Fixed carbon content %		Quantity of CO_2 likely to be released, TPA
Coal	832,190	35.09		1,070,723
Charcoal/ Coke	133120	80-86 (Consider 83)		4,05,129
Coke breeze and fines	19656	80-86 (Consider 83)		59,820
		Mol. weight		
		Material	**CO_2**	
Dolomite [$CaMg(CO_3)_2$]	96,088	184	44	22,978
Limestone [$CaCO_3$]	97736	100	44	43,004
Total				**1,601,654**

Note :
It is assumed that entire carbon from fuels by forming CO_2 and one CO_2 molecule from limestone & dolomite will be released

The total quantity of CO_2 likely to be released will be 1.6 MTPA. The mitigation plan will be as per the decarbonisation program.

c) Decarbonisation program

Decarbonisation is the process of reducing and removing net greenhouse gas outputs by reducing the amount emitted, using zero or low-emission energy sources, increasing energy efficiency and by carbon sequestration. Carbon dioxide emissions are a global concern since it is a green house gas.

Carbon capture and utilization (CCU) is the process of capturing carbon dioxide (CO_2) to be recycled for further usage. Carbon capture and utilization may offer a response to the global challenge of significantly reducing greenhouse gas emissions from major stationary (industrial) emitters. As such, there is no practically applicable technology to sequester the quantity of CO_2 at present. However, research is underway across the world and pilot projects have been executed. If any such technology becomes commercially viable in the future, it may be taken up. Plantation is a suitable method to sequester carbon and 33.11% of the plant area shall be put under greenbelt. Approximately 48,955 trees over an area of 48.38 acre shall be there within project boundary for carbon sequestration. One mature tree absorbs approximately 22 kg of CO_2/ yr. Hence, 48,955 trees will absorb 32,310 tonnes of CO_2 over a period of 30 years.

In addition to plantation, the fossil fuel based power requirement can be offset through renewable sources by installing approximately 20 MW solar

power plant on roof top. This will lead to a saving of 0.014 T/hour coal equivalent to 435 TPA of CO_2 saving. Also the road side poles within the project site will be gradually changed over to solar lighting.

4.4 AIR QUALITY

4.4.1 Impact on air quality

a) Construction phase

The construction and erection of proposed expansion plant and equipment will generate dust resulting in higher SPM levels in surrounding area. Further due to deployment of various mechanical equipment and transport vehicle, enhanced SO_2 and NO_2 levels are expected. Thus, air quality is likely to be affected which will require mitigation measures. However, the impact on the air quality during construction phase will be localized, temporary and reversible in nature.

Dust emissions from non-residential and commercial construction are a function of the total area of land disturbed and the duration of activities done. Based on field studies, the AP-42 (Compilation of Air Pollutant Emission Factors**,** US EPA, Section 13.2.3) gives the total suspended particulate emission factor estimate as 2.69 megagrams (Mg)/hectare/month of activity. The entire plant area is 59.126 ha but the construction work will be done in different patches of open spaces within the existing plant area as well as the undisturbed area of expansion area. The facilities are going to be established as per construction plan. The duration of the construction activity will last as long as it has been scheduled. Thus assuming 10% area disturbed over 3 months, the total suspended particulate (TSP) shall be 47.7 tonnes or 530 kg/day, in absence of any sprinkling for dust suppression.

The likely impacts on air quality during the construction phase are comparatively low and reversible, and managed through proper maintenance and operation of construction/erection equipment as well as periodic sprinkling.

b) Operation phase

During operation phase, the various operations would discharge particulates and gaseous pollutants, which must be controlled before discharge into atmosphere. Two types of generation and discharge of pollutants, viz., fugitive emissions and stack emissions, have been considered.

(I) Stack emission of gases from the various units and the associated facilities will add pollutants to the atmosphere, which will require mitigation measures.

(II) Fugitive emissions comprise mostly of dust generated due to handling of raw material and solid waste. The products such as ferro alloys and sinter will not contribute to dust generation.

4.4.1.1 Stack emissions

The details of stacks and stack emissions for existing and proposed expansion are summarized in **Table 4.2**.

TABLE 4.2: STACK DATA FOR EXISTING AND PROPOSED EXPANSION OF FERRO ALLOYS PLANT

Sl. No.	Production Units	Stack Height (m)	Dia (m)	Temp. (^{0}C)	Exit gas Volume (Nm^3/ hr)	Exit gas Velocity (m/s)	Emission Rate (mg/Nm^3)			Emission Rate (g/sec)		
							PM	SO_2	NO_2	PM	SO_2	NO_2
A	**EXISTING PLANT (OPERATIONAL)**											
I	**Submerged Arc Furnaces(SAF)**											
	9 MVA SAF	30	1.8	140	59,492	9.83	30	20	12	0.496	0.335	0.196
	18 MVA SAF	30	2	140	79,322	10.62	30	30	18	0.661	0.670	0.392
II	**Sinter Plant (1x150 TPD)**											
	Sinter Plant (150 TPD)	30	1.8	50	54,172	7.00	30	7	0	0.451	0.109	0.000
III	**D.G. Sets (2 x 500 KVA)**											
	DG-1 (500 KVA)	10	0.25	464	1,986	29.40	2	4	81	0.001	0.002	0.044
	DG-2 (500 KVA)	10	0.25	464	1,986	29.40	2	4	81	0.001	0.002	0.044
B	**AFTER EXPANSION (INCLUDING EXISTING)**											
1	9 MVA SAF	30	1.8	140	59,492	9.83	30	42	15	0.496	0.694	0.247
2	9 MVA SAF	45	1.8	140	59,492	9.83	30	42	15	0.496	0.694	0.247
3	9 MVA SAF	45	1.8	140	59,492	9.83	30	42	15	0.496	0.694	0.247
4	9 MVA SAF	45	1.8	140	59,492	9.83	30	42	15	0.496	0.694	0.247
5	9 MVA SAF	45	1.8	140	59,492	9.83	30	42	15	0.496	0.694	0.247
6	9 MVA SAF	45	1.8	140	59,492	9.83	30	42	15	0.496	0.694	0.247
7	9 MVA SAF	45	1.8	140	59,492	9.83	30	42	15	0.496	0.694	0.247
8	9 MVA SAF	45	1.8	140	59,492	9.83	30	42	15	0.496	0.694	0.247
9	18 MVA SAF	30	2	140	79,322	10.62	30	63	22	0.661	1.387	0.494
10	18 MVA SAF	45	2	140	79,322	10.62	30	63	22	0.661	1.387	0.494
11	18 MVA SAF	45	2	140	79,322	10.62	30	63	22	0.661	1.387	0.494
12	18 MVA SAF	45	2	140	79,322	10.62	30	63	22	0.661	1.387	0.494
	Sinter Plant											
13	Sinter Plant-Bagfilter (150 TPD)	30	1.8	50	54,093	6.99	30	7	0	0.451	0.109	0.000
14	Sinter Plant-Bagfilter (600 TPD*)	45	2	50	70,997	7.43	30	22	0	0.592	0.438	0.000
15	Sinter Plant-Bagfilter (600 TPD*)	45	2	50	70,997	7.43	30	22	0	0.592	0.438	0.000
16	Sinter Plant-Bagfilter (600 TPD*)	45	2	50	70,997	7.43	30	22	0	0.592	0.438	0.000
	Chrome Ore beneficiation (2000 TPD)											
17	No. 1- 500 TPD	30	2	100	52,450	6.34	30			0.437		
18	No. 2- 500 TPD	30	2	100	52,450	6.34	30			0.437		
19	No. 3 - 500 TPD	30	2	100	52,450	6.34	30			0.437		
20	No. 4 - 500 TPD	30	2	100	52,450	6.34	30			0.437		
	Power Plant CFBC/ AFBC											
21	2x20 MW (2x80 TPH)	90	3.2	150	3,22,695	17.28	30	100	100	2.689	8.964	8.964
22	2x20 MW (2x80 TPH)	90	3.2	150	3,22,695	17.28	30	100	100	2.689	8.964	8.964
25	1x20 MW (1x80 TPH)	90	1.6	150	77,447	16.59	30	100	100	0.645	2.151	2.151
26	2x25 MW (2x100 TPH)	110	3.2	150	3,43,348	18.38	30	100	100	2.861	9.537	9.537
	D.G. Sets (2 x 500 KVA)											
27	DG-1 (500 KVA)	10.00	0.25	464	1,986	29.40	2	4	81	0.001	0.002	0.044

Sl. No.	Production Units	Stack Height (m)	Dia (m)	Temp. (^{0}C)	Exit gas Volume (Nm^3/ hr)	Exit gas Velocity (m/s)	Emission Rate (mg/Nm^3)			Emission Rate (g/sec)		
							PM	SO_2	NO_2	PM	SO_2	NO_2
28	DG-2 (500 KVA)	10.00	0.25	464	1,986	29.40	2	4	81	0.001	0.002	0.044
29	DG-3 (1000 KVA)	10.00	0.25	497	2,411	37.30	3	5	133	0.002	0.003	0.089
30	DG-4 (1000 KVA)	10.00	0.25	497	2,411	37.30	3	5	133	0.002	0.003	0.089
31	DG-5 (1000 KVA)	10.00	0.25	497	2,411	37.30	3	5	133	0.002	0.003	0.089

*** or 5x120 TPD**

The gases coming out from the units shown above contain pollutants like particulate matter, SO_2 and NO_2. These gas streams are a major source of air pollution, if control/ mitigation measures are not incorporated. The control measures are discussed in **Section 4.4.2**.

4.4.1.2 Fugitive emissions from storage areas and material handling

For the purpose of assessing fugitive emission from the plant before and after expansion, the sources of fugitive emission have been identified as follows:

TABLE 4.3: FUGITIVE EMISSION SOURCES AND EMISSION RATES

Pollution source	Loading area, m^2	Material loaded, TPH	Emission rates µg/m^2-s		
			SPM	PM10	PM2.5
Existing					
Raw material stock yard-1	4047.12	27.4115	$2.49966X10^{-9}$	$9.37373X10^{-10}$	$5.38989X10^{-10}$
After Expansion (including existing)					
Raw material stock yard-1	4047.12	96.7851	$5.82047X10^{-9}$	$2.18268X10^{-9}$	$1.25504X10^{-9}$
Raw material stock yard-2	1955.2	46.7577	$7.39986X10^{-9}$	$2.77495X10^{-9}$	$1.59559X10^{-9}$
Raw material stock yard-3	5679.46	135.822	$5.20469X10^{-9}$	$1.95176X10^{-9}$	$1.12226X10^{-9}$

The fugitive emission factors have been calculated as per the research presented in “Emission factors for the quantification of dust in Indian Coal Mines” by Mrinal K. Ghose (Published by Center for Mining Environment, ISM, Dhanbad in its "Journal of Scientific & Industrial Research", Vol 63, September 2004 on pages 763-768). Continuous loading and unpaved surfaces have been considered and emission rate has been calculated as follows:

Particulate emission, lb/tonne of material loaded =
(0.0018*(S/5)*(U/S)*(h/10))/(((M/2)^2)*5)

Where S = Silt %, considered as 2%
U = Wind speed (mph at 4 m AG), considered as 4.175 mph
M= Unbound moisture in material (%), considered as 10%
h= Drop height (ft), considered as 1 ft

4.4.1.3 Simulation model for prediction of ground level concentrations due to stack and fugitive emissions

In order to predict the impact of the project, air quality prediction modelling has been carried out using US EPA’s ISCST3 model. ISC3 short term

mode (ISCST3) is a steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial complex. This model can account for the following: settling and dry deposition of particles; downwash; point, area, line, and volume sources; plume rise as a function of downwind distance; separation of point sources; and limited terrain adjustment.

The following options were considered while modeling to predict the incremental ground level concentrations of pollutants due to emissions from the existing & expansion plant.

- The stack emission and fugitive emission details for the existing and proposed unit have been adopted from **Table 4.2 and Table 4.3.**
- The prediction has been done to estimate concentration value over a radial distance of 10 km from the source for receptors outside the project boundary.
- Emission rate was considered constant throughout the averaging period.
- Ground level concentrations were computed without any decay co-efficient.
- The micro-meteorological observations made during the study period have been taken as input meteorological data. Calm wind conditions recorded during study period were also considered.

The dispersion modelling has been carried out for the following phases:

- **Existing -** Stack emissions and fugitive emissions from material handling yards for configuration approved in consent to operate for 0.055 MTPA ferro alloys.
- **After Expansion -** Stack and fugitive emissions from the entire project of 0.293 MTPA ferro alloys and 150 MW CPP due to stacks & material handling in stock & solid waste yards
- **Increment -** this is the resultant increment due to expansion obtained from a difference of the “existing” scenario from the “after expansion” scenario

The maximum computed concentrations in the entire study area is given in **Table 4.4** and on the ambient air quality stations is given in **Table 4.5**.

In addition to above, various scenarios have been calculated as follows:

1) **Normal** operation of APCM (assuming operation as per design efficiency).

2) **Abnormal** operation of APCM (assuming 10% decline in all APCM with respect to design efficiency).

3) **Emergency** in case of failure of APCM of stack 26 which has peak emissions.

4.4.1.4 Resultant GLC due to plant

The predicted incremental ground level concentration obtained due to stack emissions and fugitive emissions when superimposed on baseline concentration falls within the National Ambient Air Quality Standards for Residential Areas as can be seen in **Table 4.4 and Table 4.5**.

TABLE 4.4: CALCULATED MAXIMUM GROUND LEVEL CONCENTRATION FOR EXISTING PLANT (0.055 MTPA FERRO ALLOYS) AND PROPOSED EXPANSION OF PLANT TO 0.293 MTPA FERRO ALLOYS (ALL VALUES IN (µg/m^3)

Pollutant	Incremental GLC			Max. Baseline observed	Resultant	NAAQS 2009
	Existing	After Expn.	Increment due to expansion			
(a)	(b)	(c)	(d)=(b)-(c)	(e)	(f) = (c)+(e)	(g)
PM10	4.61	26.40	21.79	67.90	89.69	100
PM2.5	2.65	15.18	12.53	41.60	54.13	60
SO_2	6.71	40.67	33.96	16.20	50.16	80
NO_2	4.37	14.92	10.55	20.20	30.75	80

**** detailed calculation given in Annexure XXVII***

TABLE 4.5: CALCULATED MAXIMUM INCREMENTAL GROUND LEVEL CONCENTRATION (µg/m^3) AT AMBIENT AIR QUALITY STATIONS DUE TO FERRO ALLOYS PLANT EXPANSION

Pollutant	Station name	Existing Plant area (Admin building)	Bhanup-arha village	Gandijhara village	Chararha garhia village	Jharha-bandh village	Narahari-pur Shasan village	Meram-undali Bazar	Motanga village
PM10	1. Incremental GLC for present working	1.25	1.43	0.84	0.35	0.41	0.42	0.49	0.44
	2. Incremental GLC after expansion	4.97	4.55	3.18	1.94	1.66	1.95	2.16	1.98
	3. Increment GLC from expansion	3.72	3.12	2.34	1.60	1.26	1.53	1.67	1.54
	4. Baseline	67.90	62.00	64.00	60.20	62.70	54.80	62.00	60.00
	5. Resultant (3+4)	71.62	65.12	66.34	61.80	63.96	56.33	63.67	61.54
PM2.5	1. Incremental GLC for present working	0.72	0.82	0.48	0.20	0.24	0.24	0.28	0.25
	2. Incremental GLC after expansion	2.86	2.62	1.83	1.12	0.96	1.12	1.24	1.14
	3. Increment GLC from expansion	2.14	1.80	1.35	0.92	0.72	0.88	0.96	0.88
	4. Baseline	41.60	37.20	37.60	32.90	37.20	32.20	36.30	35.10
	5. Resultant (3+4)	43.74	39.00	38.95	33.82	37.92	33.08	37.26	35.98

Pollutant	Station name	Existing Plant area (Admin building)	Bhanup-arha village	Gandijhara village	Chararha garhia village	Jharha-bandh village	Narahari-pur Shasan village	Meram-undali Bazar	Motanga village
SO2	1. Incremental GLC for present working	0.98	1.99	1.24	0.46	0.63	0.64	0.63	0.60
	2. Incremental GLC after expansion	7.57	16.41	9.03	8.75	4.64	6.52	9.35	7.34
	3. Increment GLC from expansion	6.59	14.41	7.79	8.28	4.02	5.88	8.72	6.74
	4. Baseline	16.20	12.30	14.00	13.50	12.60	8.50	15.50	14.40
	5. Resultant (3+4)	22.79	26.71	21.79	21.78	16.62	14.38	24.22	21.14
NO2	1. Incremental GLC for present working	0.15	1.12	0.67	0.99	0.40	0.43	0.41	0.36
	2. Incremental GLC after expansion	4.86	6.18	6.55	7.05	2.49	4.21	6.35	5.44
	3. Increment GLC from expansion	4.71	5.06	5.89	6.07	2.09	3.78	5.93	5.08
	4. Baseline	20.20	18.40	15.70	15.30	13.00	10.30	22.10	18.30
	5. Resultant (3+4)	24.91	23.46	21.59	21.37	15.09	14.08	28.03	23.38

Note : Refer Annexure XVII for input & output of model

A perusal of above tables shows that the pollutant concentrations in the ambient air will remain below the National Ambient Air Quality Standard prescribed by CPCB (**Annexure IV**).

The highest resultant values in study area are likely to be 89.69 µg/m^3, 54.13 µg/m^3, 50.16 µg/m^3 and 30.75 µg/m^3 for PM_{10}, $PM_{2.5}$, SO_2 and NO_2 and the highest resultant values at ambient air quality stations are likely to be 71.62 µg/m^3, 43.74 µg/m^3, 22.79 µg/m^3 and 24.91 µg/m^3 for PM_{10}, $PM_{2.5}$, SO_2 and NO_2 which will be well within the permissible limits for residential and rural areas after adding to the baseline values. (Standards for PM10 is 100 µg/m^3, $PM_{2.5}$ is 60 µg/m^3, SO_2 80 µg/m^3 and NO_2 80 µg/m^3 as per CPCB).

4.4.1.5 Simulation model for prediction of ground level concentrations due to transportation

The anticipated traffic volume to and from the plant is expected to be in the range of 38 trips x 2 = 76 number of trucks per day at present and 514 trips x 2 = 1028 number of trucks per day after expansion, considering trucks of 25 T capacity.

For estimating the increase in the air pollutants due to transportation of raw material and finished products CALINE 4 model has been used. The assumptions, input data and other details are given in **Annexure XVIII** along with GLC isopleth maps and the results are summarised in **Table 4.6**.

TABLE 4.6: TOP 10 VALUES FOR 24 HOUR AVERAGE INCREMENTAL GLCS DUE TO TRANSPORTATION DUE TO FERRO ALLOYS PLANT (µg/m^3)

Pollutant	Maximum incremental GLC (µg/m^3)				
	Incremental GLC (µg/m^3)			Receptor No.	Section
	Existing	After Expansion	Increment		
PM_{10}	1.81	194	0.14	31	S02
$PM_{2.5}$	0.44	0.47	0.03	31	S02
SO_2	0.00	0.00	0.00	31	S02
NO_2	0.30	0.33	0.03	31	S02

4.4.1.6 Cumulative impact due emission and roads

Cumulative impact of the proposed expansion of Ferro alloys plant along with the impact due to transportation have been given **Table 4.7**.

TABLE 4.7: CALCULATED MAXIMUM GROUND LEVEL CONCENTRATION FOR PROPOSED EXPANSION OF FERRO ALLOYS PLANT AND ITS TRANSPORTATION (ALL VALUES IN (µg/m^3)

Pollutant	Incremental GLC		Max. Baseline observed	Resultant	NAAQS 2009
	Plant	Road			
(a)	(b)	(c)	(d)	(e) = (b)+(c)+(d)	(f)
PM10	21.79	0.14	67.90	89.83	100
PM2.5	12.53	0.03	41.60	54.16	60
SO_2	33.96	0.00	16.20	50.16	80
NO_2	10.55	0.03	20.20	30.78	80

Note : Refer Annexure XVII & Annexue XVIII for input & output of model

TABLE 4.8: CALCULATED MAXIMUM INCREMENTAL GROUND LEVEL CONCENTRATION (µg/m^3) AT AMBIENT AIR QUALITY STATIONS DUE TO PLANT AND TRANSPORTATION

Station name	PM_{10}			$PM_{2.5}$			SO_2			NO_2		
	Plant	Road	Total	Plant	Road	Total	Plant	Road	Total	Plant	Road	Total
Existing Plant area (Admin Building)	3.72	0.00	3.72	2.14	0.00	2.14	6.59	0.00	6.59	4.71	0.00	4.71
Chararhagarhia village	3.12	0.00	3.12	1.80	0.00	1.80	14.41	0.00	14.41	5.06	0.00	5.06
Bhanuparha	2.34	0.00	2.34	1.35	0.00	1.35	7.79	0.00	7.79	5.89	0.00	5.89
Jharhbandh	1.60	0.00	1.60	0.92	0.00	0.92	8.28	0.00	8.28	6.07	0.00	6.07
Naraharipur Shasan	1.26	0.00	1.26	0.72	0.00	0.72	4.02	0.00	4.02	2.09	0.00	2.09
Motanga	1.53	0.04	1.57	0.88	0.01	0.89	5.88	0.00	5.88	3.78	0.01	3.79
Meramundali Bazar	1.67	0.00	1.67	0.96	0.00	0.96	8.72	0.00	8.72	5.93	0.00	5.93
Gandijhara	1.54	0.00	1.54	0.88	0.00	0.88	6.74	0.00	6.74	5.08	0.00	5.08
			3.72			2.14			6.59			4.71

Note: Refer Annexure XVII & Annexure XVIII for input & output of model

TABLE 4.9: CUMULATIVE IMPACT DUE TO INCREMENTAL GLC ON AMBIENT CONCENTRATION (µg/m^3) DUE TO FERRO ALLOYS PLANT

Station name	PM10			PM2.5			SO_2			NO_2		
	Cumulative increment*	Base-line	Resul-tant	Cumulative increment*	Base-line	Resu-tant	Cumulative increment*	Base-line	Resul-tant	Cumulative increment*	Baseline	Resul-tant
Existing Plant area (Admin Building)	3.72	67.90	71.62	2.14	41.60	43.74	6.59	16.20	22.79	4.71	20.20	24.91
Chararhagarhia village	3.12	62.00	65.12	1.80	37.20	39.00	14.41	12.30	26.71	5.06	18.40	23.46
Bhanuparha	2.34	64.00	66.34	1.35	37.60	38.95	7.79	14.00	21.79	5.89	15.70	21.59
Jharhbandh	1.60	60.20	61.80	0.92	32.90	33.82	8.28	13.50	21.78	6.07	15.30	21.37
Naraharipur Shasan	1.26	62.70	63.96	0.72	37.20	37.92	4.02	12.60	16.62	2.09	13.00	15.09
Motanga	1.57	54.80	56.37	0.89	32.20	33.09	5.88	8.50	14.38	3.79	10.30	14.09
Meramundali Bazar	1.67	62.00	63.67	0.96	36.30	37.26	8.72	15.50	24.22	5.93	22.10	28.03
Gandijhara	1.54	60.00	61.54	0.88	35.10	35.98	6.74	14.40	21.14	5.08	18.30	23.38

**** Refer Table 4.8***

A perusal of above table shows that the pollutant concentrations in the ambient air will remain below the National Ambient Air Quality Standard prescribed by CPCB (**Annexure IV**). The highest resultant values at ambient air quality stations are likely to be 71.62 µg/m^3, 43.74 µg/m^3, 26.71 µg/m^3 and 28.03 µg/m^3 for PM_{10}, $PM_{2.5,}$ SO_2 and NO_2 which will be well within the permissible limits for residential and rural areas after adding to the baseline values. (Standards for PM_{10} is 100 µg/m^3, $PM_{2.5}$ is 60 µg/m^3, SO_2 80 µg/m^3 and NO_2 80 µg/m^3 as per CPCB).

4.4.2 Management of air quality

Following mitigation measures shall be taken:

a) Construction phase

Major sources of air pollution are dust and fumes from construction operation and equipment, welding fumes, and radiation during non-destructive testing of weld joints. The mitigation measures to be followed are:

- Water spraying on material to be handled before beginning work and spraying on unpaved surfaces twice a day will improve the working conditions and minimize dust pollution. 80% dust suppression can occur reducing the TSP to around 106 kg/day.
- Water spraying during loading and unloading operations to be carried out, where applicable
- The designated areas for roads and parking spaces shall be black topped at the earliest.
- Transportation to be carried out in covered trucks.

- Transport vehicles shall be maintained leak proof to avoid spillage of rubble and soil.
- Welding operations shall be carried out within cordoned areas.
- Preventive maintenance of all trucks, earthmovers and construction equipment to be done as per manufacturers norms

As per AP-42 of US EPA, the recommended measures for various activities during construction phase are summarised in **Table 4.10**.

TABLE 4.10: RECOMMENDED MEASURES FOR CONTROL OF FUGITIVE EMISSIONS DURING CONSTRUCTION

Emission Source	Recommended Control Method(s)
Debris handling	Wind speed reduction, Wet suppression#
Truck transport##	Wet suppression, Paving
Bulldozers	Wet suppression^
Pan scrapers	Wet suppression of travel routes
Cut/fill material handling	Wind speed reduction, Wet suppression
Cut/fill haulage	Wet suppression, Paving, Chemical stabilization
General construction	Wind speed reduction, Wet suppression Early paving of permanent roads

 # Dust control plans should contain precautions against watering programs that confound track out problems.

Loads could be covered to avoid loss of material in transport, especially if material is transported offsite.

^ Excavated materials may already be moist and not require additional wetting. Furthermore, most soils are associated with an" optimum moisture" for compaction.

b) During operation phase

The air quality prediction exercise carried out for stack emission gave highest resultant ground level concentrations at air quality monitoring stations of 89.69 µg/m^3 for PM10, 54.13 µg/m^3 for PM2.5, 50.16 µg/m^3 for SO_2 and 30.75 µg/m^3 for NO_2, which are within the limits of national ambient air quality standards.

Following general control measures shall be adopted:

- Keeping stack heights as per CPCB norms wherein the sulphur emissions from the stack are used to calculate the stack height ($Q=14H^{0.3}$ where H is sulphur dioxide emissions in kg/hr and H is stack height in metres). In this case they will be 45 m for proposed SAF, 45 m for sinter plant and 90 m & 110 m for various boilers of captive power plant.

- Use of high efficiency electrostatic precipitators with power plant. In other units i.e. submerged arc furnace, sinter plant and chrome beneficiation, PTFE based high volume bag filters with 25% extra capacity shall be installed.

- PM level below 30 mg/Nm^3 will be released from power plant and in all other units. Some of these emissions will be equal or much below the norms specified by MOEF&CC vide GSR 414(E) dated 30.05.2008, GSR 277(E) dated 31/03/2012 and SO 3305(E) dated 07.12.2015.

- In order to control the air pollution in the submerged arc furnace, fume extraction system will be installed. It consists of a suction hood followed by a bag filter. The suction hood will be mounted on the head of furnace as well as above tapping point, the hot gases will be sucked through the hood. The blower will suck the flue gases through the hood along with pipe, which will be connected to the bag filter. The filter will separate the solid particles, which will be removed periodically. The clean air will exhausted through the stack, in which the dust concentration is less than 30 mg/Nm^3.

- The use of dolomite, limestone as additive in power plant boilers will reduce SO_2 emissions significantly.

- Controlled combustion air supply, controlled combustion temperature and use of low NOx burners will control NO_2 formation in power plant. Provision and space for FGD to be kept as well as additional NOx control technology to comply to SO 3305(E) dated 07.12.2015.

- Regular monitoring and awareness among workers will help in controlling air pollution.

- Fugitive dust control management :

    - Fugitive dust due to handling of raw materials, coal etc. will be controlled by sprinkling or dry fogging system at ground hoppers and transfer points of conveyor system.

    - Leakage from the equipment, ducts and transfer points shall be regularly checked and stopped.

    - Fugitive emissions of smoke, gases and heat in and around the furnace top and tapping point will be removed through fume extraction systems.

    - For heat dissipation in the work zones arising from furnaces adequate ventilation will be ensured.

    - Few raw materials and most finished product are and will stored in covered sheds. Tarpaulin cover is/ will be used whenever and wherever necessary in case temporary storage of raw material is required in open.

- Water sprinkling is and will be done regularly over all open slag yard.
- Tyre wash at gate shall be provided
- Water sprinkling on roads within the plant as well on the road within the plant will be carried out periodically.
- In order to prevent the spread of fugitive dust, green belt of adequate width has been developed along the plant boundary.

➢ Summary of air pollution control systems used and their efficiency is given below:

Sl. No.	Proposed Plant facilities	Component	Air Pollution Control Device	% Efficiency (approx)
1	Raw Material handling systems in the plant for various units	Transfer points, storage yards, charging hoppers, etc	Sprinkling/ dry fog system	70-80
2	Submerged Arc Furnace	Furnaces, tapping point	Suction Hood & Bag filters	99.99
3	Sinter plant	Raw material bins	Dry fog, enclosure	70-80
		Sintering plant	Bag filter	99.99
4	Slag recovery unit	Material handling, crushing, sieving, enclosed building	Sprinkling	70-80
5	Chrome beneficiation plant	Crushing and sieving	Bag filter	99.99
6	Captive power plant	Exhaust of boiler	Electrostatic precipitator (provision for FDG & SNCR/SCR)	99.99
7	Slag yard, Ash storage	Storage	Sprinkling	70-80
8	Internal roads	(1) Road surface, (2) gate	(1) Sprinkling, (2) tyre wash	70-80

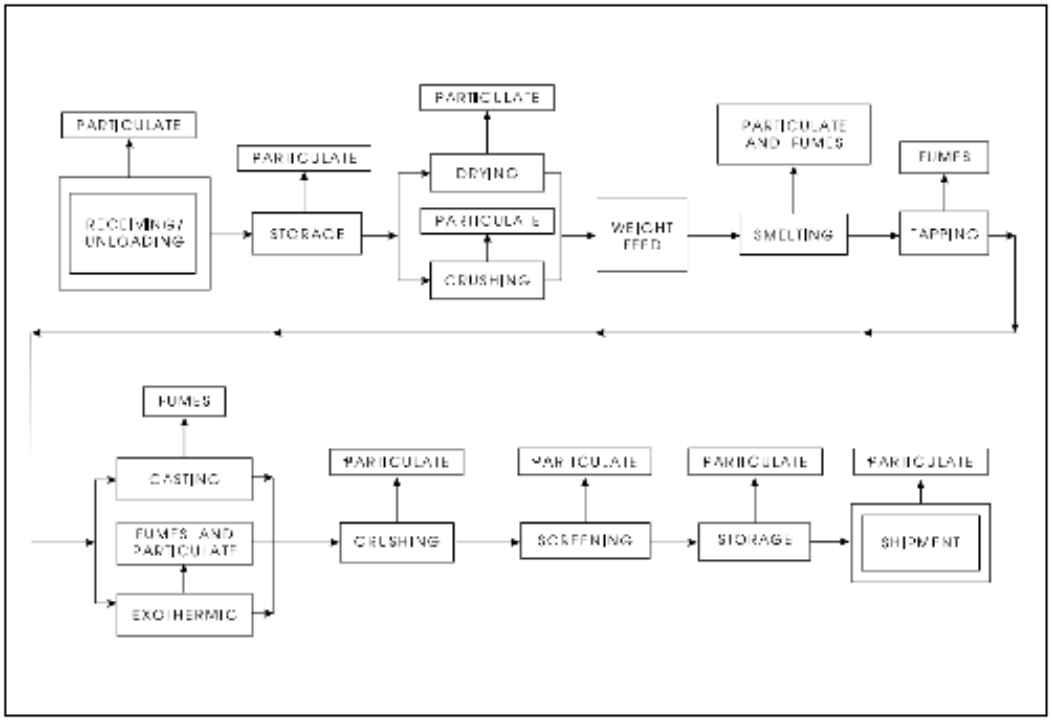
The above are described in subsequent sections.

4.4.3 Control of emissions from various sub-units

4.4.3.1 Ferro Alloy plant (Submerged Arc Furnace)

It can be seen from the process flow that particulates and fumes are the major emissions at different steps as shown in **Fig 4.2**.

FIG 4.2: PARTICULATE AND FUME EMISSION AT DIFFERENT STEPS IN A FERRO ALLOYS PLANT



Source: Fig 2.2-1, AP-42, US EPA

Unburnt reaction gases will be pulled from furnace top through fume extraction system using fans and sent through duct to high efficiency bag filters which will remove the gases and collects the particulate matter. The clean gas pass on through the fans and will exit through the stack.

Bag Filter System will be a compartment type PTFE bag filter based bag house. It will be installed & commissioned to comply with the emission norm (30 mg/Nm^3) prescribed by MoEF&CC. The flue gases from furnace will be sucked through an interconnecting ductwork by induced draft fan & exhausted to the chimney after passing through bag filter. The bag filter capacity shall be designed excess of the designed flow volume.

Apart from the source emission generated during furnace operation, considerable quantity of fugitive emission is generated during tapping operation. The tapping period is intermittent and for a short period. The **fume exhaust hood** with duct will be provided around the furnace circumference to capture the fumes generated during tapping operation. The cleaning will be off line & will take place after tapping operation is over. Emission level at the outlet of Bag House for furnace fumes & tapping fumes will be less than 30 mg/ Nm^3.

Dry Fogging System or sprinkling is proposed for materials handling and transfer points. Dry fog will agglomerate dust at the source by using atomizing nozzles to create fine water droplets that impinge the airborne dust. In case of water sprinkling, the size of droplets will be larger. The dust will then settle back onto the conveyor or stockpile. Momentum and water spray coverage is controlled to penetrate and enshroud the dust,

while droplet size and turbulence is adjusted to contact and remove the particulate from the air, with a minimum of water.

4.4.3.2 Emission Sinter plant

- ***Plant dedusting system*** - The dust laden air will be sucked through hoods and duct work and clean the air in bag filter before releasing into the atmosphere through the stack.

- ***Bag filter -*** Bag filter of suitable capacity will be used for removing the particulates before exhausting the gas to the atmosphere. The unit will have high efficiency to ensure less than 30 mg/Nm^3 of dust in the outgoing gases from the stack. The gas will pass through the filter bags depositing the dust on the outside of the filter bags. The dust will be allowed to build up until it forms a dust cake. The filtration will take place with the help of dust cake and filter media, ensuring removal of fine particulates. The cleaning of filter bags will be OFF LINE, i.e. the compartment under the cleaning cycle is an isolated using outlet pneumatic damper. Thus, at any time one compartment will be under cleaning and the rest are in operation. The dust cleaned from bag filters will be returned back to the mixing bin and reused. Cleaned gas from bag filter will be exhausted through the stack.

- ***Waste gas system -*** Waste gas main of sinter machine of adequate diameter and length fitted with expansion joints, wind box connection, down legs for dust discharge and sliding supports will be provided. Automatic double cone valves will be provided.

- ***Waste Gas Fan -*** One waste gas fan with electric motor, silencer and heat and sound insulation will be provided. A metallic / concrete self supported stack, lined with acid proof brick lining will be provided.

4.4.3.3 Stack emissions from AFBC boilers

- High efficiency electrostatic precipitator will be provided for separation of dust from the flue gas. The ESP would bring down the concentration of particulate matter to less than 30 mg/Nm3 level. Overall efficiency of ESP will be around 99.99%.

- For control of SO2, a stack of adequate height varying from 90 m to 110 m for different sized boilers shall be provided. Stoichiometric lime dosing shall be done to absorb the sulphur dioxide generated during the combustion process. Hence, dosing will be done as per sulphur content of incoming coal.

- Controlled combustion air supply, controlled combustion temperature and use of low NOx burners will control NO_2 formation in power plant. Provision and space for FGD to be kept as well as additional NOx control technology to comply to SO 3305(E) dated 07.12.2015.

- The boiler bottom hoppers and E.S.P. hoppers will be provided with a dense phase ash handling system. The dust collected from these hoppers will be sent to an ash silo by pneumatic conveying system. The ash stored in the ash silo will be loaded in trucks/ bulkers and sent for reuse at brick manufacturing units, back filling in mines, land leveling etc or storage at designated ash storage area within plant site.

4.4.3.4 Emissions from Metal Recovery Plant

During operation phase, following control measures shall be followed:

1. Metal recovery plant shall work on dry process (crushing, screening) followed by wet process (jigging).

2. Dust due to handling, crushing and sieving will be controlled by sprinkling in the dry section of the process.

3. In the west process, air pollution control measure shall not be required

4.4.3.5 Emissions from Chrome Beneficiation Plant

During operation phase, following control measures shall be followed:

1. Chrome beneficiation plant shall work on dry process (crushing, screening) followed by wet process (beneficiation).

2. Dust due to handling, crushing and sieving will be controlled by sprinkling in the dry section of the process.

3. In the west process, air pollution control measure shall not be required

4.5 LAND ENVIRONMENT

4.5.1 Impact on Land & its Management

4.5.1.1 Construction phase

Impact: The existing plant area is 52.5250 acres (21.257 ha) which is already disturbed by the construction of plant facilities, buildings, roads, etc. It is already under industrial use. Expansion shall take place on 93.575 acres (37.869 ha). Thus, the total land after expansion shall be 146.10 acres (59.126 ha).

The possible impact in expansion phase on landform of the area will occur due to land grading, digging, filling, excavation of earthworks, making roads, boundary wall and plant related civil construction activity. Exact volume of excavated earthworks is difficult to estimate at this preliminary stage. The plant layout has been designed after considering the slope of the land.

Management : No earth will be brought from outside or disposed outside the premises, if possible. In case filling is required in any portion of the land, it shall be done by using solid waste from other plants of the Company. Any excavated earth will be stored at earmarked place with proper slopes and utilized for levelling and landscaping purpose within the plant premises. The surplus earth generated during excavation will be used for grading work, utilized in making approach road and landscaping activities. Compaction of the disturbed land reclaimed will be done after completion of construction and the area designated for plantation will be regenerated with trees and bushes. Excavation work will be carried out during dry season and avoided during rainfall events to prevent soil erosion and washout of excavated materials.

4.5.1.2 Operation

Impact: The land use of the core area will be changed permanently during the construction and remain changed during the operation phase. Land use of the pre-project agricultural area has been changed to industrial for existing 21.257 ha land. Additional 37.869 ha land will be converted into industrial area. During construction phase, parts of the project area will be converted into internal roads, water reservoir, buildings, green belt and plantation, etc. The features of the plot will undergo changes due to construction. Break-up of land utilization of existing and proposed expansion plant is shown in **Table 4.11**.

TABLE 4.11: BREAK UP OF PLOT AREA

Sl. No.	Description	Existing			Proposed Additional		Total After Expansion		
		Area in acres	Area in ha	%	Area in acres	Area in ha	Area in acres	Area in ha	%
1.	Plants, facilities & tailing management	20.888	8.453	39.77	49.525	20.042	70.413	28.496	48.20
2.	Stock yards	3.5	1.416	6.66	2.5	1.012	6	2.428	4.11
3.	Area for solid waste management	1.5	0.607	2.86	5	2.023	6.5	2.631	4.45
4.	Green belt & plantation	17.5	7.082	33.32	30.88	12.497	48.38	19.579	33.11
5.	Administration buildings	0.5	0.202	0.95	1	0.405	1.5	0.607	1.03
6.	Water reservoir	6.04	2.444	11.50	0	0.000	6.04	2.444	4.13
7.	Roads	2.597	1.051	4.94	4.67	1.890	7.267	2.941	4.97
	Total	**52.525**	**21.257**	**100.00**	**93.575**	**37.869**	**146.100**	**59.126**	**100.00**

Source: Rungta Mines Ltd.

Management : Three tier greenbelt (atleast 10 m wide) is being and will be developed all along the plant boundary so that the visual aesthetic is improved, it acts as a pollutant sink, forms a barrier against noise propagation and forms a micro-habitat for small sized fauna. As required in the ToR, the area between the edge of the Lingara Nala and the facilities

shall be maintained as 50 m and the intervening area shall be either left undisturbed, used for internal road or planted as part of green belt.

4.5.2 Soil quality

Impact: The existing plant area is 21.257 ha which is already disturbed by the construction of plant facilities, buildings, roads, etc. In the expansion area of 37.869 ha, soil quality might change **during construction phase** due to handling of construction material but may also change **during operation** due to open yard storage of raw materials like manganese ores. Further, even temporary dumping of solid wastes like slag on land would also deteriorate soil quality, if appropriate control and mitigation measures will not be implemented.

Management: **During construction**, the topsoil generated during construction will be preserved and spread over the area identified for development of green belt and afforestation. The slag yard will have a stable liner to avoid leaching of materials to ground water. The raw material stack yard will also be having concrete impervious base to protect the soil below it.

During operation, the waste shall be stored on area that is lined by impervious material. All raw material stock piles will have a stable liner to avoid leaching of materials to ground water. The run off and leachates from the raw materials stack yard and solid waste disposal yard, respectively shall not be allowed to mix with storm water drainage. Runoff will be collected in a garland drain around the stock yard, settled and treated in a batch type ETP prior to reuse in sprinkling or horticulture. Excess runoff shall be released to the natural drain after monitoring and ensuring that the quality is within permissible limits.

4.6 WATER ENVIRONMENT

4.6.1 Water consumption

Total water requirement of the existing plant is 216 KLD (9 KLH) and additionally 5472 KLD (228 KLH) shall be there for proposed expansion phase. Therefore, total water requirement shall be 5688 KLD (237 KLH) 100% of the waste water generated shall be utilized for green belt watering, sprinkling on roads, stock yards & solid waste disposal areas, ash conditioning as well as back in the process. The plant will maintain zero waste water discharge system.

Water withdrawal permission for 733.972 KLD from surface water has been obtained from Office of Superintending Engineer, Rengali Right Canal Division No. II, Dhenkanal vide letter dated 14.02.2023. The water is being withdrawn from Lingara Nala for the existing project. Balance shall be applied for prior to expansion. Water permission for withdrawal of 30 KLD from borewell, has been taken from CGWA, vide NOC no. CGWA/NOC/IND/REN/1/2021/5971. This is valid from 08/05/2021 to

07/05/2024. Refer **Annexure XXIII** and **Annexure XXIV** for copies of the permissions. Rain water shall also be collected and reused within plant site.

4.6.2 Waste water generation from various sources

Details of effluent generation from various sub units is given in **Table 4.12**.

TABLE 4.12: WASTE WATER GENERATION AND REUSE

Plant facilities	Water requirement (KLH)	Discharge (KLD)	Waste water Utilization
Ferro Alloy Plant			Evaporation loss and rest of water treated in Common Effluent Treatment Plant and used for Dust suppression
Submerged Arc furnaces	26.67	0.53	Furnace shell cooling blow down to common basin for reuse in dust suppression, green belt watering, ash conditioning, etc.
Briquetting	0.75	0.04	To common basin for reuse in dust suppression, green belt watering, ash conditioning, etc.
Metal Recovery Plant	4.44	0.00	Evaporation loss & loss with material
Chrome Beneficiation Plant	25.38	0.00	Evaporation loss & loss with material 100% of tailing will be collected in tailing tank, settled/ filter pressed, and recovered water reused back for beneficiation
Sinter	24.38	1.71	to common basin for reuse in dust suppression, green belt watering, ash conditioning, etc.
CPP	150	4.50	shell cooling blow down to common basin for reuse in dust suppression, green belt watering, ash conditioning, etc.
Sub Total	**232**		
Drinking Water and Sanitary	4.7	4.22	Evaporation loss and rest of water treated in Sewage Treatment Plant and used in green belt and dust suppression
Sprinkling	0.14	0.00	Evaporation loss
Green belt	0.34	0.00	Evapotranspiration & seepage
Total Water consumption	**237**	**11**	

Run off (during rainfall days and monsoon) from raw material and solid waste storage will be routed through catch pits of sufficient volume to settle out suspended solids present in the storm water runoff. Batch type ETP shall be provided to treat the run off, if required, prior to reuse of the water.

The list of water pollution control systems existing and envisaged are summarised in **Table 4.13**.

TABLE 4.13: LIST OF WATER POLLUTION CONTROL SYSTEMS (EXISTING AND PROPOSED)

Source	Pollutants	Control systems
Raw materials/ solid waste storage yards	Suspended Solids	● Garland drains, Catch pits and Multiple desilting chambers & settling tanks of 2.5 X 1 X 1 m. ● Batch ETP for rainy days
Power plant : ● Cooling tower blow down ● boiler blow down	Temperature, Dissolved solids, pH	325 m^3 capacity Common Basin and reuse in ash quenching, dust suppression, green belt, avenue plantation & sprinkling within and outside plant.
● Submerged Arc Furnace cooling system ● Briquette plant ● Sinter plant	Dissolved Solids	Common Basin as above
Chrome Beneficiation plant (tailings)	suspended solids, dissolved solids & contaminants	Tailing tanks (1 nos.) (of 1 week capacity, assuming 20% concentrate)= 7,920 m^3 Tank size = 1600 m^2 X 5 m depth Recovered water 100% reused in beneficiation.
Metal recovery plant (jigging unit)	suspended solids, dissolved solids & contaminants	Modular tanks provided with jigging units & recovered water 100% reused back in jigging
Workshop for R&M	Oil & Grease, SS	OWS of 0.2 m^3 & settling tank
Canteens, toilets	pH, BOD, Suspended Solids	STP - 150 KLD and few decentralised septic tanks
Storm water drains all along internal roads & interceptor drain on periphery	Suspended Solids	Desilting chamber prior to storage in rain water harvesting ponds and raw water reservoir

4.6.3 Waste water sources and treatment

Waste water generation from the operation phases will be on account of the following activities which are described along with the treatment option:

1. The prevention and control of water pollution aims at conserving the make-up water by recycling around 98% of the waste water. However,

occasionally small quantities of effluents have to be discharged to prevent build up of excess dissolved solids. **Industrial wastewater** comprising blow downs from cooling towers and boilers of pwer plant, wastewater from water pre-treatment, effluent from service water uses like plant washings, leakages, etc. and blow downs/ effluents from ferro alloys, sinter plant, briquetting plant, etc contain high TDS & SS and will be collected in a "Common Basin" and utilized for dust suppression, ash quenching and green belt watering.

2. **Chrome beneficiation Plant-** Tailing/ slime shall be generated from the beneficiation plant. Dewatering of tailing storage area shall be done in tailing tank as well as filter press and the recovered water will be recycled back in the process. Filtered tailing shall be disposed in tailing dump in wet cake form after drying in slime pond. The area will be lined with the HDPE lining.

3. **Jigging plant -** waste water shall be generated from the washing process in the jigging part of the metal recovery plant. The water shall be separated from the washed material through gravity and collected in the jigging tank for 100% reuse in the jigging plant.

3. **Run off** (during rainfall days and monsoon) from dolomite, limestone, ore handling areas and run off from solid waste storage & handling areas. will be routed through catch pits of sufficient volume to settle down suspended solids present in the storm water runoff. A batch ETP to treat this water prior to reuse is envisaged

4. **Sewage from buildings**- Sewage from the toilets, washrooms and canteen will be treated in Sewage Treatment Plant. After treatment, treated waste water will be used in horticulture. At decentralised locations, there shall be septic tank systems as well.

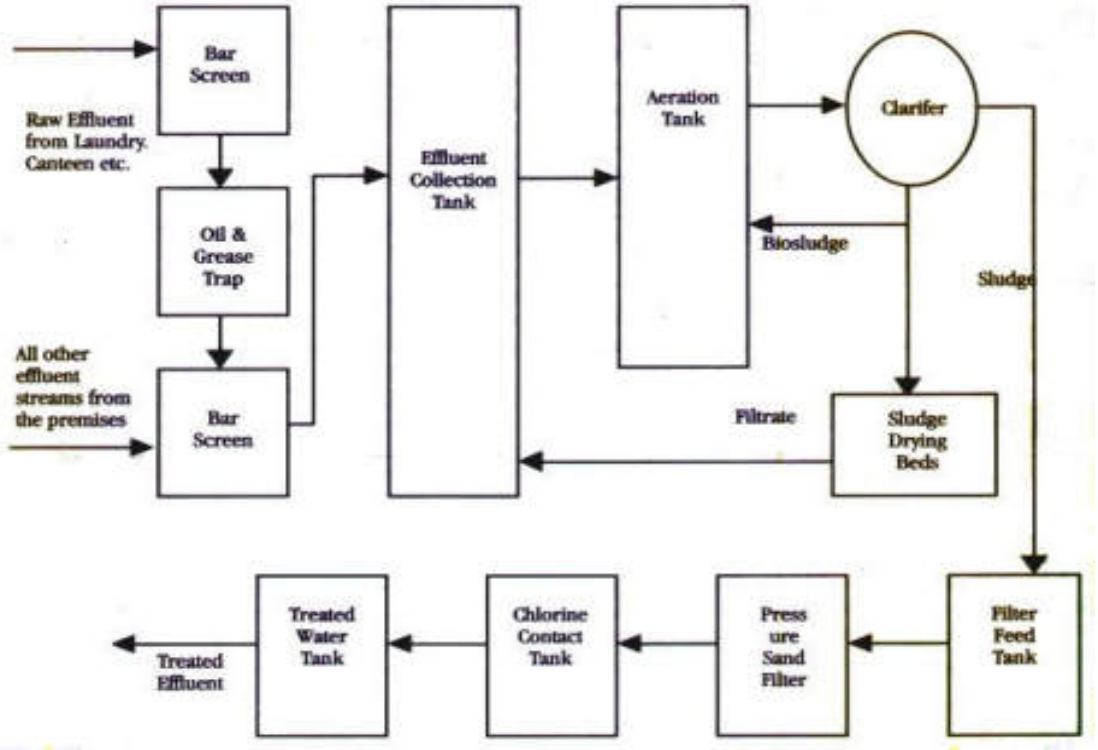
   The plant sanitary sewage from administrative blocks etc will be segregated from industrial waste and routed to the sewage treatment plant (STP) through sewer network. The STP shall constitute of Bar screens, Oil and grease Trap, Equalization tank, Aeration tank, Clarifier tank, Filter feed tank, Pressure sand Filter, Tertiary Treatment and treated effluent water tank step by step shall be as described below:

i)	Bar screens	:	For screening and removal of coarse suspended solids from the effluent while it passes through the bar scanner.
ii)	Oil and grease Trap	:	Removes the floating oil and grease from the effluent
iii)	Equalization tank	:	Collects and equalizes the raw effluent
iv)	Aeration tank	:	Mixes the effluent and provides excess of air (oxygen). The aerobic bacteria in the biomass oxidize the suspended and dissolved organic matter. The organic matter is biodegraded by the bacterial mass. Complex carbon compounds are degraded and CO_2 generated. Complex organic

			nitrogen compounds are degraded to form ammonia, nitrite and nitrates.
v)	Clarifier tank	:	Separates suspended biological material. Part of the sludge is returned to aeration tank to provide biomass for the treatment and excess is flown to sludge drying bed.
vi)	Filter feed tank	:	The treated effluent is stored before passing to pressure sand filter
vii)	Pressure sand Filter	:	Removes the fine suspended mater from the treated effluent.
viii)	Tertiary Treatment	:	Chlorine or UV will be used for disinfection of waste water.
ix)	Clean treated effluent water tank	:	Holds water before lifting to high-level storage tanks.

The schematic diagram of the sewage treatment plant is given in **Fig 4.3**.

FIG 4.3: SCHEMATIC DIAGRAM OF SEWAGE TREATMENT PLANT



5. **Maintenance, workshop & plant cleaning :** Oil & grease during repair and maintenance of machinery and vehicles will get spilled for which the water collected in the workshop will be passed through oil-water separator (OWS) to remove oil & grease. The water from plant washing or maintenance work will also be passed through OWS to collect oil & grease, which is being and will be stored in a separate container and disposed to authorized recycling vendor.

Recirculating cooling water system is & shall be provided in the plant. The recirculating cooling water pumps to the various consumers (power plant, furnace, etc.) in the plant will pump cold water from the cooling tower basin.

The hot water return from the consumers will return to the cooling tower for cooling and recirculation.

To meet the requirement of demineralization water as make-up water for boiler, de-mineralization plant of suitable capacity will be provided. Water quality shall meet the Turbine and Boiler Manufacturers' recommendation.

Entire waste water from complex shall be treated and reused for green belt watering, sprinkling and dust suppression. There shall be no liquid waste discharge from the plant premises except during monsoon when the sprinkling and watering demand will be almost negligible.

4.6.4 Ground water pollution and management plan

As such the plant working has been planned on zero discharge basis therefore no pollution of any form to ground water is anticipated on account of industrial activity.

The company does not propose to use ground water for any industrial purpose during operation of the plant, hence, no adverse impact on account of industrial activity is foreseen. Ground water will be used for human consumption only.

The company proposes to enhance ground water recharge by adopting artificial recharge practice as discussed in the next section.

4.6.5 Rain water harvesting

Rain water harvesting scheme will be implemented in the total project after proposed expansion. It is proposed to collect the rain water in the surface water reservoir. The water that shall get collected in the surface water reservoir is calculated as given in **Table 4.14**.

TABLE 4.14: SURFACE WATER RESERVOIR IS CALCULATED

Sl. No.	Plant Facilities	Area for harvesting, m^2	Runoff co-efficient	Annual Rainfall Average, mm	Run off harvested, m^3	Remark
1	Plants, facilities & tailing management (assuming 20% builtup)	56992	0.9	1272.6	65275	To raw water reservoir
2	Stock yards	24280	0.8	1272.6	24719	To settling tank & then raw water reservoir
3	Area for solid waste management	26310	0.8	1272.6	26786	To settling tank, batch ETP & then common basin for reuse
4	Green belt & plantation	195790	0.3	1272.6	74749	Recharges ground water through rain water harvesting trenches
5	Administration	6070	0.9	1272.6	6952	Recharges ground water

Sl. No.	Plant Facilities	Area for harvesting, m^2	Runoff co-efficient	Annual Rainfall Average, mm	Run off harvested, m^3	Remark
	buildings					through rain water harvesting pits
6	Water reservoir	24440	1	1272.6	31102	Directly into Raw water reservoir
7	Roads	29410	0.8	1272.6	29942	To raw water reservoir via desitling chambers
	Total	363292			259525	
	Reused for plant (1)+(2)+(3)+(6)+(7)				177824	To raw water reservoir (68.5%)
	Recharged to ground (4)+(5)				81701	Recharge to ground (31.5%)

No. of rainy days = 66.1 days

Water harvested on rainy days = 177824 KL

Average daily harvesting = 2690.2 KL

Losses (evaporation, 1 inch/day) = 61.1 KL

Average daily water available = 2629.1 KL

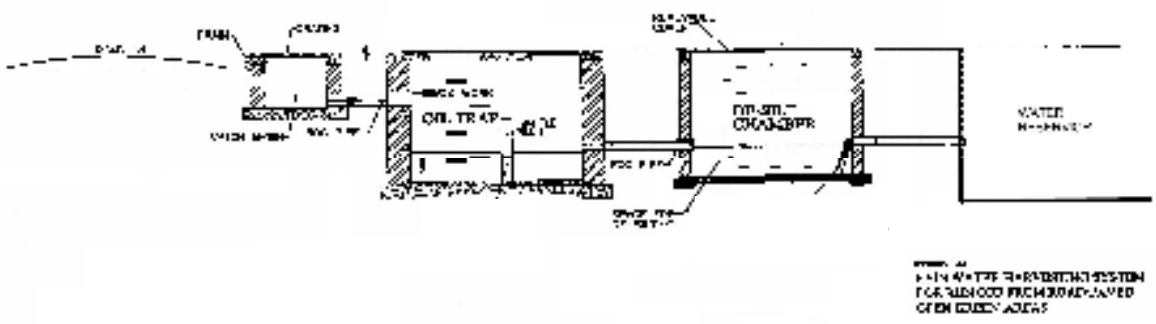
Daily industrial water requirement = 5568 KLD

On rainy days, the harvested can meet = 47 % water requirement of plant, thus reducing, water withdrawal requirement from surface water source

Water availability on non rainy day = 0

The surface run off water shall be passing through settling chambers before reaching the reservoir or rain water harvesting ponds to reduce suspended particulate load. Once the suspended solids settle further in the rain water harvesting pond, the water will be pumped to the raw water reservoir for utilisation. The typical settlement system is shown in **Fig 4.4.**

FIG 4.4: RAIN WATER OIL TRAP AND DESILTING CHAMBER PRIOR TO RESERVOIR



4.7 SOLID WASTE - GENERATION, IMPACT AND UTILISATION

4.7.1 Impact

A. Construction phase:

During the construction phase, the generation of solid waste will be low and comprises of rejected and waste construction material and predominantly of used packaging material. It will be managed as follows:

- Construction wastes will be segregated as much as possible at site itself to increase the feasibility of recycling concrete and masonry as filling material and steel pieces as saleable scrap.
- Garbage collection points will be established around the work sites.
- Empty packaging materials, drums, glass, tin, paper, plastic, pet bottles, wood, thermocol and other packaging materials, solder butts, etc will be disposed through recyclers.
- Waste from nearby plants in the 10 km radius will also be available and useful for leveling of land.
- The construction spoils, Muck generated from drains and sedimentation pits, etc. will be temporarily stored at designated dumpsite located inside the plant premises. Later on these wastes will be used for landfilling / leveling work within the plant premises. Careful design, planning and good site management would minimize muck mixed with soil, concrete, mortars and cement grouts.

B. Operation phase:

The main solid waste generated from existing and proposed expansion of ferro alloys plant will be slag. Besides this dust from bag filters as well as ash from captive power plant in expansion phase shall be generated. Domestic waste shall be generated from the plant office.

4.7.2 Management

The quantum of solid waste generation from the different units of existing 0.055 MTPA and proposed expansion to 0.293 MTPA along with 150 MW capacity Captive Power Plant and its management is given in **Table 4.15**.

TABLE 4.15: SOLID WASTE GENERATION AND MANAGEMENT (TPA)

Name of Solid Waste	Generation, TPA	Used inhouse, TPA	Transported outside, TPA	Remark
1. Ferro Alloy Plant				
Fe-Mn Slag	352051	166176	185875	47% directly reuseable for Fe-Si manufacturing in house and balance sold to other

Name of Solid Waste	Generation, TPA	Used inhouse, TPA	Transported outside, TPA	Remark
				manufacturers
Bag Filter Fines (Fe-Mn)	58675	58675	0	100% dust will be reused in Sinter Plant.
Slag (Si-Mn)	115400	115400	0	100% sent to metal recovery plant for Manganese recovery(~5%), balance (95%) used as construction sand
Bag Filter Fines (Si-Mn)	4616	4616	0	100% dust will be reused in Sinter Plant*.
Bag Filter Fines (Fe-Si)	20480	20480	0	100% dust will be reused in Sinter Plant
Slag (Fe-Si)	5632	0	5632	100% sold, reusable in cupola furnace
Slag (Fe-Cr)	274176	274176	0	100% send for Chrome recovery (~5%) through Chrome Beneficiation Plant. After TCLP test on remaining material (~95%), it will be used as landfill/ base material in roads (when Cr within permissible limits), else sent to the nearest TSDF facility. Fe-Cr slag is also reusable for 100% sold, reusable for making in refractory castables in non-recovery coke oven batteries, coal-fired power boilers, industry furnaces, etc
Bag Filter Fines (Fe-Cr)	44237	44237	0	100% dust will be reused in Sinter Plant.
Slag (Pig Iron)	88627	88627	0	100% sent to metal recovery plant for Fe recovery(~5%), balance (95%) used as construction sand
Bag Filter Fines (Pig Iron)	4616	4616	0	100% dust will be reused in Sinter Plant
2. Metal Recovery Plant				
Rejects (Si-Mn)	109630	0	109630	100% used as construction sand
Rejects (Pig Iron)	84196	0	84196	100% used as road base, filling and construction
3. Chrome Beneficiation Plant				
Rejects	198000	0	198000	100% reusable. The waste tailings shall be collected in tailing decantation tank, dewatered and dredged. The

Name of Solid Waste	Generation, TPA	Used inhouse, TPA	Transported outside, TPA	Remark
				dewatered tailing shall passed through filter press and converted to cakes. The cake will be stored in a tailing dump, which will be lined with the HDPE lining. After TCLP test on the cakes, it can be used as landfill/ base material in roads (when Cr is within permissible limits), else it will be sent to the nearest TSDF facility at Jajpur, Odisha. Area required for Tailing cake storage = 3500 m^2 for 17,100 m^3 dried tailing cake for 90 days with height 5-6 m. The fine contents going with the wash water is usually in the range of 1%, based on experience of the Company, and this too is recoverable, dewatered and re-useable for sintering.
4. Sinter Plant				
Sinter Return Fines	84240	84240	0	100% dust will be reused in Sinter Plant.
Bag filter (sinter plant)	11232	11232	0	100% dust will be reused in Sinter Plant.
5. Power plant (CFBC)				
Fly ash	283287	35840	247447	For handling of fly ash of the steam generator, dense phase, pneumatic conveying system will be provided. The ash collected in the hoppers located in economizer, air pre-heated sections of ESP hoppers will be pneumatically conveyed and collected. 100% reused as per Fly Ash Utilisation Notification 1999 and its amendments of 2003, 2009, 2016. Sent for cement making, brick making, block making, aggregate making and road making. Area will be earmarked in the

Name of Solid Waste	Generation, TPA	Used inhouse, TPA	Transported outside, TPA	Remark
				solid waste storage yard for emergency storage of ash.
Bottom Ash	70822	0	70822	100% reused as per Fly Ash Utilisation Notification 1999 and its amendments of 2003, 2009, 2016. Area will be earmarked in the solid waste storage yard for emergency storage of ash.

Slag yard has been designated separately for slag storage till re-utilised. The slag yard will have stable liner and garland drain connected with settling tank for settlement of solids from rain water runoff.

Transportation of solid waste from point of generation to slag yard shall be done in tractor trolleys. As the slag storage site is proposed within the plant premises, transportation will not be a major problem. Water sprinkling shall be done to minimize airborne particulate matter. Periodical road cleaning and maintenance of roads shall also be carried out to avoid air pollution problem due to dust. Maintenance of tractor trolleys shall be done to avoid break downs & road blockages.

Unplanned disposal of these solid wastes can have severe adverse impact on the environment; therefore, adequate control and mitigation measures are to be taken, which have been spelt out in **Table 4.16** as well as those below for **other wastes**:

- **Soiled cotton / cloth wastes** (generated during cleaning of machines and equipment) will be collected in bins and sent for municipal disposal or to co-processsors for combustion.

- **Electronic wastes** and used batteries will be collected and given to authorized recyclers. Management of e-waste shall be in line with the E-Waste (Management) Rules, 2016.

- The **municipal solid waste** (domestic) is being and will be segregated. The biodegradable waste will be composted/vermi-composted and used as manure for green belt maintenance. Recyclable materials like packaging materials, empty drums, bottles, glass, metals, paper, plastic, etc will be given to recyclers. The non-biodegradable component will be disposed in designated sanitary landfill site on weekly basis. All the process will be carried out as per Solid Waste Management Rules, 2016.

- **Hazardous waste** management is and shall be done for following as per Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016.

TABLE 4.16: HAZARDOUS WASTE GENERATION

Sl. No.	Category of HW as per Schedules I, II & II of Rules	Hazardous Waste description	Mode of disposal
1	Schedule- I Stream - 5.1	Used/ spent oil	Storage in containers over impervious floor under well ventilated covered shed followed by disposal through captive use/ authorised TSDF facility

The nearest TSDF facility is at Jajpur (approximately 130 km aerially). Till disposal, the hazardous waste storage within the plant will follow CPCB's "Guidelines for Storage of Incinerable Hazardous Wastes by the Operators of Common Hazardous Waste Treatment, Storage and Disposal Facilities and Captive HW Incinerators". Following points will be taken care of:

- Storage in Shed for incinerable hazardous wastes
- Separate sheds for non compatible waste
- Impervious floor, raised plinth level (150 mm)
- Waste management is and will also be done under following applicable rules:
  - In first aid centre- as per Biomedical Waste (Management & Handling) Rules, 2016
  - Plastic Waste Management Rules, 2016 and its amendments (2022)
  - Battery Waste Management Rules, 2022
- Flyash shall be collected in dry form from the ESP and use in manufacturing of Bricks and road making closed trucks and given to prospective entrepreneurs for cement making, brick making, block making, aggregate making and road making.

Details of solid waste storage area

Company has earmarked 2.631 ha (Existing: 0.607 ha; proposed expansion: 2.023) or dumping and stacking the solid wastes. This will serve more as temporary storage yard as 100% of the waste is recyclable or reusable.

However, taking due precautions, the dumping area is and will be well protected with garland drain all around the stacking area. The garland drain would have slope from all sides so that the rain water can travel by gravity through the slope up to collection pit. This garland pit will be constructed with pitch stones. Vertical baffle walls will be constructed at suitable intervals at the bend points of garland drain in both side of the

vertical wall in alternate manner to settle the solid waste that flow along with water in the garland drain. The deposited material will be manually drawn out from the garland drain to minimize the silting at water collection tank.

The stacking of solid wastes will be done properly, layer by layer in various areas that too step by step. Care shall be taken in dumping area about proper approach roads for transportation. Stacking / dumping of different solid wastes shall be done on separate dumping areas identified for them within the solid waste disposal yard. Each tipper/ tractor trailer shall be unloaded uniformly in planned manner so that equal height of stack is maintained all around at all the times.

4.8 NOISE AND VIBRATION

4.8.1 Noise

Construction phase: During construction phase, the equipment used for construction will be the main noise sources which will have temporary and reversible impact on the noise level of the area. The movement of vehicles bringing construction material and plant components for installation will also generate noise. Construction activities such as cutting, welding, use of vibration machines, etc shall also generate noise. The workers in the vicinity of construction activities, construction machinery, vehicles, etc will be exposed to noise during working hours.

Operation phase: In the existing and proposed expansion plant - furnaces, sinter machines, crushers, sieves, boiler, TG, loading and unloading, moving vehicles, moving machinery parts, DG sets, ID fans, motors, pumps etc are and will be the major noise sources. The entry gate area is and will be the traffic-affected and hence, a noise prone area.

After the establishment of the proposed expansion plant, noise sources & traffic affected area will become a major noise concerned areas. The sources of noise generation during operation phase will be as follows:

- Operation of the furnaces and other sub-units
- Material handling operations, crushers
- ID Fans, motors, pumps
- Trucks, dumpers, loaders, scrappers and earth-movers
- Operation of turbines, etc.

Operation of plant equipments are and will continuously generate noise, which will have adverse impact on the ambient noise levels. However, the adverse impact is anticipated to be limited to the plant area and its immediate surroundings. The adverse impact can be more within the project area, and may cause hearing loss and other related problems to the workmen, if mitigation through protective measures are not taken.

Noise propagation through mathematical model and impacts of noise with distance from source has been studied and brought out below.

As the equipment generate noise generally in the range of 100 dB(A) at source it can be safely assumed that the ambient noise levels on any point of boundary line of plant are not higher than 100 dB(A). It has, also been assumed that the area within the expansion units within an imaginary line running at a distance of 3-5 m (say) from noise generating machines will be termed as point noise source to avoid complication in the absence of availability of exact location of various noise generating units, their arrangements and shapes.

Taking extreme case of two machines each generating 100 dB(A) working at a point will add upto 103 dB(A) overall noise level. Such source noise level has been considered here for anticipating the impacts. Noise attenuation with distance in all directions over flat open bare ground is given by

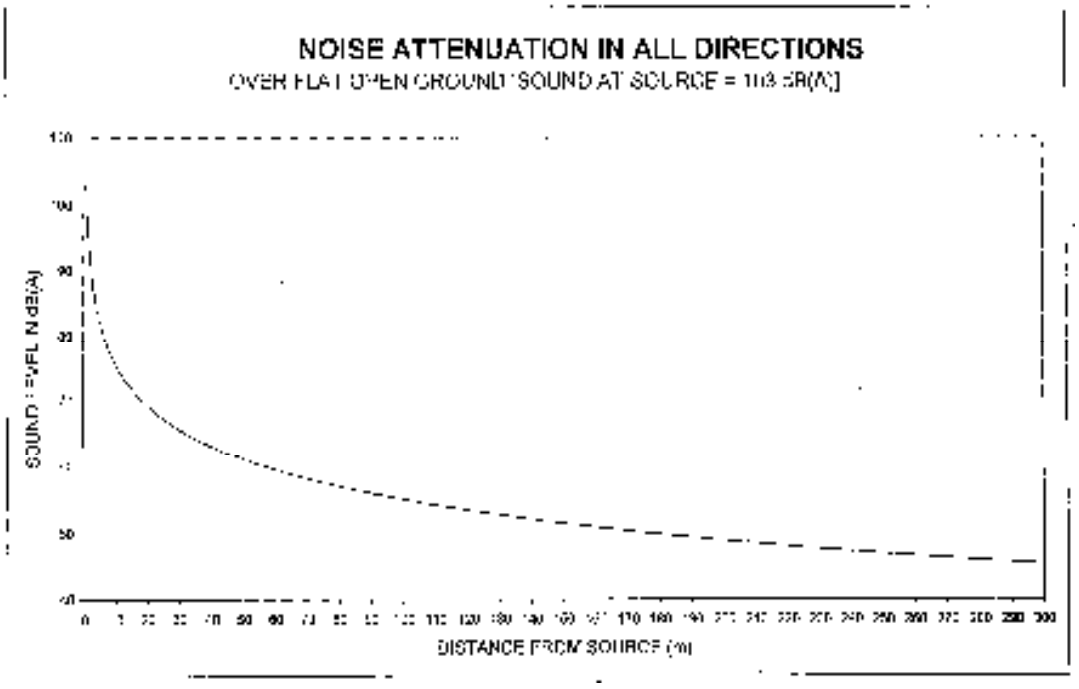
Sound level dB(A) = $Lw - 20 \log_{10} R - 8$

Where :

L_W = Sound level of source, dB(A) assumed 103 dB(A)
R = Source distance, m

The same has been plotted in **Fig 4.5**. Assuming source noise level as 103 dB(A).

FIG 4.5: NOISE ATTENUATION WITH DISTANCE IN ALL DIRECTIONS OVER FLAT OPEN BARE GROUND



A perusal of graph shows that the sound levels attenuate to value as shown in **Table 4.17**.

TABLE 4.17: NOISE ATTENUATION WITH DISTANCE ON FLAT BARE GROUND WITHOUT AND WITH GREEN BELT COMBINED NOISE OF MORE THAN ONE SOURCE = 103 dB(A)

Distance from source (m)	Noise level reduced from 103 dB(A)	
	Without green belt, dB(A)	With green belt, dB(A)
20	70.0	68.5
60	60.0	55.5
100	56.0	49.0
150	52.0	41.0
180	50.0	33.0
300	45.0	<33.0

It means that after distance of about 300 m, the machine noise will merge into the background noise in the day time. This noise level is same as the limit [45 dB(A)] prescribed by Noise Pollution (Regulation and Control) Rules, 2000" (**Annexure VIII**) at night time for residential areas. Due to plantation around the plant site, it will be possible to further lower the noise levels below the prescribed limits. It may be noted that the combined noise from various sub-plants cannot be more than 103 dB(A) at any point considering the distance between their relative locations. Hence, by combination of such control measures, it will be possible to keep the noise levels below the prescribed limits.

Negligible impact will be there to local people as the plant is being and will develop a thick peripheral greenbelt which will act as a noise absorbing medium preventing the noise from travelling to the village. With respect to the plant boundary, the nearest houses are of Chararhagarhia at a distance of approximately 200 m west from expansion area plant boundary. Thus, anticipated sound levels will be in the vicinity of 65 dB(A), which will be similar to the National Ambient Air Quality Standards for Noise of 65 dB(A) during day time for commercial areas.

The noise level data recorded at various places in the study area is well within the desired limit. But, the future establishment of noise due the proposed expansion project activity may pose some problem, if project management will not adopt appropriate control measures.

4.8.2 Noise pollution control measures

Construction phase: Modern and well maintained machinery will be used for construction activities of expansion phase such that noise levels will be minimized at source itself. The equipment will be kept in good condition to keep noise level well below limits at work place. The onsite workers exposed to high noise equipment and noisy area will be provided with

protective devices like ear muffs/plugs. Also traffic will be monitored, vehicles will have PUC certificates and the heavy vehicles carrying construction material will not be allowed during peak traffic hours. Noise and fugitive dust curtains/ barriers will be erected around the areas under construction.

Operation phase: The following measures are being and will be taken up to keep the noise levels within permissible limits:

- Provision and maintenance of green belt. The plant will develop 19.579 ha area (33.11%) under green, which will help to prevent noise generated within the plant from spreading beyond the plant boundary.
- Periodic maintenance of noise generating machinery including transportation vehicles
- The noise generation is being and will be reduced at source by erecting noise dampening enclosures or acoustic enclosures and by maintaining the machines and greasing them regularly.
- Provision made for special vibration dampners, rubber packing etc to prevent propagation of noise and vibration to surrounding areas.
- Provision of air silencers to reduce the noise generated by the machines/ equipment/ vehicles.
- Provision of acoustic enclosures on DG sets, to used only in case of power failure or any emergency.
- All the workers engaged at and around high noise generating sources have been and will be provided with ear protection devices like ear mufflers/plugs. Their place of attending the work will be changed regularly so as to reduce their exposure duration to high levels. They will be regularly subjected to medical check-up for detecting any adverse impact on the ears.
- The Factories Act to reduce hearing loss, stipulates the noise levels up to 85 dB(A) as acceptable limits for 8 hour working shift per day **(Annexure VIII)**. Noise levels may, however, exceed the prescribed limits in certain work places. At these work places, workers will be posted for shorter durations only.

4.8.3 Vibration

The industrial machinery generates vibrations, for the management of which the company has installed vibration dampners in existing plant and maintains the moving as well the stationary parts to reduce vibrations. The same management steps shall be followed in the expansion phase also. The company shall comply with the Part “B” of the Schedule XXIII of Model Rules Under The Factories Act, 1948 (refer **Annexure VIII**).

4.9 TRANSPORTATION

4.9.1 Impact

Raw material will be transport through Rail/ Road. Presently raw material is being transport by Rail/ Road.

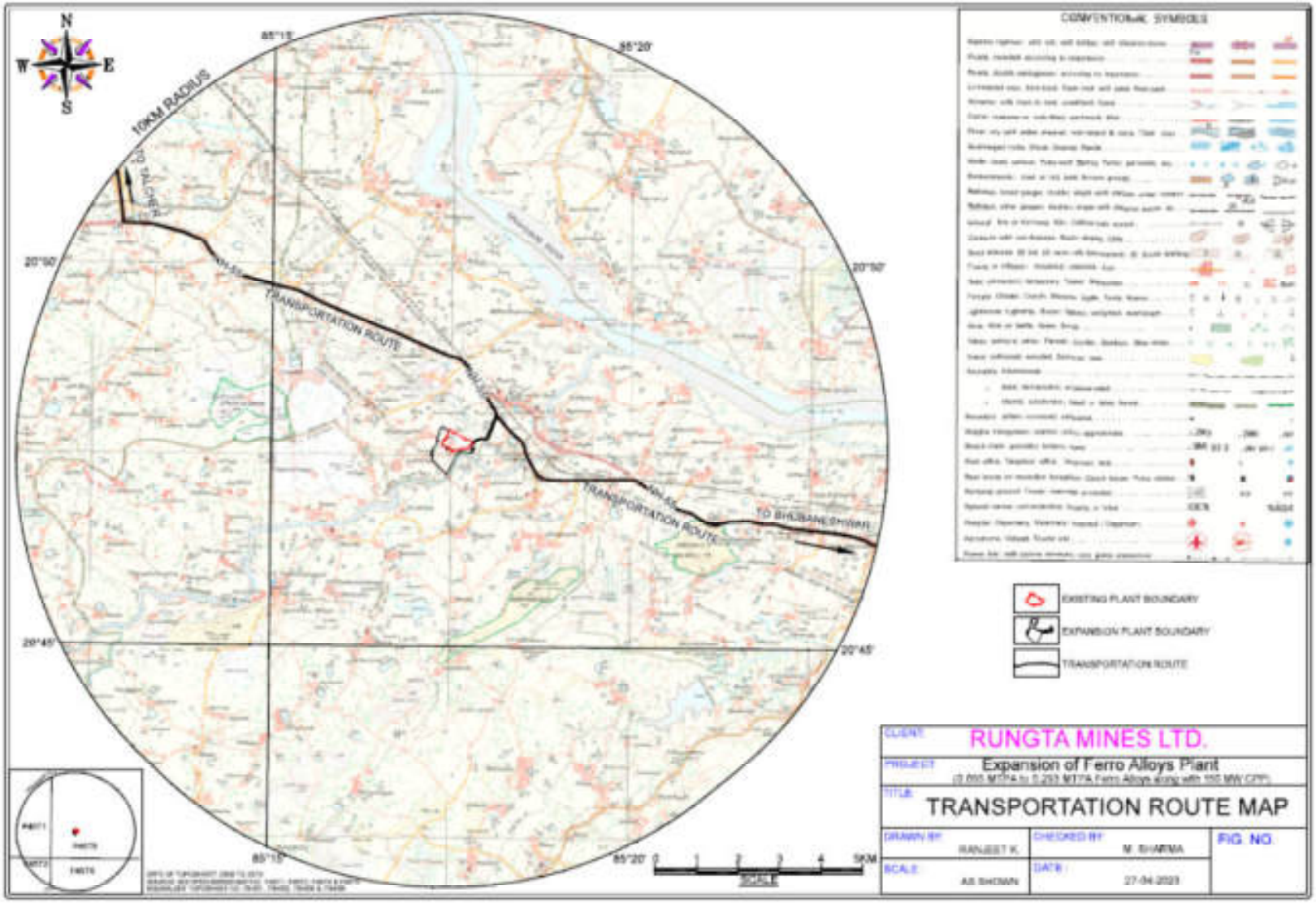
Usually material comes and will come in future also in 10-30 T trucks. Since the trucks will be plying on public roads, therefore maximum size is currently 30 T for commercial truck in that area. This will keep the projected road traffic at minimum possible. The solid waste and finished product can be evacuated through same trucks except few cases where the nature of the finished product will require specific type of truck.

Raw material will come from various places in Odisha such as Sundargarh, Talcher, Bhubaneshwar, Chattisgarh and Maharashtra and the finished product transportation will take place towards Rourkela, Bhubaneshwar, Raigarh, Jamshedpur, Meramundali Station and Paradeep (port). The route of transportation is shown in **Fig 4.6** and the calculation for traffic is given in **Table 4.18** assuming a 1:1 ratio of 20 T and 25 T trucks.

TABLE 4.18: TRANSPORTATION OF MATERIAL

Sl. No.	Material	Existing Plant		Additional		Total after expansion	
		Trucks	To & Fro	Trucks	To & Fro	Trucks	To & Fro
a.	Raw Material	**38**	**76**	437	874	**475**	**950**
b.	Solid waste	**9**	**18**	54	108	**63**	**126**
c.	Product	**14**	**28**	83	166	**97**	**194**
d.	Less incoming trucks that can take outgoing product	14	28	83	166	97	194
e.	Less incoming trucks that can take solid waste except ash	9	18	15	30	24	48
	Total increase in traffic (a+b+c-d-e)	**38**	**76**	**476**	**952**	**514**	**1028**
	Equivalent PCU's		**228**		**2856**		**3084**
	Carying capacity Utilisation:						
Approach road	Existing		14.83		14.83		14.83
	Additional		5.7		71.4		77.1
	Total		20.53		86.23		91.93
NH55	Existing		81.9		81.9		81.9
	Additional		0.65		8.16		8.81
	Total		82.55		90.06		90.71

FIG 4.6: TRANSPORTATION ROUTE



For transportation from ferro alloys plant, the increase in traffic is 1028 truck trips/day after expansion. The equivalent passenger car units (PCU's) (1 truck=3 PCU's) are 3084/day. On the approach road, with respect to the existing traffic volume and maximum capacity utilisation (Refer Table 3.13, Chapter 13), the resultant increase will be 14.83% on approach road to plant from NH55 and 8.81% on the NH55. This is a low impact on the traffic density. The impact shall be in terms of increase is pollutant gases due to vehicular emissions and dust on road becoming air-borne. The air quality modelling for traffic movement has already been carried out and given in section 4.4.1.5.

It may be further noted that the traffic calculations have been done for the traffic scenario assuming that a truck brings in raw material to the plant will not go empty while empty trucks will not come to pick the products. This is so because the transporters operate in such a manner that the truck bringing in the raw material will take away finished product.

The location of the nearest railway siding will be Meramandali raiway station.

4.9.2 Mitigation

Vehicular pollution control and management plan is being and will be followed in future also:

- All trucks used for transportation of raw material and finished product will be covered with tarpaulin, maintained, optimally loaded and have PUC certificates.
- Maintenance shall be as per the periodicity and procedure specified by the manufacturer
- Trucks will be weighed at the weigh bridge to ensure optimal loading, which in turn optimizes emissions
- Annual statutory Fitness certification for commercial vehicles will be ensured.
- Pollution Under Control (PUC) certificates will be obtained every three months for all categories of vehicles. In case of petrol vehicles idling CO measurements will be taken and in case of diesel vehicles, free acceleration smoke will be measured.
- Vehicles will be Euro-IV compliant or higher, as applicable
- Old vehicles will be phased out to ensure lower emissions by newer vehicles
- Water sprinkling on roads and parking area within plant
- Speed bumps and caution signs along roads

- Training and sensitisation of drivers as part of safety week awareness programs

- Pollution control measures at the **railway siding** shall comprise of:

  - Water Sprinklers- Stationary water sprinklers at every 15m interval. Also mobile water sprinklers will be used on the internal haul roads within siding.
  - Tyre Wash- Tyre wash shall be provided at the siding exit point.
  - Greenbelt- Trees to be planted along the peripheral boundary, where permitted by the Railway Authority
  - Workers- Dust masks will be provided as safety measure to the workers, engaged at dust generation points like loading/unloading points, material handling at stock yards, etc.

- Safety measures are the **railway siding** shall comprise of:

  - CCTV cameras installed all around the siding.
  - Entry Register would be kept at the entry gate.
  - Three security guards will be available in each of the 3 shift.
  - Barriers will be installed at entry/ exit of railway siding to control movement of trucks.
  - Adequate parking arrangements so that trucks are not on the public road awaiting loading/ unloading
  - undertake regular sweeping to remove dust from roads outside the siding. Sprinkling will be carried out on need basis only to avoid muck/mud formation. Loaded trucks shall be covered before exit from the siding area onto public road.
  - Basic Facilities for staff/ Workers will be provided comprising of drinking water, toilets with septic tanks and rest rooms

The local infrastructure of the area such as road network is adequate to handle the additional traffic and no additional infrastructure needs to be constructed. The width of the NH-55, Angul to Dhenknal (Near Nimabahali Bazar Village) is approximately 18 m with divider in the middle. It is a black topped, well maintained road. Large number of trucks are plying on it on the national highway. The movement of light motor vehicles is uniform during the daytime and low during the night hours. The width of the village road from Plant to NH 55 is approximately 7 m. Negligible traffic is there on this road.

Furthermore, **Fig 4.7** shows just the plant layout indicating plant machineries, road details with traffic channelization.

FIG 4.7: PLANT LAYOUT SHOWING ROADS AND TRAFFIC MOVEMENT W.R.T. FACILITIES

4.10 ECOLOGY

4.10.1 Impact on ecology

Construction Phase: The impacts caused by construction activities include the following:

- Exhaust emissions from diesel run engines, construction machinery and vehicles.
- Dust emission during construction and material transport.
- Noise caused by vehicles transporting construction materials
- Noise caused by handling of construction materials
- Noise & exhaust emissions from diesel run engines of construction machinery

During construction the transport of construction material will cause dust emission, emission of exhaust gases from vehicles such as CO_2, CO and NOx. The fugitive dust may coat the leaves of plants and trees exist in the project area. Fauna that occur in the project area and surroundings may be disturbed by the sounds of vehicles, construction and construction equipment i.e. largely avian fauna.

The impacts caused by construction to fauna are temporary and not long term and most (if not all) the observed and documented flora and fauna of the project area will adapt to following impacts:

- Spraying of water over construction materials like sand and gravel will minimise dust emission.
- Properly maintained vehicles shall be allowed to reduce noxious emission.
- And the temporary labour camps shall be provided with proper sanitation facilities

Wild Life - There is no Rare/ Endangered species found within core area of the project site.

Also fugitive particles deposition on the agriculture fields and on standing crops may dropdown the soil fertility and yield of crops. This may reduce the yield and quality of fodder grasses and fodder species and dissipate the milk quality of cows and buffalos feeding on it.

Noise due to frequent vehicular movement and operational activities may cause disturbance of movement of birds, small reptiles, mammals. Such huge disturbance may lead to behavioral changes in animals, birds, and reptiles too.
The project will create significant ecological and environmental impacts on the following components:

- Soil compaction (*vehicular movements may exert the negative impacts on soil fertility, cause soil compaction, microbial biomass etc.*)

- Ambient Air Quality (*air pollution due to construction and operational phase and vehicular movements*).

- Ambient Noise quality (*HEMM and vehicular movement*).

- Area of the existing plant is 21.257 ha and for proposed expansion phase shall be 37.869 ha. Total area of the plant after expansion shall be 59.126 ha. Vegetation over this area will also be disturbed. Approximately 300 trees exist in the expansion area.

The buffer area has floral species, which are commonly found species. Agricultural crops and fruit trees form a part of the commonly found flora in the study area. Impact due to airborne dust from construction activities and transportation are envisaged. Impact can be there in terms of tree cutting for firewood by construction labour in case control measures are not adopted.

There are three Protected/Reserve forests namely Ganthigarhia PF, Jharbandh RF and Nimidha RF present in the study area However, no forest of any type falls within the core area. Bio-diversity status of plant species is medium within the study area. There are no wildlife sanctuaries or fragile ecosystems within the study area. Hence, adverse impact on wildlife or fragile eco-system is not envisaged.

During construction phase, no impact on terrestrial eco-system comprising birds and animals is envisaged. On the contrary, with progressive growth of greenery, terrestrial microhabitats have developed in the long run. Availability of water and food wastes during the day will attract some birds and animals towards the site.

Operation Phase: Out of total existing plant area of 21.257 ha., 7.082 ha. area is already under plantation. Hence, impact anticipated on the flora in the project area can be managed. The impact on the surrounding ecology during the operation of the project will mainly occur from the deposition of air pollutants. Chronic and acute effects on plants and animals may be induced when the concentration of air pollutants exceeds threshold limits. The incremental emissions of air pollutants are not likely to induce any significant changes in the ecology because the national ambient air quality standards will remain within the limits. However deposition of small amount of pollutants may also affect the surrounding ecosystem. Thus, the project is therefore planned with most efficient air pollution control systems for achieving 30 mg/Nm^3 dust emission level from all the stacks so that the impact on nearby ecosystem are minimized. Most of the fugitive dust emission generation points will also be fitted with efficient air pollution control systems (ESP, fume extraction systems and bagfilters). Water sprinkling / dry fog type system will be used at to suppress the generation of fugitive dust, where necessary.

The outcome of the air quality prediction modelling shows that it will experience maximum increment of 21.93, 12.56, 33.96 & 10.58 $\mu g/m^3$ of

PM_{10}, $PM_{2.5}$, SO_2 & NOx respectively due to operation of proposed expansion plant and transportation. Thus, the project has been planned with most efficient air pollution control systems on its stacks. Most of the fugitive dust emission points are also fitted with efficient air pollution control systems (fume extraction systems, suction hoods and bag filters). Water sprinkling / dry fog type system will be used at to suppress the generation of fugitive dust, where necessary.

USEPA air quality criteria for SO_2 stipulates 0.2 ppm (524 $\mu g/m^3$) level when visible injury to sensitive vegetation in humid regions after 3 hours exposure is observed. In another case, level 0.5 ppm SO_2 level (1310 $\mu g/m^3$) for 1 hour exposure results in visible injury to sensitive vegetation in humid regions. At higher SO_2 concentration of 10 ppm (26214 $\mu g/m^3$), visible injury to vegetation in arid regions is observed. Such high ambient air concentration of sulphur dioxide, is not likely to occur in the area.

USEPA air quality criteria for NO_2 stipulates 2 ppm (3760 $\mu g/m^3$) level when foliar injury to vegetation at 4 hours exposure is observed. At a lower NO_2 concentration of 0.25 ppm (470 $\mu g/m^3$) during the growing period, decrease of growth and yield of tomatoes and oranges are observed. Such high ambient air concentration of nitrogen dioxide is unlikely in the study area.

4.10.2 Management of ecology

Construction phase: The top soil removed prior to construction will be stored and laid back on the area identified for further plantation.

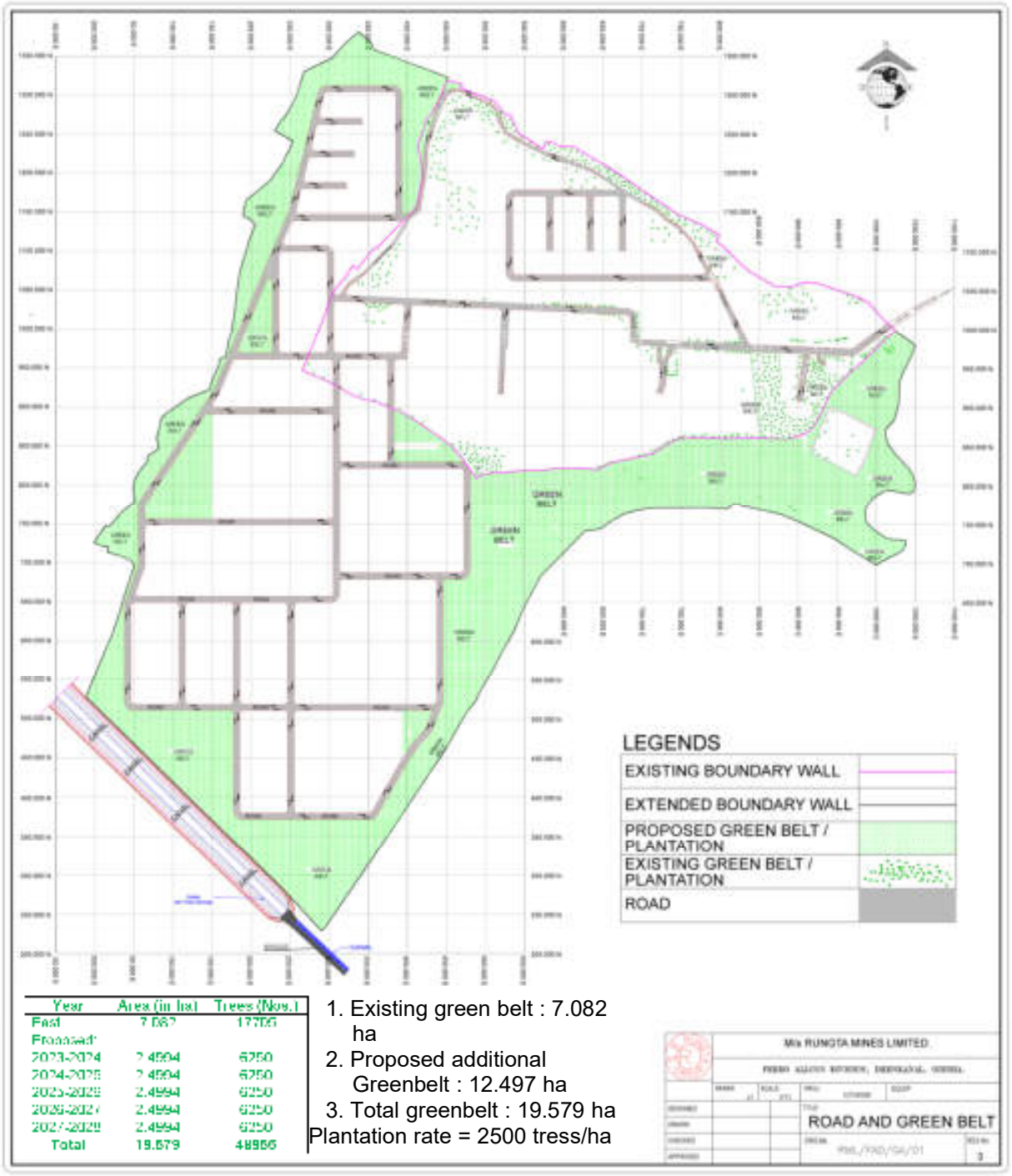
About 300 trees may have to be removed as per the proposed layout. However, the endeavour will be to conserve them to the extent possible during design stage itself. However, due permission will be sought from the concerned authority and compensatory plantation carried out. Transplantation of tree will be preferred, if possible.

There is no resident large mammalian fauna, but the development of proposed green belt and plantation will provide food and habitat for fauna. Under the proposed green belt and plantation programme, 19.579 ha (total after expansion) of land within premises (about 33.0 % area) shall be provided with green cover in the form of green belt and plantation.

Plant layout with green belt (existing and proposed), road details and plantation details is given in **Fig 4.8**.

Operation phase: Being an operational industry, the green belt is being established in 33% of the existing plant area of 7.082 ha. The main consideration during development of green belt and plantation are effective trapping of fugitive emission, act as sink for stack emissions, sequester carbon, noise control, balancing ecology, waste water reuse and aesthetics.

FIG 4.8: PLANT LAYOUT WITH GREEN BELT (EXISTING AND PROPOSED), ROAD DETAILS AND PLANTATION DETAILS



Plants act as natural sink for a variety of pollutants as well as replenish air with fresh oxygen. The plant species would be fast growing, evergreen having large crown. As a single plant does not have all the qualities, a mixture of several varieties of plants will be chosen. Native trees will be preferred. The widths of the belt will be as per the availability all along the boundary, the criterion for selection of area/ location for green belt would be along pre dominant wind direction, along plant boundary and roadside avenue plantation and around administrative building.

The species planted and suggested for plantation is Kaneer (*Nerium*), Ber (*Zizyphus*) Gulmohar (*Delonix regia*), Siris (*Albizzia lebbeck*), Neem (*Azadirachta indica*), Mango (*Mangifera indica*), Peepal (*Ficus religiosa*), Sunari (*Cassia fistula*), Patuli (*Lagerstronea praviflora*), Bel (*Aegle marmelos*), Kadamb (*Anthocephalus kadamba*), Champa (*Michelia champaka*), Nageswar (*Mesua ferrea*), Baula (*Mimosops elengi*), Jamun (*Syzygium cumini*), Amla (*Emblica officilnalis*) etc. Native species will be preferred.

The plantation programme shall be as given in **Table 4.19**.

TABLE 4.19: PROPOSED PLANTATION PROGRAMME

Year	Area (in ha)	Trees (Nos.)
Past	7.082	17705
2023-2024	2.4994	6250
2024-2025	2.4994	6250
2025-2026	2.4994	6250
2026-2027	2.4994	6250
2027-2028	2.4994	6250
Total	**19.579**	**48955**

4.10.3 Wildlife conservation plan

There are no endemic or endangered species found in core zone. 4 mammals, 5 reptiles and one avian fauna are present in the buffer zone. Request letter for preparation of “Site Specific Conservation Plan” has been made to Divisional Forest Officer, Dhenkanal Forest Division has been submitted and given in ***Annexure XXV.*** The preparation of the plan is underway. Some of the wildlife conservation measures that are being followed and proposed by the company have been given below.

1) **Free Distribution of Seedlings:** Provision for distributing seedlings, preferably of fuel wood species to the stake holders of the adjoining villages for planting in their back ward and/or vacant places which in future will meet their bonafide need.

2) **Avenue plantation:** It is proposed to do avenue plantation.The species chosen for this plantation will be Sunari (*Cassia fistula*), Patuli (*Lagerstronea praviflora*), Neem (*Azadirachta indica*), Bar (Ficus Bengalensis), Aswata (Ficus religiosa), Dimiri (Ficus glomerata), Nageswar (*Mesua ferrea*), Jamun (*Syzygium cumini*), Mango

(*Mangifera indica),* Amla (*Emblica officilnalis*) etc.Plants not only serve food but also provide nesting and roosting place

3) **Promotion of awareness:** In order to achieve the goal of wildlife management and conservation purpose, it is necessary to build strong awareness among the surrounding villagers along with working personnel of the plant regarding the value of bio diversity. It is also suggested to hold meetings to convince the stake holders that without their co-operation, forest staff may not be able to protect forests.

4) **Immunisation to Cattle:** In order to prevent the spreading of diseases from cattle to wildlife, periodical vaccination to village cattle is essential.

6) **Provision of Sign Boards:** On sensitive points on the road passing through forest area where wildlife movement is regular, to keep aware the passerby- sign board will be provided.

Budgetary provision shall be made by the Company for execution of the wildlife conservation in consultation with the DFO. Some activities of wildlife conservation plan may be undertaken under CSR.

4.11 SOCIO-ECONOMICS - IMPACT AND MANAGEMENT

(i) Demography & Employment

During operation phase, total direct manpower requirement is 2000 (existing 500; proposed expansion 1500) persons for various activities like loading, unloading, handling, transportation, general cleaning, horticulture and other miscellaneous works inside the Plant. Three shifts working for 350 days is planned. Many more persons will be indirectly engaged either on contract basis or in transportation of materials in provision of different services associated with the project. As majority of unskilled and semi-skilled persons will be from the surrounding villages, the net in-migration on account of the job opportunities will be for the highly skilled and supervisory/managerial level posts. Therefore, the project will have significant positive impact on employment and economy of the study area. A portion of the wages earned by the employees and other workers will find its way into the study area in form of cost of services and local food products. This will improve the economic conditions of local inhabitants involved in such service provisions. Therefore, some impact on demographic and economic profile is foreseen.

(ii) Amenities

With the commencement of expansion, amenities for communication, education, health, entertainment, canteen, etc would further improve in and around the project area. These amenities will be available to local people also, who will be directly associated with the plant. Even those not associated in the project related activities will be benefited by these amenities. The project management shall undertake social and physical

infrastructure development as a part of their social welfare activities on receipt of requests from inhabitants of Chararhagarhi and Kangelapal.

(iii) Land losers and displaces

No rehabilitation and resettlement plan has been made as no displacement of population.

In the existing plant, the private land required for the plant belonged to local inhabitants, to whom appropriate compensation has been paid for the purchase of the land. It has been purchased on mutually acceptable rates. The land use is now completely industrial in existing plant area.

In the expansion phase, proposed additional 93.575 acres (37.869 ha) comprises 81.695 acres is private land and 11.880 acres is government land. 39.935 acres private land is purchased and balance to be purchased for which compensation shall be paid as per government norms. Preference will be given to land losers for employment. Part of the land to be acquired for the project is low yield agricultural land without irrigation facilities. This is a very small fraction of total agricultural land falling in study area; hence, no significant adverse impact on agriculture is envisaged.

Those land losers opting for job in the company will be trained and absorbed. Additionally, provision of contractual jobs shall also be there. Employment to marginal land loser will be given priority. Land losers not opting for employment will be provided training & skill development opportunities and priority in job contracts. Scholarships to students from PAFs will be given.

4.12 OCCUPATIONAL HEALTH AND SAFETY

4.12.1 Occupational, Health & Safety Hazards

The existing plant is a ferro alloys unit undergoing expansion in capacity with captive power plant. The table below summarises causes of main injuries and the corresponding prevention strategies. These prevention strategies are also proposed in expansion phase

Injury Causes:	**Prevention:**
a) Slip, Trips & Falls	a) Housekeeping, clear designated walkways
b) Falling/Moving Objects	b) Guards on Machines and elevated areas
c) Lifting & Overload	c) Manual Handling Training
Injury Types	d) Proper use of PPE
d) Arms and Hands	e) Proper use of PPE
e) Legs and Feet	f) Lifting gear, forklifts
f) Back Injuries	

4.12.2 Impact on workers

The occupational safety and health are very closely related to productivity and healthy relation between employer and employees. The main factors of occupational health in the operations are dust, gases and noise, and those for safety are exposure to excessive heat, accidental contact with hot materials, contact with moving parts of machines & equipment, etc. The health and safety of personnel is the primary consideration during operation to achieve uninterrupted production and compliance with statutory requirements. Workers in a ferro alloys plant are exposed to many health hazards. The common health hazards are:

i. Exposure to high temperature operations

ii. Exposure to fugitive dust in material handling and operations, which may cause respiratory diseases

iii. Direct contact with moving machines and equipment.

All these can cause adverse impact if appropriate control measures are not adopted. Exposure problems to noise, dust, heat and gases are the major occupational hazards. Bronchitis, asthama and noise induced hearing loss are the typical occupational health hazards identified from such plant.

4.12.3 Mitigation measures for protection of health of workers

Measures to be implemented to reduce the dust generation at the originating point include installing control devices and / or regular water sprinkling. Plant personnel working in dust prone areas will be required to wear personnel protective equipment like half or full masks and replacing the mask if it I damaged or soiled.

For noise, Personal Protective Equipments (PPE) like earplugs and muffs are being and will be provided and administrative pressure shall be applied for using them. Auditory examination by qualified doctors upon the first employment and thereafter periodic examination is being and will be conducted which include determination of auditory threshold for pure tones. Job rotation schemes is being and shall be practiced for over-exposed persons.

Following general measures shall be implemented for protection of health of workers:

a) Maintenance of pollution control system such as dust suppression system, bag filters, etc. safety appliances;

b) Regular maintenance of equipment;

c) Regular checking of break down or leakage;

d) Use of personal protection equipment wherever needed;

e) Display of relevant safety norms to be followed in different operational areas;

f) Use of 'Safety Permit' system for all maintenance jobs;

g) Provision of ear plugs or muffs to workers exposed to high noise levels;

h) Rotation of duties of workers;

i) Creating awareness amongst workers concerning health, environment and safety through posters, discussion, slogan etc.;

j) Periodical medical examination of workers;

k) Provision of suitable civil amenities such as drinking water, good housekeeping in canteen, toilets etc.;

l) Assessment of risk from health hazards at work place;

m) Monitoring of different factors leading to occupational health hazards and taking timely action to mitigate the impact, etc.

n) The exposure levels will be maintained within the prescribed limits of the Second Schedule of the Factories Act, 1948 and its amendments till date, for iron oxide fumes (<5 mg/m3 for 8 hours), silica in terms of respirable dust (=10/% respirable quartz+2 in mg/m3), chromates as Cr (0.05 mg/m^3 for 8 hours) and Manganese (as Mn) dust and compounds (*C05 for 8 hours)1.

4.12.4 Specific Measures for Ensuring Safety

The practices followed and to be followed in the plant are as follows:

Electrical safety – All the electrical installations have and will have rain protection shed, earth pit, three pin industrial plug top, rubber mat in front of panels, fire extinguishers etc.. All the electrical equipment like welding machines, light points, portable electrical tools etc are and will be connected through ELCBs. In case of defects found during checking, they are and will be replaced immediately. Also the earth resistance value will be checked at regular intervals.

Display of Safety Posters/ Slogans/ Warnings – It is and will be displayed at conspicuous locations to spread awareness amongst the workers at site.

Work Permit System – Before starting of any critical/ hazardous work (excavation/ radiography/ working at height/ confined space/ electrical

[1]https://labour.gov.in/sites/default/files/Factories_Act_1948.pdf accessed on 12.12.2022
**C denotes Ceiling limit*

maintenance, etc.) it is and will remain mandatory to take prescribed work permit which will be in the knowledge of authorized persons as they sign in that format.

Valid Test Certificate – It is and will be mandatory in future also to have valid load test certificate by competent person for all the cranes, lifts, hoists, lifting tools/tackles used at site and displayed on the machine.

PPEs & Safety Gadgets – Use of PPEs is and will be necessary for all staffs/ workers of the plant and contracting agencies.

License for all drivers/operators – All the drivers/ operators inside the premises has and will have valid license with them, and should be produced when asked. The speed limit inside the premises will be 20 km/hr displayed at various locations.

Fire Management System – Portable fire extinguishers/ fire buckets at various fire prone locations have been and will be provided.

4.12.5 Existing OHS Facility

Ferro Alloys plant is already operational in Tulasidiha. An OHS centre is present at plant. The same OHS shall be expanded and used by the employees of the expansion phase. It is well equipped and manned by competent person and safety officer. Qualified MBBS doctor with assistant runs the centre.

The following tests are and will be conducted at the OHS centre along with technical support from private clinical laboratory, for the existing and proposed expansion project:

Pre-employment medical examination: A detail history with through physical examination is being and will be done prior to induction. The purpose of this examination is to place right man in right job and for future reference.

Periodic Medical Examination: Periodic medical examination is being and will be carried out and maintained in expansion phase also as per Factories Act & Odisha Factories Rule.

Specific Examination: This will be done in special cases only or of workers returning to work after long illness or injury. .

Supervision and Notification: The activities are:

i) To ensure cleanliness and good quality of food in the canteen.

ii) Notification of any Occupational Health problems to the management, if encountered.

iii) Maintenance of Health Records and its analysis

Other measures for OHS

- As per requirement, First-aid boxes have been and shall be provided and maintained at different locations of plant.
- **Safety Induction** – All the new staffs/ workers is and will go through safety induction before engagement at site. A prescribed format is being and will be filled and signed by Safety Officer as an evidence of induction.
- **Safety Tool Talk** – It is and will be organized every month for the workers in the presence of site supervisor/ site engineer. Job related safety precautionary measures, good safety practices, case studies etc. Are being and will be discussed.
- **Site Safety Inspection** – Safety Officer appointed by Rungta Mines Limited takes and will continue to take daily round of project site and the unsafe conditions as well as the unsafe actions noticed is being will be informed to the immediate supervisor/ engineer for an early rectification. Apart from the above activity, every week a selected area is and will be inspected jointly like Safety Superviser, area engineer, workmen etc. and the unsafe points observed are and will be sent to the concerned site in-charge in the prescribed format for an early compliance. Follow-up is and will be made by Safety officer for timely compliance.
- ***Reporting of incidents/ near miss case*** – It is and will be mandatory to report all the incidents & near miss cases in the prescribed format by the Deputy Manager (Safety) within 12 hours of incident to Factory Manager.
- ***Safety Committee Meeting*** – Company does and will conduct safety review meeting with all the contracting agencies once in every month. The Unit head and the safety officer of the contracting agency are and will be present in the meeting. Various issues related to incidents, non-complied unsafe points, good safety practices, improvements, incident trend & near misses are and will be discussed religiously with target date. The minutes of meeting are and will be circulated to all members for their compliance.
- ***Safety Awareness/ Motivational Program*** – Company conducts an will continue to conduct National Safety Week, Road Safety Week, World Environment Day, National Fire Service Week etc. and distributes prizes to the winners of the contests organized among the staffs/ workers for the purpose. Apart from this contracting agencies does and will continue to organize safety competitions among their workers fortnightly and distribute prizes to the best safety conscious workers to motivate.

- ***Safety Pledge*** – Safety Pledge is and will be administered at site first day of every month where the entire worker gather and safety messages are and will be delivered by Safety Supervisor.
- ***Fire & Safety Training*** – Site based safety training programs are and will be arranged time to time for the staffs and workmen to educate and make them conscious. Best safety practices, case studies on incidents and root causes are and will also be discussed to make them aware. Demonstrations like rescue, effective use of PPEs are and will also be organized by various PPEs and safety gadget suppliers for their optimum use.
- ***Penalty* system**– Company has and will have a penalty system for those who violate safety norms repeatedly after various instruction verbally and written. The amount is and will be debited from the Running Bill of the concerned contractor.
- ***Good House Keeping***- Company has and will maintain good house keeping and reward the contractors who maintain the best house keeping.
- ***Self Containing Breathing Apparatus (SCBA)*** – Company will procure the SCBA for emergency use
- ***Safety Reward Scheme*** – Company is planning to award the best safety performing contractors half yearly/yearly.

Since the units of the plant are are under operation, the medical data of the workers is presented below:

<table>
<tr><th>Parameter</th><th>Details</th></tr>
<tr><td>OHS facility</td><td>Inside</td></tr>
<tr><td>Pre-Employment / Periodical monitoring frequency as per Factory Act</td><td>Periodic medical, Pre-employment & annual as per Form no. 31 A (Sample given in Annexure XXVI)</td></tr>
<tr><td>Records available</td><td>Yes, in plant premises (summary given in Annexure XXVII)</td></tr>
<tr><td>Tests carried out / records Periodical Medical Examination (PME) & Initial Medical Examination (IME)</td><td>
<table>
<tr><th>Sl. No.</th><th>Parameters for Medical Examination</th></tr>
<tr><td>1</td><td>Age</td></tr>
<tr><td>2</td><td>Height</td></tr>
<tr><td>3</td><td>Weight</td></tr>
<tr><td>4</td><td>Body Mass Index (BMI)</td></tr>
<tr><td>5</td><td>Blood Group</td></tr>
<tr><td>6</td><td>Eye Vision (LT/RT)</td></tr>
<tr><td>7</td><td>Heart Sound</td></tr>
<tr><td>8</td><td>Respiratory systems</td></tr>
<tr><td>9</td><td>Cardivascular systems</td></tr>
<tr><td>10</td><td>Abdomen Tenderness (Yes/No</td></tr>
<tr><td>11</td><td>Nervous System (Fits/Epilepsy)</td></tr>
</table>
</td></tr>
</table>

Parameter	Details
	12 Locomotors System 13 Skin 14 Harnia 15 Hydrocele
Occupational Health & Safety budget	Capital cost = Existing: Rs. 21 lakhs; Proposed: Es. 69 lakhs Recurring cost = Existing: Rs.23.27 lakhs; Proposed: Rs. 26.46 lakhs
Safety measures in plant	• Safety Manager appointed to look after the safety aspect. • Provision of rest shelter in plant premises with amenities like canteen, drinking water etc. • Provision to use of safety appliances, display board, safety slogan etc. • PPE to workers. • Training to workers for safe handling of material and machines. • Safety awareness week.

4.13 POTENTIAL IMPACT MATRIX

Potential impacts that will occur due to proposed plant on environment, ecology and socio-economics during construction and operation phase and are summarized in **Table 4.20** based in the findings in this chapter**.**

TABLE 4.20: IMPACT IDENTIFICATION MATRIX

Sl. No.	Activity	Environment	Ecological	Socio-economic
a.	**Construction Phase**			
1	Storage of construction materials	-	-	
2	Transportation of construction materials	--	-	+
3	Construction activities	---	-	+
b.	**Operation Phase**			
1	Transportation of raw materials	--	-	+
2	Storage of raw materials, intermediate and finished products	-		
3	Operation of submerged arc furnaces, sinter plant, power plant, etc.	---	-	++
4	Operation of DG set	--		
5	Development of green belt	+	+++	+
6	Employment generation			+++

Note : Each "+" or "-" denotes the positive or negative level of impact, respectively. The number of +/- denotes the magnitude

CHAPTER 5

ANALYSIS OF ALTERNATIVES

5.1 NO PROJECT SCENARIO

No project scenario is considered mainly with respect to:

1. **Utilization of natural resources:** In a “no project” scenario, resources that will be saved will be Coke Fines 18,144 TPA, Iron Ore / Mill Scale/ Sinter 23,080 TPA, Chome-ore concentrate26,333 TPA, Molasses 41,073 TPA, Chrome Ore Lump 46,080 TPA, Dolomite 86,476 TPA, Lime Stone 92,120 TPA, Charcoal / Coke 110,804 TPA, Manganese Ore (38%-40%) 137,405 TPA, Low-Grade High Silicon Mn Ore165,077 TPA, Quartz (94%-95%) 193,686 TPA, Low grade Chrome ore 385,824 TPA, Iron Ore Fines 492,480 TPA, Manganese Ore Concentrate 615,602 TPA and Coal 822,999 TPA. However, in project scenario the utilisation of waste material such as fly ash will also not be there to the tune of 3,20,478 TPA.

2. **Environmental impacts:** Since there will be no raw material consumption, no transportation, no processing in a “no project” scenario, there shall be no increase in pollution in air. There will be no discharge to the environment in both “no project” and “project” scenario. In a “no project” scenario, the flyash from captive power plant will also not be there, therefore, solid waste utilization will not be there.

3. **Benefits of the ferro plant to the society:** The expansion project is proposed mainly for the purpose of best utilisation of existing infrastructural facilities including land, water, manpower, roads, etc. It will give employment to 1500 persons (direct employees) and about equal number of indirect employment. The project will contribute in form of infrastructural development and taxes to the government and contribute in social welfare measures to the society. In a “no project” scenario, none of these benefits shall accrue to the society or the State Government.

The demand of ferro alloys are used as additives in steel making as de-oxidants and as alloying agent. These are added in steel production process not only for deoxidation but also for grain size control as well as for improvement in the mechanical properties of steel. Depending upon the process of steel making and the type of steel being made, the requirement of Ferro Alloys varies widely. Therefore, expanding a ferro alloys plant from 0.055 to 0.293 MTPA is a prudent step, considering the present steel market situation.

In the absence of the project, there will not be any depletion of natural resources or adverse impacts on environment. However, it will imply the ferro alloys deficit in the nation shall continue and there shall be no economic benefit along the supply chain of raw materials, due to direct employment or domestic sale/ export of finished goods.

Hence, “No Project Scenario” will widen the steel demand/ supply with demand exceeding the supply.

5.2 SITE ALTERNATIVES

The existing plant is located in Tulasidiha village and expansion of ferro alloy plant is proposed to be located at villages Chararhagarhia & Kangelapal, District Dhenkanal, Odisha. The focus of the company was to obtain land adjoining to the existing plant, to the extent possible. Following three land parcels were identified for the proposed expansion of Ferro alloy Plant:

1. Site 1- North of the plant towards Meramandali Railway Station
2. Site 2- South-East of existing unit, across Lingra Nadi.
3. Site 3- South of project in Tulasidihi, Charadagada & Kangelapal villages.

The above sites are all located adjacent or near to the existing plant. However, the factors that were impacted the selection were as follows:

- **Alternate Site-1:** Site is a water logged area and is in close proximity to another industry/ plant due to which the cumulative impact of air pollution may be higher.
- **Alternate Site-2:** Site is across the Lingara Nadi in reference to the existing plant. Expansion area and existing area will have to be integrated through the construction of bridge on Lingara Nadi, entailing several complications that can be avoided. Also the site contains the majorly agricultural area of the nearby villagers.
- **Alternate Site-3:** It comprises of less agriculture area than the Site-2. It is situated in close proximity to the company’s existing unit.

Considering the factors given above, Site-3 was finalised and the proposed expansion project will be implemented in an adjoining area of 93.575 acres of land to the existing plant area of 52.525 acres. The alternate sites are shown in **Fig 5.1**.

FIG 5.1: ALTERNATE SITES CONSIDERED

The advantages of the proposed location are as follows:

- Easy availability of dominant raw material (different grades of iron ore & fines). It can be procured from Odisha Mineral Corporation, other private mines and open market
- Surface water availability and sanction by received from Odisha government
- The proposed expansion plant will also be a help in strengthening the overall economy of the state by virtue of sales of and revenue from value added finished product.
- Availability of labour from nearby village is there.
- Access through road is convenient.
- Power can be generated within the plant in future and met through the proposed Captive Power Plant. Facility for inter connection with transmission & distribution system for evacuation of power will not be

required since the generated power will be utilized within premises, thereby eliminating the need of power evacuation system. State electricity board's grid supply is also available.

5.3 TECHNOLOGY SELECTED AFTER ASSESSING ALTERNATIVES

5.3.1 Captive Power Plant

(source: Technical EIA guidance Manual for Thermal Power Plants by IL&FS Ecosmart Limited, September 2009)

Thermal power technologies involve combustion or gassification of oil, natural gas or coal to produce electricity. Steam generating plants burn all types of coals (anthracite, bituminous, sub-bituminous, lignite and brown coals), oil, natural gas and biomass independently or in combination.

The two fundamental processes for extraction of energy from coal are (i) Direct Solid Combustion such as conventional Pulverised Coal (PC) Combustion or the emerging Fluidised Bed Combustion (FBC) and (ii) Indirect combustion through Coal Gassification followed by coal gas combustion. Another way to generate power is through waste heat recovery boilers using waste heat from exit gases of plant units such as DRI, coke over and blast furnace.

In addition, there can be power generation through waste heat recovery of flue gases from various processes.

(i) Fluidized bed combustion plant

Fluidised Bed Combustor is a "three-in-one device" characterized by highly desirable features of multi-fuel capability, pollution (SO_2 and NOx) control and energy conservation.

Fluidized bed combustion (FBC) reduces emissions of SO_2 and NO_2 by controlling combustion parameters and by injecting a sorbent (such as crushed limestone) into the combustion chamber along with coal. Coal mixed with limestone is fluidized by jets of air in the combustion chamber. Sulphur released from the coal as SO_2 is captured by the sorbent in the bed to form a solid calcium compound that is removed with ash. More than 90 per cent of SO_2 can be captured this way.

At combustion temperatures of 760 to 871°C, the fluidized mixing of the fuel and sorbent enhanced both combustion and sulphur capture. The operating temperature range is about half of that of a conventional pulverized coal boiler and below the temperature at which thermal NO_x is formed. In fact, fluidized bed NO_x emissions are about 70 to 80 percent lower than those for conventional pulverized coal boilers. Thus, fluidized bed combustors substantially reduce both SO_2 & NO_x emissions.

Fluidized bed combustion can be circulating (CFBC), atmospheric (AFBC), pressurized (PFBC) or Integrated Gasification Combined Cycle (IGCC).

AFBC operates at atmospheric pressure while PFBC operates 6 to 16 times higher pressure. PFBC offers potentially higher efficiency and consequently, reduce operating costs and waste relative to AFBC.

The principle of the various types of boilers are diagrammatically shown in **Fig 5.2**.

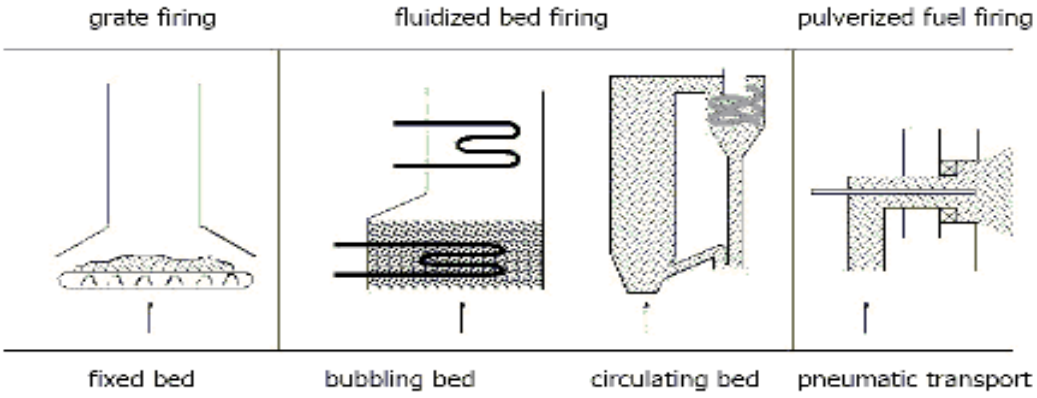


FIG 5.2: COMBUSTION SYSTEMS FOR SOLID FUELS
(source: http://en.wikipedia.org/wiki/Fluidized_bed_combustion)

1) CFBC (Circulating Fluidized Bed Combustion): Circulating fluidized bed is a relatively new technology with the ability to achieve lower emission of pollutants. During the combustion phase, upwards jets of air will cause the solid fuels to be suspended. This is to ensure the gas and solids will mix together turbulently for better heat transfer and chemical reactions. The fuel will be burnt at a temperature of 760-920°C to prevent nitrogen oxide from forming. Sulfur dioxide released during combustion will be absorbed by limestone or dolomite used to mix with the fuel particles in the fluidization phase. The sulfur absorbing chemical and fuel are recycled to increase the efficiency of producing a higher quality steam as well as lower the emission of pollutants.

2) AFBC (Atmospheric Fluidised Bed Combustion): Atmospheric fluidized beds use limestone or dolomite to capture sulfur released by the combustion of coal. Jets of air suspend the mixture of sorbent and burning coal during combustion, converting the mixture into a suspension of red-hot particles that flow like a fluid. These boilers operate at atmospheric pressure.

3) PFBC (Pressurised Fluidised Bed Combustion): The first-generation PFBC system also uses a sorbent and jets of air to suspend the mixture of sorbent and burning coal during combustion. However, these systems operate at elevated pressures and produce a high-pressure gas stream at temperatures that can drive a gas turbine. Steam generated from the heat in the fluidized bed is sent to a steam turbine, creating a highly efficient combined cycle system.

4) IGCC (Integrated Gasification Combined Cycle): This technology uses a high pressure gasifier to turn coal and other carbon based fuels into pressurized gas-synthesis gas (syngas). IGCC plants are advantageous in comparison to conventional coal power plants due to their high thermal efficiency, low non-carbon greenhouse gas emissions and capability to process low grade coal. The key disadvantage is the amount of CO_2 released without pre-combustion capture.

(ii) Waste heat recovery boiler based Power Generation Unit

When outlet gases of a process are containing substantial sensible heat, it is can be utilized for power generation through waste heat recovery boilers. The waste heat recovery boilers consist of radiation chambers with water walls just like conventional boiler with a drum to evaporate steam at 88 kg/cm^2 pressure. The steam is carried to super heater system where the temperature is maintained at 515°C. The boiler has an economizer, which utilises the heat of outgoing gases to raise the temperature of feed water from 100 to 200 °C. The steam is used to rotate the turbine and to generate power. The condensed steam is collected and recycled to the boilers as boiler feed water. A DM water plant is provided for preparation of de-mineralized water for make-up to the steam-condensate cycle. The output of the boilers will be used to generate electricity through Steam Turbo Generator Sets. The flue gases leave the economizer zone at about 150°C. The gases are passed through ESPs, where the dust concentration is brought down to below statutory limits for the process emitting flue gases.

Chosen Technology: For the proposed 150 MW Captive power plant, AFBC/ CFBC based technology has been chosen.

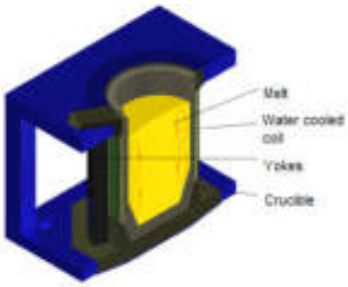
5.3.2 Ferro Alloys Plant

Ferro alloys are used to manufacture various types of carbon and steel, essentially to impart certain physical and chemical properties in a particular grade of steel viz. change of tensile strength, ductility, hardness, corrosion resistance, wear resisting or abrasion resistance properties etc.

Several specialised furnaces are used to melt the metal. Furnaces are refractory lined vessels that contain the material to be melted and provide the energy to melt it. Modern furnace types include electric arc furnaces (EAF), induction furnaces, cupolas, reverberatory and crucible furnaces. Furnace choice is dependent on the alloy system quantities produced. For ferrous materials EAFs, cupolas, and induction furnaces are commonly used. Reverberatory and crucible furnaces are common for producing aluminium, bronze and brass castings.

The various alternative available for melting in steel production are as follows:

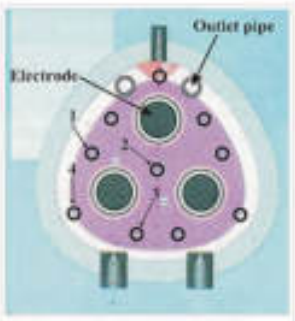
(1) Induction furnace[1]***:*** An induction furnace is an electrical furnace in which the heat is applied by induction heating of metal. The advantage of the induction furnace is a clean, energy-efficient and well-controllable melting process compared to most other means of metal melting. Most modern foundries use this type of furnace and now also more iron foundries are replacing cupolas with induction furnaces to melt cast iron, as the former emit lots of dust and other pollutants.



(2) Electric arc furnaces[2]: An electric arc furnace (EAF) is a furnace that heats charged material by means of an electric arc. Industrial electric arc furnace temperatures can be up to 1,800°C. Arc furnaces differ from induction furnaces in that the charge material is directly exposed to an electric arc, and the current in the furnace terminals passes through the charged material.


A schematic cross-section through an EAF. Three electrodes (yellow), molten bath (gold), tapping spout at left, refractory brick movable roof, brick shell, and a refractory-lined bowl-shaped hearth.

(3) Submerged Arc Furnaces: The Submerged-arc furnace is a particular sub-type of electric arc furnace. The nomenclature submerged means that the furnace's electrodes are buried deep in the furnace burden. A reduction reaction takes place near the tip of the electrodes to facilitate the furnace's process. The electrode tips are buried in the slag/c harge, and arcing occurs through the slag, between the matte and the electrode[3].



A top view of a submerged-arc furnace for phosphorus production

The term “Submerged Arc Furnace” does not really describe all Electric Smelting processes because in some cases, arcing is to be avoided. Although each Smelting Process is unique, most processes fall into one of three operating modes:-

- **Slagless Processes-** with an arc between the electrode and the metal bath.
- **Slag Processes-** frequently with a coke bed formed under the electrode. The coke bed floats on the slag layer and the current passes through the coke bed and the slag before reaching the molten metal. In these slag processes arcing is usually minimized.
- **Slag Resistance Processes-** where the heat is generated by the current passing through a slag layer. There is no coke bed and no arcing should occur.

[1] Source: https://en.wikipedia.org/wiki/Induction_furnace accessed 24.04.2023

[2] Source : https://en.wikipedia.org/wiki/Electric_arc_furnace accessed 24.04.2023

[3] Source : https://en.wikipedia.org/wiki/Submerged-arc_furnace_for_phosphorus_production accessed 24.04.2023

The most widespread use of Submerged Arc Furnaces in the United States today is in the production of Silicon Alloys. In these Slags-Less processes an arc is made between the Electrodes and the Metal bath within a cavity under the charge mix[4].

Chosen technology: The existing technology adopted for the ferro alloys plant is submerged arc furnace. Ferro manganese and silico manganese smelting generate substantial slag whole ferro silicon smelting is essentially a slag-less process. Still some slag formation takes place because of the presence of impurities in raw materials.

The submerged arc furnaces have a open or closed top design. In closed top, ambient air can be prevented from mixing with the processes off- gas, then the off-gas contains 65 to 70% CO and can be used as fuel for other plant processes such as raw material drying.

However, the existing units as well as proposed units shall have furnaces with be open top with movable attachments to close the furnace top during operation. The hood shall have an exhaust system connected to the fume extraction system leading to the bag filter for removal of particulate matter prior to release to atmosphere.

5.3.3 Sinter Plant

There are three types of sinters as follows[5]:

Non flux or acid sinters – For preparing the sinter mix, no flux is added to the iron/ other ores. These days, non flux sinters are very rarely being produced.

Self fluxing or basic sinters – These are the sinters where sufficient flux is added in the sinter mix taking into account the acidic oxides in the furnace burden for producing slags of desired basicity (CaO/SiO_2) in the furnace.

Super flux sinters – These are the sinters where sufficient flux is added in the sinter mix taking also into account the acidic oxides in the coke ash in addition to the other acidic oxides in the furnace burden for producing slags of desired basicity in the furnace.

In the proposed plant, the sinter will be produced by reuse of the bag filter dust, material handling fines, recovered metal from metal recovery plant, ore fines/ concentrate purchased from open market, etc. Only coke fines will be added with some fresh Manganese Ore Concentrate. The sinter made will be used in submerged arc furnaces.

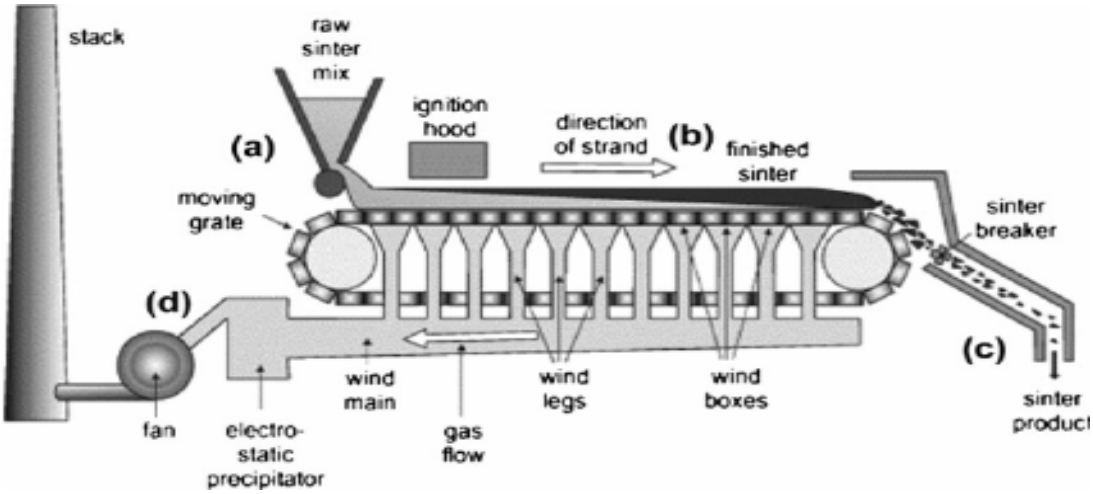
[4] Source: Commentary on Submerged Arc Furnaces published by The EPRI Centre for Materials Production at https://p2infohouse.org/ref/10/09042.pdf accessed 24.04.2023

[5] Source: https://www.ispatguru.com/understanding-sinter-and-sinter-plant-operations/ accessed 24.04.2023

Manufacturing process can occur through the following methods:

- ***Travelling Grate***, which is typically used in steel plants - Traveling grate sintering process begins with the preparation of a raw mix of iron/ other ores, fluxes, in-plant dust and spillage fines, solid fuel, and return fines. Water is added to the raw mix to obtain optimum permeability for lower electricity consumption, maintained by conveying the raw mix carefully onto the sinter machine. Its surface is then ignited, air is induced through the ignited layer and sintering proceeds in a vertical direction in the sinter strand's material bed. The sinter is then cooled, usually in a separate sinter cooler located at the sinter machine's discharge end. The process is represented diagrammatically in **Fig 5.3**.

FIG 5.3: DIAGRAMMATIC REPRESENTATION OF TRAVELLING GRATE SINTER MAKING PROCESS



Source: Fig 1 from Assessment of exposure to PCDD/F, PCB, and PAH at a basic oxygen steelmaking (BOS) and an iron ore sintering plant in the UK, Jackson et.al. January 2012, Annals of Occupational Hygiene 56(1):37-48

- ***Sinter pan***, which are used by Ferro Alloys manufacturers to sinter the mix of coke and ferro alloys powder, before charging the mass into the furnace

Chosen technology: For proposed ferro alloys plant, the more prevalent technology i.e. sinter pan technology shall be used for sinter manufacturing.

5.3.4 Chrome beneficiation plant

The purpose of chrome beneficiation is to make the ore concentrate suitable for subsequent treatments both physically (granulometry) and chemically. The choice of beneficiation method depends on the mineral characteristics of the ore deposits, gangue mineral assemblage and the degree of dissemination of constituent minerals. The general process for chromite beneficiation has two major parts:

1) comminution (for preparing the material to the subsequent unit operations) and

2) concentration.

There are various challenges that are faced in chrome ore beneficiation which are related to minimising tailing losses, beneficiation of low and sub-grade chromite ore (10–30% Cr2O3), recovery of unrecoverable ultrafine chrome particles, reprocessing of stockpiled tailings containing valuables, concentrate with required Cr2O3 content and Cr/Fe ratio, etc.

Keeping the above in mind, the nature of raw material and the final product quality required for the manufacture of ferro chrome, the chromite ore is planned to be prepared through crushing & sizing followed by wet process beneficiation comprising of hydro cyclones and top feed gravity distributor spirals.

Tailing disposal poses a challenge and in the past, tailing dams or tailing ponds used to be created where the tailing used to be stored and decanted water reused. However, considering the rising costs of the metal, recovery of metal fines from tailings is also carried out and the tailings are removed from the tank, de-watered and wet cakes are dumped in designated area, thereby, reducing the land requirement also. Rejects from the chrome beneficiation process also find use as road base, filling and construction.

5.4 SITE ALTERNATIVES - TECHNICAL AND SOCIAL CONCERNS

The main technical and social concerns of the chosen alternatives are as follows:

	Technical Concerns	**Social Concerns**
Site Alternatives:		
Alternative Site-1 : North of the plant towards Meramandali Railway Station	Site is a water logged area	Site is in close proximity to another industry/plant due to which the cumulative impact of air pollution may be higher on surrounding population.
Alternative Site-2 : South-East of existing unit, across Lingra Nadi	• No direct connectivity will be possible between the existing & proposed sites even though they are aerially approximately 100-150 m apart. Road connectivity will be 1.7 km.	• Site is across the Lingara Nadi in reference to the existing plant. • Expansion area and existing area will have to be integrated through the construction of bridge on Lingara Nadi, entailing several complications that can be avoided. • Also the site contains the majorly agricultural area of the nearby villagers. (approximately 40 nos.)
Alternative Site-3	• Site is situated in close proximity to the company's	• It comprises of less agriculture area than the Site-2.

	Technical Concerns	Social Concerns
	existing unit. Thus existing facilities can be utilized for the proposed expansion phase also	
Technology:		
1. Ferro Alloys Plant		
1.1 Induction Furnace	• Leaching of molten steel to the lining. • Nature of lining (alkaline/ acidic) can affect the number of heats per day • Total volume of material charged has to be less than half the size of the crucible	• Respiratory occupational health hazards • Injury due to exposure to molten metal & slag, hot gases, moving part, slip, fall, explosion in shell, etc • Disposal of waste can pose social challenges also
1.2 Electric Arc Furnace	• The arc can only generate point-like heating sources, which will cause uneven heat distribution in the furnace. • The arc will react with the furnace gases and vapor and release large quantities of Hydrogen and Nitrogen.	• Production of slag will be more in this process. • Heavy trucks are needed for scrap handling • Needs to be a closed top process • Fourth hole tapping required for safety of workers health • Hazards same as above but higher risk of explosion of shell due to water leakage
1.3 Submerged Arc Furnace	• Lesser slags in some processes. • The stirring action is inherent due to electromagnetic forces set up by the current resulting in uniform heating of charge.	• Lesser slag has social advantage • Reusability of slag of one product as raw material of another is theire • Lesser risk of explosion of shell, atlhough other hazards to workers remain same as above two
2. Captive Power Plant		
2.1 Circulating fluidized bed Combustion	• Lower emission of pollutants • Gas and solids will mix together turbulently for better heat transfer and chemical reactions • Sulfur absorbing chemical and fuel are recycled to increase the efficiency of producing a higher quality steam as well as lower the emission of pollutants.	• Respiratory occupational health hazards • Injury due to exposure to hot gases and hot surfaces, moving part, slip, fall, explosion, etc • Disposal of ash can pose social challenges also
2.2 Atmospheric	• Use limestone or dolomite to	• Same as above

	Technical Concerns	Social Concerns
Fluidised Bed Combustion	capture sulfur • Boilers operate at atmospheric pressure.	
2.3 Pressurised Fluidised Bed Combustion	• Systems operate at elevated pressures and produce a high-pressure gas stream	• Same as above
2.4 Integrated Gasification Combined Cycle	• Amount of CO_2 released without pre-combustion capture. • Solid waste is generated is lower	• Same as above

5.5 CONCLUSION

In this ferro alloys plant, submerged arc furnace with slag operation will be adopted with open top and movable panels (to enable closure of the gap between top and furnace during operation). The top hood will be connected to fume extraction system leading to a bag filter, thus, releasing clean air into the atmosphere. The technology is being and shall be adopted to minimize emission and environmental pollution.

On the basis of site alternatives, it is concluded that the site-3 is suitable for the expansion of the proposed project as some of the land is already in possession of the company and existing facilities available for operation of existing plant can be utilized for the expansion phase also.

CHAPTER 6

ENVIRONMENTAL MONITORING PROGRAM

6.1 INTRODUCTION

The efficiency of the organizational set up responsible for implementation of the programme is dependent on the success of any environmental management programme. Regular monitoring of various environmental parameters is also necessary to evaluate the effectiveness of the management programme so that necessary corrective measures can be taken in case there are some drawbacks in the proposed programme. Environmental quality parameters at work zone are important for maintaining safe working environment also. This chapter deals with the creation of an arrangement for successful implementation of environmental monitoring plan. Rungta Mines Ltd. is and shall be responsible for environmental protection.

6.2 PROPOSED ORGANIZATIONAL SET-UP

Since the ferro alloys is an operational plant, hence, an environmental management team is already functional, which is and will continue to function in conjunction with the Environment Department at Head office in Chaibasa. The same team shall be responsible for the plant after expansion. The organizational chart has been presented in Fig 10.1 in Chapter 10 along with the roles and responsibilities of its members in section 10.2.

At present, the statutory agencies (SPCB/CPCB) are monitoring the plant through online stack monitoring system connected to their servers, with occasional manual sampling. Third party monitoring is also carried out.

After expansion plant, the monitoring for various parameters of air, water, noise, soil, waste water, stack, etc. will be carried out by an MOEF&CC / NABL accredited/ recognised laboratory as per the monitoring schedule given in Table 6.1 and 6.2. The samples will be collected from the plant and taken for analysis in their laboratory. Within the plant, various online monitoring equipment are installed in the existing stack for monitoring emission parameters and stack monitoring systems will be installed in the expansion phase also. Online ambient air quality station will also be also installed within the project site after commencement of enhanced production after expansion.

6.3 MONITORING SCHEDULE AND PARAMETERS

Pollution control equipment are an integral part of the production units. They are and will be maintained like any other equipment of production units. Th

Mechanical Department, therefore, holds the responsibility of maintenance and operation through its staff. Expenses are and will be made every year in the operation and maintenance of such equipment and the performance is and will be evaluated by continuous and periodic monitoring.

To evaluate the effectiveness of environment management programme, regular monitoring of the important environmental parameters are being and will be carried out to ascertain the following:

- Pollution control status within the plant area.
- Generate data for predictive or corrective purpose in respect of pollution.
- Effectiveness of pollution control measures and control facilities.
- To assess environmental impacts.
- To follow the trend of parameters which have been identified as critical.
- Ensure compliance to the conditions of the environmental clearances, consent to operate and consent to establish.
- Submit periodical compliance reports to MOEF&CC, SPCB and submission of various returns under Hazardous waste, Environmental Statement, etc.

The schedule, duration and parameters for monitoring of expansion project post completion have been proposed as given in **Table 6.1**. For construction phase and **Table 6.2** for operation phase.

TABLE 6.1: ENVIRONMENT MONITORING MATRIX DURING CONSTRUCTION PHASE

Aspect	Activity	Monitoring parameter	Location	Monitoring Frequency	Responsi-bility
Topography	Change in topography in expansion area due to digging and filling, construction of the plant buildings, storage sheds, roads, etc.	a. Quantity of cutting (in cum) b. Quantity of filling (in cum)	Within plant premises	Everyday when the cutting/ filling is taking place	Manager (Civil)
Drainage	Disturbance to runoff, drainage pathways and sheet flow due to construction in the expansion area	Review and approval of proposal for storm water drainage after detail designing	a. Project site	One time at design stage	Manager (Civil)

Aspect	Activity	Monitoring parameter	Location	Monitoring Frequency	Responsi-bility
		Construction of storm water drainage system as per specifications	Where the construction is taking place in the project site	During construction everyday monitoring by Civil engineer	Manager (Civil)
Water quality	➢ Suspended solids in run-off due to loose soil at construction site during heavy precipitation. ➢ Domestic waste water (sewage) from construction workers to septic tank.	➢ Check TSS at water reservoir ➢ Observe whether overflow from septic tank	➢ Water reservoir ➢ Septic tank	➢ On rainy days ➢ Every 15 days	Manager (Civil)
Air quality	Increase in dust (Particulate Matter) concentration due to construction activities of plant, vehicular movement, excavation and material handling activities	➢ Verifying construction of enclosures ➢ Verification of log of sprinkling & actual site conditions ➢ Verifying cover on trucks and construction of speed breakers ➢ Records of PUC of vehicles	Within construction zone	Daily site inspections and weekly verification of records by security staff and Junior Manager (Environment)	Manager (Civil)
Noise	Increase in noise level due to construction equipment.	➢ Noise levels at site ➢ Verification of PPE of workers through surprise checks	Within construction zone/area	Daily site inspections and weekly verification of records	➢ Junior Manager (Environment) ➢ Deputy Manager (Safety)
Terrestrial ecology	Clearing of small vegetation (bushes) prior to construction	Record of green belt plantation	Within plant area	At time of green belt plantation	Junior Manager (Environment)
Excavated soil	Loss of excavated top soil	➢ Verification of top soil quantity records (removal & reuse), ➢ Observation of storage area, ➢ Observation of reuse in green belt area	Within plant area	Daily during soil removal activity	➢ Head (Civil) ➢ Junior Manager (Environment)

TABLE 6.2: POST PROJECT ENVIRONMENT MONITORING MATRIX DURING OPERATION PHASE

Sl. No.	Activity	Aspect	Monitoring parameter	Methodology	Monitoring locations	Frequency and duration of monitoring	Reporting schedule	Responsibility
1.	Production process	Air	Air Quality Monitoring: Parameters: (1) PM10, $PM_{2.5}$, SO_2, NO_2, (2) CO, Lead, Ammonia, Benzene, BaP, Arsenic and Nickel (As per NAAQS 2009)	IS:5182 (Parts 2, 6, 11, 12, 23), CPCB guidelines, IS 3025 (Part 2) ICP Method	Plant premises	Online continuous air quality monitoring station will be installed to monitor PM10, PM2.5, SO_2, NOx.	Continuously data will be transmitted to the SPCB/ CPCB	Junior Manager (Environment)
					Plant premises & in residential areas	One 24 hourly sample quarterly basis or as per the MoEF&CC/CPCB/ SPCB guidelines, whichever are most stringent.	Submitted every month to the SPCB.	Junior Manager (Environment)
2.	Production process	Air	Stack Emission Monitoring: PM and SO_2, as applicable	IS:11255 (Part 1) & flue gas analyser manual	At all major process stacks (where combustion/ reaction is taking place)	• Online continuous monitoring system is in place as per SPCB directions for applicable existing stacks and the same shall be installed in future also on new stacks. • Manual monitoring will be carried out for process & non-process stacks every months.	• Continuously data is transmitted to the SPCB/ CPCB • Submitted every month to SPCB	Junior Manager (Environment)
3.	Production process	Air	Fugitive Emission Monitoring	IS:5182 (Part 4)	Major sources of fugitive dust	As per the MoEF&CC/ CPCB/ SPCB guidelines, whichever are most stringent	Every Month	Junior Manager (Environment)
4.	Production process	Water	Water Quality/effluents		Neutralization tank-inlet and outlet	Periodic sampling - monthly for inlet & outlet	Submitted every month to SPCB.	Junior Manager (Environment)
			Ground Water quality as per IS : 10500 including heavy metals but excluding	Various parts of IS 3025 for sampling & analysis, APHA	Ground water-within plant & 2 locations outside plat towards	Ground water - once in a year	• Submitted every year to CGWA. • Will be submitted	Junior Manager (Environment)

Sl. No.	Activity	Aspect	Monitoring parameter	Methodology	Monitoring locations	Frequency and duration of monitoring	Reporting schedule	Responsibility
			radioactivity & pesticides		Brahmani river		with Six monthly EC compliance in future.	
			Surface water quality as per CPCBs designated best use criteria	Various parts of IS 3025 for sampling & analysis, APHA	Surface water upstream & downstream of plant	Ground water - once in a year	Will be submitted with Six monthly EC compliance in future.	Junior Manager (Environment)
5.	Production process	Noise	Ambient noise level	CPCB guidelines	Within plant	Monthly	Every Month	Junior Manager (Environment)
6.	Production process	Health	Health checkup	Approved medical procedures	Monitored in plant as well medical Centre	Medical check ups prior to induction & periodically as per rules; consultation on need basis	Every Year as per Factory Act & Factory Rules	Deputy Manager (Safety)
7.	Production process	Hazardous Waste	Inventory of hazardous waste	Form 3 & Form 4 of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016	Within plant	Annually	Monthly / Annual returns filed to SPCB as per HWM authorisation	Junior Manager (Environment)
8.	Production process	Solid Waste	Inventory of solid waste	Environmental statement	Within plant	Yearly	Environmental statement filed annually	Junior Manager (Environment)
9.	Production process	Water	Water consumption	Water meter	Intake point	Continuous monitoring, reading recorded every day	Monthly online returns filed to SPCB & Yearly to CGWA	Junior Manager (Environment)
10.	Nil	Ground Water	Depth to water table	• Peizometer • Sounder or tape	• Peizometer in plant area • Tape measurement in villages between plant and Brahmani River	Every season	• Yearly to CGWA • Six monthly with EC compliance in future	Junior Manager (Environment)

**** Subject to modification in future according to circumstances (wind directions, SPCB discussion, status of operation/ construction, site conditions, etc)***

The company carries out in house controls and checks to ensure that the air pollution control equipment are operational. Continuous stack monitoring equipment give an indication in case the emissions exceed limits, to enable the company to take immediate corrective action. Monthly/ quarterly environmental monitoring will be carried out by MOEF&CC/ NABL accredited laboratory. After study of the monitoring results, mid course corrections, modifications, improvements, etc. can be carried out in the Air Pollution Control systems and Waste Water Treatment Systems.

Within the premises of the existing plant, green belt plantation is being carried out, which prevents spread of pollution and helps to keep the environment of the surrounding villages clean. The plantation is being and will be properly guarded by watch and ward personnel. Provision has been and will be made for fertilizers application and watering on schedule. Expansion area will also have additional greenbelt, with manuring and watering as per schedule.

The company celebrates 5th of June every year as World Environment Day with an aim to spread the message of clean environment.

Detail of methodology and identification of monitoring points (between the plant and drainage in the direction of flow of surface/ ground water): The flow of drainage is south west to north east via the Lingara Nadi, which is flowing adjacent to the plant and joining Brahmani river near village Khargaprasad. The monitoring of drainage shall be carried out at :

- Surface water - (1) Lingara Nadi near Gandijhara (upstream of plant) & (2) Lingara Nadi near Motanga (downstream of plant)
- Ground water - (1) Meramundali Bazar and (2) Khargaprasad villages. Both villages are in the downgradient of plant.

6.4 BUDGETARY PROVISION FOR ENVIRONMENTAL MONITORING

Capital and recurring cost estimated for monitoring through in-house equipment as well as through third party, is given in **Table 6.3** and **6.4**, respectively.

TABLE 6.3: CAPITAL COST FOR ENVIRONMENTAL MONITORING

Particulars	Existing 0.055 MTPA Ferro Alloys Plant			Proposed Additional 0.238 MTPA Ferro Alloys Plant			Total for 0.293 MTPA Ferro alloys Plant	
	No. of eqpt.	Unit cost	Capital cost	No. of eqpt.	Unit cost	Capital cost	No. of eqpt.	Capital cost
PM2.5 sampler				1	1	1	1	1
Respirable dust sampler				1	0.65	0.65	1	0.65
CAQMS with Micro-meteorological station (Auto)				4	30	120	4	120
Online Stack Monitoring systems	2	6	12	18	6	108	20	120

Particulars	Existing 0.055 MTPA Ferro Alloys Plant			Proposed Additional 0.238 MTPA Ferro Alloys Plant			Total for 0.293 MTPA Ferro alloys Plant	
	No. of eqpt.	Unit cost	Capital cost	No. of eqpt.	Unit cost	Capital cost	No. of eqpt.	Capital cost
Water sampling kit				1	0.1	0.1	1	0.1
TDS meter (portable)				1	0.05	0.05	1	0.05
Conductivity meter (portable)				1	0.05	0.05	1	0.05
TSS (portable)				1	1	1	1	1
pH meter (portable)				1	0.05	0.05	1	0.05
Noise meter				1	0.5	0.5	1	0.5
Total			**12**			**231.4**		**243.4**

TABLE 6.4: RECURRING COST FOR ENVIRONMENTAL MONITORING

Particulars	Recurring cost (Rs. Lakhs)		
	Existing 0.055 MTPA Ferro Alloys Plant	Proposed Additional 0.238 MTPA Ferro Alloys Plant	Total for 0.293 MTPA Ferro alloys Plant
Third party monitoring	0	3.6	3.60
Annual Depreciation	2.40	46.12	48.52
Power consumption	0.45	9.83	10.28
Repair & Maintenance including oils, lubricants	0.53	10.17	10.7
Manpower	1.35	4.8	6.15
Total	**4.73**	**74.52**	**79.25**

The additional capital investment on environmental monitoring activities for expansion project is envisaged as Rs. 231.4 lakhs. The additional recurring cost on environmental monitoring activities for expansion project is calculated as Rs. 74.52 lakhs/annum.

Procurement schedule for the monitoring equipment/ services is as follows:

1. ***Continuous stack monitoring systems*** - already procured and installed on operational units. The balance shall be installed along with the construction of the particular sub-unit so that the stack monitoring system commences operation along with operation of the unit.

2. ***Continuous ambient air quality monitoring stations*** - They will be installed after the completion of construction in a phase wise manner till the plant achieves full production. The locations of the existing stations may be changed, if required, on the directions of the SPCB/ CPCB.

3. ***Monitoring through third party*** - Monthly for some parameters/ matrices and quarterly for the remaining as described in **Table 6.1** & **Table 6.2.**

CHAPTER 7

ADDITIONAL STUDIES - RISK ASSESSMENT & DISASTER MANAGEMENT PLAN

Chapter 7 comprises of various additional studies prescribed in the EIA Notification dated 14.09.2006. In the case of this project, it comprises of the following: (1) Risk Assessment and Disaster Management and (2) Public Consultation.

This chapter deals with identification of risks and preventive measures for disaster. Proposed expansion of ferro alloys plant along with 150 MW captive power plant may face certain types of hazards which can disrupt normal activities abruptly and lead to disaster like fires, inundation, failure of machinery, electrocution to name a few. Disaster management plan is formulated with an aim of taking precautionary steps to control the hazard propagation and avert disaster and also to take such action after the disaster which limits the damage to the minimum.

Definitions pertinent to this chapter are:

- "Accident" is a particular type of incident in which an injury or illness actually occurs.
- "Consequence"- A measure of the expected effects of an incident.
- "Disaster" is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Though often caused by nature, disasters can have human origin.
- "Emergency" is an unexpected occurrence requiring immediate action.
- "Frequency" The number of occurrences of an event per unit of time
- "Hazard" is a source or a situation with the potential for harm in terms of human injury or ill-health, damage to property, damage to the environment, or a combination of these.
- "Incident" is a "work-related event(s) in which an injury or ill health (regardless of severity) or fatality occurred, or could have occurred.
- 'Likelihood' is commonly understood to be the measurement of how often an event might occur, while 'consequence' is the outcome of an event expressed quantitatively in terms of a loss, injury disadvantage or lost opportunity.

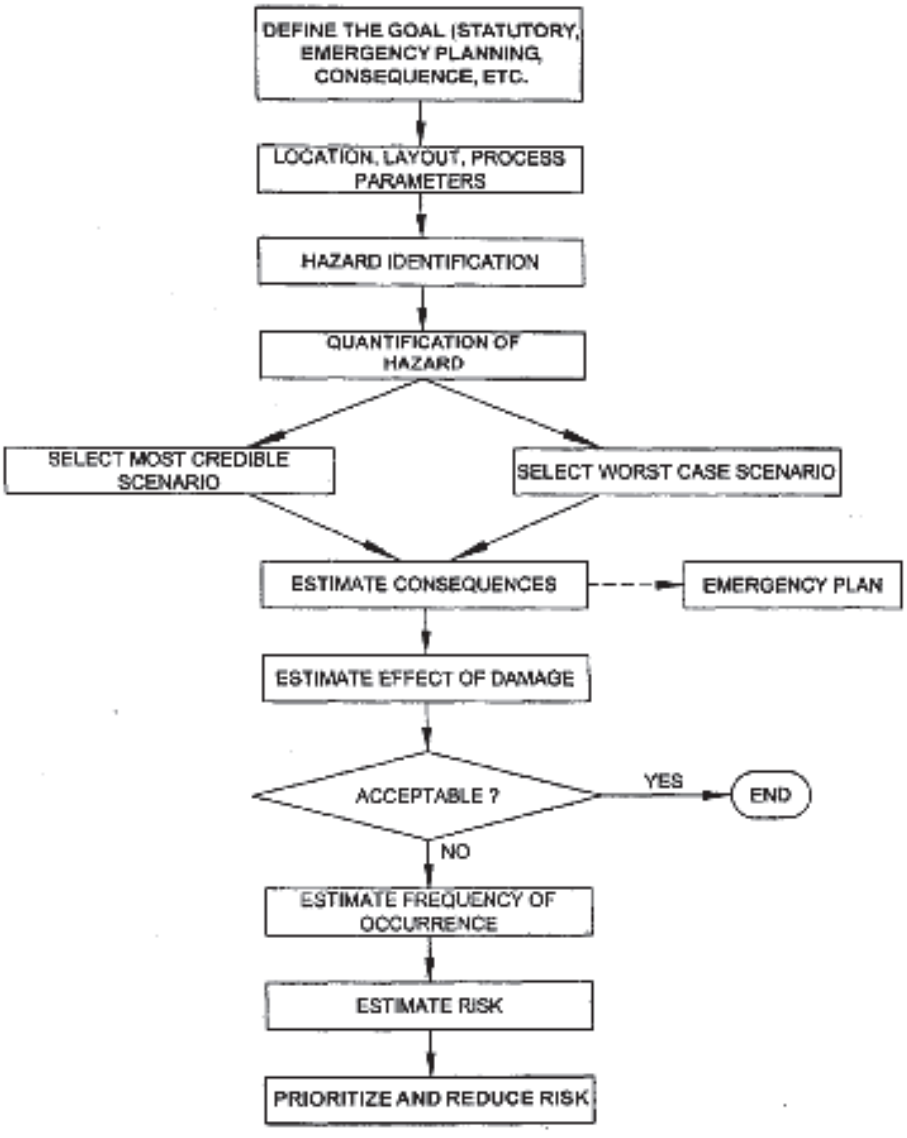
- "Mitigation System" is defined as the equipment and/or procedures designed to respond to an accident event sequence by interfering with accident propagation and/or reducing the accident consequence.

- "Probability — An expression for the likelihood of occurrence of an event or an event sequence during an interval of time or the likelihood of the success or failure of an event on test or on demand.

- "Risk" is defined as a likelihood of an undesired event (accident injury or death) occurring within a specified period or under specified circumstances. The level of risk reflects the likelihood of the unwanted event and the potential consequences of the unwanted event.

The hazard identification and risk analysis has been carried out as per the code of practice given in IS 15656:2006. The steps followed for risk analysis is given in **Fig 7.1**.

FIG 7.1: FLOW CHART FOR RISK ANALYSIS



Source: Fig 1 from IS 15656:2006

7.1 PLANT DESCRIPTION

Rungta Mines Limited is operating 0.055 MTPA ferro alloys plant and Sinter Plant (Manganese) of quantity 3600 Tonne/Month. Now, the company is proposing to enhance the capacity of the ferro alloys to 0.293 MTPA along with 150 MW CPP by acquiring additional land adjacent to the existing land.

The existing plant is located in village Tulasidiha and proposed expansion shall take place in additional villages Charadagada & Kangelapal in District Dhenkanal of Odisha. The proposed expansion area shall be between latitude 20°47'14.93"N to 20°47'52.48"N and longitude 85°17'14.82"E to 85°17'51.21"E. The location of the project is given in **Fig 1.1, Chapter 1**.

The surrounding of the projects can be seen in **Fig 7.2** later and the entire 10 km radius map can be seen in **Fig 3.1 of Chapter 3**. The following are present in its surroundings:

- Eastern side - Chitiparha village habitation, 510 m
- Western side - Chararhagarhi village habitation, 200 m
- Northern side - Factory of Navbharat ventures, 910 m
- Southern side - Galaparha village, 1350 m

The plant intends to expand in order to meet the growing market demand for ferro alloys in that region. The expansion shall be carried out by installation of following additional facilities given in **Table 7.1**.

TABLE 7.1: PROPOSED ADDITIONAL PRODUCTION FACILITIES

Sl. No.	Plant Equipment/ Facilities	Existing Capacity, TPA	Proposed Additional Capacity, TPA	Total (Existing + Proposed), TPA
1	Ferro Alloy Plant			
	Ferro Manganese OR	55,008	238,368	293,376
	Silico Manganese OR	39,960	190,840	230,800
	Ferro Chrome OR	-	230,400	230,400
	Ferro Silicon	-	102,400	102,400
2	Pig Iron	-	369,600	369,600
3	Metal Recovery plant	19,980	95,420	115,400
4	Briquette Plant for Ferro chrome	-	461,127	461,127
5	Briquette Plant for Ferro manganese	-	476,738	586,754
6	Sinter plant	43,200	518,400	561,600
7	Chrome ore beneficiation	-	660,000	660,000
8	Power plant	-	150 MW	150 MW

The detailed table on changes from existing to expanded facilities is given in Chapter 2, Table 2.2 and the increase in raw material consumption due to

expansion is given in Table 2.26. The main raw material increase shall be as follows:

- Iron ore fines from 41,040 to 5,33,520 TPA
- Coke fines from 1,512 to 19,656 TPA
- Limestone from 5,616 to 97,736 TPA
- Dolomite from 9,612 to 96,088 TPA
- Quartz from 5,994 to 1,99,680 TPA
- Charcoal/ Coke from 22,316 to 1,33,120 TPA
- Manganese ore from 28,771 to 1,66,176 TPA
- Low grade High Silicon Moil ore from 34,565 to 1,99,642 TPA
- Coal from 9,191 to 8,32,190 TPA

7.2 HAZARD IDENTIFICATION AND RISK ASSESSMENT

Identification of hazards in the proposed expansion of ferro alloys plant is of primary significance in the analysis, quantification and cost effective control of accidents involving chemicals and other hazardous material. A hazard in fact is the characteristic of a process that presents potential for an accident. Hence, all the components of a process need to be thoroughly examined to assess their potential for initiating or propagating an unplanned sequence of events, which can be termed as an accident.

Risk assessment involves identifying, analysing and controlling hazards and risks. In the working atmosphere, it is not possible to avoid or eliminate risk factor completely. As a consequence of health and safety awareness many measures are being taken to ensure the security of an individual working in the industrial premises. However, it is possible to minimize the risk factor to minimal or acceptable level.

The risk assessment process includes:

1. Identification of a hazard and associated risk.
2. Assessment of the risk, which includes the likelihood, the severity and assigning a priority for correction followed by control of the risk, which includes elimination, engineering a barrier, administration controls and personal protection equipment.
3. Documentation of the process.
4. Monitoring and review of the process.

7.2.1 Identification of a hazard and risk associated

The objective of hazard identification is to identify and evaluate the hazards and the unintended events, which could cause an accident. The first task usually is to identify the hazards that are inherent to the process and/or plant and then focus on the evaluation of the events, which could be associated with hazards.

Hazard analysis involves the identification of hazards at a facility and evaluating possible scenarios leading to unwanted consequences. The hazard analysis stage is a very important part of the risk management process, as no action can be made to avoid or reduce the effects of unidentified hazards.

Hazard identification study generates a list of failure cases which may usually be derived reliably by considering: (a) form in which chemicals are stored or processed, (b) nature of hazard it poses and (c) quantity of material contained a relies on a structured and systematic approach to identify potential hazards. There are various techniques that can be used to perform this task at various stages during the life cycle of plant process like Checklist, Preliminary hazard analysis, Failure modes and effects analysis, Hazard and operability study, Fault tree analysis, Event tree analysis,etc. We have adopted Preliminary hazard analysis as a tool for identifying the hazard in the process.

Preliminary Hazard Analysis(PHA)

Preliminary Hazards Analysis identifies early potential hazards associated with or inherent in a process design, thus, eliminating costly and time consuming delays caused by design changes made later.

An assessment of the conceptual design is conducted for the purpose of identifying and examining hazards related to raw materials and chemicals handling, major process components, utility and support systems, etc. It also focuses on identifying the general and occupational hazards and suggests corrective measures.

In the proposed expansion of ferro alloys plant major hazard is electrocution, fire and explosion due to storage of flammable fuel and chemicals, use of oxygen and improper shell cooling. Other hazardous installation is the boiler where the generated steam can cause burn hazard, it can catch fire or explode.

The hazard shall be higher for workers directly exposed to raw material and chemical handling areas where not only the danger due to failure of machinery but also inhalation of dust, fumes, etc exists. In other areas where heat generating equipment such as furnace, boilers, blow down water, etc. are there, the risks pertain to exposure to heat and hazard of explosion due to high pressure. Several examples of hazards that may cause injury can be:

- slips, trips and falls on the same level
- falls from height
- unguarded machinery
- falling objects
- engulfment
- working in confined spaces
- moving machinery, on-site transport, forklifts and cranes
- exposure to controlled and uncontrolled energy sources
- inhalable agents (gases, vapours, dusts and fumes)
- skin contact with chemicals (irritants (acids, alkalis), solvents and sensitizers)
- contact with hot metal;
- fire and explosion;
- extreme temperatures;
- radiation (non-ionizing, ionizing);
- noise and vibration;
- failures in automation;
- electrical burns and electric shock;
- manual handling;
- flammable liquids in the presence of ignition sources;
- poorly designed tools having the potential to cause injury;
- degraded and worn hand tools;
- used/ waste oil on the floor, causing a slipping hazard;

The hazards are identified based on the layout of the plant (refer **Fig 2.1**) and the process flow sheets and process description (refer flow sheets of different processes in **section 2.3**). The manufacturing process involves receiving of mineral ores and other raw materials and then mixing of ore materials, reducing agents and any fluxes outside the furnace takes place. After this charge mix is periodically fed into the submerged arc furnace, then the hot metal usually allowed to accumulate until tapping occurs at appropriate intervals preceded by removal of slag. Finally the finished products are stored in finished product shed and sold to steel industries The nature of the raw material and product plays a major role in the hazard

analysis, risk assessment and its mitigation. Hence, the MSDS of the major raw materials has been given in **Annexure XXXIII.**

There can be hazards on the road while to and fro movement of truck during transportation of material as follows:

- High concentration of traffic during duty hours
- Heterogenous traffic
- Violation of traffic rules/ speed limit
- Road Condition
- Condition of vehicle

In the existing plant & proposed expansion project, type of likely hazards and possible areas have been assessed after careful evaluation of the condition, plant layout, process and working condition in different units of the factory. Following area have been identified as sensitive and hazard prone as per preliminary hazard analysis for process and storage area and is tabulated in **Table 7.2**.

TABLE 7.2: PRELIMINARY HAZARD ANALYSIS FOR THE PROPOSED EXPANSION OF FERRO ALLOY PLANT

Sl. No.	Hazard area	Process/ Storage and items	Nature of Hazard	Hazard Potential	Provisions for mitigation measures
1	Raw materials handling	Metallurgical coke, coke breeze & fines, minerals and ore	Dust, toxic, injury, fire in case of flammable raw materials	Moderate to major	• Provision of Standard operating and handling procedure. • Provision of adequate training to workers and ensuring proper use of PPE. • Conduct regular safety audits. • Provision of fire fighting equipment.
2	Chemical handling	Water treatment Chemicals like acids/ alkalis	Toxic, injury	Moderate	• Same provisions as for raw materials handling. • Cautionary sign boards
		Lube oils/greases	Fire	Moderate	
3	Ferro alloy plant units	Contamination of cooling water bleed off/ blow down	Can cause water pollution	moderate	• Standard operating procedure for furnace operation and periodic maintenance. • Have trained/ skilled manpower with proper PPE kits. • Provision of fire fighting
		Hot molten metal & slag Handling (charging and tapping)	Heat radiation, contact with hot metal, injury, explosion when it comes in contact	Major	

Sl. No.	Hazard area	Process/ Storage and items	Nature of Hazard	Hazard Potential	Provisions for mitigation measures
			with water		equipment. • Proper working environment having good ventilation, etc.
		Cooling jacket & furnace (submerged arc)	Explosions, injury, heat radiation, contact with hot metal	Major	
4	Captive power plant	Coal storage	Fire	Moderate	• Standard operating procedure for furnace operation and periodic maintenance. • Have trained/ skilled manpower with proper PPE kits. • Install pressure, temperature and other necessary sensors monitored through control room • Fire fighting equipment.
		Boiler	Steam burn, explosion, fire	Major	
5	Pollution control systems	Bag filter house, Electrostatic precipitators	excessive emissions due to failure of control system causing acute air pollution	Moderate	Continuous emission monitoring and periodic maintenance
6	Electric power supply & grid sub station	Electrical components, switch yard, transformers, high voltage cables	Fire, burn, shock, injury due to component failure and short circuit	Major	• Entry restriction for unauthorised workers. • Installation of cautionary sign boards • Installation of fire fighting equipment
7	Liquid fuel like HSD	Fuel handling & storage area	Flammable and explosive at elevated temperature	Major	• Provision of SOP and handling procedure • PPE kits to worker • Periodic auditing • Storage area to be barricaded • Fire protection system
8	Hydraulic oil and lubricants	Accidental discharge of hydraulic oil under pressure	Fire & Toxic	Moderate	Same provisions as for liquid fuel.
9	Transformer	Transformer oil	Flammable and explosive at elevated temperature	Major	• SOP & handling procedure to be followed • PPE kits to worker • Periodic auditing

As per preliminary hazard analysis, it is observed that during operation phase major hazards and accidents may occur from raw material (coal, mineral ores, etc.) storage and handling, ferro alloys making process (furnace, hot molten metal and slag handling), power plant boiler, electric power supply & grid sub station and fuel & oil storage.

7.2.2 Assessment of risk and its control

Risk analysis follows as extensive hazard analysis. It involves the identification and assessment of potential impact. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of population, etc. Much of this information is difficult to get or generate. Consequently the risk analysis is often confined to maximum credible accident studies.

Risk evaluation

Risk is defined as probability of occurrence of an accident and its consequences. The risk may be computed by the following formula:

$R = FC$

Where: *R = risk (loss or injury per year);*
F = frequency or likelihood (event per year); and
C = consequence (loss or injury per event).

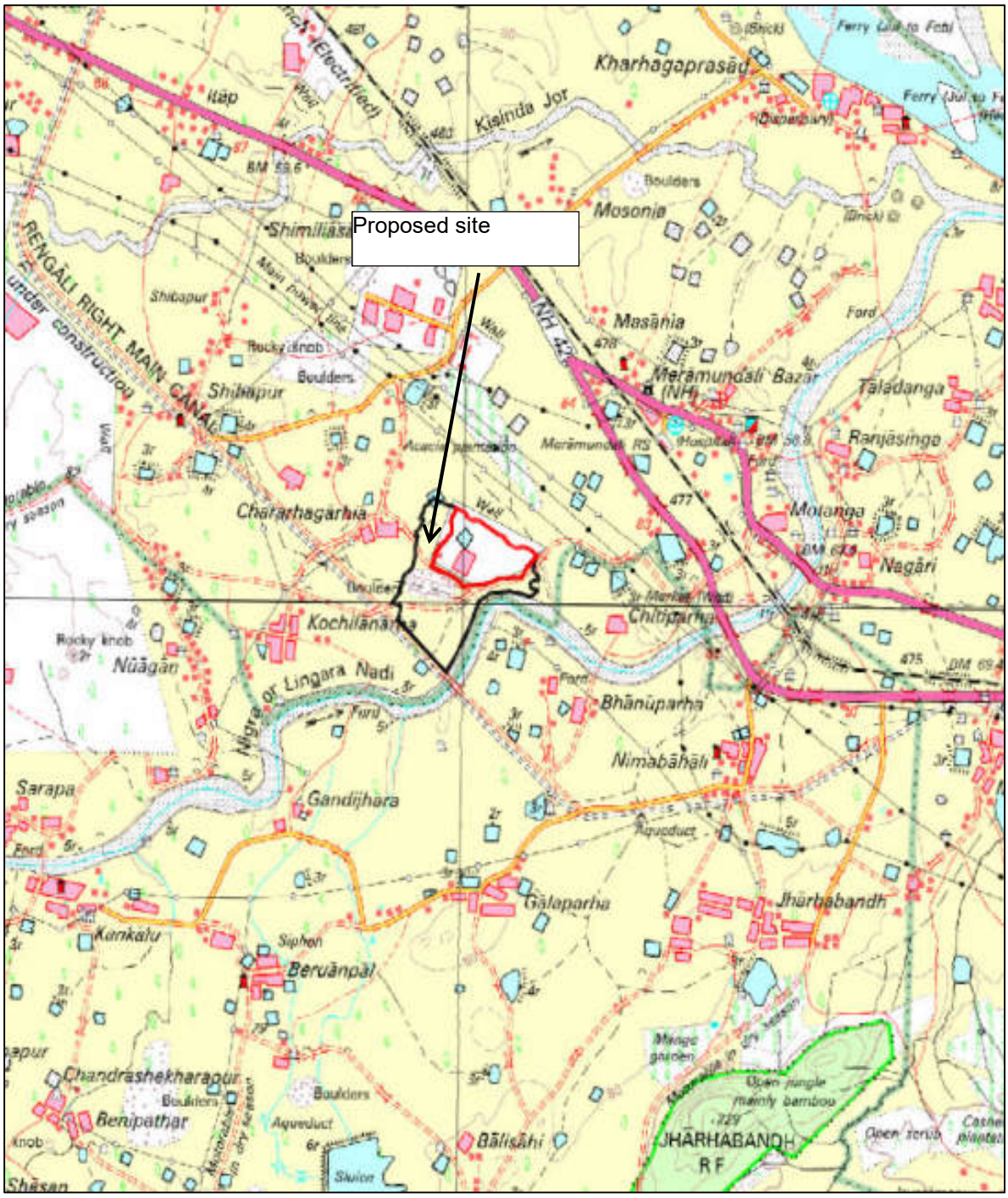
The above concept of risk is based on one specific aspect i.e. individual working in a particular environment that is exposed to a definite level of risk and has been calculated in detail in section 7.2.3 in matrix format.

Risk assessment is dependent on wind direction, stability class and population density. The wind directions for the entire year can be seen in **Fig 3.3 & 3.4**. In 1981-2010, it can been seen that in the morning wind flow is predominantly from north-east or north-west throughout the year while in evening, wind is predominantly it has been from north east (Nov-Jan), north west (Feb-Mar, Aug-Nov), south east (April-May) & south west (June-July). In 1991-2020, it can been seen that in the morning, wind flows predominantly from the north-west during January to March and June to December and from north-east during only two months i.e. April to May. In the evening, wind flows from north-east during January and October to December, from north-west during February to March and August to September, from south-east for two months during April & May and during June and July wind flows predominantly from south-west.

The nearest habitation are at villages Chitiparha (population 256, 0.5 km E), Chararhagarhia (population 835, 0.2 km W) and Bhanupada (population 293, 0.5 km S).

The nearby areas that can be under risk can be seen in **Fig 7.2**.

FIG 7.2: MAP SHOWING NEAREST HABITATION FROM PROJECT SITE



The population as per Census 2011 within 5 km radius around the proposed plant is as follows:

Distance from plant	Population (approx.)
Within 1 km	3210
Within 2 km	9230
Within 3 km	20980
Within 4 km	31540
Within 5 km	42020

All systems natural or man made shall be subject to failure. The nature of failure varies widely as do the causes of failure and the events leading to failure. The failure of systems could be due to:

- Misconception of systems required capability or environment.
- Design deficiencies and erroneous assumption.
- Errors in operational process
- Improper management of the systems.
- Risk evaluation to determine the acceptable level and reduce the risk level.
- Control decision monitored for meticulous implementation to prevent the occurrence of unclassified and unacceptable accidents.

Attempts have been made to reduce failures of man-made systems with the introduction of safety measures, quality control, reliability analysis, condition monitoring and other approaches in design in order to reduce the probability of failure. Use of measures such as factor of safety shall be usually resorted to in order to improve the reliability of design and where health of the person is at great risk. Such factor has to be very high, reducing probabilities of accidents/ disaster to a very low level.

High-Speed Diesel (HSD) is and will be used at existing as well as expansion phase and the same will be used after proposed expansion project and installation of additional facilities. Storage of fuel for existing plant are done under shed in Barrels with all applicable requirement of fire and safety measures. Same storage shall be considered for proposed expansion project. Fire hydrant points and fire extinguishers have been provided at storage locations. The characteristics of auxillary fuel based on IS 11489 -1985 (Reaffirmed in 2020) has been given in **Table 7.3**.

TABLE 7.3: FUELS CHARACTERISTICS FOR HSD

Sl. No.	Characteristics	Unit	Specifications
1.	Density @ 15ºC,Max	gm/ml	0.845
2.	Flash Point COC Min	ºC	35
3.	Gross Cal Value, Min	Cal/gm	10,500
4.	Pour Point, Max	ºC	3 (winter) & 15 (Summer)
5.	Sediment, Max	%/Wt.	0.05
6.	Sulphur Total Max	%/Wt.	350 mg/kg
7.	Water Content Max	%/Vol.	0.05
8.	Ash Percentage Max	%/Wt.	0.01