DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

PROPOSED KANTIO –PUTASAHI SAND QUARRY

AT

BRAHMANI RIVER, KANTIO-PUTASAHI VILLAGE, KAMAKHYANAGAR TAHASIL, DHENKANAL DISTRICT, ODISHA STATE

PROJECT ACTIVITY - MINING OF MINERALS 1(A) (I) PROJECT CATEGORY – B

PROJECT PROPONENT

TAHASILDAR, KAMAKHYANAGAR
ODISHA STATE

MONITORING PERIOD: - OCTOBER – DECEMBER 2020

PREPARED BY

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ABBREVIATIONS	
AAQM	Ambient Air Quality Monitoring
AMSL	Above Mean Sea Level
bgl	Below Ground Level
CPCB	Central Pollution Control Board
dB	Decibel
DG	Diesel Generator
E	East
EIA	Environmental Impact Assessment
EMC	Environmental Management Cell
EMP	Environmental Management Plan
ENE	East of North- East
EPA	Environmental Protection Agencies
ESE	East of South East
FCC	False Colour Composite
GIS	Geographical Information System
GPS	Global Positioning System
HP	Horse Power
Hr.	Hour
IMD	Indian Meteorological Department
IRS	Indian Remote Sensing Satellite
ISCST	Industrial Source Complex, Short Terms
ISO	International Organization of Standardization
ISS	Indian Standard Specification
KLD	Kilo Litre Per Day
Km	Kilometer
KW	Kilo Watt
LOS	Level of Service
m	Meter
MCDR	Mining Conservation & Development Rules
mg	Milligram
MoEF&CC	Ministry Of Environment Forest and Climate Change
N	North
NE	North-East
NNE	North of North-East

ABBREVIATIONS	
NNW	North of North-West
NO_2	Nitrogen Dioxides
NTU	Naphelo Turbidity Unit
NW	North-West
OB	Over Burden
OH&S	Occupational Health and Safety
PCU	Passenger Car Unit
PM	Particulate Matter
PPE	Personal Protective Equipment
PPM	Part Per Million
Pvt.	Private
R&R	Rehabilitation and Resettlement
RDS	Respirable Dust Sampler
SE	South- East
SEIAA	State Level Environmental Assessment Authority
SO_2	Sulphur-di-Oxide
SOI	Survey of India
SOPs	Standard Operating Procedures
SPCB	State Pollution Control Board
SPM	Suspended Particulate Matter
SSE	South of South-East
SSW	South of South-West
TDS	Total Dissolve Solid
TOR	Terms of Reference
TPA	Tons Per Annum
TPA	Tone Per Hour
TPH	Tons Per Hour
TS	Total Solid
US EPA	United State Environmental Protection Agencies
w.e.f.	With Effective From
w.r.t.	With Reference To
W/W	Weight By Weight
WNW	West of North-West
WSW	West of South-West

1 INTRODUCTION

1.1 GENERAL

Brahmani River Sand Quarry, Kantio-Putasahi is a sand mining project over an area of 12.50 acres/ 5.06 Ha. Located in village – Kantio-Putasahi, Tahasil - Kamakhyanagar in District - Dhenkanal of Odisha. The mining lease granted by Tahasildar, Kamakhyanagar, Dhenkanal will be auctioned and leased out to the successful bidder after obtaining statutory clearances by Tahasildar, District- Dhenkanal. The mining lease will be granted on for long term basis for 5 years and the lease period will start from the date of registration of executed lease deed and attached as **Annexure-I.** The Mining Plan has been approved on dated 29.04.2020 by the approving authority, Office of the Joint Director, Geology, Zonal Survey, Dhenkanal and attached as an **Annexure-II**. It is relevant to mention here that approval of Mining Plan has been conferred under section 2 of Rule 28 (4) of OMMC, 2016 as per clause 5. As per EIA notification 2006 and subsequent amendments, the project is coming under B1 Category and the lease area is more than 5.0 Ha.

The Brahmani River Sand quarry, Kantio-Putasahi is on Khata no-857, Plot no- 6980 of Kissam Nadi at village Kantio-Putasahi in Kamakhyanagar Tahasil in Dhenkanal District of Odisha. The mining lease area is listed as an identified sand minor mineral in the DSR Serial No-52, of the Dhenkanal district. The sand quarry lies on river bed Brahmani. Brahmani River Sand Quarry, Kantio-Putasahi, is a minor mineral project for exploitation of river sand. The average production is proposed to be 18210 cum/year and 91050 cum is the total production during the plan period. This sand would be mainly used for civil works in major projects and infrastructures development so as to meet the market potential.

As per the Environmental Impact Assessment (EIA) Notification dated 14th September 2006 and its subsequent amendments, the proposed Brahmani River Sand Quarry falls under 'Category B1', since the project is more than 5.0 Ha.

The ToR application submitted to SEIAA, Odisha on 27.11.2020 with proposal No. SIA/OR/MIN/58641/2020. SEIAA meeting was held on 11.12.2020. ToR was issued with F.No. 10259/SEIAA dated: 17.12.2020. ToR letter is enclosed as **Annexure –III** for the preparation of EIA/EMP report.

1.2 PURPOSE OF THE REPORT

The purpose of the report is to identify environmental aspects, impacts and mitigation measures arising out from the proposed project and to prepare EIA report as per the Terms of Reference (ToR) finalized by State Environment Impact Assessment Authority (SEIAA), Odisha vide ToR F.No. 10259/SEIAA dated: 17.12.2020 as a part of Environmental Clearance (EC) as mentioned in EIA notification 2006 and amendments till date. This report is prepared based on "General Structure of EIA" given in Appendix III and IIIA of mentioned EIA notification.

Tahasildar, Dhenkanal as part of the compliance from SEIAA has appointed **M/s. Rightsource Industrial Solutions Pvt. Ltd**, Plot No.203, H.No.5-36/203, Prashanthinagar, Kukatpally IDA, Hyderabad – 500072 as Environmental Consultants who are accredited by National Accreditation Board for Education and Training (NABET), Quality Council of India (QCI), New Delhi.

1.3 IDENTIFICATION OF PROJECT & PROJECT PROPONENT

1.3.1 IDENTIFICATION OF PROJECT

The Sand mine is over an extent of 5.06 ha located in Kantio-Putasahi Village, Kamakhyanagar Tahasil, Dhenkanal District and Odisha State. The area is marked in the survey of India Topo sheet No. 73 H/9. The mine area falls in the Brahmani River and the details of area are given in Table 1.1. The geographical coordinates of the mine lease areas are given in Table 1.2.

TABLE 1-1 DETAILS OF AREA

District & State	Village	Tahasil	Sy.No.	Extent	Ownership	Nature of Excavation
Dhenkanal, Odisha State	Kantio- Putasahi Village.	Kamakhyanagar	River Bed	5.06 Ha	Govt. Land	Open Excavation

TABLE 1-2 THE GEOGRAPHICAL COORDINATES OF THE MINE LEASE AREAS

LOCATION	LONGITUDE & LATITUDE		
	BP	LATITUDE	LONGITUDE
Specified Area	1	20°45'50.36"N	85°30'05.03"E
	2	20°45'51.23"N	85°30'05.77"E
	3	20°45'52.13"N	85°30'06.66"E
	4	20°45'52.88"N	85°30'07.31"E
	5	20°45'53.92"N	85°30'08.25"E
	6	20°45'54.35"N	85°30'08.65"E

7	20°45'54.09"N	85°30'09.19"E
8	20°45'53.68"N	85°30'09.91"E
9	20°45'53.10"N	85°30'10.86"E
10	20°45'52.69"N	85°30'11.56"E
11	20°45'52.24"N	85°30'12.31"E
12	20°45'51.92"N	85°30'12.86"E
13	20°45'51.70"N	85°30'13.33"E
14	20°45'51.40"N	85°30'13.89"E
15	20°45'51.00"N	85°30'14.61"E
16	20°45'50.53"N	85°30'15.36"E
17	20°45'50.15"N	85°30'15.91"E
18	20°45'49.85"N	85°30'16.40"E
19	20°45’49.36"N	85°30'17.16"E
20	20°45’49.07"N	85°30'17.74"E
21	20°45'48.84"N	85°30'18.05"E
22	20°45'48.28"N	85°30'17.47"E
23	20°45'47.63"N	85°30'16.85"E
24	20°45'46.98"N	85°30’16.25"E
25	20°45'46.31"N	85°30'15.60"E
26	20°45'45.60"N	85°30'14.94"E
27	20°45'44.86"N	85°30'14.25"E
28	20°45'46.18"N	85°30'12.13"E
29	20°45’46.90"N	85°30'11.01"E
30	20°45'47.97"N	85°30'09.14"E
31	20°45’48.67"N	85°30'07.96"E
32	20°45’49.54"N	85°30'06.40"E

1.3.2 SIZE OF THE PROJECT

The area is 5.06 Ha/12.50 acres. The proposed Sand production is 18210 m^3 per year. The mining of sand from Brahmani River Sand Quarry, Kantio- Putasahi will be carried out by open cast manual method.

1.3.3 LOCATION OF THE PROJECT

The area under discussion is featured in Survey of India Topo Sheet No – (73H/9) and is bounded between the Latitude -20° 45’ 44.86” N to 20° 45’ 54.35” N & Longitude – 85° 30’ 05.03” E to 85° 30’ 18.05” E. The Lease area is located at a distance of 15 kms from Dhenkanal town, 19km from Tahasil Kamakhyanagar and 66 kms from the State Capital Bhubaneswar. Sadashibapur Railway Station is the nearest railway station located at a distance of 3.0 kms from the lease area. Nearest Road Bridge is at a distance of 5.90 kms from the mining lease. Darajang road connecting to the

lease area with the District road is at distance of 5.18kms. NH – 42 is the nearest major district road which is at distance of 4.35 km. SH 64 is the nearest State Highway which is at a distance of 30.16 kms.

1.3.4 NEED FOR THE PROJECT AND ITS IMPORTANCE

Ordinary sand is used as a raw material in all type of construction and infrastructure project. The need of ordinary sand is in all fields are very essential as it is a compulsory for all types of construction, and industries fields. Proposed production of sand is contributing enhancing state production of ordinary sand. A mine is providing employments to the local labour in rural area, thus the villagers of nearby villages have more employment opportunities.

1.4 SCOPE AND METHODOLOGY OF THE STUDY

The Environmental Impact Assessment has been prepared to assess the current environmental scenario of the area, will identify and address the impacts, where these are adverse in nature, and there after design imitative measures to manage such impacts in a manner as to conserve environment and ecology of the area. The EMP has been prepared with a view to ultimately ensure that the adverse impacts are minimized if these cannot be prevented altogether.

The Environmental Impact Assessment report has been prepared as per TOR recommended and issued by the State Level Environmental Impact Assessment Authority, Odisha on 17th of December 2020.The base line monitoring study has been carried out during the Winter season (October 2020 to December 2020) for various environmental components so as to assess the anticipated impacts of the proposed project on the environment

Primary data collection coupled with secondary data collection so as to establish the baseline environmental status of the study area;

- Identify various existing pollution loads in and domestic activities in the study area.
- Predict incremental levels of pollutants in the study area due to the mining activity.
- Evaluate the predicted impacts on the various environmental attributes in the study area by using scientifically developed and widely accepted Environmental Impact.
- Identification of mitigation measures and preparation of an Environmental Management Plan (EMP) outlining the measures for improving environmental quality and scope for future projects for environmentally sustainable development.
- Identify critical environmental attributes required to be monitored regularly.

1.5 STRUCTURE OF EIA REPORT

The EIA report has been presented in order to group the environmental parameters under physical, biological, demographic & socio-economic environments, anticipated impacts and mitigation measures. The EIA report has been prepared as contents given in EIA Notification 2006 and subsequent amendments. The structure of EIA Report is as given below:

Chapter 1 - Introduction: This chapter gives the basic information about the project and project site. It also discusses the justification of the project and the purpose of the EIA study including the scope of the study.

Chapter 2 - Description of the Project: This chapter deals with the details of the mine plan and various mining parameters like mineral reserves, exploration, year wise mining plan, excavation method etc. and also the facilities to monitor and treat the pollutants. The features of the proposed project are described in this chapter.

Chapter 3 – Description of the Environment: The methodology for assessing various baseline Environmental components in the study area prior to the commencement of the project has been identified in this chapter. The various parameters of present environmental status are identified under different aspects, which include location and regional setting of the area, physical aspect which include land use, land cover and soil quality of the study area. Hydrology aspect consists of surface and ground water quality. Meteorological aspect contains all the climatic factors and ambient air quality of the study area. Ecological environment describes the flora and fauna of the region. Human aspect includes the demographical features, socioeconomic environment and infrastructure facilities of the study area.

Chapter 4 - Anticipated Environmental Impacts and its Mitigation Measures: This chapter provides the details of the Environmental Impact Assessment of the project during construction and operation stages. It ascertains the impacts of the proposed project on the various components of environment. The mathematical modelling exercises pertaining to ground level concentrations of air pollutants have been presented in this chapter with suitable mitigation measures.

Chapter 5 - Analysis of Alternatives: This chapter gives details of various alternatives in respect of technologies to be deployed are considered in this project.

Chapter 6 - Environment Monitoring Plan: This chapter emphasizes the formation of an Environment Management Cell with trained staff equipped with all monitoring facilities for monitoring of all environmental parameters during construction project monitoring. Organization structure for environmental management and frequency of monitoring has also been provided.

Chapter 7 - Additional Studies: A summary of the additional studies/activities conducted as per the requirements of the TOR is given in this chapter. A brief description of the Public Hearing is described in this chapter. The additional studies conducted are Risk Assessment and Disaster Management Plan and Hydro-geology Study. Although separate reports will be submitted for the Hydro-geology Study, a brief account has been given in the chapter. The Risk Assessment section provides information regarding the activities associated with the project likely to pose a risk to man, environment or property. Such activities include displacement, transport of raw materials, storage. It also provides details regarding precautionary measure to be taken. On-site disaster management describing the on-site and off-site emergencies commands and controls have also described in this chapter.

Chapter 8 - Project Benefits: The benefits that will be accrued from the project in the locality in particular and society in general as well as development will be identified and described in this chapter.

Chapter 9 Environmental Cost & Benefit Analysis: Not applicable as this chapter is needed if recommended at the scoping stage.

Chapter 10 - Environmental Management Plan: In this chapter, an environmental strategy to mitigate the adverse effects likely to occur on environmental parameters during mining phase has been drawn up for the proposed mining project.

Chapter 11 –Summary &Conclusion- Over all justification for implementation of the project. Explanation of how, adverse effects have been mitigated.

Chapter 12 –Disclosure of the Consultant: The detailed profile of the environment consultant along with their professional capabilities and expertise as well as work experiences are highlighted in this chapter.

1.6 COMPLIANCE OF TOR

Compliance of TOR Issued by SEIAA, Odisha vide F.No. 10259/SEIAA dated: 17.12.2020.

STANDARD TERMS OF REFERENCE		
1.	Year wise production details since 1994 should be given, clearly stating the highest production achieved in any one year prior to 1994. It may also be categorically informed there had been any increase in production after the EIA Notification 1994 came into force, w.r.t the highest production achieved prior to 1994.	Not applicable as it is a proposed mine.
2.	A copy of the document in support of the fact that the Proponent is the rightful lessee of the mine should be given.	Brahmani River Sand Quarry, is a sand mining project over an area of 12.50 acres/ 5.06 Ha. Located in village- Kantio-Putasahi, Tahasil - Kamakhyanagar in District - Dhenkanal of Odisha. The mining lease granted by Tahasildar, Kamakhyanagar, Dhenkanal will be auctioned and leased out to the successful bidder after obtaining statutory clearances by Tahasildar Kamakhyanagar, District- Dhenkanal. The mining lease will be granted on for long term basis for 5 years and the lease period will start from the date of registration of executed lease deed and attached as **Annexure-I.**
3.	All documents including approved mine plan, EIA and Public Hearing should be compatible with one another in terms of the mines lease area, production levels, waste generation and its management, mining technology etc. and should be in the name of the lessee.	While preparing EIA it has been ensured that all the documents including approved mine plan and EIA is compatible with one another in terms of the mine lease area, production levels and mining methodology etc. and are in the name of lessee.

4.	All corners co-ordinates of the mine lease area, superimposed on High Resolution Imagery/ toposheets, topographic sheets, geomorphology and geology of the area should be provided. Such an Imagery of the proposed area should clearly show the land use and other ecological features of the study area (core and buffer zone).	All corner co- ordinates of the mine lease area are given in the section 1.3.1 of chapter 1. Satellite map and Topomap of the project area is given in the Figure 2.2 and Figure 2.3 of chapter 2 respectively. Geology of the study area is given in the section no.2.5 of chapter 2.
5.	Information should be provided in Survey of India Topo sheets in 1:50,000 scale indicating geological map of the area, geomorphology of land forms of the area, existing minerals and mining history of the area, important water bodies, streams and rivers and soil characteristics.	The area is located in the Topo sheet of 73 H/9. Topo map of the study is area is given in the Figure 2.3 of Chapter 2.
6.	Details about the land proposed for mining activities should be given with information as to whether mining confirms to the land use policy of the State; land diversion for mining should have approval from State land use board or the concerned authority.	The Sand mine is over an extent of 5.06 ha located in Kantio-Putasahi Village, Kamakhyanagar Tahasil, Dhenkanal District and Odisha State. The area is marked in the survey of India Topo sheet No.73 H/9. The mine area falls in the Brahmani River and the details of area are given in Table 1.1. The geographical coordinates of the mine lease areas are given in Table 1.2 of chapter 1.
7.	It should be clearly stated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/violation of the	The project proponent is committed to safe guard and sustainable development. Environment Monitoring Cell shall be established for reporting Environmental Issues. Responsibilities of Environmental Monitoring Cell are given in the section 6.3 of chapter 6.

	environment or forest norms/condition? 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-compliance/ 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.	
8.	Issues relating to Mine Safety, including subsidence study in case of underground mining and slope study in case of open cast mining, blasting study etc. should be detailed. The proposed safeguard measures in each case should also be provided.	Method of Mining is Manual. Mine safety details are given in the section 7.6 of chapter 7.
9.	The study area will comprise of 10km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine/lease period.	The study area is taken as 10km Radius around the proposed project area. Since it is Sand mining project, waste generation is not involved.
10.	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the mine lease area should be prepared to encompass, preoperational, operational and post operational phases and	Land use of the study area is given in the Chapter 3 of EIA report.

	submitted. Impact, if any, of change of land use should be given.	
11.	Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area, distance from mine lease, its land use, R&R issues, if any, should be given.	Over burden generation is not involved because it is Sand mining project.
12.	A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry of ascertain the status of forests, based on which, the Certificate in this regards 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.	There is no forest land in the project site. Project site located in the Brahmani River.
13.	Status of forestry clearance for the broken up area and virgin forest land involved in the project including deposition of Net Present Value (NPV) & Compensatory Afforestation (CA) should be indicated. A copy of the forest clearance should also be furnished.	Proposed mining area is in Brahmani River. Hence forest clearance is not required.
14.	Implementation status of recognition of forest right under the Scheduled Tribes and other Traditional Forest Dwellers	Not Applicable

	(Recognition of Forest Rights) Acts, 2006 should be indicated.	
15.	The vegetation in the RF/PF areas in the study area, with necessary details, should be given.	Details of forests falling in10km Radius of project area ✓ Machhia Reserved Forest, 4 km, NE ✓ Korian Reserved Forest, 9 km, SE ✓ Maharagadi R.F, 3 km, in SW direction ✓ Alnabereni R F, 9 km, N Details are given in the Table 2.1 of chapter 2.
16.	A study shall be got done to ascertain the impact of the mining project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly, detailed mitigate measures required, should be worked out with cost implications and submitted.	There is no wildlife sanctuary within the study area. Details of fauna existing within the study area are given in the Chapter 3. Anticipated impact of mining on the same along with suggested mitigation measures are incorporated in the chapter 4.
17.	Location of National Parks, Sanctuaries, Biosphere Reserves, wildlife Corridors, Ramsar site Tiger/Elephant Reserves (existing as well as proposed), if any, within 10km of the mines lease should be clearly indicated, supported by a location map duly authenticated by chief wildlife warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the standing committee of National Board of Wildlife and copy furnished.	There are no National parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Tiger /Elephant Reserves (existing as well as proposed) in the core.

18.	A detailed biological study area [core zone and buffer (10km radius of the periphery of the mines lease)] shall be carried out. Details of the flora and fauna, endangered, endemic and RET species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the schedule of the fauna present. In case of any scheduled I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with state forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.	There are no schedule-I fauna present in the study area. A detailed biological study is discussed under Chapter-3.
19.	Proximity to areas declared as 'Critically Polluted' or the project areas likely to come under the 'Aravali Range', (attracting court restrictions for mining operations) should also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB or State Mining Department should be secured and furnished to the effect that the proposed mining activities could be considered.	Not Applicable. The proposed project does not fall within 10 Km radius of any CRITICALLY POLLUTED area and also project area does not fall in Aravali hill ranges.
20.	Similarly, for coastal projects, a CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL,	The proposed project does not fall within CRZ area. Not Applicable.

	CRZ area, location of the mines lease w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: the mining projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).	
21.	R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SC's/ST's 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 their action programmes prepared and submitted accordingly, integrating the sectoral programmes of the line departments of the State Government. It may be clearly brought out whether the village(s) located in the mine lease 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.	Since the project area is falling in Brahmani river, there will be no resettlement or rehabilitation involved in the project area, hence compensation details are not applicable.
22.	One season (non monsoon) i.e. March- May (summer season), October- December (post monsoon season), December-February (Winter season) primary baseline data on ambient air quality as per CPCB notification of 2009, water quality, noise level, soil and flora and fauna shall be	One season data of ambient air quality, water quality, noise level, metrology, soil and flora and fauna has been collected during post monsoon season October 2020 to December 2020.Details are given in Chapter 3.

	collected and the AAQ and other data so complied 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 500m of the mine lease in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given.	
23.	Air quality modeling should be carried out for prediction of impacts of the project on the air quality of the area. It should also take into account the impact of the movement of vehicles for transportation of minerals. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on allocation 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 be also indicated on the map.	Prediction of impacts on air Environment has been carried out by using AERMOD was done and mentioned in section 4.2.2 of Chapter -4. Wind rose map showing pre-dotminant wind direction has been carried out and the results are given in Chapter-3 under Figure no.3.2.
24.	The water requirement for the project, its availability and sources should be furnished. A detailed water balance should	Water requirement for the project will be 2.5 KLD. Water required in the project will be for drinking purpose and dust suppression,

	be provided. Fresh water requirement for the project should be indicated.	which will be sourced from water tanker.
25.	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the project should be provided.	Total requirement of water will be 2.5 KLD, which will be met from water tanker; NOC will be obtained from Gram Panchayat.
26.	Description of water conservation measures proposed to be adopted in the project should be given. Details of rainwater harvesting proposed in the project, if any, should be provided.	The project is River bed sand mining. No rainwater harvesting proposed.
27.	Impact of the project on the water quality, both surface and ground water, should be assessed and necessary safeguard measures, if any required, should be provided.	The project is River bed sand mining. No infrastructure development on surface water to obstruct the flow of river, also during rainy season, there will be no mining Operations. The ground water quality will not be changed because mining activity will not intersect the ground water table as it is restricted to 1m depth as per SSMMG 2016 and it's subsequent amendment. Impact of project on surface & ground water is monitored and mitigation measure are also provided in Chapter-4.
28.	Based on actual monitored data, it may clearly be shown whether working will intersect ground water. Necessary data and documentation in this regards may be provided. In case the working will intersect ground water table, a detailed Hydro Geological Study should be undertaken and report furnished. The report inter-alia, shall include details of the aquifers present	Ground water will not be disturbed by the mining activity of the proposed project. As per SSMMG 2016 sand mining is not allowed below 03m or 1m above ground water level. It will not intersect the ground water table. Below ground water working is not proposed and pumping will not be required. Permission from GGWA is not required.

	and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of groundwater should also be obtained and copy furnished.	
29.	Details of any stream, seasonal or otherwise, passing through the lease area and modification/diversion proposed, if any, and the impacts of the same on the hydrology should be brought out.	The proposed project is for the riverbed sand mining at Brahmani River. No diversion or modification of water channel is proposed or expected due to mining activities from the proposed project. Any river crossing shall be done after due permission of the Irrigation Department. No stream is passing through lease area.
30.	Information on site elevation, working depth, groundwater table etc. should be provided both in AMSL and bgl. A scientific diagram may also be provided for the same.	Working depth is restricted to 1m only as per SSMMG 2016 and it's subsequent amendment.
31.	A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the project. Phase- wise plan of plantation already done should be given. The plant species selected for greenbelt should have greater ecological value and should be of good utility value to local population with emphasis on local and native species and	Greenbelt will be developed in the buffer zone of mine lease area and village haulage roads side also. Quarrying of river sand does not involve any drilling and blasting. Any adverse impact on account of loading, transportation and extraction of sand from river bed may alter the flow of water and it may reduce bank erosion. As the quarry lease area is not suitable for afforestation and green belt development, no greenbelt is planned. Quarrying of sand will be done as per the approved quarrying plan and strictly in

	the species which are tolerant to pollution.	accordance with the rules and regulations so that the adverse impacts could be minimized.
32.	Impact on local transport infrastructure due to the project should be indicated. Projected increase in truck traffic as a result of the project in the present road network (including those outside the project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as state government) should be covered. Project proponent shall conduct impact of Transportation study as per Indian Road Congress Guidelines.	Impact on the local Transport infrastructure is given in the Chapter 4.
33.	Details of the onsite shelter and facilities to be provided to the mines workers should be included in the EIA Report.	All the site services and other facilities including regular & periodic health checkup, Eye camp, Adult & Female education & training programmes shall be provided outside nearer to the lease. For transportation of mineral product, roads will be strengthed.
34.	Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA report.	Post mining land use will be not be changed. Sand will be replenished every year. Although bank protection measures will be included.
35.	Occupational Health impacts of the project should be anticipated and the proposed preventive measures spelt out in detail.	These points are in EMP of project and implementation of the same would be done in discussion with authorities. Periodical

	Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed.	medical examination and health camp is proposed. EMP cost details are givenin the section no. 10.4 of chapter 10.
36.	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures are given in the chapter 4 and budgetary allocations are given in the CSR cost.
37.	Measures of socio economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.	Socio- economic details are given the section 3.5 of chapter 3.
38.	Detailed environmental management plan (EMP) to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if any, occupational health impacts besides other impacts specific to the proposed Project.	Detailed EMP is geven in the chapter 10 and EMP cost details are given in the section no 10.4 of chapter 10.
39.	Public Hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan with budgetary provisions to implement the same should be provided	Public hearing details will be given in the final EIA report.

	and also incorporated in the final EIA/EMP Report of the Project.	
40.	Details of litigation pending against the project, if any, with direction/order passed by any Court of Law against the project should be given.	There is no litigation pending against the project.
41.	The cost of the project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	Project cost is 40 Lakhs and EMP cost will be 2.50 lakhs Capital and 6.0 Lakhs Recurring.
42.	A Disaster Management Plan shall be prepared and included in the EIA/EMP report.	Disaster Management Plan is given in the section no. 7.5 of chapter 7.
43.	Benefits of the Project if the Project is implemented should be spelt out. The benefits of the project shall clearly indicate environmental, social, economic, employment potential, etc.	✓ Improve physical and social infrastructure of the area. ✓ Generate direct as well as indirect employment. ✓ Green belt development
44.	**Besides the above, the below mentioned general points are also to be followed:**	
a)	Executive Summary of the EIA/EMP report.	Complied.
b)	All documents to be properly referenced with index and continuous page numbering.	Complied
c)	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
d)	Project Proponent shall enclose all the analysis/testing reports of Water, Soil, Air, Noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be	Complied

	available during appraisal of the Project.	
e)	Where the documents provided are in a language other than English, an English translation should be provided.	Noted and agreed
f)	The Questionnaire for environmental appraisal of mining projects as devised earlier by the ministry shall also be filled and submitted.	Noted and agreed
g)	While preparing the EIA report, the instructions for the Proponents and instructions for the consultants issued by MoEF&CC vide O.M No. J- 11013/41/2006-IA.II (I) dated 4th August, 2009, which are available on the website of this Ministry, should be followed.	Complied
h)	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.	Noted and Agreed
i)	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 condition stipulated in the environment	Noted and Agreed

	clearance for the existing operations of the project, should be obtained from the Regional office of Ministry of Environment, Forest and Climate Change, as may be applicable.	
j)	The EIA report should also include (i) surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area.	Attached as **Annexure IV**
Specific ToRs		
1.	Whether it is an existing mine? If yes, submit the copy of Environmental Clearance and compliance to EC conditions from the Regional Office, SPCB. The year which last operated. 1(a) The project proponent has to carry by engaging appropriate consultant a study of the annual replenishment rate of sand by collecting pre-monsoon & post monsoon data from the field to know the quantum or volume of sand deposited/replenished & extracted in the mining lease area. The detailed comparision of both pre monsoon and post monsoon elevation data shall be included in the study report. The replenishment rate of sand may be studied as per the procedure laid down in the Enforcement and Monitoring Guidelines for Sand Mining, 2020 (www.moef.gov.in)	It is a proposed New Project.

	issued by the MoEF &CC, Govt. of India. The finding of the study shall be submitted to SEIAA along with the final EIA/EMP report to assess the rate of replenishment to mined out sand.	
2.	Area of the 'no mining zone' specially demarcated within the list out area for safety of the river bank/any bridge or such other structure nearby; and the dimensions and geo-co-ordinates of this zone w.r.t lease boundary.	

BP	LATITUDE	LONGITUDE
1	20°45'50.36"N	85°30'05.03"E
2	20°45'51.23"N	85°30'05.77"E
3	20°45'52.13"N	85°30'06.66"E
4	20°45'52.88"N	85°30'07.31"E
5	20°45'53.92"N	85°30'08.25"E
6	20°45'54.35"N	85°30'08.65"E
7	20°45'54.09"N	85°30'09.19"E
8	20°45'53.68"N	85°30'09.91"E
9	20°45'53.10"N	85°30'10.86"E
10	20°45'52.69"N	85°30'11.56"E
11	20°45'52.24"N	85°30'12.31"E
12	20°45'51.92"N	85°30'12.86"E
13	20°45'51.70"N	85°30'13.33"E
14	20°45'51.40"N	85°30'13.89"E
15	20°45'51.00"N	85°30'14.61"E
16	20°45'50.53"N	85°30'15.36"E
17	20°45'50.15"N	85°30'15.91"E
18	20°45'49.85"N	85°30'16.40"E
19	20°45'49.36"N	85°30'17.16"E
20	20°45'49.07"N	85°30'17.74"E
21	20°45'48.84"N	85°30'18.05"E
22	20°45'48.28"N	85°30'17.47"E
23	20°45'47.63"N	85°30'16.85"E
24	20°45'46.98"N	85°30'16.25"E
25	20°45'46.31"N	85°30'15.60"E
26	20°45'45.60"N	85°30'14.94"E
27	20°45'44.86"N	85°30'14.25"E
28	20°45'46.18"N	85°30'12.13"E
29	20°45'46.90"N	85°30'11.01"E
30	20°45'47.97"N	85°30'09.14"E
31	20°45'48.67"N	85°30'07.96"E
32	20°45'49.54"N	85°30'06.40"E

3.	Any approach road existing or will be constructed inside the safety zone?	Nearest Road bridge is at a distance of 5.90 kms from the mining lease. Darajang road connecting to the lease area with the District road is at distance of 5.18kms. NH – 42 is the nearest major district road which is at distance of 4.35 km. SH 64 is the nearest State Highway which is at a distance of 30.16 kms.
4.	Mitigation measures to be taken to ensure not to disturb free flow of river	Mitigation measures are given in the chapter 4.
5.	Distance of the river bank/ embankment from the lease boundary. It is a river bank or embankment?	Distance of the river bank/ embankment from the lease boundary is 50 m.
6.	Any ramp existing or will be constructed on the river bank/ embankment for movement of vehicles to reach the nearest road.	Ramp will be constructed on the river bank/ embankment for movement of vehicles to reach the nearest road.
7.	Distance of the village road/city road/district road/public road for the river bank. Is this road single road/double road.	Nearest Road bridge is at a distance of 5.90 kms from the mining lease. Darajang road connecting to the lease area with the District road is at distance of 5.18kms. NH – 42 is the nearest major district road which is at distance of 4.35 km. SH 64 is the nearest State Highway which is at a distance of 30.16 kms.
8.	No. of village (s) and name of village (s) or the city (s) or urban place (s) or semi urban place (s) through which the sand carrying vehicles will ply and the distance of it from the river bank or embankment whether there is any forest land in the intervening area through which the sand carrying trucks will ply.	Kantio- Putasahi Village Road will be used for transport the Sand from lease area which is 4.35 km to NH 42.
9.	Whether schools/colleges/hospitals/healt	The mining lease is at a distance from areas

	h centers/ bus stops/ religious places existing nearby and if so, the distance of it from the bank or the road through which the vehicle will ply or existing alongside the raod?	occupied by sensitive man-made land uses – School, colleges and hospitals are available at Kantio Putashi
10.	Any plantation done in the safety zone or embankment in case of an existing mines and if so, the area of plantation, number of species? If not, the plan for it to arrest bank erosion.	Green belt details are given in Chapter 2.
11.	Any stone packing in the river bank/ embankment existing in case of existing mines and if not, the plan for it.	Not applicable
12.	Whether, any alternative mine exists or explored or can be explored if this mine is otherwise found unsuitable? Please furnish details.	Not applicable
13.	(i) Whether permission taken or will be taken from water resource authority or the concerned authority of the roads to be used for plying of vehicles loaded with sand or empty vehicles for the same sfter the river bank. (ii) Responsibility of perennial maintenance of these roads and the mechanism for the same.	All satutarary permissions will be obtained for mining operations.
14.	No. and type of vehicles to be used daily and the frequency for the purpose of transportation and the time and duration of such transportation. Whether permission taken or will be taken for the	08/16 number of trucks and tractors are used transportation of sand mineral and frequency of plying will be 30 minutes.

	appropriate authority for the purpose.	
15.	Intersection point of the haulage roads with the main SH/NH/public road and the traffic density study at appropriate locations by domain expert with remedial measures for decongestion and road safety.	Nearest Road bridge is at a distance of 5.90 kms from the mining lease. Darajang road connecting to the lease area with the District road is at distance of 5.18kms. NH – 42 is the nearest major district road which is at distance of 4.35 km. SH 64 is the nearest State Highway which is at a distance of 30.16 kms.
16.	(i) Any bridge (road/rail) existing and the distance of it from the lease boundary. (ii) Any culvert of small bridge will be used by the plying vehicles carrying the sand minerals.	Nearest Road bridge is at a distance of 5.90 km from the mining lease area.
17.	Any High Transmission Electric line existing and if yes, the distance of the same from the boundary of the lease.	There is no High Transmission Electric line existing in the mine leasea area. Nearest Electrical Transmission line is at distance of 1.5 km from mine lease area.

2 PROJECT DESCRIPTION

2.1 TYPE OF PROJECT

This project is proposed for the excavation of sand from the bed of river Brahmani. The mining operations will be carried open excavation with manual method only in its existing form for direct usage as an aggregate with cement and steel in construction of structures. The total extent of area is 5.06 ha for which Environmental Clearance is required with proposed total production capacity 91050 M^3 for five years. The total project cost is Rs. 40 Lakhs only.

2.2 NEED OF THE SAND MINING PROJECT

The ordinary sand is to be used for construction purpose and the government wishes to minimize the gap between demand and supply, thereby facilitating the availability of sand to the public. In order to meet the statutory requirements, the lessee intends to obtain Environmental Clearance from Statutory Authorities.

The ordinary sand is used as an aggregate with cement and steel in construction of structures.

2.3 LOCATION OF THE PROJECT

The total extent area of the lease for this quarry is 5.06 Ha at Kantio- Putasahi Village, Kamakhyanagar Tahasil, Dhenkanal District and Odisha State. Quarry Land is classified as Government land and leased by Tahasildar, Dhenkanal, and Odisha. The area under discussion is featured in Survey of India Topo Sheet No – 73H/9 and is bounded between the Latitude - -20° 45’ 44.86” N to 20° 45’ 54.35” N & Longitude – 85° 30’ 05.03” E to 85° 30’ 18.05” E.

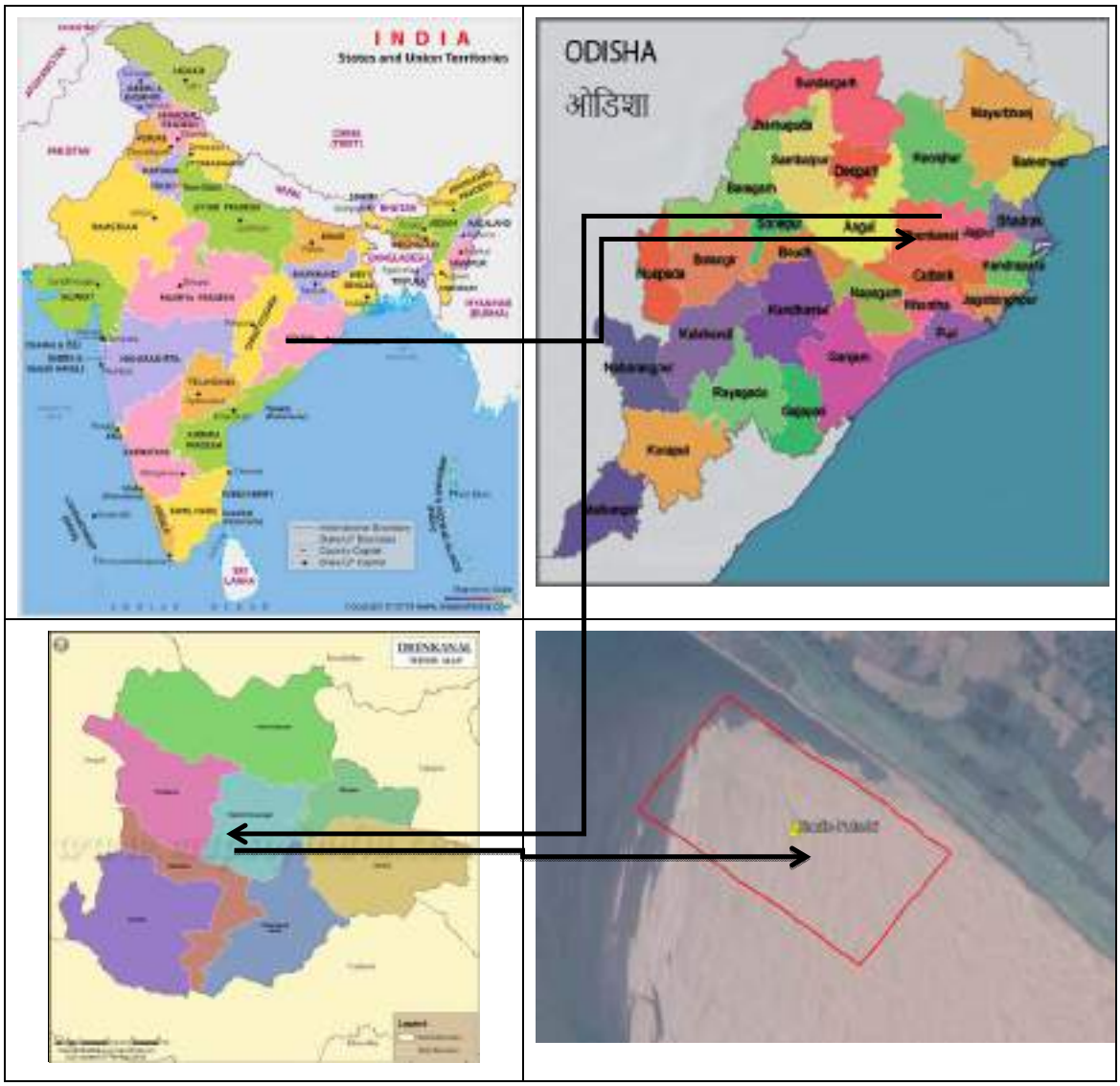


FIGURE 2-1 Location Map of the Project Site

The area under discussion is featured in Survey of India Topo Sheet No – (73H/9) and is bounded between the Latitude -20° 45' 44.86" N to 20° 45' 54.35" N & Longitude – 85° 30' 05.03" E to 85° 30' 18.05" E. The Lease area is located at a distance of 15 kms from Dhenkanal town, 19km from Tahasil Kamakhyanagar and 66 kms from the State Capital Bhubaneswar. Sadashibapur Railway Station is the nearest railway station located at a distance of 3.0 kms from the lease area. Nearest Road bridge is at a distance of 5.90 kms from the mining lease. Darajang road connecting to the lease area with the District road is at distance of 5.18kms. NH – 42 is the nearest major district road which is at distance of 4.35 km. SH 64 is the nearest State Highway which is at a distance of 30.16 kms. The location map of project site and surrounding are given below.

FIGURE 2-2SATELLITE MAP 10 KM FROM THE PROJECT SITE

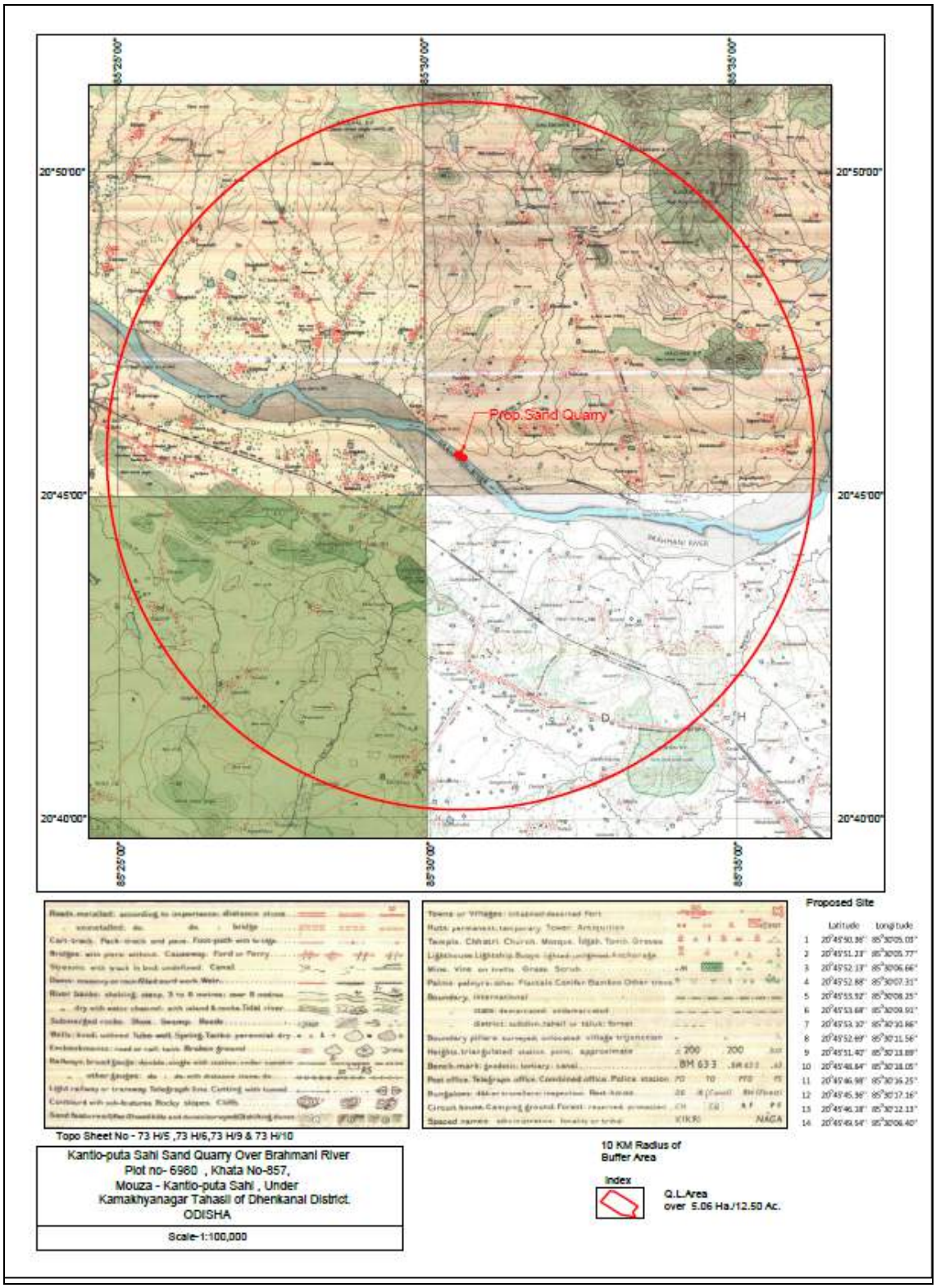


FIGURE 2-3 TOPO MAP 10 KM FROM THE PROJECT SITE

TABLE 2-1 PROJECT SUMMARY & SALIENT FEATURES WITHIN 15KM RADIUS OF THE LEASE AREA BOUNDARY

S.No.	Particulars	Details
1.	Land use at the Project Site	Mining will be carried out at the site for ordinary sand as construction material (Aggregate)
2.	Nearest Highway	Nearest Road bridge is at a distance of 5.90 kms from the mining lease. Darajang road connecting to the lease area with the District road is at distance of 5.18kms. NH – 42 is the nearest major district road which is at distance of 4.35 km. SH 64 is the nearest State Highway which is at a distance of 30.16 kms.
3.	Nearest Railway station	Sadashibapur Railway Station, 3.0 Km (S)
4.	Nearest Village	Kantio-Putasahi is 1.2 km from the proposed area in NE direction
5.	Nearest Major Settlement	Kantio-Putasahi is 1.2 km from the proposed area in NE direction
6.	Nearest Major Town	Kamakhyanagar is 18 km from the proposed area in NE direction.
7.	Communication Network	Amenities like Telephone, Post and Telegraph Office, Police Station, Primary Health Center etc., are available at Kantio-Putasahi.
8.	Education	Primary School Education is available at nearby village. Higher Education are available at Kantio-Putasahi.
9.	Medical Facility	RMP Doctor is available at Kantio-Putasahi, Nursing Homes and Hospitals are located at Kantio-Putasahi.
10.	Availability of Water	The ground water level is about 4m to 14m

		below sand level.
11.	Availability of Electricity	Electricity is available in all human settlements
12.	Hills/Valleys	Nil
13.	Ecologically Sensitive Zone (Wild Life Sanctuaries)	Nil
14.	Reserved Forests	➢ Machhia Reserved Forest, 4 km, NE ➢ Korian Reserved Forest, 9 km, SE ➢ Maharagadi R.F, 3 km, in SW direction ➢ Alnabereni R F, 9 km, N
15.	Water Bodies	➢ Bega Nadi, 0.1m, SW direction ➢ Indrajit Nadi, 0.2km, N direction ➢ Agana Nadi, 8km,SW direction
16.	Defence Installation/ Historical Monuments/ Archaeological/ Ports	Anantashayana Vishnu, Saranga is the nearest archaeological site from the lease area which is at 33 km distance.
17.	Historical Places	Nil
18.	Areas occupied by sensitive man-made land uses (Hospitals, schools, places worship, community facilities)	The mining lease is at a distance from areas occupied by sensitive man-made land uses – There is a temple at a distance of 1.3 km from the mining lease. School and RMP hospitals are available at Kantio Putashi
19.	Nearest River	Brahmani River
20.	Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions) similar effects	The area is not sensitive to earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions. Zone-II (Least Active)

The total extent area of the lease for this quarry is 5.06 Ha at Kantio-Putasahi Village, Kamakhyanagar Tahasil, Dhenkanal District and Odisha State.

In this mining lease area only 5.06 hectare area is available for mining as per Terms of Reference approved by SEIAA; Odisha for the proposed production capacity of 18210 M^3 per year and 91050 M^3 for five years. It is an open cast mine and it is proposed to do mining by manual method.

TABLE 2-2 QUARRY LAND DETAILS

District & State	Village	Tahasil	Sy. No.	Extent	Ownership	Nature of Excavation
Dhenkanal, Odisha State	Kantio-Putasahi Village.	Kamakhyanagar	Khata No:.857, Brahmani River	5.06 Ha	Govt. Land	Open Excavation

2.4 EXISTING LAND USE PATTERN:

The proposed specified sand bearing area is over the river bed which will be submerged under water during monsoon and floods. The adjacent areas are classified as agricultural lands by the revenue authorities.

Type of land use	Area (Ha.)
Water channel area	0.315
Left over area adjacent to water channel	0.176
Quarry Safety zone area	0.514
Water logged area	Nil
Potential Mineable surface area within the plan period	4.055
Total	**5.06**

2.5 GEOLOGY AND EXPLORATION

2.5.1 RESERVE

The reserve is estimated based on local parameters. The lease area belongs to recent quaternary River bed deposits consisting of sand, silt, clay, gravel and alluvial deposits.

2.5.2 PHYSIOGRAPHY

The sand bed is on the river Brahmani. The Kantio-Putasahi Sand bed deposit represents a gently sloping to almost flat terrain with highest altitude of 47mRL towards southern part.

The general slope is towards north. Vegetation is scanty with small bushes existing in the auction hold area. There is no human settlement within area.

2.5.3 REGIONAL GEOLOGY

Gondwana Group Palaeozoic-Mesozoic Upper Mahanadi valley basin which is in this baisn, the Gondwana sediments unconformably overlie the Precambrian basement; the latter comprising migmatitic granitic gneiss, amphibolite, schist and quartzite traversed by pegmatite and quartz veins. Era (Upper Carboniferous-Early Permian)- Glacio-lacustrine and fluial sediments were deposited in linear basins along faulted troughs over the Precambrian basement. These sediments, characterized by fluvial assemblages of interbeded sandstone-shale sequence. While the lower Gondwana rocks are a vast repository of coal, the Upper Gondwana witness sandstones of Palaeozoic-Mesozoic era. Gondwana rocks are exposed over a large area along NW-SE trending linear belt in the Mahanadi valley rift/graben in three major basins (Tlcher, lbriver & Athgarh). Besides these, a number of small patches outliers) of Gondwana rocks occur in Angul, Dhenkanal districts and others. The lower Gondwana rocks have vast resources of coal. The stratigraphic successions are as below;

Stratigraphic set-up

Upper Gondwana	Migmatitic granitic gneiss, amphibolite, schist and quartzite	Palaeozoic Mesozoic
	Conglomerate, sandstone, shale fireclay	Lower Cretaceous
Middle Gondwana	Conglomerate, ferruginous sandstone, red shales	Lower to Middle Triassic
----------Un-Conformity----------		
Lower Gondwana	Fine to medium grained sandstone, siltstone, clay-beds, coal	Upper permian
	Sandstone, shale, clay, ironstone shale	Middle Permian
	Conglomerate, sandstone, shale, fireclay, coal	Lower Permian

----------Un-Conformity----------		
	Boulder Bed, green shale, sandstone, marlstone	Upper carboniferous to lower Permian
----------Un-Conformity----------		
	Grinite, greisses, amphibolites, migmatites	Precambrain

The Quaternary consists of both Pleistocene and Holocene formations spanning over a period of about 1.8 million years up to present time. Studies on the Quaternary sediments of the state for nearly two decades have led their classification into five formations. These, arranged in order of decreasing antiquity area i) Naira (ii) Bolgarh (iii) Kaimundi (iv) Bankigarh and (v) Recent formations.

The alluvial valley facies include the flood plain deposit which occur parallel to the present river courses. The sediments are represented by alternate bands of silt, fine white sand and mottled clay. The sediments dispay nominal oxidation implying immature pedogenic alteration. The lower delta facies passes seaward into their coastal equivalents.

The above are best developed around Barkul, Jaipur and Paradip areas. The alluvial valley facies include the flood plain deposit which occur parallel to the present river courses. The sediments are represented by alternate bands of silt, fine white sand and mottled clay. The sediments display nominal oxidation implyimg immature pedogenic alteration. The lower delta facies passes seaward into their coastal equivalents (Younger Coastal Facies), represented by yellow, medium to fine sands of the stranded beach-ridge segments.

Litho-Stratigraphy of Quaternary sequence in Odisha

Morpho Units	Litho Units	Tentative age
Present day Surface	Present day channel fill (Fine to medium sand with little clay and silt).	Late Holocene
Bankigarh Surface	Bankigarh Formation (Brownish sandy clay)	Late to Middle Holocene
Kalmundi Surface	Kalmundi Formation (Caliche bearing sandy clay).	Late Pleistocene to early Holocene
Bolagarh surface/ Naira Surface	Bolgarh Formation (Secondary laterite formation). (Semi-consolidated Pebbly sandstone with ash bed).	Middle to Early Pleistocene
~ ~ ~ ~ ~ ~ ~ ~ ~ ~	Unconformity ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	
Basement	Precambrian to Tertiary rocks.	

LOCAL GEOLOGY

The sand deposit in Brahmani River near Kantio-Putasahi belongs to recent to sub recent deposits of Holocene age. Beach sand younger and older alluvium also belongs to the same age. The proposed area is occupied by a gently sloping to almost flat deposits of sand. The basement consists of Tertiary deposits and the sequence of litho units encountered in the auction hold area is as follows:

Sand

↓

Alluvium

LITHOLOGY:

The characteristic features of the litho units of the area are described below:

Sand: The area under reference is covered with grey to white sand deposits with average probable thickness of 2m within the lease area. Sand by definition is a loose, incoherent mass of mineral materials and is a product of natural processes. These processes are the

disintegration of rocks and corals under the influence of weathering and abrasion. When sand is freshly formed, the particles are usually angular and sharply pointed, but they grow gradually smaller and more rounded as they become constantly worn down by the wind or water. Sand particles tend to settle quite rapidly because of their shape, density and size.

The composition of sand is highly variable in nature, depending on the local rock types/sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide or SiO_2), usually in the form of quartz which because of its chemical inertness and considerable hardness, is the most common mineral reistant to weathering.

Alluvium: Decomposed vegetal materials admixed with clay and soil constitutes alluvium which is underlain by the sand bed with some clayey matter.

2.5.4 RESERVE

The Geological reserve has been estimated by considering the following parameters.

i. Outcome of geological mapping; Fresh patches of unexploited river sand occurrences are observed within the area. The maximum RL of the surface sand zones is around 47m.

ii. It is observed that, the defference in elevation between the highest and lowest points is much less. Gradient of the river is also very low. Therefore, surface area method has been adopted for estimation od reserve or this river bed sand

iii. Thickness of sand zone: The mRL of the surface sand zone is around 47m. Considering the observations of thickness of sand bed of the area the maximum possible thickness of sand bed that can mined out i.e. 2m is assumed as the thickness of sand over the area for estimation of reserve.

iv. The quarry lease area is a new source, quarry lease for minor mineral (River sand) has been proposed to be granted by the Tahasildar, Kamakhyanagar to the successful bidder for minor mineral (River sand) for five years after auction and the present document is being prepared for the lessee which would be decided through auction by the competent authority and the process would require at least 2 to 3 months from now. Also, the pattern of sand deposition in the ensuring years

of the lease period is impossible to ascertain right now. To overcome this, the total lease area has been considered as potential zone for sand deposition excluding the water channel areas, if any located within the area and Geological resource has been calculated based on this area and the present thickness of sand deposit.

In the absence of any monitored database, it is assumed that 100% of the above calculated resource would be replenished cumulatively which the total QL period of 5 years. Considering the above, the total geological resource of the QL area for the lease period has been calculated by doubling the above calculated resource.

v. The resource of river sand over the area has been categorized as probable reserve.

vi. The foreign particles in the sand such as wood and other floating waste have been considered as waste. However, the volume of waste is negligible in quantity and in practice the waste will not be separated during mining. So recovery factor has been taken as 100% for sand.

vii. Total volume of excavation of sand is saleable.

Mineable Reserve:

viii. The sand resource within safety zone area of 7.5m barrier all along the proposed area boundary and 10m barrier the water channel (if any) present within the proposed area have been excluded from the above calculated geological resource for compulation of mineable reserve as above has been taken as available mineable reserve over the area as per MoEF Notification dated 25.07.2018 which can be extracted during the total span of the plan period.

Calculation of Reserve:

Based on the above Considerations, site specificity & chosen local parameters, the reserve has been calculated for river bed sand zone by surface area method.

Volume of Sand is V=AxTxR

Where, V=Volume of sand m3

A= Surface area of potential sand patch

T= Average thickness of sand bed in m

R= Replenishment factor for the QL period of five years

Total estimated geological resources as 189796 cum.

Similarly, total extractable mineable reserve of river bed sand is worked out to be 53014 cum.

TABLE 2-3 CATEGORY WISE GEOLOCAL RESERVE OF SAND BED

Geological Resources Calculation of sand for the QL period				
Area of Potential sand zone (m^2)	**Thickness of sand in m**	**Replenishment Factor (100%)**	**Geological Resources of sand in m^2**	**Category**
A	B	C	D=AxBxC	E
47449	2	2	189796	Probable

TABLE 2-4 CATEGORY WISE MINEABLE RESERVE OF SAND BED

Mineable Reserve Calculation of sand for the QL period					
Area of Potential sand zone excluding safety zone (m^2)	**Thickness of sand in m**	**Replenishment Factor (100%)**	**Mineable Reserve of sand in m^2**	**Extractable Mineable reserve**	**Category**
A	B	C	D=AxBxC	E=Dx0.6	F
40550	2	2	162200	97320	Probable

Right now, the sand resources available within the source is 11955 m^2x 2 m=23910 m^3 which is more than the MGQ provided by the Tahasildar.

2.6 MINING & METHOD OF MINING

Semi-Mechanized- Mining shall be undertaken to extract sand, mainly through an open pit spread over the river course devoid of water or nominal water that may be encountered below.

Mining Method:

The mode of the deposit, geomorphology of the area and its hydrological condition are some of the factors that favours the open cast method of mining.

Mining will be done by excavators for excavation & loading into trucks/tractors and manually also. The sand will be transported from Brahmani River sand bed to the users/ destination through trucks /tractors. The mining will be undertaken on single shift basis. The local man power shall be engaged in the mine. The macines to used. The details are given below.

Sl.No.	Name	Capacity	No. of Fleet
1	Excavators	0.9 Cum	1
2	Safety gears helmets, safety shoes, Goggles & hand gloves	----------	As required
3	Transporting vehicles	$0.9m^3$	1

As such the river bed sand are loose, no drilling & blasting is required. Benching pattern is not feasible in case of sand, as the angle of repose of sand is 35^0, based on this the Ultimate pit slope limit has been taken as 35^0. The maximum depth of mining will be of 2m or up to water table whichever is less. There will be no existing quarry within the proposed area after replenishment. Total available minable reserve over the area has been estimated considering the probable zone of occurrence of river sand bed within the proposed area as revealed during field visit and assuming uniform rate of year wise replenishment over the area. Yearwise development of quarries for five-year plan period will be decided depending upon the occurrences of sand bed over the proposed area during the respective year to achieve the target production. Therefore, quarry lay out will be over the whole proposed area depending upon the probable sand bed after replenishment leaving stipulated safety zones. 45mRL or upto water table whichever is less. The present level of the lease area is 47mRL. During plan period, the quarry floor will be 45mRL or upto water table whichever is less. The proposed pit lay out have been shown in the development plan and also in progressive Mine Closure Plan.

TABLE 2-5YEARWISE PRODUCTION OF SAND DURING PLAN PERIOD

Year	Production in m^3
1st	18210
2nd	18210
3rd	18210
4th	18210
5th	18210
Total	91050

Over Burden Removal

No overburden is anticipated.

Loading

The ordinary Sand will be loaded by manually by labours.

Hauling

Ordinary Sand is transported through tractors with trailers.

2.6.1 STOCK YARD

The applicant should obtain permission from the competent authority for stock yard under Mineral Dealer Rules '2000 if the sand is to be transported for long distance as per the norms of the Concerned Department.

2.7 WATER REQUIREMENT

Water requirement for the project will be 2.5 KLD. Water required in the project will be for drinking purpose and dust suppression, which will be sourced from water tanker.

2.8 POWER REQUIREMENT AND SOURCE

Power Requirement will not be required for operations as the mining will be worked out during day time only. Minimal power required for office shall be taken from the general electric supply of the area.

2.9 MAN POWER REQUIREMENT

Employment Generation from the project is 13 nos. of people. OMS has been assumed to be 7 cum. Indirect employment through creation of shops/ stalls, hired vehicles, etc. also can be generated to full fill the day-to-day requirements of the mining personals.

2.10 MINE DRAINAGE

The shallow depth excavation on dry/ nominally wet sand has been proposed, which will have negligible or no impact on drainage. Abandoned stream channels on terrace and inactive flood plains have been preferred rather than active channels.

Water that minght percolate (if any) into excavation area has to be pumped out to channelize to river course during excavation. Stream will not be diverted to form inactive channels. Mining below subterranean water level will be avoided as a safeguard against any water contamination. Source has been finalized avoiding concave side of river bank/channel to prevent bank erosion.

It is observed from the dug well in the adjacent plain area and in the nearby villages that the ground water table varies between 4m to 14m from the surface level depending upon seasonal variations. During dry season the water table falls to 14m from the surface where as during rainy season the water table remains at 4m from the surface. As the mining activities presently proposed are maximum up to 2m that to within the river course and the total mining operation will be achieved through manual means, so there will be no effect on ground water table.

2.11 STACKING OF MINERAL REJECTS AND DISPOSAL OF WASTE

a. **Nature of Topsoil/Waste and Mineral Rejects: There is no topsoil and no mineral rejects are anticipated.**
b. **Solid waste during the plan period:** No waste is anticipated in Ordinary Sand excavation.
c. **Storage and utilization of topsoil:** No topsoil is going to be generated in this plan period.
d. **Proposal for reclamation of land effected by Mining:** The reclamation of the excavated sand will be a natural process as the flowing water during rainy days will fill the mined out pits.
e. **Afforestation Programme:** Afforestation is not possible as the entire area is occupied by the sand. Plants will be developed on either side of the approach road on the banks of river.

f. **Measure to control to erosion /sedimentation of watercourses:** There will not be any erosion/ sedimentation in the subject area because; there will not be any water discharge form mine workings.

g. **Treatment and Disposal of water from Mine:** No water will be disposed from mine.

2.12 SITE SERVICES

Temporary Site Services will be provided by the applicant. Make shift Office. First Aid and Rest shed will be constructed by the ramp side of the specified sand bearing area.

2.13. GREEN BELT

Plantation work will be carried out at the safety zone of the lease area. 100 number of saplings proposed during plan period will be planted. Plantation shall be done with suitable local species like teak, mango, jammu, jhaun, neem etc. per year and also along the approach road during the plan period.

2.14 PROJECT COST

Project cost of the project is 40 Lakhs.

3 DESCRIPTION OF ENVIRONMENT

3.1 SCOPE

Collection of baseline data of different Environmental Attributes like Air, Water, Noise, and Soil, Socio-economic etc., proposed production capacity is an important stage in the preparation of Environmental Impact Assessment (EIA), which helps to predict the changes which may occur after the implementation of the project.

EIA report contains a description of existing environment that would be or might be affected directly or indirectly by proposed project. Environmental baseline monitoring is a very important stage of EIA. Environmental baseline monitoring, during the operational phase, helps in judging the success of mitigation measures in protecting the environment. The main objectives of describing the environment, which may be potentially affected, are (i) to assess present environmental quality and the environmental impacts and (ii) to identify environmentally significant factors. The chapter contains information on existing environmental scenario of the proposed project study area.

Environmental facets that are considered in relation to mining can be categorized into following groups:

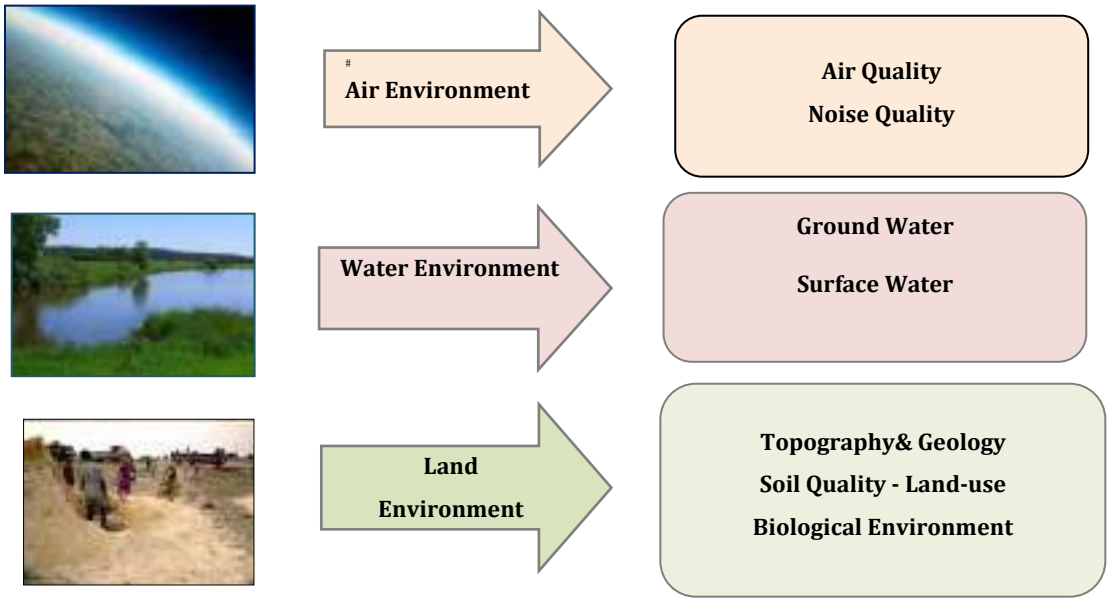


TABLE 3-1 SALIENT FEATURES OF BASELINE ENVIRONMENTAL STUDIES

Attribute	Parameter	Frequency of Monitoring
Micro -meteorological Studies	Wind Details like speed, direction, Temperature, Relative Humidity and Rainfall	3 months data has been collected to assess air pollution impacts on the surrounding environment.

Ambient Air Quality	PM_{10} $PM_{2.5}$ Sulphur Dioxide (SO_2) Oxides of Nitrogen (NO_x)	3 months data has been collected to assess baseline Air Quality status of the area.
Noise Quality Data	Noise levels	1 middle month data has been collected to identify noise producing areas.
Water Quality, Soil Quality Data and Land Use pattern	Physical & Chemical parameters along with measurement of heavy metals and land use parameters.	To establish baseline Water Quality, Soil Quality for future reference and Land Use Pattern in the area.
Socio-Economic & Demographic Studies	Socio-Economic parameters	To know the present Socio Economic status of the study area

3.2 STUDY AREA

The proposed mine lease boundary is considered as a center, a radial distance of 10 km is considered as study area for baseline data collection and environmental monitoring. The study area of map is given in below **Figure 3.1.**

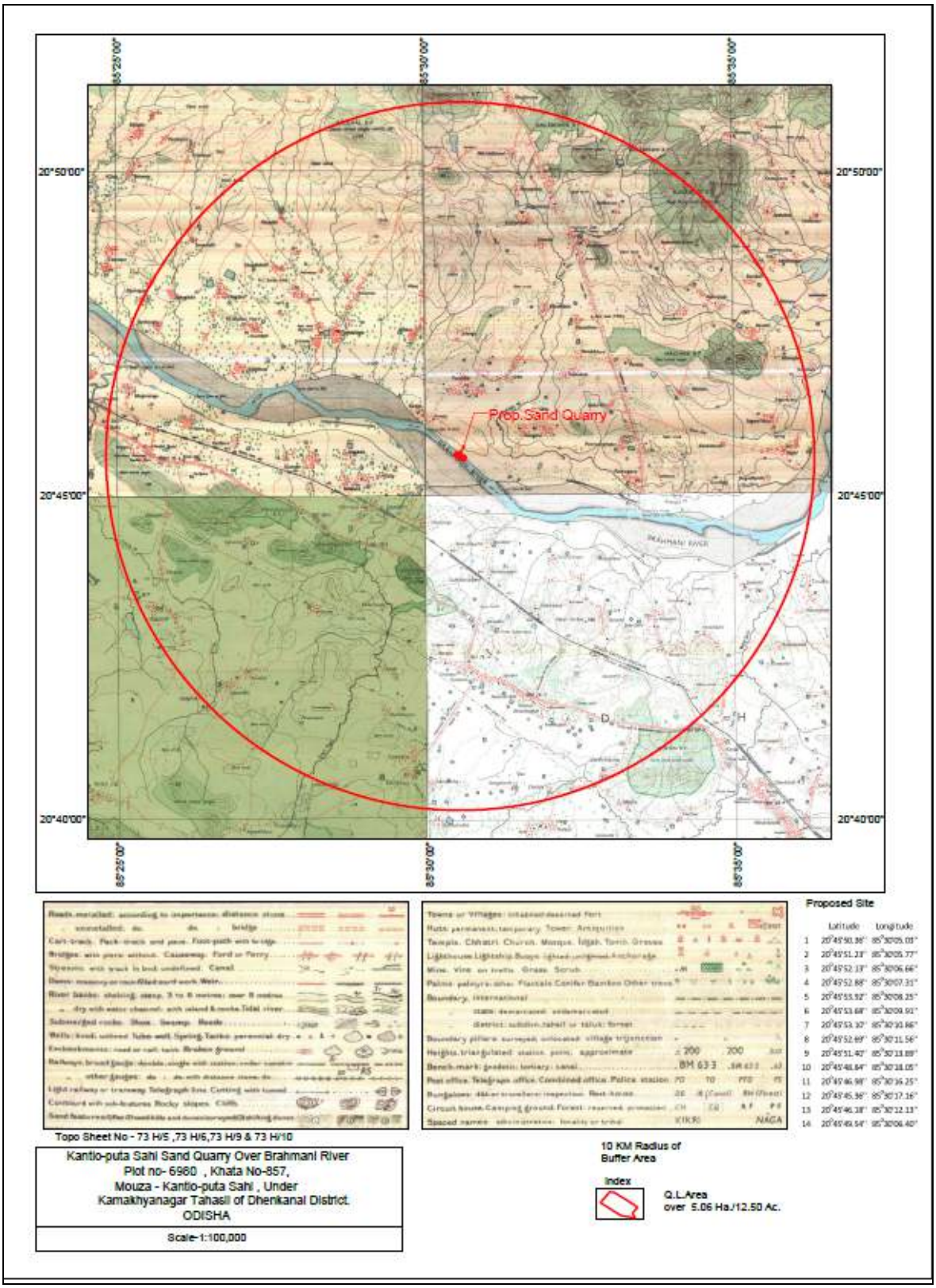


FIGURE 3-1 TOPO MAP OF 10KM RADIUS OF STUDY AREA

3.3 STUDY PERIOD

The baseline data generation for the EIA-EMP has been carried out during October 2020 to December 2020 for the period of three months.

3.4 COMPONENTS AND METHODOLOGY

To achieve the objectives of ToR, M/S Rightsource Industries Private Limited team members visited the study area and monitored the environmental parameters as per of ToR Letter and accordance with the Guidelines for EIA, issued by the Ministry of Environment, Forests and Climate Change, Government of India. The components of the study are given below:

TABLE 3-2 COMPONENTS OF BASELINE STUDY

Sl.No.	Component	Sl.No.	Component
1	Land use	6	Water Environment
2	Hydrogeology	7	Land Environment
3	Air Quality and Meteorology	8	Biological Environment
4	Air Environment	9	Socio-economic Environment
5	Noise Environment		

Data Collection Methodology

The baseline information on micro-meteorology, ambient air quality, water quality, noise levels, soil quality and floristic descriptions are largely drawn from the data generated by NABL Accredited Lab. The FAEs are also involved in selection of monitoring locations and data collection. Micrometeorological data at site was recorded using automatic weather station. Apart from these, secondary data have been collected from Census Handbook, Revenue Records, Statistical Department, Soil Survey and Land use Organization, District Industries Centre, Forest Department, Central Ground Water Authority, etc.

3.5 LAND USE LAND COVER OF THE STUDY AREA

Land Use (LU) refers to man's activities and various uses, which are carried on land. Land Cover (LC) refers to natural vegetation, water bodies, rock / soil, artificial cover and others resulting due to land transformation. Although land use is generally inferred based on the cover, yet both the terms land use and land cover are closely related and interchangeable.

Information on the rate and kind of change in the use of land resources is essential to the proper planning, management and regulation of the use of such resources. Knowledge about the existing land use and trends of change is essential if the nation is to tackle the problems associated with the haphazard and uncontrolled growth. A systematic framework is needed for updating the land use and land cover maps that will be timely, relatively inexpensive and appropriate for different needs at both national and state levels. The rapidly developing technology of remote sensing offers an efficient and timely approach to the mapping and collection of basic land use and land cover data over large area. The satellite imageries are potentially more amenable to digital processing because the remote sensor output can be obtained in digital format. Land use data are needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved from or maintained at current levels.

It is required to carry out the land use / land cover study for the project study area (10 km radius) to obtain the necessary environmental clearances from statutory authorities. The objective of the study is to carryout land use / land cover study for the proposed project. The LU / LC study is carried out using the Satellite Imageries (IRS RS2 LISS III / IV Rabi and Khariff) in addition to Survey of India toposheets. Appropriate guidelines are followed while preparing the LU / LC map for the project study area.

A) SCOPE OF THE WORK

(Standard Operation Procedure for Land Use / Land Cover Study)

- The LU/LC study shall be carried out for a study area of 10km radius taking site as centre using the satellite imageries (IRS RS2 III/IV 5.8m Resolution) for Rabi/ Khariff season.
- Procurement of latest satellite imagery (IRS RS2 III/IV 5.8m Resolution) based on availability) Rabi or Khariff seasons.
- Satellite imagery processing and interpretation of land use as per land use classification covering 10km radius of proposed Project Site.
- Calculation of land use breakup w. r. t. each land use category covering 10km of proposed Project Site.
- Preparation and submission of reports, satellite imageries and maps.

Pre-Field Interpretation:

- Collection of Survey of India Topographical maps on 1: 50,000 scale from Survey of India (SOI).
- Procurement of Satellite Imagery from National Remote Sensing Agency (NRSC) site Geo Co-ordinates from site center taken 10 Km radius.
- Using ERDAS image processing software processed the raw satellite data.
- Using ARCGIS software converting the all base features from the toposheet, and overlaying the same features on the satellite imagery.
- Using remote Sensing techniques tone, color, texture and shadow etc. draft land use map is prepared.
- Before site/ground truthing randomly mark field, data checked. With which field work will be carried out.

SITE/ground trothing:

- Site visit - capture the Geo-Coordinates of Boundary Pillars and record in field note book.
- Take traverses and observe the land use categories and map it on the field map on draft map with field photographs.
- Observe the each land use category like single crop/double crop, industrial area, settlements, forest lands, water bodies, waste lands and etc.
- The buffer zone area will randomly traverse for correlating mapping units.
- Collecting secondary data from agricultural department and local people.

ROLE OF REMOTE SENSING AND GIS

Remote sensing and GIS are the modern techniques of terrain analysis and information generation. They not only ensure faster and easier analysis / interpretation but also help to modify / manipulate the data at will so as to meet the objective of the study.

A. REMOTE SENSING (RS)

Remote Sensing (RS) generally involves in processing of remotely sensed data in digital form using image-processing techniques, which created a new and wider dimension in analysis and interpretation. Remote sensing enables one to acquire information about an object or phenomena from a distance through detection or measurement of electromagnetic energy coming from the object. The use of remote sensing techniques for the study of natural resources has been found to be of considerable value. The information derived from the remote sensing is compatible with topographic maps of Survey of India on 1:50,000 or 1:25,000 scale. With the use of high-altitude sensor platform, it is now possible to record extensive areas on a single image, which covers a maximum of 34,000 sq. km (185x185km) and minimum of 3600-sq.km area. Thus, one can have a synoptic view over large area and also an integrated picture of the landscape. By using the satellite imagery, it is possible to conduct surveys in areas, which are difficult to access. Some of the advantages of utilizing remote sensing techniques are given below:

- Satellite image serves as a permanent record of a landscape at a point of time from which land use changes can be monitored and evaluated.
- Satellite data is cost effective when compared to conventional methods. It can be obtained quickly; its information is accurate, reliable and up to date.
- Preparation of thematic layers by using satellite imagery is time saving when compared to conventional method.
- Satellite data can be effectively integrated with the conventional data for analysis, planning and decision-making.

B. GIS

Geographic Information System (GIS) is a powerful set of tool, which can perform correlation. GIS is a system for manipulating and analyzing spatial data to provide information to support planning and decision-making. GIS can also be defined as “decision support system involving the integration of spatially referenced data in a problem solving environment’ (Cowen, 1988). It comprises facilities for the input, management, retrieval, manipulation, analysis and display of spatial data. Its functions can be grouped as data acquisition, data utilization, data management, output and display.

GIS technology is useful as planning / decision-making tool for resource management. The selective retrieval and analysis capabilities of GIS are used to manipulate the database and provide a variety of information for resource management. GIS is an aid to analyze the thematic maps prepared through remote sensing and field visits. It stores all the maps prepared and database attached to them in digital format, which permits rapid access and processing. Combination of Remote sensing and GIS technologies are very important for assessment and management of natural resources, where integration of data from different sources is an essential requirement.

DATA USED DETAILS

The data is used for the preparation of different maps for the study natural resources. The data is used by using the application of Remote Sensing and GIS technologies

TABLE 3-3 DETAILS OF SOURCES & THE MAPS PREPARED

Sl.No.	Source	Maps Prepared
1.	Survey of India's topographic maps and satellite imageries	Base map and Drainage map
2.	Satellite Imageries	Land use / Land cover

TABLE 3-4 SURVEY OF INDIA'S TOPOGRAPHIC MAPS

Sl.No.	Topographic Map No.	Scale	Year of Survey	Year of Publication
1.	73 H/9	1: 50,000	2010	2011

TABLE 3-5 SATELLITE DATA OF NATIONAL REMOTE SENSING CENTRE

Sl.No.	Season	Sensor path/row	Satellite/Sensor	Date of Pass
1.	Winter	105/57	IRS RS2 LISS III	January 2019

3.5.1 LAND USE / LAND COVER

Land use/land cover map is prepared by visual interpretation of high-resolution satellite data with the help of Survey of India Topographic maps on 1:50,000 scale. Two seasons' data is used for the delineation of different units. The units are confirmed by the ground truth/field visits.

Level-II classification of National (Natural) Resources Information System (NRIS) has been followed for the delineation of units.

Land use/Land cover map of the study area is integrated with village map and analyzed with the help of GIS to get the village wise findings of the present land use of the study area, which is given elaborately in the following tables:

Land use refers to man's activities and various uses, which are carried on land. Land cover refers to natural vegetation, water bodies, rock/soil, artificial cover and others resulting due to land transformation. Although land use is generally inferred based on the cover, yet both the terms land use and land cover are closely related and interchangeable. Information on the rate and kind of change in the use of land resources is essential to the proper planning, management and regulation of the use of such resources.

Knowledge about the existing land use and trends of change is essential if the nation is to tackle the problems associated with the haphazard and uncontrolled growth. A systematic framework is needed for updating the land use and land cover maps that will be timely, relatively inexpensive and appropriate for different needs at national and state level. The rapidly developing technology of remote sensing offers an efficient and timely approach to the mapping and collection of basic land use and land cover data over large area. The satellite imageries are potentially more amenable to digital processing because the remote sensor output can be obtained in digital format. Land use data are needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels.

Basic Concepts of Land Use

Clawson has given nine major ideas or concepts about land. These are:

- Location or the relation of a specific parcel of land to the poles, the equator, and the major oceans and landmasses. There is also relationship between various tracts of land, as well as a political location.
- Activity on the land, for what purpose this piece of land or tract is used.
- Natural qualities of land, including its surface and subsurface characteristics and its vegetative cover.
- Improvements to and on the land. This is closely related to the activity.

- Intensity of land use or amount of activity per unit area.
- Land tenure, i.e. who owns the land, which uses it.
- Land prices, land market activity and credit as applied to land.
- Interrelations between activities on the land and other economic and social activities.
- Interrelations in the use between different tracts of land.

METHODOLOGY FOR LAND USE / LAND COVER MAPPING

The land use/land cover map is prepared by adopting the interpretation techniques of the image in conjunction with collateral data such as Survey of India topographical maps and census records. Image classification can be done by using visual interpretation techniques and digital classification using any of the image processing software. For the present study, ERDAS 9.1 version software is used for preprocessing, rectification, enhancements and classifying the satellite data for preparation of land use land cover map for assessing and monitoring the temporal changes in land use land cover and land developmental activities.

The imagery is interpreted and ground checked for corrections. The final map is prepared after field check. Flow chart showing the methodology adopted is given in the different land use / land cover categories in the study area has been carried out based on the NRSC land use / land cover classification system.

For analysis and interpretation, and preparation of LU/LC map, two types of data are needed:

1. Basic data 2. Ground data

Basic data includes:

- Fused data of LISS III
- Toposheets on 1 : 50,000
- Local knowledge
- Area map on any scale to transfer details
- Reports and other literature of the study area

Ground data: Ground data is very much essential to verify and to increase the accuracy of the interpreted classes and also to minimize the field work.

Data analysis: For analysis and interpretation of satellite data, the study can be divided into three parts:

A. Preliminary work

B. Field work

C. Post field work

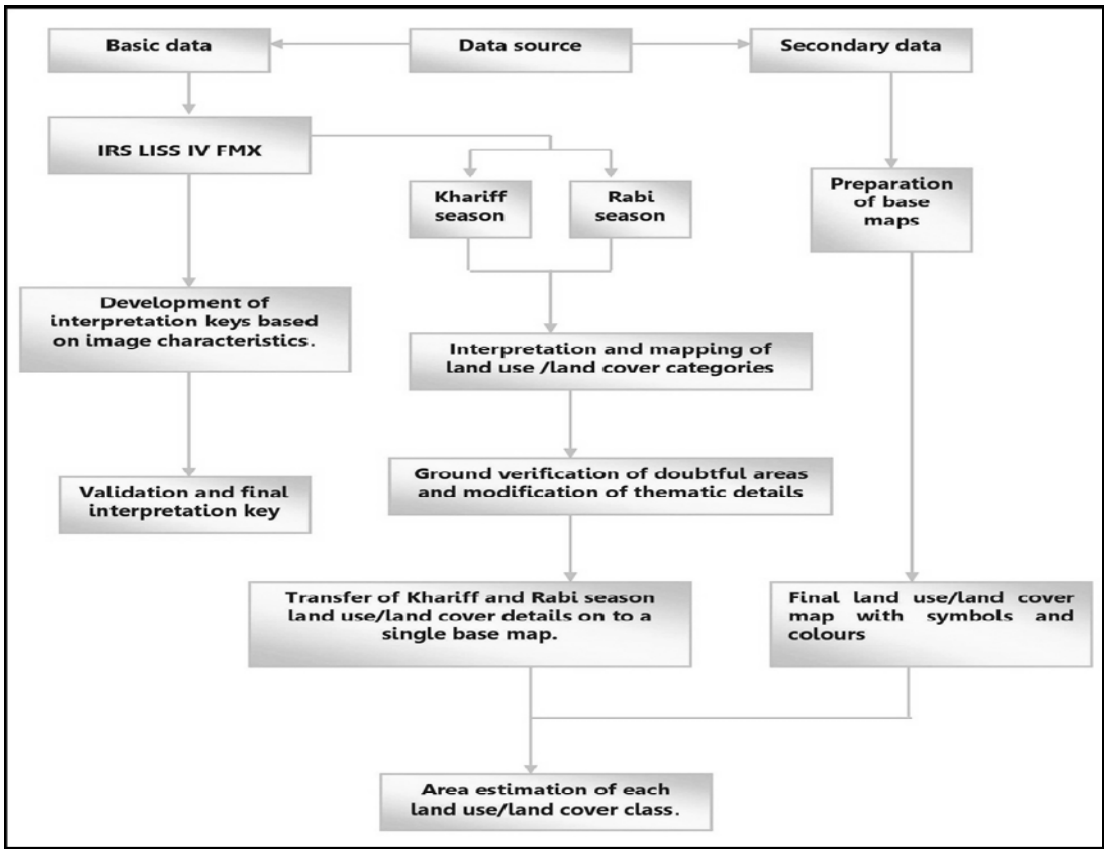


FIGURE 3-2 METHODOLOGY ADOPTED FOR LAND USE CLASSIFICATION AND MAPPING

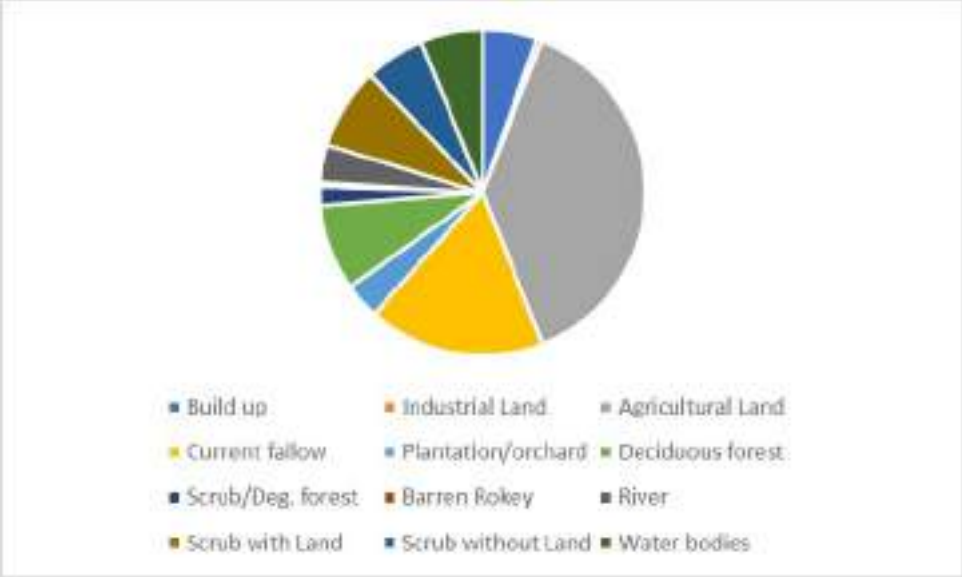
3.5.2 RESULTS

In the present study, both digital image processing and using visual interpretation technique were used to generate output of Land use cover map of study area. A land use/ land cover details of the study area is shown in **Figure- 3.3**. A land use pattern of the study area (10 km from the project site) is shown in **Figure- 3.4** standard False Colour Composite (FCC) image has also been generated on the same scale and is shown in **Figure- 3.5.**The land use pattern of the study area is given in **Table 3.6.**

TABLE 3-6 LAND USE (AREA & PERCENTAGE) PATTERN OF 10KM AREA

Sl No	Lu Description	Area_Ha	%
1	Build up	1755.47	5.390406
2	Industrial Land	165.912	0.509455
3	Agricultural Land	12418.7	38.13328
4	Current fallow	5731.03	17.59789
5	Plantation/orchard	1151.71	3.53648
6	Deciduous forest	2778.84	8.5328
7	Scrub/Deg. forest	635.376	1.951007
8	Barren Rokey	126.108	0.387231
9	River	1200.82	3.687279
10	Scrub with Land	2650.47	8.138623
11	Scrub without Land	1943.7	5.968391
12	Water bodies	2008.43	6.167153
	Total Areain Ha	32566.57	100

FIGURE 3-3 LAND USE /LAND COVER (IN PERCENTAGE) PATTERN OF 10KM STUDY AREA DIAGRAM



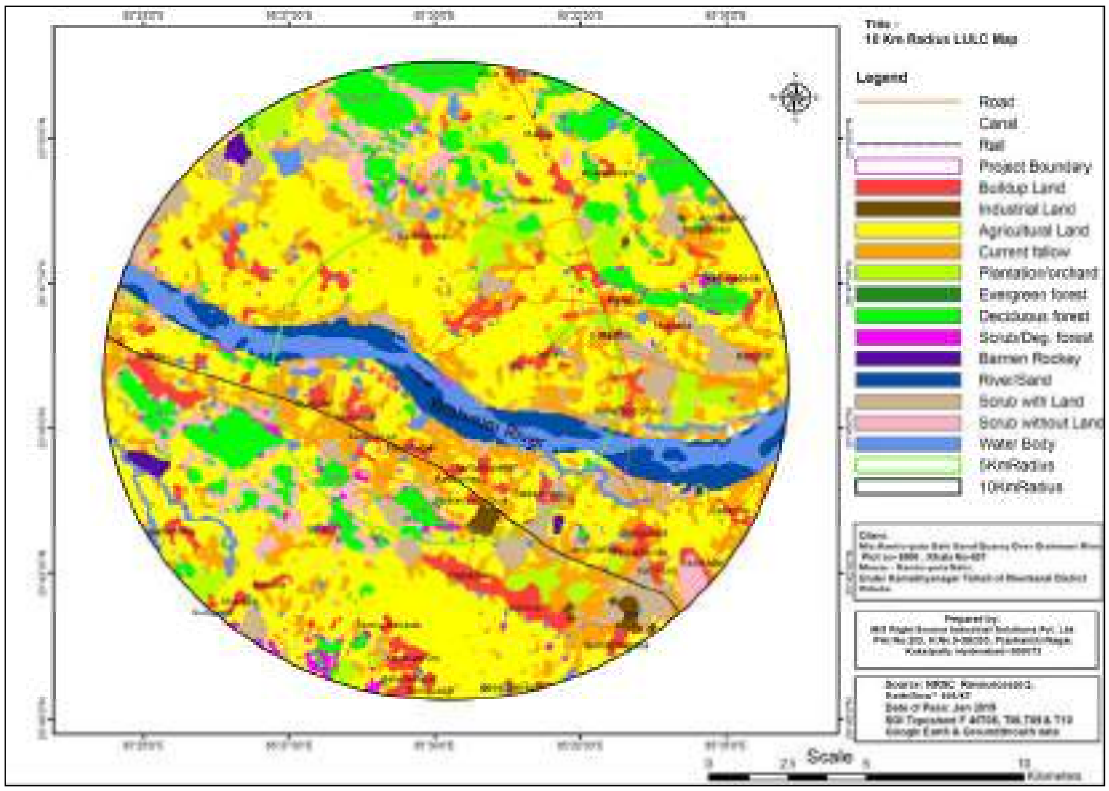


FIGURE 3-4 LAND USE /LAND COVER PATTERN IMAGE OF 10 KM RADIUS OF AREA

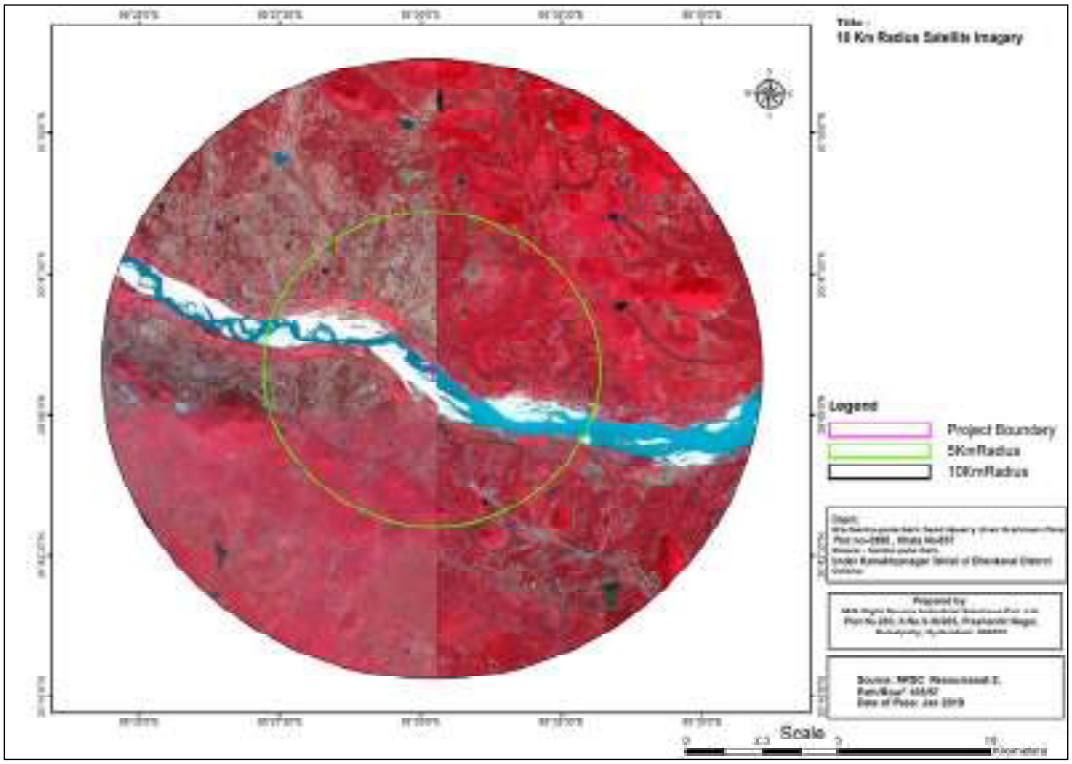


FIGURE 3-5 SATELLITE IMAGERY OF 10KM STUDY AREA

3.6 HYDRO GEOLOGY

The geological set-up of the area, to a large extent, governs the occurrence as well as the movement of groundwater in the district. 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. Hydrogeological surveys reveal the lithological characteristics and the role of the tectonic deformation thus resulting deep-seated intersecting fractures, on the occurrence and distribution of groundwater reservoirs and their water-bearing as well as water-yielding properties. The lineaments formed due to tensile deformations have been picked up from the Remote Sensing Studies. Groundwater occurs under water table condition in recent alluvium as well as in the semi-consolidated formations whereas in the deeper fractured rocks, the groundwater occurs under semi-confined to confined condition. Depending on the different aquifer systems and their parameters in different lithounits, the major hydrogeological units in the state can be divided into three categories: i) Consolidated formations, ii) Semi-consolidated formations and iii) Un-consolidated formations.

Water-bearing properties of the Consolidated Formations

The crystalline rocks like granite, granite gneiss, khondalite etc that comprise most part of the district is devoid of any primary porosity. But the process of weathering and fracturing imparts secondary porosity in these rocks, permitting storage and transmission of groundwater. The thickness of the weathered zone is usually more in the topographic lows and undulating plains than in the highland areas. Groundwater occurs under water table condition in the weathered zone and under semi-confined to confined condition in the deeper fractured zones. The wateryielding capacity of the fractured rocks largely depends on the degree of fracturing, their horizontal extent as well as their interconnection.

Aquifer System and Aquifer Parameters of the Different Litho-units

Granite and Granite Gneiss: Major parts in the district are occupied by the granite, granite gneiss that are highly weathered and fractured. The thickness of the weathered zone varies from 5m to 20 m, which form the repository of groundwater at shallow depth. Groundwater occurs under phreatic condition in this zone and can be developed through dug wells. The depth of dug wells varies from 4.5 m to 14.0 m and the water level varies from 1.26 to 13.70 m below ground level during premonsoon and from 0.60 to 12.50 m below ground level during post-monsoon period. The deep bore wells yield up to 12.0 litre per second depending upon the topographic setting, proximity to major lineaments, thickness of weathered zone and number as well as potential of saturated fracture zones. The result of shallow deposit wells constructed by CGWB in this district indicates that weathered as well as semi-weathered granite gneiss form moderately potential aquifer.

Khondalite: These rocks are restricted to higher elevations forming steep linear ridges and hence groundwater potential is limited although foliated nature of the rock facilitates deep weathering. In pediment areas, the thickness of the weathering varies widely. The average depth of dug wells is about 10 m. The water level varies from 7.0 to 8.0 m below ground level during pre-monsoon and from 3.0 to 6.0 m below ground level during post-monsoon period.

Water-bearing Properties of the Semi-consolidated Formations

These are represented by rocks of Gondwana formation, which have faulted contact with the Pre-Cambrian rocks. It consists mainly of sandstone and shale. The friable and loosely cemented sandstone forms the aquifer. Ground water occurs in pheratic condition in the weathered zone and semi-confined to confined condition in deeper fractured and friable sandstone beds. The aquifer in these formations may sustain limited to moderate yield. Auto-flowing condition has been encountered at Kumuda. The average depth of dug wells in these formations range from 7.40 to 8.60 m below ground level. The depth of wells drilled by CGWB varies from 28.24 m (Kusponga) to 289.0 m (Kumuda) and the yield ranges from 0.50 to 12.0 litres per second.

Water-bearing Properties of the Un-consolidated Formations

Laterites and alluvium of Sub-Recent to Recent age constitute the unconsolidated formations which occur as thin, discontinuous patches adjoining the rivers. Laterites occur as capping over the older formations and tapped through dug wells. The depth to water level ranges from 3.34 to 10.12 m below ground level during pre-monsoon and from 0.97 to 6.87 m below ground level during postmonsoon period. The thickness of alluvium is about 25 m and form shallow potential aquifer. The aquifer sustains moderate yield. Recent alluvium occurs in thin, discontinuous patches as valley fills and also along the course of major rivers and streams.

Aquifer Characteristics of Crystalline Rocks

In the hard crystalline rocks, the recharge of ground water from precipitation or seepage from surface water bodies percolate into the weathered and semiweathered (Saprolite) zone. The presence of fractures in the basement rock, which opens up to the overlain saprolite zone facilitates downward percolation and movement of the water, which can be tapped through dug wells in the weathered and semi-weathered zone and through bore wells in the deeper horizons. At places, confined condition gives rise auto flowing wells (Kumuda). The groundwater potential of various zones i.e. saprolite (tapped through dug wells), weathered basement rock and shallow fractured rocks (tapped mostly through hand pumps) and deeper fractured rock (tapped through deep bore wells) vary considerably depending upon their lithological and structural characteristics. By conducting pumping tests both in dug wells and in bore wells in different litho-units and by analysing the data adopting various methods, it has been concluded that granite gneiss forms the most potential aquifer followed by khondalites. Yield is poor in Gondwana sediments in deeper horizons whereas moderate yield can be obtained in the weathered zone. But the un-consolidated alluvium forms the most prolific aquifer.

Ground Water Exploration

Exploratory drilling has been taken up CGWB in Dhenkanal district with an objective to delineate the nature and degree of connectivity of fractures and their yield potential down to a depth of 200 m. Till March 2011, 25 no. of bore wells have been constructed in the crystalline as wells as semi-consolidated formation in this district under normal and also

accelerated ground water exploration programmes. The depth range of these wells varies from 70 to 200 m and the yield of these wells varies from negligible to 5.9 lps. The yield range of these wells is given as under:

No. of wells	Depth ranges (m)	No. of wells with yield (lps)		
		<2	2 to 5	>5
25	38-202	15	6	4

Depth to Water Level (Pre-monsoon and Post- monsoon), 2011. The depth to water level is measured from the National Hydrograph Stations located in different blocks 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.

Seasonal Fluctuations

The fluctuations in the depth to water level in 2011 shows rise in water level from 1.10 to 7.30 m in all the NHS wells.

Long Term Water Level Trend in last 10 years in Ground Water monitoring Wells

The long-term trend in depth to water level in Dhenkanal district over the last 10 years period shows that i) a rise of 0.03 to 0.30 m in 68% of wells and 0.02 to 0.16 m fall in 32% of wells during the pre-monsoon period and ii) a rise of 0.03 to 0.30 m in 31% of wells and 0.02 to 0.58 m fall in 67% of wells during the post-monsoon period.

Ground Water Resources

The groundwater resources of the district have been assessed adopting the methodology recommended by the Ground Water Estimation Committee (1997), constituted by the Govt. of India. The task was jointly carried out by the Central Ground Water Board and the Ground Water Survey & Investigation, Dept. of Water Resources, Govt. of Orissa. The block wise computation of ground water resources has been presented in the following table. 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 ground water draft for irrigation is through dug wells and shallow tube wells. A large number of hand pumps, fitted in PHED bore wells and tube wells, also cater to the rural and urban

water supply needs. On the basis of the estimated ground water potentials, a detailed scheme for ground water development may be launched in the district. So far, ground water development in the district has been meagre and all the blocks fall under the safe category. 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.

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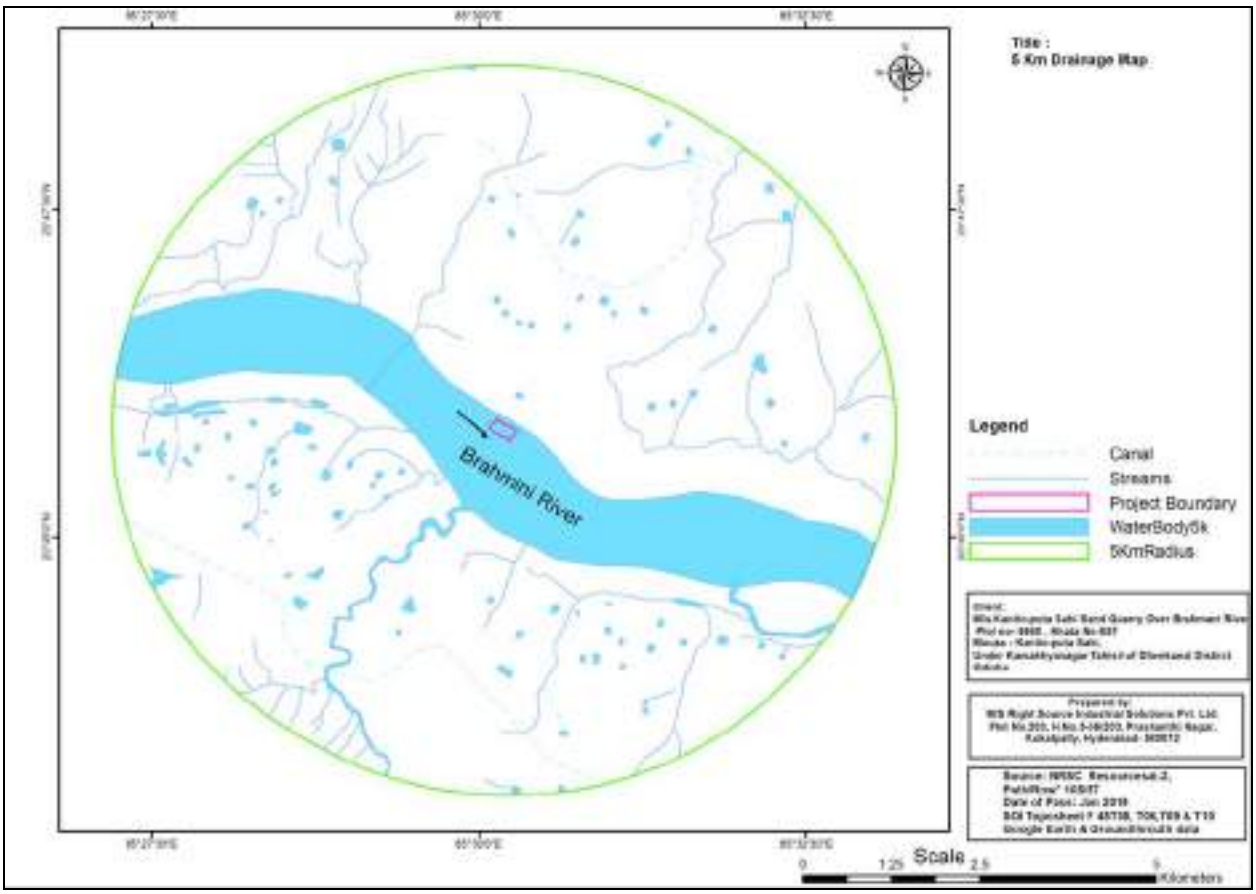


FIGURE 3-6 DRAINGAE MAP

3.7 AIR QUALITY AND METEOROLOGY

Climate

The climate of the area is characterized by a hot and dry summer from March to May, a south-west monsoon or rainy season from June to September, a pleasant post-monsoon or retreating monsoon from October to November and a cool winter from December to February. Therefore, climatologically, four seasons viz. summer (pre-monsoon), monsoon, post-monsoon and winter could be deciphered comprising the following months:

- Summer : March, April, May
- Monsoon : June, July, August, and September
- Post-monsoon : October and November
- Winter : December, January, and February

Air Pollutants upon discharge to atmosphere pass through a number of mechanisms, which include diffusion and transportation leading to dispersion. These mechanisms are governed by the local atmospheric conditions. All these result in the necessity to collect the meteorological parameters like ambient temperature, wind speed, wind direction, and other weather conditions (relative humidity, atmospheric pressure etc.), which will be ultimately used for the prediction of the ground level concentrations of the air pollutants through mathematical modeling.

For this purpose, a temporary auto weather station was installed to record micro meteorological data on wind speed, wind direction, Ambient Temperature, Solar Insulation and Relative Humidity on hourly basis.

The primary data from the site was matched with secondary data of IMD station, for data proofing.

A sophisticated on-site meteorological observatory was established near project site and operated continuously for three months' period (October 2020 to December 2020). The observatory was located about 10 m above the ground level and ensured to be free from any obstruction to wind. Besides, this location was found to be most suitable one being close to the project site. The Wind rose diagram for the entire period is shown in **Figures 3.7.**

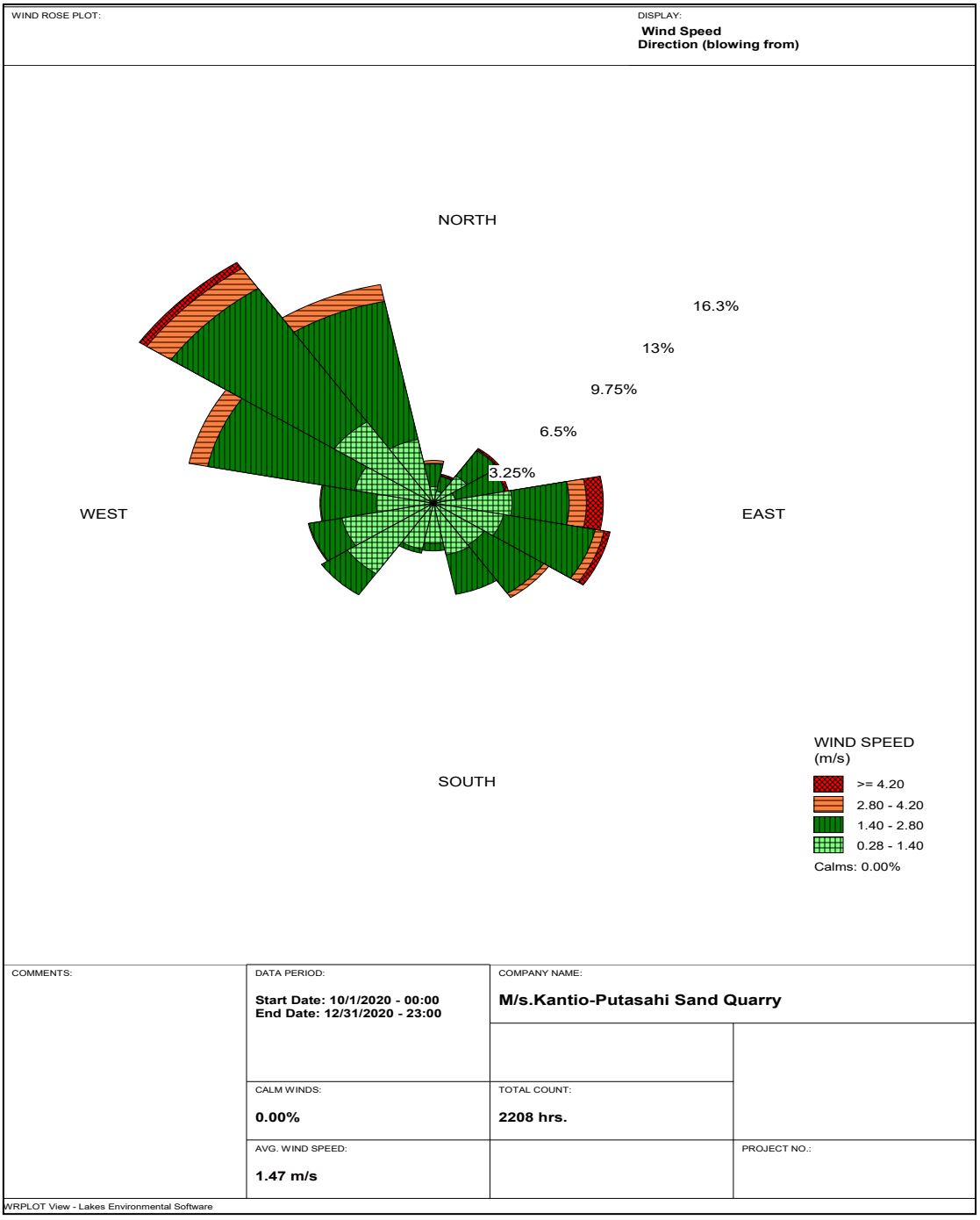


FIGURE 3-7 WIND ROSE (OCTOBER 2020 TO DECEMBER 2020)

Windrose Observations:

First predominant wind is East followed by SE.

3.8 AMBIENT AIR ENVIRONMENT

An assessment of the existing air quality is required to establish the reference level. To accomplish this, Ambient Air Quality Monitoring (AAQM) Stations were set up within 10 km radius of ongoing mining area. Data over baseline status of ambient air quality was generated with following objectives:

- Qualitative analysis of air environment of the area.
- Representation of regional back ground levels
- Influence of existing sources of pollution

The major contributors/sources of air pollution in the area are

- Vehicular traffic
- Windblown Dust

Ambient Air Quality

The ambient air quality monitoring was carried out at 8 locations. The location and descriptions of AAQM stations is shown in **Table 3.7 & Figure 3.8.** The parameters monitored during the study period were Particulate Matters (PM_{10}), Particulate Matter ($PM_{2.5}$),Sulphur dioxide (SO_2) and Oxides of nitrogen (NO_x).The results of AAQM are depicted in the **Table 3.8 to 3.11.**

TABLE 3-7 AMBIENT AIR QUALITY MONITORING LOCATIONS

S.No.	Code	Sampling Locations	Distance
1	A1	Mine Site	-
2	A2	Kantio Putasahi	2.1km N
3	A3	Jogidih	2.3 km ENE
4	A4	Rasasingha	2.0 km S
5	A5	Mahadia	1.8 km SW
6	A6	Tumusingha	3.0 km NW
7	A7	Baulapur	2.6km SE
8	A8	Rainrusinghapur	5.0 km E

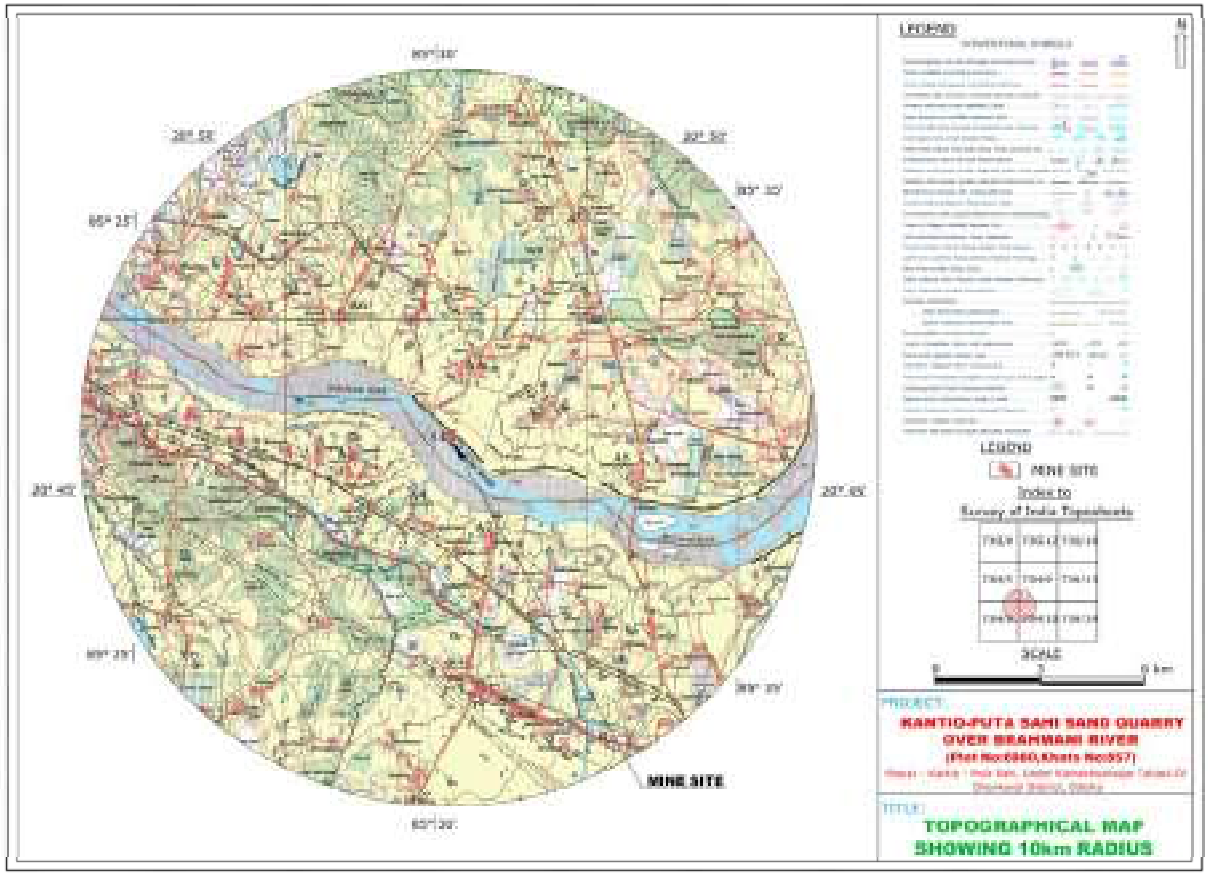


FIGURE 3-8 AMBIENT AIR QUALITY MONITORING LOCATION MAP

TABLE 3-8 PARTICULATE MATTER - PM_{10}

Location Name	Minimum	Maximum	Average	98th Percentile
Mine Site	57.1	63.0	60.8	62.8
Kantio Putasahi	52.7	57.3	55.3	57.2
Jogidih	54.1	58.2	56.1	57.8
Rasasingha	53.0	57.5	54.9	57.0
Mahadia	52.6	57.6	54.4	57.2
Tumusingha	52.2	56.4	55.1	56.4
Baulapur	53.0	56.3	54.8	56.3
Rainrusinghapur	57.3	61.9	59.9	61.8

TABLE 3-9 PARTICULATE MATTER - $PM_{2.5}$

Location Name	Minimum	Maximum	Average	98th Percentile
Mine Site	22.8	25.2	24.3	25.1
Kantio Putasahi	20.7	25.8	23.4	25.7
Jogidih	21.6	23.3	22.5	23.1
Rasasingha	21.2	23.0	22.0	22.8
Mahadia	17.4	22.5	20.1	22.4
Tumusingha	20.9	22.6	22.0	22.6
Baulapur	21.2	22.5	21.9	22.5
Rainrusinghapur	21.9	27.0	24.6	26.9

TABLE 3-10 SULPHUR DIOXIDE - SO_2

Location Name	Minimum	Maximum	Average	98th Percentile
Mine Site	12.7	14.0	13.5	14.0
Kantio Putasahi	16.2	21.7	19.0	21.6
Jogidih	12.0	12.9	12.5	12.9
Rasasingha	11.8	12.8	12.2	12.7
Mahadia	15.1	20.6	17.9	20.5
Tumusingha	11.6	12.5	12.3	12.5
Baulapur	11.8	12.5	12.2	12.5
Rainrusinghapur	17.8	23.3	20.6	23.2

TABLE 3-11 OXIDES OF NITROGEN – NO_X

Location Name	Minimum	Maximum	Average	98th Percentile
Mine Site	20.1	21.4	20.9	21.4
Kantio Putasahi	18.3	24.0	21.2	23.9
Jogidih	19.4	20.3	19.9	20.3
Rasasingha	19.2	20.2	19.6	20.1
Mahadia	17.4	23.1	20.3	23.0
Tumusingha	19.0	19.9	19.7	19.9
Baulapur	19.2	19.9	19.6	19.9
Rainrusinghapur	21.3	27.0	24.2	26.9

Conclusion

The analysis of ambient air quality data for three months consequently indicates excellent ambient air conditions at site as well as around the site upstream as well as downstream. Particulate matter PM_{10} as well as $PM_{2.5}$ is within limits prescribed. SO_2 and NO_x levels are well below the limits prescribed hence overall picture as far as ambient air is concerned is positive.

BASELINE SCENARIO

a) Particulate Matter (PM_{10})

Suspended particulate matter in general terms is the particulate matter in suspension in ambient air. It includes dust, smoke etc. In general, some of the important sources of suspended particulate matter are mines. The following sources of suspended particulate matter in the study area are identified:

- ✓ Emission due to vehicular movement
- ✓ Dust generation from ground or other mining operations

Particulate matter (PM_{10}) monitored in the study area showed 98th percentile values in the range of 53.8-62.8µg/m^3. Highest value of 62.8µg/m^3 was recorded at mine site.

The 24-hourly average values of PM_{10} were compared with the National Ambient Air Quality Standards (NAAQS) and found that all sampling stations recorded in the study area are within the applicable limits i.e., 100 µg/m^3 for SPM in rural areas.

b) Sulfur Dioxide (SO_2)

Sulfur dioxide gas is an inorganic gaseous pollutant. Sulfur dioxide emissions are expected to be emitted wherever combustion of any fuel containing sulfur takes place. The sulfur in the fuel will combine with oxygen to form sulfur dioxide. The following sources of sulfur dioxide in the study area are identified:

- ✓ Emissions from domestic/consumption of fuel (coal, diesel, etc.)
- ✓ Emissions from Machinery equipment's used for mining activity and local residents

Sulfur dioxide in atmosphere is significant because of its toxicity; sulfur dioxide is capable of producing illness and lung injury. Further it can combine with water (moisture) in the air to form toxic acid aerosols that can corrode metal surfaces, fabrics and the leaves of plants. Sulfur dioxide is an irritant to the eyes and respiratory system. Excessive exposure to sulfur

dioxide can cause bronchial asthma and other breathing related diseases as it affects the lungs.

98th percentile values of Sulphur dioxide in the study area were in the range of 12.5-23.2µg/m^3. Maximum value of Sulphur dioxide 23.2µg/m^3 recorded at Project site.

The 24-hourly average values of SO_2 were compared with the National Ambient Air Quality Standards (NAAQS) and it was found that all sampling stations recorded values are below the applicable limits 80 µg/m^3 for rural areas.

c) Oxides of Nitrogen (NO_x)

The important sources of oxides of Nitrogen are from utilities and auto exhaust due to vehicular movement in mine lease area. The following sources of oxides of nitrogen in the study area are identified.

- ✓ Emissions from field burning of coal.
- ✓ Emissions from vehicular movements in the study area.

Oxides of Nitrogen in the presence of sunlight will undergo reactions with a number of organic compounds to produce all the effects associated with photochemical smog. NO_X has inherent ability to produce deleterious effects by themselves like toxicity. It causes asphyxiation when its concentration is great enough to reduce the normal oxygen supply from the air.

98th percentile value of Nitrogen dioxide in the study area was in the range of 19.9 - 26.9µg/m^3. Maximum value of Nitrogen dioxide, was found 26.9µg/m^3 at the Ondagudem.

The 24-hourly average values of NO_x were compared with the National Ambient Air Quality Standards (NAAQS) and it was found that all sampling stations recorded values are below the applicable limits 80 µg/m^3 for rural areas.

3.9 NOISE ENVIRONMENT

Noise survey has been conducted in the study area covering residential transportation commercial and calm zones. The main objective of noise monitoring in the study area is to establish the baseline noise level, which is needed for assessing impact of total noise which is expected to be generated in the proposed project activities. Noise is measured in terms of loudness of the sound. Sound is a form of energy that propagates through an elastic

medium at a speed that is determined by the properties of that medium. Since loudness of sound is important to the effects of noise on people, dependence of loudness upon frequency must be taken into account in environmental noise assessments. Several methods have been developed by researchers using the frequency spectrum of sound arrive at the loudness index or the given sound. For measuring the intensity of the sound "Sound level meter" is used which gives intensity of sound in terms of dB (A).

The basic step associated with impact assessment on the noise components of the environment involves identification and evaluation of the present noise status on the general population. Therefore noise level measurement was carried out at each ambient air quality station and also at site. The objectives of Noise environment studies are:

- To assess the ambient noise level in the study area.
- To characterize the noise pollution area.
- To predict the temporal changes in the ambient noise level of the area.

Noise pollution in the study area is associated with the Industrial activities, Vehicular traffic. To judge the ambient noise level of the area, noise levels were recorded at 4 locations in dB (A). The details of location are given in **Table 3.12** and **Figure 3.9.** Monitoring results of the Noise level recorded at 8 locations is given in **Table 3.13.**

TABLE 3-12 LOCATION OF NOISE MONITORING STATIONS

S.No	Code	Location
1	N1	Mine Site
2	N2	Kantio Putasahi
3	N3	Jogidih
4	N4	Rasasingha
5	N5	Mahadia
6	N6	Tumusingha
7	N7	Baulapur
8	N8	Rainrusinghapur

TABLE 3-13 NOISE LEVELS DURING STUDY PERIOD

Code	Location	Equivalent Noise Levels dB(A)	
		Day Equivalent (Ld)	Night Equivalent (Ln)
N1	Mine Site	50.4	40.8
N2	Kantio Putasahi	55.3	41.2
N3	Jogidih	50.5	38.9
N4	Rasasingha	51.1	35.7
N5	Mahadia	53.0	34.1
N6	Tumusingha	51.1	35.7
N7	Baulapur	50.3	36.2
N8	Rainrusinghapur	58.0	44.0

It is observed that the noise values obtained were within the prescribed Ambient Air Quality Standards with respect to Noise.

AMBIENT NOISE STANDARDS

Ministry of Environment Forests & Climate Change (MoEF&CC) has notified the noise standards vide gazette notification dated February 14, 2000 for different zones under the Environment Protection Act (1986). These standards are given in **Table 3.14.**

TABLE 3-14 NOISE STANDARDS IN RESPECT OF DIFFERENT ZONES

Area Code	Category of Area	Noise dB (A) L_{eq}	
		Daytime*	Night time*
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note:

1. *Daytime is from 6.00am to 10.00 pm and Nighttime is from 10.00 pm to 6.00 am.*
2. *Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicle hours, loud speakers and bursting of crackers are banned in these zones*

NOISE LEVEL RESULTS

The noise monitoring within the study area was recorded using sound level meter (Model No: SL 4030). Noise readings were taken at 8 different locations in the study area.

Conclusion

The values of noise observed in some of the areas are primarily owing to vehicular traffic and other anthropogenic activities. Noise monitoring reveals that the Minimum & minimum noise levels at day time were recorded as 50.3 dB(A) &58.0 dB(A) respectively. The minimum and maximum noise levels at night time were found to be 34.1 dB(A) & 44.0 dB(A) respectively It is observed that the noise levels are well within the prescribed Ambient Air Quality Standards with respect to Noise.

3.10 WATER ENVIRONMENT

WATER QUALITY

Surface water and groundwater samples were collected from different sources within the study area and some important physical and chemical parameters were considered for depicting the baseline status of the study area.

WATER QUALITY ASSESSMENT

Selected water quality parameters for water resource of the study area have been used for describing the water environment and assessing the impacts. About 4 ground water samples were collected in the study area to assess the water quality. Water samples are drawn from the hand pumps being used by the villagers for domestic needs.

GROUND WATER MONITORING METHODOLOGY

To evaluate the physico-chemical characteristics of the water resources existing in the study area, water samples of ground water sources were collected during the post-monsoon season and characterized for physico-chemical parameters. There samples were taken as grab sample and were analyzed for various parameters and compared with standards IS: 10500. The locations of water sampling stations have been shown in **Table 3.15**

TABLE 3-15 GROUND WATER SAMPLING LOCATIONS IN THE STUDY AREA

S.No	Code	Location	Source
1	GW1	Kantio Putasahi	Bore well Water
2	GW2	Jogidih	
3	GW3	Rasasingha	
4	GW4	Mahadia	
5	GW5	Tumusingha	
6	GW6	Baulapur	
7	GW7	Rainrusinghapur	
8	GW8	Ragadisahi	

The quality of ground water was studied by collecting 8 water samples from representative hand pump and tanks. The physico-chemical characteristics of ground water samples presented in **Table 3.16.**

Table 3.16 GROUNDWATER QUALITY IN THE STUDY AREA

S. No	Parameter	Method	Unit	Kantio Putasahi	Jogidih	Rasasingha	Mahadia	IS 10,500 Limits	
								Acceptable	Permissible
1	pH	APHA 23rd Edition 4500 H+ B	--	7.21	7.44	7.22	7.93	6.5-8.5	No Relaxation
2	Color	APHA 23rd Edition 2120 B	CU	<1.0	< 1.0	< 1.0	<1.0	5	15
3	Total Dissolved Solids	APHA 23rd Edition 2540 C	mg/l	795.0	565.8	675.0	575.0	500	2000
4	Total Alkalinity (as CaCO3)	APHA 23rd Edition 2320 B	mg/l	300.0	280	270.0	240	200	600
5	Total Hardness (as CaCO3)	APHA 23rd Edition 2340 C	mg/l	425.0	280	305.0	235	200	600
6	Calcium (as Ca)	APHA 23rd Edition 3500 Ca B	mg/l	125.06	50.24	80.02	58.0	75	200
7	Magnesium (as Mg)	APHA 23rd Edition 3500-Mg B	mg/l	25.40	36.45	25.0	21.73	30	100
8	Sulphate (as SO4)	APHA 23rd Edition 4500 SO4 D	mg/l	32.6	24.64	80.0	37.34	200	400
9	Chloride (as Cl)	APHA 23rd Edition 4500 Cl- C	mg/l	170.5	94.76	121.9	126.9	250	1000
10	Lead as Pb	APHA 23rd Edition 3111B	mg/l	< 0.001	< 0.001	< 0.001	< 0.001	0.01	No Relaxation
11	Cadmium as Cd	APHA 23rd Edition 3111B	mg/l	<0.001	< 0.001	< 0.001	< 0.001	0.003	No Relaxation
12	Total Chromium as Cr	APHA 23rd Edition 3111B	mg/l	<0.05	< 0.05	< 0.05	< 0.05	0.05	No Relaxation
13	Copper as Cu	APHA 23rd Edition 3111B	mg/l	< 0.01	< 0.01	< 0.01	< 0.01	0.05	1.5
14	Zinc as Zn	APHA 23rd Edition 3111B	mg/l	< 0.5	< 0.5	< 0.5	< 0.5	5	15
15	Nickel as Ni	APHA 23rd Edition 3111B	mg/l	<0.01	< 0.01	< 0.01	< 0.01	0.02	No Relaxation
16	Fluorides as F	APHA 23rd Edition 4500 F- D	mg/l	<0.5	<0.5	1.0	1.1	1	1.5
17	Aluminium as Al	APHA 23rd Edition 3500 Al B	mg/l	<0.03	< 0.03	< 0.03	< 0.03	0.03	0.2
18	Boron as B	APHA 23rd Edition 4500 B B	mg/l	<0.2	<0.2	<0.2	<0.2	0.5	1
19	Manganese as Mn	APHA 23rd Edition 3111B	mg/l	<0.02	<0.02	<0.02	< 0.02	0.1	0.3
20	Iron as Fe	APHA 23rd Edition 3500 Fe B	mg/l	<0.05	< 0.05	< 0.05	< 0.05	0.3	No Relaxation
21	Nitrate Nitrogen	APHA 23rd Edition 4500 NO3 B	mg/l	5.8	5.12	4.41	5.6	45	No Relaxation
22	Sodium as Na	APHA 23rd Edition 3500 Na B	mg/l	154.5	82.14	118.0	112.0	--	--
23	Potassium as K	APHA 23rd Edition 3500 K B	mg/l	10.5	< 5.0	8.0	< 5.0	--	--
24	Odour	APHA 23rd Edition 2150 B	--	Agreeable	Agreeable	Agreeable	Agreeable	--	--
25	Electrical Conductivity	APHA 23rd Edition 2510 B	µmho/ cm	1230.0	855	1010.0	870.0	--	--
26	Phosphorus as P	APHA 23rd Edition 4500 P C	mg/l	1.25	<0.1	0.55	0.52	--	--

Table 3.16 GROUNDWATER QUALITY IN THE STUDY AREA

S. No	Parameter	Method	Unit	Tumusingha	Baulapur	Rainrusinghapur	Ragadisahi	IS 10,500 Limits	
								Acceptable	Permissible
1	pH	APHA 23rd Edition 4500 H+ B	--	7.54	7.28	7.41	7.23	6.5-8.5	No Relaxation
2	Color	APHA 23rd Edition 2120 B	CU	< 1.0	< 1.0	<1.0	<1.0	5	15
3	Total Dissolved Solids	APHA 23rd Edition 2540 C	mg/l	690.0	640.0	590.0	465.0	500	2000
4	Total Alkalinity (as CaCO3)	APHA 23rd Edition 2320 B	mg/l	410.0	415.0	310.0	290.0	200	600
5	Total Hardness (as CaCO3)	APHA 23rd Edition 2340 C	mg/l	430.0	440.0	325.0	300.0	200	600
6	Calcium (as Ca)	APHA 23rd Edition 3500 Ca B	mg/l	95.6	105.04	92.18	70.14	75	200
7	Magnesium (as Mg)	APHA 23rd Edition 3500-Mg B	mg/l	45.20	41.0	21.87	27.94	30	100
8	Sulphate (as SO4)	APHA 23rd Edition 4500 SO4 D	mg/l	45.6	40.0	32.14	28.45	200	400
9	Chloride (as Cl)	APHA 23rd Edition 4500 Cl- C	mg/l	80.29	54.0	72.9	62.99	250	1000
10	Lead as Pb	APHA 23rd Edition 3111B	mg/l	< 0.001	<0.001	< 0.001	<0.001	0.01	No Relaxation
11	Cadmium as Cd	APHA 23rd Edition 3111B	mg/l	<0.001	<0.001	<0.001	<0.001	0.003	No Relaxation
12	Total Chromium as Cr	APHA 23rd Edition 3111B	mg/l	<0.05	<0.05	<0.05	<0.05	0.05	No Relaxation
13	Copper as Cu	APHA 23rd Edition 3111B	mg/l	< 0.01	<0.01	< 0.01	<0.01	0.05	1.5
14	Zinc as Zn	APHA 23rd Edition 3111B	mg/l	< 0.5	<0.5	< 0.5	<0.5	5	15
15	Nickel as Ni	APHA 23rd Edition 3111B	mg/l	<0.01	<0.01	<0.01	<0.01	0.02	No Relaxation
16	Fluorides as F	APHA 23rd Edition 4500 F- D	mg/l	0.36	0.80	0.36	0.33	1	1.5
17	Aluminium as Al	APHA 23rd Edition 3500 Al B	mg/l	<0.03	<0.03	<0.03	<0.03	0.03	0.2
18	Boron as B	APHA 23rd Edition 4500 B B	mg/l	<0.2	<0.2	<0.2	<0.2	0.5	1
19	Manganese as Mn	APHA 23rd Edition 3111B	mg/l	<0.02	<0.02	<0.02	<0.02	0.1	0.3
20	Iron as Fe	APHA 23rd Edition 3500 Fe B	mg/l	< 0.05	< 0.05	< 0.05	< 0.05	0.3	No Relaxation
21	Nitrate Nitrogen	APHA 23rd Edition 4500 NO3 B	mg/l	5.6	4.8	5.2	6.0	45	No Relaxation
22	Sodium as Na	APHA 23rd Edition 3500 Na B	mg/l	72.0	46.0	68.0	58.2	--	--
23	Potassium as K	APHA 23rd Edition 3500 K B	mg/l	< 5.0	6.0	< 5.0	<5.0	--	--
24	Odour	APHA 23rd Edition 2150 B	--	Agreeable	Agreeable	Agreeable	Agreeable	--	--
25	Electrical Conductivity	APHA 23rd Edition 2510 B	µmho/ cm	1110.0	1050.5	920.0	755.0	--	--
26	Phosphorus as P	APHA 23rd Edition 4500 P C	mg/l	0.12	0.17	0.11	0.15	--	--

Observation of Ground Water

Ground water samples collected from four locations within 10 km radius of the proposed site showed all parameters well within the drinking water standards specified in IS 10500. So, all sites of water are suitable for drinking purposes.

SURFACE WATER

The collected surface water samples were analyzed and results of surface water analysis are given in Table 3.17.

- ✓ **Physical Parameters**
  - **Colour:** The colour of surface water samples was found in the range of 2 Hazen unit to 3 Hazen unit.
  - **Odour:** Surface water samples were found odourless.
  - **Turbidity:** The turbidity of surface water samples was found in the range 2.1 to 2.8 NTU.
  - **pH:** The pH value of all surface water samples ranges from 7.63 to 7.78.
  - **Electrical Conductivity:** Electrical conductivity in surface water samples ranges from 242 µS/cm to 280 µS/cm.
  - **Total Dissolved Solids (TDS):** The TDS in surface water samples range from 129 to 151 mg/l.
- ✓ **Chemical Parameters**
  - **Total Alkalinity:** The total alkalinity of surface water samples range between 50mg/l to 60 mg/l.
  - **Total Hardness:** The total hardness of surface water samples range between 60 mg/l to 70 mg/l.
  - **Calcium:** The Calcium content in surface water samples range from 17 mg/l to 20 mg/l.
  - **Magnesium:** The Magnesium content in surface water samples range from 4.2 mg/l to 5.1 mg/l.
  - **Chloride:** The chloride content in surface water samples range from 39 mg/l to 45 mg/l.
  - **Sulphate:** Sulphate content in surface water sample ranges from 8 to 9 mg/l.

- **Nitrate:** Nitrate content in surface water samples ranges from 1 mg/l to 3 mg/l.
- **Iron as Fe:** The iron content in all surface water sample ranges from 0.08 to 0.12 mg/l.
- **Manganese as Mn:** The Manganese content in all surface water sample were BDL(<0.02 mg/l).
- **Fluoride as F:** Fluoride content in surface water samples ranges from 0.26 mg/l to 0.31 mg/l.
- **Sodium:** Sodium content in surface water samples ranges from 24 mg/l to 29 mg/l.
- **Potassium:** Potassium content in surface water samples ranges from 1.6 mg/l to 2.7 mg/l.
- **Zinc:** Zinc content in all surface water samples found to be 0.09 mg/l to 0.16 mg/l.
- **Chemical Oxygen Demand (COD):** The COD level of the SW samples found to be in the range between 8 mg/l to 11 mg/l.
- **Dissolved Oxygen (DO):** The DO level of the SW samples found to be in the range between 6.9 mg/l to 7.1 mg/l.
- **Bio-chemical Oxygen Demand (BOD):** The BOD level of the SW samples found to be <2.0 mg/l.

✓ **Biological Parameters**

- **Total Coliform Count:** Total Coliform Count in surface water samples ranges from 33 to 60 MPN/ 100ml.
- **Coli:** E. Coli in surface water samples ranges from 4 to 8 MPN/ 100ml.

✓ **Other Parameters :**Aluminum, Selenium, Phenolic Compounds, PCBs, PAH, Mineral oil, Pesticides and Cadmium, Mercury, Nickel, Total Arsenic, Total Chromium, Selenium, Cyanide in all surface water samples were found below detection limit (BDL).

The results of surface water samples were compared to CLASS – C category. Analysed parameters meet permissible limits.

TABLE 3-17 RESULTS FOR SURFACE WATER ANALYSIS

S.No	Parameters	Unit	Test method	SW1 Brahamani River (Kateni -Upstream)	SW2 Brahamani River (Kotagara Downstream)	SW3 Brahamani River (Project Site)
1	Colour	Hazen	IS 3025 Part 4	2	3	2
2	Odour	-	IS 3025 Part 8	No Odour Observed	No Odour Observed	No Odour Observed
3	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2017)	2.5	2.1	2.8
4	pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff:2017)	7.74	7.63	7.78
5	Electrical Conductivity,	µS/cm	IS : 3025 Part 10-1984 (Reaff: 2012)	242	262	280
6	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2017)	129	135	151
7	Total Hardness as $CaCO_3$	mg/l	IS : 3025 Part 21-2009 (Reaff: 2019)	60	66	70
8	Total Alkalinity as $CaCO_3$	mg/l	IS : 3025 Part 23- 1986(Reaff:2019)	50	54	60
9	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2019)	39	43	45
10	Sulphate as SO_4	mg/l	APHA 23rd EDN -4500- SO42- E	8	8	9
11	Fluoride as F	mg/l	APHA 23rd EDN -4500-F B&D	0.26	0.31	0.29
12	Nitrate as NO_3	mg/l	APHA 23rd EDN -4500- NO3- B	1	3	2
13	Ammonia as NH_3	mg/l	APHA 23rd EDN -4500- NH3 B&C	0.05	0.09	0.10
14	Phosphate as PO_4	mg/l	IS : 3025 Part 31-1988 (Reaff:2019)	0.01	0.02	0.04
15	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2019)	24	26	29
16	Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2019)	1.6	2.2	2.7
17	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2019)	17	18	20
18	Magnesium as Mg	mg/l	APHA 23rd EDN 3500 Mg B	4.2	5.1	4.8
19	Iron as Fe	mg/l	APHA 23rd EDN -3111 B	0.10	0.12	0.08
20	Manganese as Mn	mg/l	APHA 22nd EDN -3111 B	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)
21	Phenolic compounds as Phenol	mg/l	APHA 22nd EDN 5530 B,C	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
22	Copper as Cu	mg/l	APHA 23rd EDN -3111 B	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)

23	Mercury as Hg	mg/l	APHA 23rd EDN -3112B	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
24	Cadmium as Cd	mg/l	APHA 23rd EDN -3111 B	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)
25	Selenium as Se	mg/l	APHA 23rd EDN -3113B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
26	Total Arsenic as As	mg/l	APHA 23rd EDN -3113 B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
27	Cyanide as CN	mg/l	APHA 23rd EDN -4500-CN E	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)
28	Lead as Pb	mg/l	APHA 23rd EDN -3111 B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
29	Zinc as Zn	mg/l	APHA 23rd EDN -3111 B	0.09	0.11	0.16
30	Total Chromium as Cr	mg/l	APHA 23rd EDN -3111 B	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
31	Nickel as Ni	mg/l	APHA 23rd EDN -3111 B	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)
32	Aluminum as Al	mg/l	APHA 23rd EDN -3500-Al-B	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
33	Total Suspended Solids	mg/l	IS : 3025 Part 17-1984 (Reaff: 2019)	7	5	5
34	Anionic Surfactants as MBAS	mg/l	APHA 23rd EDN -5540 C	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)
35	Dissolved Oxygen as O_2	mg/l	IS:3025:Part-38:1989 (Reaff:2019)	7.1	6.9	7
36	Chemical Oxygen Demand	mg/l	IS:3025:Part-58:2006 (Reaff:2019)	10	11	8
37	Bio-Chemical Oxygen Demand at 27°C for 3 days	mg/l	IS:3025:Part-44:1993 (Reaff:2019)	<2	<2	<2
38	Oil and Grease	mg/l	IS:3025:Part-39:1991 -Reaff:2019)	<1	<1	<1
39	Total Coliforms	MPN/100ml	IS: 1622 -1981 (Reaff – 2014)	33	60	60
40	E coli	MPN/100ml	IS: 1622-1981(Reaff – 2014)	4	8	6

3.11 LAND ENVIRONMENT (SOIL CHARACTERISTICS)

The present study on soil quality establishes the baseline characteristics in the study area surrounding the mining lease area. The study has been addressed with the following objectives.

- To determine the base line characteristics.
- To determine the soil characteristics of proposed project site.
- To determine the impact of industrialization/urbanization on soil characteristics.
- To determine the impacts on soils from agricultural productive point of view.

Soil samples were collected from 6 locations to assess the existing soil conditions representing various land use conditions and geological features and each these locations were identified randomly from where soil was collected from 30 cm below the surface. The samples were collected, labeled in the field with number and site name and sent to laboratory for analysis. The soil sampling locations are given in **Table 3.18**

TABLE 3-18 SOIL SAMPLING LOCATIONS IN THE STUDY AREA

S.No	Code	Location
1	S1	Project site
2	S2	Kantio-Putasahi
3	S3	Jogidih
4	S4	Rasasingha
5	S5	Mahadia
6	S6	Tumusingha

Soil analysis was carried out and the results are given in Table 3.19

TABLE 3-19 SOIL ANALYSIS RESULTS

S.No	Parameters	S1 Project site	S2 Kantio-Putasahi	S3 Jogidih	S4 Rasasingha	S5 Mahadia	S6 Tumusingha
1	pH (1:5 Soil Suspension)	7.52	7.68	7.23	7.56	7.82	7.41
2	Bulk Density, g/cc	1.36	1.34	1.47	1.51	1.39	1.45
3	Moisture Content, %	3.66	4.17	2.68	3.02	2.78	2.54
4	Electrical conductivity, mS/cm (1:5 Soil Suspension)	0.073	0.104	0.056	0.063	0.125	0.084
5	Total Nitrogen as N, kg/ha	278	251	214	207	341	284
6	Available Phosphorous as P, kg/ha	29.4	23.6	15.6	18	25.3	17.2
7	Available Potassium as K , kg/ha	281	312	214	198	242	274
8	Exchangeable Calcium as Ca, m.eq/100g	11.4	12	8.71	9.23	10.7	8.62
9	Exchangeable Magnesium as Mg, m.eq/100g	3.22	2.84	2.61	2.44	3.01	2.19
10	Exchangeable Sodium as Na, m.eq/100g	1.14	1.51	0.84	0.96	1.41	1.12
11	Organic matter (%)	1.04	0.75	0.61	0.78	1.11	0.92
12	Organic Carbon as C, %	0.60	0.43	0.35	0.45	0.64	0.53
13	Texture Classification	Loam	Loam	Sandy Loam	Sandy Loam	Loam	Sandy Loam
14	Sand (%)	45.2	43.6	65.8	60.1	40.4	62.4
15	Clay (%)	14.2	16	7.68	7.1	17.3	8.5
16	Silt (%)	40.6	40.4	26.52	32.8	42.3	29.1

BDL - Below Detection Limit; DL – Detection Limit

3.11.1 OBSERVATION

- The pH values ranging from 7.23 to 7.82 indicating the moderate and ideal of plant growth properties.
- The texture of the soil sample is predominantly Sandy Loam in most of the places with Loam in some locations. The sand, silt and clay properties were found to be in the range of 40.4% to 65.8%, 26.52% to 42.3% and 7.1% to 17.3%.
- The conductivity of the soil ranges from 0.056 mS/cm to 0.125 mS/cm.
- The moisture content in the study locations ranged from 2.54% to 4.17%.
- The available nitrogen content ranges between 207 kg/Ha to 341 kg/Ha in the locality and the value of phosphorus content varies between 15.6 kg/Ha to 29.4 kg/Ha. This indicates that the soil has very high quantities of Nitrogen and Phosphorus.
- The potassium content varies from 198 kg/Ha to 312 kg/Ha, which indicates that the soils have medium levels of potassium.
- The organic carbon properties of the soil was found to be in the range of 0.35% to 0.64% and Organic Matter was found to be in the range of 0.61% to 1.11%.

From the above observations, it was found that the soil in the Study area shows moderate fertility and ideal for plant growth.

3.12 ECOLOGY AND BIODIVERSITY

An ecological survey of the study area was conducted particularly with reference to the existing biological resources in the study area. Ecological studies are one of the important aspects of Environmental Impact Assessment with a view to conserve environmental quality and biodiversity. Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprise of both plant and animal communities, which interact not only within and between themselves but also with the abiotic components viz. physical and chemical components of the environment.

Generally, biological communities are good indicators of climatic and edaphic factors. Studies on biological aspects of ecosystems are important in Environmental Impact

Assessment for safety of natural flora and fauna. The biological environment includes terrestrial and aquatic ecosystems.

The animal and plant communities co-exist in a well-organized manner. Their natural settings can get disturbed by any externally induced anthropological activities or by naturally occurring calamities or disaster. So, once this setting is disturbed, it sometimes is either practically impossible or may take a longer time to come back to its original state. Hence changes in the status of flora and fauna are an elementary requirement of Environmental Impact Assessment studies, in view of the need for conservation of environmental quality and biodiversity. Information on flora and fauna was collected within the study area. Relevant details on aquatic life within the study area were collected from related government offices.

3.12.1 OBJECTIVES OF ECOLOGICAL STUDIES

The objective of the present study was undertaken with a view to understand the present ecosystem on the following lines:

- To collect the baseline data for the study along with a description of the existing terrestrial, wetland and aquatic biodiversity.
- To assess the scheduled species in the proposed site (rare, endangered, critically endangered, endemic and vulnerable).
- To identify the locations and features of ecological significance
- To identify the impacts of proposed project before, after and during development

3.12.2 METHODOLOGY ADOPTED FOR THE STUDY

To achieve above objectives a detailed study of the area was undertaken in 10 km radius area with the proposed project site as its centre. The different methods adopted were as follows;

- Compilation of secondary data with respect to the study area from published literature and government agencies;
- Generation of first hand data by undertaking systematic ecological studies in the area;
- Interrogating local people so as to elicit information for local plants, animals and their uses

The present report gives the review of published secondary data and the results of field sampling conducted during December 2020.

3.12.3 TERRESTRIAL ECOLOGY

3.12.3.1 Study area

As per Champion & Seth Classification, Odisha state has 18 forest types belonging to four forest type groups, viz. Tropical Dry Deciduous Forests (Group 5), Tropical Moist Deciduous Forests (Group 3), Tropical Semi Evergreen Forests (Group 2) and Littoral & Swamp Forests (Group 4). Major forests are found mainly in the districts of Gajpati, Khandamal, Sambalpur and Deogarh. A total of 50,347 km^2 forest cover recorded in the State which is about 32.33% of the total state's geographical area.

Among the total forest area, most of the forest area in the district comes under Moderately Dense Forest category (1,350 km^2) followed by open forest and very dense forest.5 The ecological surveys were carried out based on various secondary sources (Forest Department Data, Scientific Studies etc.) which further validated from various primary surveys including consultation with local people. The biological studies were carried out in two zones: core zone (Within Project Area) and buffer zone (10 km surrounding the core area). As per the revised classification of Champion and Seth, the most of the area falls within the study area comes under Tropical Dry Deciduous forest.

3.12.3.2 Forest blocks in study area

The details of forest blocks in study area are presented below in the Table 3.18. Small plantations agro forestry) could also be seen in the buffer zone of the project (*Leucaena leucocephala, Eucalyptus globulus, Tectona grandis*).

TABLE 3-16 DETAILS OF THE FOREST BLOCKS IN THE STUDY AREA

S.No	Details of forest blocks	Distance (Km)	Direction
1	Nadlipal RF	9.5	NW
2	Sundarakol RF	9.5	NE
3	Anlabereni RF	9	NE
4	Sunajhgar RF	9	NE
5	Machhia RF	8	NE
6	Mahargadi RF	6.5	SW
7	Mahargadi RF	5	SW
8	Mahargadi RF	4.3	SW

3.12.4 CROPPING PATTERN

The agriculture is dependent on the moderate monsoon. Irrigation facilities in form of canals/ponds/wells 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 3.19.

TABLE 3-17 AREA UNDER MAJOR FIELD CROP & HORTICULTURE IN DHENKANAL DISTRICT

S.No.	Particulars
Major field crop cultivated	
1	Paddy
2	Horse gram
3	Green gram
4	Black gram
5	Groundnut
6	Mustard
Horticulture crops – fruits	
1	Mango
2	Citrus
3	Cashew
4	Coconut
5	Banana
Horticulture crops - Vegetables	
1	Potato
2	Onion
3	Sweet potato
4	Vegetables
Medicinal and Aromatic crops	
1	Garlic
2	Turmeric
3	Ginger
4	Coriander
Plantation crops	
1	Eucalyptus
2	Teak

3.12.5 METHODOLOGY

3.12.5.1 Flora

A comprehensive list of the plant species of the study area was made based on the plant species collected during winter season by the survey teams. The species were further separated in to trees and shrubs (perennials), herbaceous species, medicinal and aquatic plants. These plants were identified with the help of Flora of Orissa (Saxena and Brahman

1994), Flora of the presidency of the Madras (Gamble and Fischer 1915-1936), and eFloras (2014). For the purpose of calculation of Importance Value Index (IVI), quadrat sampling and line intercept methods were used for estimation of frequency, density and cover. For determination of frequency and density of herbaceous species, a nested quadrat of 1 m x 1 m was used. A total of 20 quadrats from each sampling locations (Table 3) were taken at random. However, for calculating the frequency and density of different shrubs, 20 quadrats of 5m x 5 m were used. For determination of the frequency and density of different trees 20 quadrats of 20m x 20m were taken. Density was calculated as the number per m^2 in case of herbaceous plants and as number per hectare in case of trees and tree like plants.

The IVI values were calculated as the sum of relative frequency, relative density and relative dominance (dominance was based on cover). Frequency, density, abundance, IVI values and the indices of diversity of the plant species in the study area including the area of submergence were determined basing on standard ecological methods (Curtis and Mc Intosh, 1950) widely used in phytosociology as outlined hereunder:

$$\text{Frequency} = \frac{\text{Total number of quadrats in which a species occur}}{\text{Total number of quadrats studied}} \times 100$$

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

$$\text{Abundance} = \frac{\text{Total number of individuals of the species occurring}}{\text{Total number of quadrats in which the species occur}}$$

$$\text{Relative frequency (RF)} = \frac{\text{Frequency of one species}}{\text{Sum of all frequencies}} \times 100$$

$$\text{Relative density (RD)} = \frac{\text{Number of individuals of a species}}{\text{Total number of individuals of all species}} \times 100$$

$$\text{Relative dominance (RDom)} = \frac{\text{Combined basal area of a single species}}{\text{Total basal area of all species}} \times 100$$

Importance Value Index (IVI) = RF + RD + RDom

Based on the IVI values, Shannon –Wiener Indices of Diversity and Simpson Index of dominance were calculated by using a computer progamme called "PAST". The data collected were also used to compute community indices like species diversity (H') of different tree species was calculated by using the Shannon- Weiner Index (Shannon and Weiner, 1963), as such:

$H' = -\Sigma (ni/N)/ n (ni/N)$,

Where, ni/N, which denotes the importance probability of each species in a population, ni= Importance of value of species and N is the total number of individuals of all species in that vegetation type. Species dominance (Cd) was calculated following Simpson (Simpson, 1949): Such that

$Cd = \Sigma (ni/N)^2$,

Where, ni and N are the same as those for Shannon-Weiner information function.

TABLE 3-18 TERRESTRIAL AND AQUATIC SAMPLING LOCATIONS

S.No.	Location	Latitude	Longitude
Terrestrial Ecology			
1	Talberna	20 45 54.12	85 24 38.52
2	Kankeli RF	20 42 15.36	85 25 19.45
3	Barbank South RF	20 39 51.41	85 26 17.29
4	Chheliabedha	20 46 04.54	85 24 34.49
5	Budhipahad	20 46 19.24	85 21 32.31
6	Niumidha RF	20 45 05.06	85 20 46.36
Aquatic Ecology			
1	Mine site	20 48 15.06	85 22 43.80
2	Brahmani River Upstream	20 48 20.16	85 22 36.27
3	Brahmani River downstream	20 48 00.34	85 24 32.41

3.12.5.2 Fauna

A linear transect of 1 km each was chosen for sampling at each site. Each transect was trekked for 1.5 hr for the sampling of faunal diversity through following methods for

different categories. For the sampling of butterflies, the standard 'Pollard walk' method was employed and all the species that could not be identified in the field were collected using a butterfly net besides photographing them.

For bird's sampling 'point sampling' along the fixed transect (foot trails) was carried out. All the species of birds were observed through a binocular and identified with the help of field guide book and photographs.

For the sampling of mammals, direct count on open width (20m) transect was used. In addition, information on recent sightings/records of mammals by the villagers/locals was also collected. For carnivores, indirect sampling was carried out and the mammals wee identified by foot marks, faeces and other marks/sign created by them. In case of reptiles mainly lizards were sampled by direct count on open width transects.

The study of fauna takes substantial amount of time to understand the specific faunal characteristics of area. The assessment of fauna has been done by extensive field survey of the area. During survey, the presence of wildlife was also inhabitants depending on animal sightings and frequency of their visits in the project area which was later confirmed from forest department, Wildlife department etc.

3.12.6 OBSERVATIONS

Flora

The core zone of the study area is mine lease area. As the core area is river bed which comprised *Saccharum officinarum* and some aquatic annuals. The species which are observed nearby lease area are *Ammania baccifera*, *Ludwigia perennis*, *Cyperus iria*, *Cyperus rotundus*, *Calotropis gigantea*, *Ageratum conyzoides*, *Cleome viscosa* and *Scirpus* sps. There are no tree species in the mine lease area.

The structure and composition of vegetation in the buffer zone was studied by visual observations during the site visit. The buffer zone of 10km radius area composed hilly area, Deciduous Sal forests, Plain agriculture fields, barren lands, plantations and human habitation. No parks and sanctuaries exist within 10 km of the lease area.

The vegetation found in the study area varies from hilly to plain area. In the hilly region, vegetation is generally observed in the hill top and foot hill. The species observed in the hilly area are *Shorea robusta*, *Anogeissus latifolia*, *Bauhinia racemosa*, *Schleichera oleosa* etc.

The main agricultural crops in the study area are Rice, Maize, Vegetables, Mango and Cashew plantations. The tree species are observed along the agriculture and human habitations are *Mangifera indica*, *Anacardium occidentale*, *Delonix regia*, *Anogeissus acuminata*, *Thespesia populnea* etc. The shrubs and herbs species are observed in the study area are *Chromolaena odrata*, *Lantana camara*, *Combretum ovalifolium*, *Hyptis sauveolens*, *Randia dumetorum*, *Sida acuta*, *Justicia procumbens*, *Borreria hispida* etc. A detailed list of floral species observed in the buffer zone is given in Table 3.19.

TABLE 3-19 FLORA OBSERVED IN THE STUDY AREA

S.No.	Scientific name	Family	Vernacular name	Habit
1	*Abrus precatorius*	Fabaceae		Climber
2	*Abutilon indicum*	Malvaceae		Shrub
3	*Acacia ferruginea*	Mimosaceae	Garkari	Tree
4	*Acacia leucophloea*	Mimosaceae	Gohira	Tree
5	*Acacia nilotica*	Mimosaceae	Babul	Tree
6	*Acacia sinuata*	Mimosaceae	Dantari	Climber
7	*Acalypha indica*	Euphorbiaceae		Herb
8	*Acanthospermum hispidum*	Asteraceae		Herb
9	*Achyranthes aspera*	Amaranthaceae		Herb
10	*Achyranthes porphyristachya*	Amaranthaceae		Herb
11	*Aeginetia indica*	Orobanchaceae		Herb
12	*Aegle marmelos*	Rutaceae	Bel	Tree
13	*Aerva lanata*	Amaranthaceae		Herb
14	*Aganosma caryophyllata*	Apocyanaceae	Malati	Climber
15	*Ageratum conyzoides*	Asteraceae	Pokesunga	Herb
16	*Ailanthus excelsa*	Simarubaceae	Mahalimb, hahal	Tree
17	*Alangium salvifolium*	Alangiaceae	Ankulo	Tree
18	*Albizia chinensis*	Mimosaceae	Gharalanjia	Tree
19	*Albizia lebbeck*	Mimosaceae	Siris	Tree
20	*Albizia odoratissima*	Mimosaceae		Tree
21	*Allmania nodiflora*	Amaranthaceae		Herb
22	*Alloteropsis cimicina*	Poaceae		Grass
23	*Alternanthera sessilis*	Amaranthaceae		Herb
24	*Alysicarpus monilifera*	Fabaceae		Herb
25	*Ammania baccifera*	Lythraceae		Herb
26	*Andrographis paniculata*	Acanthaceae	Bhuineen(Chireita)	Herb
27	*Anisochilus carnosus*	Lamiaceae		Herb

28	*Anisomeles indica*	Lamiaceae		Herb
29	*Annona squamosa*	Annonaceae	Ata	Shrub
30	*Anogeissus acuminata*	Combretaceae	Phasi	Tree
31	*Anogeissus latifolia*	Combretaceae	Dhaura	Tree
32	*Anthocephalus chinensis*	Rubiaceae	Kadamba	Tree
33	*Antidesma acidum*	Euphorbiaceae	Mamuri	Tree
34	*Aphanamixis polystachya*	Meliaceae	Panikusum	Tree
35	*Apluda mutica*	Poaceae		Grass
36	*Ardisia solanacea*	Myrsinaceae	Narasingh Khara	Shrub
37	*Argemone mexicana*	Papaveraceae	Sarpuni	Herb
38	*Argyreia nervosa*	Convolvulaceae		Climber
39	*Argyreia setosa*	Convolvulaceae	Baghchaar	Climber
40	*Aristida funiculata*	Poaceae		Grass
41	*Aristida setacea*	Poaceae		Grass
42	*Aristolochia indica*	Aristolochiaceae		Herb
43	*Artocarpus heterophyllus*	Moraceae	Panasa	Tree
44	*Artocarpus lacucha*	Moraceae	Jeutha	Tree
45	*Arundinella khasiana*	Poaceae		Grass
46	*Arundo donax*	Poaceae		Grass
47	*Arundo sectosa*	Poaceae		Grass
48	*Asparagus racemosus*	Liliaceae	Satabari	Climber
49	*Asystasia gangetica*	Acanthaceae		Herb
50	*Atalantia monophylla*	Rutaceae	Narguni	Shrub
51	*Atylosia scaraboides*	Fabaceae	Banakolthi	Herb
52	*Azadirachta indica*	Meliaceae	Neem	Tree
53	*Bambusa arundinacea*	Poaceae	Kanta bans	Shrub
54	*Barringtonia acutangula*	Barringtoniaceae	Hinjal	Tree
55	*Bauhinia racemosa*	Caesalpiniaceae		Tree
56	*Bauhinia vahlii*	Caesalpiniaceae	Siall	Climber
57	*Biophytum sensitivum*	Oxalidaceae		Herb
58	*Blepharis maderospatensis*	Acanthaceae		Shrub
59	*Boerhavia diffusa*	Nyctaginaceae		Herb
60	*Bombax ceiba*	Bomabacaceae	Simili	Tree
61	*Borreria hispida*	Rubiaceae		Herb
62	*Boswellia serrata*	Burseraceae	Salai	Tree
63	*Brachiaria ramosa*	Poaceae		Grass
64	*Breynia vitis-idea*	Euphorbiaceae		Shrub
65	*Bridelia retusa*	Euphorbiaceae		Tree
66	*Bridelia squamosa*	Euphorbiaceae	Kasi	Tree

67	*Buchanania lanzan*	Anacardiaceae	Char	Tree
68	*Bulbostylis barbata*	Cyperaceae		Sedge
69	*Bursera serrata*	Burseraceae	Nimburumoi	Tree
70	*Butea monosperma*	Leguminosae	Palas	Tree
71	*Butea superba*	Papilionaceae	Budli	Climber
72	*Crotalaria pallida*	Fabaceae	Jhunjhuka	Herb
73	*Calamus rotang*	Palmaceae	Kanta bet	Climber
74	*Calamus viminalis*	Palmaceae	pani bet	Climber
75	*Calotropis gigantea*	Asclepiadaceae	Arrkha	Shrub
76	*Calycopteris floribunda*	Combretaceae	Khukundia	Climber
77	*Canavalia gladiata*	Papilionaceae	Maharata	Climber
78	*Canscora decussata*	Gentianaceae	Kalmegh	Herb
79	*Canthium dicoccum*	Rubiaceae	Dalsingha	Shrub
80	*Canthium parviflorum*	Rubiaceae		Shrub
81	*Capparis zeylanica*	Capparidaceae	Asadhua	Climber
82	*Cardiospermum halicacabum*	Sapindaceae		Climber
83	*Careya arborea*	Lecythidaceae	Kumbhi	Tree
84	*Carissa carandas*	Apocynaceae		Shrub
85	*Carissa spinarum*	Apocynaceae	Ankhukoli	Shrub
86	*Caryota urens*	Arecaceae	Salapa	Tree
87	*Casearia elliptica*	Flacourtiaceae	Khakada	Tree
88	*Cassia auriculata*	Caesalpiniaceae		Shrub
89	*Cassia fistula*	Caesalpiniaceae	Sunari	Tree
90	*Cassia florida*	Caeasalpiniaceae	Chakunda	Tree
91	*Cassia obtusifolia*	Caesalpiniaceae	Bhul Chakunda	Herb
92	*Cassia occidentalis*	Caesalpiniaceae		Herb
93	*Cassine glauca*	Verbenaceae	Chauli	Tree
94	*Catunaregam malabarica*	Rubiaceae	Phiriko	Shrub
95	*Catunaregam nutans*	Rubiaceae	Salara	Tree
96	*Catunaregam uliginosa*	Rubiaceae	Tolko	Shrub
97	*Cayratia auriculata*	Vitaceae		Climber
98	*Ceiba pentandra*	Bomabacaceae		Tree
99	*Celastrus paniculatus*	Celastraceae	Pingo, Pengu	Climber
100	*Celosia argentea*	Amaranthaceae		Herb
101	*Centella asiatica*	Apiaceae	Brahmi buti	Herb
102	*Cephalostachyum pergracile*	Poaceae	Bolongi bans	Tree
103	*Chloris barbata*	Poaceae		Grass
104	*Chloroxylon swietenia*	Flindersiaceae	Bheru	Tree

105	*Chromolaena odorata*	Asteraceae		Shrub
106	*Chrysopogon grylius*	Poaceae		Grass
107	*Cipadessa baccifera*	Meliaceae	Nalbali	Shrub
108	*Cissampelos pareira*	Menispermaceae	Akanbindu	Climber
109	*Cleistanthus collinus*	Euphorbiaceae	Karia	Tree
110	*Cleome gynandra*	Cleomaceae		Herb
111	*Cleome viscosa*	Cleomaceae		Herb
112	*Clerodendrum serratum*	Verbenaceae		Shrub
113	*Clerodendrum viscosum*	Verbenaceae	Kumti	Shrub
114	*Clitorea ternatea*	Fabaceae		Climber
115	*Coccinia grandis*	Cucurbitaceae		Climber
116	*Cocculus hirsutus*	Menispermaceae		Climber
117	*Cochlospermum religiosum*	Cochlospermaceae	Genduli	Tree
118	*Combretum roxburghii*	Combretaceae	Atundi	Climber
119	*Commelina benghalensis*	Commelinaceae		Herb
120	*Corchorus acutangulus*	Tiliaceae		Herb
121	*Costus speciosus*	Costaceae		Herb
122	*Crateva religiosa*	Capparidaceae	Baurna	Tree
123	*Crotalaria laburnifolia*	Fabaceae		Herb
124	*Crotalaria verrucosa*	Fabaceae		Herb
125	*Croton bonplandianum*	Euphorbiaceae		Herb
126	*Cryptolepis buchanani*	Asclepiadaceae	Gopkan	Climber
127	*Curcuma sulcata*	Zingiberaceae		Herb
128	*Cyanotis cristata*	Commelinaceae		Herb
129	*Cycas circinalis*	Cycadaceae	Urguna	Shrub
130	*Cymbopogon martinii*	Poaceae	Dhanwantary	Grass
131	*Cynodon dactylon*	Poaceae	Duba	Grass
132	*Cyperus compressus*	Cyperaceae		Sedge
133	*Cyperus rotandus*	Cyperaceae		Sedge
134	*Dactyloctenium aegyptium*	Poaceae		Grass
135	*Dalbergia latifolia*	Leguminosae	Sissu	Tree
136	*Dalbergia paniculata*	Leguminosae	Barbakulia	Tree
137	*Datura metal*	Solanaceae		Herb
138	*Dendrocalamus strictus*	Poaceae	Salia	Tree
139	*Dendronbium aphyllum*	Orchidaceae		Herb
140	*Denrophthoe falcata*	Loranthaceae		Tree
141	*Pongamia paniculata*	Leguminosae	Karanja	Tree
142	*Desmodium gangeticum*	Fabaceae		Herb
143	*Desmodium triflorum*	Fabaceae		Herb

144	*Dicanthium annulatum*	Poaceae		Grass
145	*Digera muricata*	Amaranthaceae		Herb
146	*Dillenia aurea*	Dilleniaceae	Chotarai	Tree
147	*Dillenia pentagyna*	Dilleniaceae	Ral	Tree
148	*Dioscorea alata*	Dioscoreaceae	Khamba Alu	Climber
149	*Dioscorea anguina*	Dioscoreaceae	Kossa Alu	Climber
150	*Dioscorea belophylla*	Dioscoreaceae	Kanta Alu	Climber
151	*Dioscorea bulbifera*	Dioscoreaceae	Pata Alu	Climber
152	*Dioscorea oppositifolia*	Dioscoreaceae	Pani Alu	Climber
153	*Dioscorea pentaphylla*	Dioscoreaceae	Karba Alu	Climber
154	*Dioscorea tomentosa*	Dioscoreaceae	Bana Alu	Climber
155	*Diospyros chloroxylon*	Ebenaceae	Karakendu	Tree
156	*Diospyros ferrea*	Ebenaceae	Guakuli	Shrub
157	*Diospyros malabarica*	Ebenaceae	Makharkendu	Tree
158	*Diospyros melanoxylon*	Ebenaceae	Kendu	Tree
159	*Diospyros montana*	Ebenaceae	Halda	Tree
160	*Diospyros sylvatica*	Ebenaceae	Kauchia	Tree
161	*Diptrocanthus prostratus*	Acanthaceae		Herb
162	*Drimia indica*	Hyacynthaceae		Herb
163	*Drypetes roxburghii*	Euphorbiaceae	Poichandia	Tree
164	*Eclipta prostrata*	Asteraceae		Herb
165	*Ehretia laevis*	Boraginaceae	Dambalu	Tree
166	*Elephantopus scaber*	Asteraceae		Herb
167	*Emilia sonchifolia*	Asteraceae		Herb
168	*Entada pursaetha*	Mimosaceae	Nato	Climber
169	*Eragrostis coarctata*	Poaceae		Grass
170	*Eranthemum purpurascens*	Acanthaceae		Shrub
171	*Erythrina variegata*	Leguminosae	Paldhua	Tree
172	*Eucalyptus globulus*	Myrtaceae	Eucalyptus(patas)	Tree
173	*Eulaliopsis binata*	Poaceae	Panasi	Grass
174	*Euphorbia antiquorum*	Euphorbiaceae		Herb
175	*Euphorbia hirta*	Euphorbiaceae		Herb
176	*Euphorbia nivulia*	Euphorbiaceae	Kantasidhu	Shrub
177	*Euphorbia royleana*	Euphorbiaceae	Sijhu	Tree
178	*Evovlulus alsinoides*	Convolvulaceae		Herb
179	*Evovlulus nummularius*	Convolvulaceae		Herb
180	*Flemingia paniculata*	Papilionaceae		Shrub
181	*Flemingia strobilifera*	Papilionaceae		Shrub
182	*Ficus benghalensis*	Moraceae	Bara	Tree

183	*Ficus hispida*	Moraceae	Tambal	Tree
184	*Ficus lutescens*	Moraceae	Jari	Tree
185	*Ficus parasitica*	Moraceae	Kaskasi Jhari	Shrub
186	*Ficus racemosa*	Moraceae	Dimiri	Tree
187	*Ficus religiosa*	Moraceae	Aswasth	Tree
188	*Ficus semicordata*	Moraceae	Purhai	Tree
189	*Ficus virens*	Moraceae	Kuajari	Tree
190	*Fimbristylis cymosa*	Cyperaceae		Sedge
191	*Fioria vitifolia*	Malvaceae	Banachanda	Shrub
192	*Firmiana colorata*	Sterculiaceae	Panikodala	Tree
193	*Flacourtia indica*	Flacourtiaceae	Baincha	Shrub
194	*Gardenia gummifera*	Rubiaceae	Gurudu	Tree
195	*Gardenia latifolia*	Rubiaceae	Damgurudu	Tree
196	*Gardenia turgida*	Rubiaceae	Karadha	Tree
197	*Garuga pinnata*	Burseraceae	Patimoi	Tree
198	*Gisekia pharnaceodis*	Aizoaceae		Herb
199	*Glochidion lanceolarium*	Euphorbiaceae	Chikni (Kalicha)	Tree
200	*Gloriosa superba*	Colchicaceae		Climber
201	*Glycosmis pentaphylla*	Rutaceae	Chauidhua	Tree
202	*Gmelina arborea*	Verbenaceae	Gambhari	Tree
203	*Gouania tiliaefolia*	Rhamnaceae	pichhuli	Climber
204	*Grevillea robusta*	Proteaceae	Silveroak	Tree
205	*Grewia elastica*	Tiliaceae	Mirigachara	Tree
206	*Grewia rothii*	Tiliaceae		Shrub
207	*Grewia tiliaefolia*	Tiliaceae	Dhaman	Tree
208	*Gymnema sylvestre*	Asclepiadaceae	Gulmari	Climber
209	*Gynura lycopersifolia*	Asteraceae		Herb
210	*Haldina cordifolia*	Rubiaceae	Kurum	Tree
211	*Hedyotis corymbosa*	Rubiaceae		Herb
212	*Helicteres isora*	Sterculiaceae	Muraphal Murimuri	Shrub
213	*Hemidesmus indicus*	Asclepiadaceae	Anantamula	Climber
214	*Heteropogon contortus*	Poaceae	Sinkula Guguchhia	Grass
215	*Hiptage benghalensis*	Melpighiaceae	Latanageshwar	Climber
216	*Holarrhena antidysenterica*	Apocynaceae	Korei	Shrub
217	*Holoptelia integrifolia*	Ulmaceae	Dhauranjo	Tree
218	*Homalium nepalense*	Samydaceae	Khakaa	Tree
219	*Hybanthus ennaespermus*	Violaceae		Herb
220	*Hymenodictyon excelsum*	Rubiaceae	Kanso	Tree
221	*Hyptis suaveolens*	Lamiaceae	Gongatulashi	Herb

222	*Ichnocarpus frutescens*	Apocynaceae	Suam Noi	Climber
223	*Imperata arundinacea*	Poaceae	Chhana	Grass
224	*Imperata cylindrica*	Poaceae		Grass
225	*Indigofera cassioides*	Papilionaceae	Gillira	Shrub
226	*Indigofera trita*	Papilionaceae		Herb
227	*Ipomoea hederifolia*	Convolvulaceae		Herb
228	*Ipomoea obscura*	Convolvulaceae		Herb
229	*Iseilema prostratum*	Poaceae		Grass
230	*Ixora arborea*	Rubiaceae	Telkuruma	Tree
231	*Ixora pavetta*	Rubiaceae		Shrub
232	*Jatropha gossypifolia*	Euphorbiaceae		Herb
233	*Justicia adhatoda*	Acanthaceae	Basanga	Shrub
234	*Justisia betonica*	Acanthaceae		Herb
235	*Justisia glauca*	Acanthaceae		Herb
236	*Kalanchoe pinnata*	Crassulaceae	Amarpoi	Herb
237	*Kydia calycina*	Malvaceae	Banakopasia	Tree
238	*Kyllinga nemoralis*	Cyperaceae		Sedge
239	*Lagerstroemia parviflora*	Lythraceae	Sidha	Tree
240	*Lagerstroemia speciosa*	Lythraceae	Panipatuli	Tree
241	*Lannea coromandelica*	Anacardiaceae	Mal or Moi	Tree
242	*Lantana camara*	Verbenaceae	Bholupodi	Shrub
243	*Leea asiatica*	Ampelidaceae	Banachiretia	Shrub
244	*Lepidagathis cristata*	Acanthaceae		Herb
245	*Leucas cephalotes*	Lamiaceae		Herb
246	*Leucas montana*	Lamiaceae		Herb
247	*Limonia acidissima*	Rutaceae	Kaitho	Tree
248	*Lindernia anagallis*	Scrophulariaceae		Herb
249	*Lindernia crustacea*	Scrophulariaceae		Herb
250	*Litsea glutinosa*	Lauraceae	Jaisanda	Tree
251	*Loranthus longiflorus*	Loranthaceae	Madanga	Epiphyte
252	*Ludwigia perennis*	Onagraceae		Herb
253	*Macaranga peltata*	Euphoribiaceae	Manda	Tree
254	*Madhuca indica*	Sapotaceae	Mohua, Mohul	Tree
255	*Mallotus philippensis*	Euphorbiaceae	Kamalagundi	Tree
256	*Mangifera indica*	Anacardiaceae	Amba	Tree
257	*Manilkara hexandra*	Sapotaceae	Khirkoli	Shrub
258	*Marsdenia tenacissima*	Asclepiadaceae	Ghaya	Climber
259	*Martynia annua*	Pedlaiaceae		Shrub
260	*Maytenus emarginata*	Celastraceae		Shrub

261	*Melastoma malabathricum*	Melastomataceae	Gangai	Shrub
262	*Melia composita*	Meliaceae	Batra	Tree
263	*Merremia tridentata*	Convolvulaceae		Herb
264	*Merremia umbellata*	Convolvulaceae		Herb
265	*Miliusa tomentosa*	Annonaceae	Patmossu	Tree
266	*Miliusa velutina*	Annonaceae	Gandhapalas	Tree
267	*Millettia exensa*	Papilionaceae	Arkala	Climber
268	*Mimosa pudica*	Mimosaceae	Lajwanti	Herb
269	*Mimosa rubicaulis*	Mimosaceae	Kirkichikanta	Shrub
270	*Mitragyna parvifolia*	Rubiaceae	Mundi (Mitakania)	Tree
271	*Momordica charantia*	Cucurbitaceae		Climber
272	*Morinda pubescens*	Rubiaceae	Anchu	Tree
273	*Moringa oleifera*	Moringaceae	Sajna	Tree
274	*Mucuna pruriens*	Papilionaceae	Baidank	Climber
275	*Mullogo nudicaulis*	Aizoaceae		Herb
276	*Mullogo pentaphylla*	Aizoaceae		Herb
277	*Murraya paniculata*	Rutaceae	Kamini	Shrub
278	*Naringi crenulata*	Rutaceae	Bentha	Tree
279	*Nyctanthes arbor-tristis*	Oleaceae	Gangasiuli	Tree
280	*Ochna obtusata*	Ochnaceae	Patharchampa	Tree
281	*Ocimum tenuflorum*	Labiatae	Tulshi	Shrub
282	*Ocimum basilicum*	Lamiaceae		Herb
283	*Opismenus burmanii*	Poaceae		Grass
284	*Oroxylum indicum*	Bignoniaceae	Phanphana	Shrub
285	*Osbeckia stellata*	Melastomataceae		Herb
286	*Ougeinia oogeinsis*	Papilionaceae	Bandhan	Tree
287	*Oxalis corniculata*	Oxalidaceae		Herb
288	*Paederia scandens*	Rubiaceae	Prasarini	Climber
289	*Panicum repens*	Poaceae		Grass
290	*Pavetta tomentosa*	Rubiaceae	Kukurchatia	Shrub
291	*Pavonia zeylanica*	Malvaceae		Herb
292	*Pedaluim murex*	Pedaliaceae		Herb
293	*Pentanema indicum*	Asteraceae		Herb
294	*Pergularia daemia*	Asclepiadaceae		Climber
295	*Perotis indica*	Poaceae		Grass
296	*Phoenix acaulis*	Palmae	Bankhajuri	Shrub
297	*Phoenix sylvestris*	Arecaceae		Tree
298	*Phyllanthus emblica*	Euphorbiaceae	Amla	Tree
299	*Phyllanthus niruri*	Euphorbiaceae		Herb

300	*Phyllanthus reticulatus*	Euphorbiaceae		Shrub
301	*Piper longum*	Piperaceae	Pipali	Herb
302	*Pithecolobium dulce*	Mimosaceae		Tree
303	*Plumbago zeylanica*	Plumbaginaceae		Herb
304	*Pogostemon benghalense*	Labiatae	Pokusunga	Shrub
305	*Polyalthia cerasoides*	Annonaceae	Patmossu	Tree
306	*Polycarpea corymbosa*	Caryophyllaceae		Herb
307	*Portulaca oleracea*	Portulacaceae		Herb
308	*Portulaca quadrififda*	Portulacaceae		Herb
309	*Premna hamiltonii*	Verbenaceae		Shrub
310	*Premna tomentosa*	Verbenaceae		Tree
311	*Pseudarthria viscida*	Fabaceae		Herb
312	*Pseudosorghum fasciculare*	Poaceae		Grass
313	*Pterocarpus marsupium*	Fabaceae	Bija	Tree
314	*Pterospermum xylocarpum*	Sterculiaceae	Giringa	Tree
315	*Pueraria tuberosa*	Papilionaceae	Handiphuta	Climber
316	*Rauwolfia serpentina*	Apocynaceae	Pataigaruda	Shrub
317	*Rhynchosia minima*	Fabaceae		Herb
318	*Rothia indica*	Fabaceae		Herb
319	*Ruellia tuberosa*	Acanthaceae		Herb
320	*Saccharum spontaneum*	Poaceae	Tenda	Grass
321	*Sansevieria roxburghiana*	Agavaceae		Herb
322	*Sapindus emarginatus*	Sapindaceae		Tree
323	*Schefflera venulosa*	Araliaceae	Jari	Shrub
324	*Schleichera oleosa*	Sapindaceae	Kusum	Tree
325	*Securinega virosa*	Euphorbiaceae		Shrub
326	*Semecarpus anacardium*	Anacardiaceae	Bhalia	Tree
327	*Shorea robusta*	Dipterocarpaceae	Sal	Tree
328	*Sida acuta*	Malvaceae		Herb
329	*Sida cordifolia*	Malvaceae		Herb
330	*Sida rhombifolia*	Malvaceae		Shrub
331	*Smilax ovalifolia*	Liliaceae	Matri	Climber
332	*Smilax perfoliata*	Liliaceae	Mutri	Climber
333	*Smilax zeylanica*	Liliaceae	Mutri	Climber
334	*Solanum surattense*	Solanaceae	Ankaranti	Herb
335	*Solanum torvum*	Solanaceae		Shrub
336	*Solena amplexicaulis*	Cucurbitaceae	Matka	Climber
337	*Soymida ferbrifuga*	Meliaceae	Rohini	Tree
338	*Sphaeranthus indicus*	Asteraceae		Herb

339	*Spondias pinnata*	Anacardiaceae	Ambada	Tree
340	*Sporobolus indicus*	Poaceae		Grass
341	*Stachytarpeta jamaicensis*	Verbenaceae		Herb
342	*Sterculia urens*	Sterculiaceae	Giridhini	Tree
343	*Sterculia villosa*	Sterculiaceae	Kidaia	Tree
344	*Stereospermum chelonoides*	bignoniaceae	Patuli	Tree
345	*Streblus asper*	Moraceae	Sahara	Tree
346	*Streblus taxioides*	Moraceae	Jhumpuri	Shrub
347	*Strobilanthes scaber*	Acanthaceae	Kakusia	Shrub
348	*Strychnos nux-vomica*	Loganiaceae	Kuchila	Tree
349	*Strychnos potatorum*	Loganiaceae	Kotokol	Tree
350	*Suregada multiflora*	Euphorbiaceae	Khakada	Tree
351	*Symphorema polyandrum*	Verbenaceae	badichang	Shrub
352	*Symplocos racemosa*	Styraceae	Ludha	Tree
353	*Syzygium cuminii*	Myrtaceae	Jambu (Jamun)	Tree
354	*Syzygium operculatum*	Myrtaceae	Paijamu	Tree
355	*Tamarindus indica*	Caesalpiniaceae	Tentuli	Tree
356	*Tarenna asiatica*	Rubiaceae	Jojoka	Shrub
357	*Tectona grandis*	verbenaceae	Saguan	Tree
358	*Tephrosia purpurea*	Fabaceae		Herb
359	*Teramnus labialis*	Fabaceae		Herb
360	*Terminalia alata*	Combretaceae	Asan	Tree
361	*Terminalia arjuna*	Combretaceae	Arjuna	Tree
362	*Terminalia bellirica*	Combretaceae	Bahada	Tree
363	*Terminalia chebula*	Combretaceae	Harida	Tree
364	*Themeda triandra*	Poaceae		Grass
365	*Thysanolaena maxima*	Poaceae	Phulchanchani	Grass
366	*Tiliocora acuminata*	Menispermaceae		Climber
367	*Tragia involucrata*	Euphorbiaceae		Herb
368	*Tragia plukenetii*	Euphorbiaceae	Bichhuati	Climber
369	*Trewia nudiflora*	Euphorbiaceae	Panigrambhari	Tree
370	*Tribulus terrestris*	Zygophyllaceae		Herb
371	*Trichosanthes cucumerina*	Cucurbitaceae	Banakunduri	Climber
372	*Trichosanthes tricuspidata*	Cucurbitaceae	Makiria	Climber
373	*Tridax procumbens*	Asteraceae		Herb
374	*Triumfetta rhomboidea*	Tiliaceae		Herb
375	*Tylophora indica*	Asclepiadaceae		Herb
376	*Typha angustata*	Typhaceae		Herb
377	*Urena lobeta*	Malvaceae		Herb

378	*Vanda tesellata*	Orchidaceae		Herb
379	*Vernonia aspera*	Compositae	Agnijhal	Shrub
380	*Vernonia cinerea*	Asteraceae		Herb
381	*Vitex negundo*	Verbenaceae	Begunia	Shrub
382	*Vitex peduncularis*	Verbenaceae	Charaiguri	Tree
383	*Wendlandia heynei*	Rubiaceae	Tilei	Tree
384	*Wendlandia tinctoria*	Rubiaceae		Tree
385	*Woodfordia fruticosa*	Myrtaceae	Dhatki or Jhatki	Shrub
386	*Wrightia arborea*	Apocynaceae	Pitakarichio	Tree
387	*Wrightia tinctoria*	Apocynaceae		Tree
388	*Xylia xylocarpa*	Mimosaceae	Kongra	Tree
389	*Zingiber purpureum*	Zingiberaceae		Herb
390	*Zizyphus glaberrima*	Rhamnaceae	Ghontol	Tree
391	*Zizyphus mauritiana*	Rhamnaceae	Borkuli	Tree
392	*Zizyphus oenoplia*	Rhamnaceae	Kontaikuli	Climber
393	*Zizyphus xylopyrus*	Rhamnaceae		Tree

Phytosociology of the plants

In buffer area, the present study revealed that the species composition based on IVI in tree species such as *Terminalia alata*, *Shorea robusta*, *Cleistanthus collinus* and *Garuga pinnata* are predominant and dominant species are *Anogeissus latifolia*, *Dalbergia paniculata*, *Chloroxylon swietenia* and Syzygium cumini are dominant species (Table 3.20). In terms of shrubs and lainas, *Cadaba fruticosa, Securinega leucopyrus, Carissa carandas* and *Clerodendrum inerme* are the predominant species and *Catunaregam spinosa, Allophylus serratus, Acacia pennata* and *Ziziphus oenopolia* are dominant species (Table 3.21). In herbaceous vegetation, *Andrographis paniculata, Eclipta prostrata, Phyllanthus amarus* and *Brachiaria ramosa* are predominant plant species and dominant species *Stachytarpeta jamaicansis, Periscaria barbata, Achyranthes aspera* and *Vernonia anthelmintica* (Table 3.22).

TABLE 3-20 IVI OF TREE SPECIES IN THE BUFFER AREA

Species Name	D	F	BA	RD	RF	Rdom	IVI
Terminalia alata	9.5	100	0.26	4.88	2.94	8.76	16.59
Shorea robusta	13.5	100	0.176	6.94	2.94	5.94	15.83
Cleistanthus collinus	11	100	0.18	5.66	2.94	6.07	14.66
Garuga pinnata	11	100	0.16	5.66	2.94	5.39	13.99
Anogeissus latifolia	10.5	100	0.165	5.4	2.94	5.56	13.9

Dalbergia paniculata	9.5	100	0.153	4.88	2.94	5.15	12.98
Syzygium cuminii	9.5	100	0.095	4.88	2.94	3.21	11.04
Chloroxylon swietenia	7.5	100	0.119	3.86	2.94	4	10.8
Bridelia retusa	7.5	100	0.109	3.86	2.94	3.68	10.47
Albizia odoratissima	7.5	100	0.102	3.86	2.94	3.44	10.24
Lannea coromandelica	8	100	0.091	4.11	2.94	3.06	10.12
Buchanania lanzan	7.5	100	0.085	3.86	2.94	2.87	9.669
Diospyros sylvatica	6	100	0.094	3.08	2.94	3.16	9.188
Pterospermum xylocarpum	2.5	50	0.146	1.29	1.47	4.93	7.688
Semecarpus anacardium	5	50	0.084	2.57	1.47	2.85	6.892
Wrightia tinctoria	3.5	100	0.057	1.8	2.94	1.91	6.651
Aegle marmelos	3	100	0.041	1.54	2.94	1.38	5.866
Xylia xylocarpa	3.5	50	0.072	1.8	1.47	2.45	5.716
Alangium salvifolium	4	50	0.064	2.06	1.47	2.16	5.684
Grewia tiliaefolia	4	50	0.055	2.06	1.47	1.85	5.379
Bauhinia racemosa	2	100	0.041	1.03	2.94	1.38	5.352
Mitragyna parvifolia	3.5	50	0.053	1.8	1.47	1.78	5.047
Lagerstroemia parviflora	3	50	0.052	1.54	1.47	1.75	4.764
Mallotus philippensis	3	50	0.052	1.54	1.47	1.75	4.763
Firmiana colorata	1.5	100	0.031	0.77	2.94	1.04	4.752
Polyalthia cerasoides	2	100	0.02	1.03	2.94	0.67	4.642
Schleichera oleosa	4	50	0.028	2.06	1.47	0.95	4.474
Gardenia latifolia	3	50	0.039	1.54	1.47	1.33	4.34
Haldina cordifolia	2	50	0.04	1.03	1.47	1.35	3.85
Dillenia pentagyna	3	50	0.024	1.54	1.47	0.82	3.829
Terminalia chebula	2.5	50	0.024	1.29	1.47	0.82	3.581
Kydia calycina	1.5	50	0.033	0.77	1.47	1.11	3.355
Ficus racemosa	2	50	0.017	1.03	1.47	0.58	3.082
Acacia leucophloea	1	50	0.032	0.51	1.47	1.09	3.07
Phyllanthus emblica	2	50	0.015	1.03	1.47	0.49	2.99
Morinda pubescens	1.5	50	0.02	0.77	1.47	0.67	2.915
Sterculia urens	1.5	50	0.019	0.77	1.47	0.64	2.881
Ficus semicordata	1.5	50	0.016	0.77	1.47	0.56	2.798
Aphanamixis polystachya	1.5	50	0.014	0.77	1.47	0.47	2.71
Pterocarpus marsupium	1	50	0.015	0.51	1.47	0.5	2.489
Ougeinia oogeinensis	1	50	0.013	0.51	1.47	0.43	2.414
Strychnos potatorum	1	50	0.01	0.51	1.47	0.32	2.307
Butea monosperma	1	50	0.008	0.51	1.47	0.26	2.249
Caryota urens	1	50	0.006	0.51	1.47	0.19	2.179

Hymenodictyon excelsum	1	50	0.005	0.51	1.47	0.17	2.158
Diospyros melanoxylon	0.5	50	0.011	0.26	1.47	0.39	2.115
Litsea glutinosa	0.5	50	0.007	0.26	1.47	0.24	1.969
Macaranga peltata	0.5	50	0.005	0.26	1.47	0.17	1.895
Antidesma acidum	0.5	50	0.004	0.26	1.47	0.14	1.869
Miliusa velutina	0.5	50	0.003	0.26	1.47	0.09	1.815
Total	**194.5**	**3400**	**2.965**	**100**	**100**	**100**	**300**

TABLE 3-21 IVI OF SHRUBS AND CLIMBERS IN THE BUFFER AREA

Species Name	D	F	BA	RD	RF	Rdom	IVI
Cadaba fruticosa	14	100	0.204	8.36	4.35	7.91	20.62
Securinega leucopyrus	11	100	0.174	6.57	4.35	6.75	17.66
Carissa carandas	9	100	0.169	5.37	4.35	6.55	16.27
Clerodendrum inerme	8.5	100	0.15	5.07	4.35	5.82	15.25
Catunaregam spinosa	7.5	100	0.142	4.48	4.35	5.49	14.31
Allophylus serratus	7.5	100	0.139	4.48	4.35	5.37	14.2
Acacia pennata	7.5	100	0.129	4.48	4.35	5	13.82
Ziziphus oenopolia	9.5	100	0.073	5.67	4.35	2.82	12.83
Lantana camara	8	100	0.092	4.78	4.35	3.56	12.69
Calotropis gigantea	7	100	0.105	4.18	4.35	4.06	12.59
Olax scandens	6.5	100	0.069	3.88	4.35	2.69	10.92
Cayratia pedata	6.5	50	0.122	3.88	2.17	4.72	10.78
Cardiospermum corindum	6	100	0.065	3.58	4.35	2.52	10.45
Cassia auriculata	6.5	50	0.098	3.88	2.17	3.78	9.837
Cipadessa baccifera	4	100	0.06	2.39	4.35	2.31	9.042
Ventilago maderaspatana	3.5	50	0.104	2.09	2.17	4.04	8.299
Cassia Montana	3.5	100	0.045	2.09	4.35	1.73	8.163
Glycosmis pentaphylla	4.5	50	0.075	2.69	2.17	2.92	7.776
Ehretia laevis	3.5	50	0.085	2.09	2.17	3.29	7.555
Helicters isora	5	50	0.059	2.99	2.17	2.3	7.457
Dodonaea viscosa	5	50	0.058	2.99	2.17	2.24	7.403
Ochna obtusata	3.5	50	0.06	2.09	2.17	2.33	6.59
Eugenia bracteata	3.5	50	0.035	2.09	2.17	1.34	5.605
Hugonia mystax	3	50	0.037	1.79	2.17	1.45	5.418
Jatropha gossypifolia	2	50	0.047	1.19	2.17	1.8	5.17
Canthium coromandelicum	2.5	50	0.038	1.49	2.17	1.48	5.149
Combretum ovalifolium	2.5	50	0.036	1.49	2.17	1.39	5.059
Benkara malabarica	1.5	50	0.043	0.9	2.17	1.66	4.727
Rivea hypocrateriformis	1.5	50	0.029	0.9	2.17	1.13	4.204
Naravelia zeylanica	1.5	50	0.013	0.9	2.17	0.5	3.568

Calotropis procera	1	50	0.014	0.6	2.17	0.54	3.308
Derris scandens	1	50	0.013	0.6	2.17	0.52	3.292
Total	**167.5**	**2300**	**2.581**	**100**	**100**	**100**	**300**

TABLE 3-22 IVI OF HERBACEOUS VEGETATION IN THE BUFFER AREA

Name of the plant	F	D	A	R.F	R.D	R.A	IVI
Andrographis paniculata	38	0.85	2.24	3.46	3.91	2.06	9.44
Eclipta prostrata	38	0.78	2.05	3.46	3.59	1.89	8.94
Phyllanthus amarus	35	0.75	2.14	3.19	3.45	1.98	8.62
Brachiaria ramosa	38	0.65	1.71	3.46	2.99	1.58	8.03
Vernonia anthelmintica	38	0.65	1.71	3.46	2.99	1.58	8.03
Parthenium hysterophorous	21	0.65	3.1	1.91	2.99	2.85	7.76
Achyranthes aspera	31	0.65	2.1	2.82	2.99	1.93	7.75
Cymopogon flexuosus	30	0.65	2.17	2.73	2.99	2	7.72
Alysicarpus monilifer	25	0.65	2.6	2.28	2.99	2.4	7.67
Panicum sumatrense	25	0.65	2.6	2.28	2.99	2.4	7.67
Lepidagathis cristata	28	0.59	2.11	2.55	2.72	1.94	7.21
Brachiaria reptans	27	0.57	2.11	2.46	2.62	1.95	7.03
Cleome chelidonii	21	0.52	2.48	1.91	2.39	2.28	6.59
Eragrostis amabilis	24	0.51	2.13	2.19	2.35	1.96	6.49
Euphorbia hirta	28	0.49	1.75	2.55	2.25	1.61	6.42
Trichodesma indicum	28	0.48	1.71	2.55	2.21	1.58	6.34
Chloris barbata	24	0.48	2	2.19	2.21	1.84	6.24
Triumfetta rhomboidea	26	0.45	1.73	2.37	2.07	1.6	6.04
Hemidesmus indicus	25	0.45	1.8	2.28	2.07	1.66	6.01
Oldenlandia umbellate	19	0.45	2.37	1.73	2.07	2.18	5.99
Cassia tora	21	0.45	2.14	1.91	2.07	1.98	5.96
Hedyotis corymbosa	23	0.42	1.83	2.09	1.93	1.68	5.71
Echinochloa crus-galli	20	0.42	2.1	1.82	1.93	1.94	5.69
Apluda mutica	12	0.36	3	1.09	1.66	2.77	5.52
Indigofera aspalathoides	24	0.38	1.58	2.19	1.75	1.46	5.39
Tridax procumbens	27	0.35	1.3	2.46	1.61	1.2	5.27
Cyperus rotundus	15	0.35	2.33	1.37	1.61	2.15	5.13
Sphaeranthus indicus	15	0.35	2.33	1.37	1.61	2.15	5.13
Zornia gibbosa	15	0.35	2.33	1.37	1.61	2.15	5.13
Acalypha ciliata	21	0.35	1.67	1.91	1.61	1.54	5.06
Dichanthium annulatum	17	0.35	2.06	1.55	1.61	1.9	5.06
Commelina bengalensis	18	0.35	1.94	1.64	1.61	1.79	5.04
Waltheria indica	18	0.34	1.89	1.64	1.56	1.74	4.95
Crotalaria retusa	12	0.31	2.58	1.09	1.43	2.38	4.9

Tribulus terrestris	18	0.32	1.78	1.64	1.47	1.64	4.75
Cynodon dactylon	19	0.31	1.63	1.73	1.43	1.5	4.66
Gomphrena globosa	19	0.31	1.63	1.73	1.43	1.5	4.66
Barleria longiflora	18	0.31	1.72	1.64	1.43	1.59	4.65
Mimosa pudica	12	0.28	2.33	1.09	1.29	2.15	4.53
Corchorus aestuans	15	0.28	1.87	1.37	1.29	1.72	4.38
Dactyloctenium aegyptium	10	0.25	2.5	0.91	1.15	2.31	4.37
Heteropogan contortus	10	0.24	2.4	0.91	1.1	2.21	4.23
Imperata cylindrica	12	0.25	2.08	1.09	1.15	1.92	4.16
Aristida adscensionis	18	0.25	1.39	1.64	1.15	1.28	4.07
Rhynchosia minima	15	0.24	1.6	1.37	1.1	1.48	3.95
Aristolochia indica	12	0.21	1.75	1.09	0.97	1.61	3.67
Vernonia cinerea	17	0.21	1.24	1.55	0.97	1.14	3.65
Cissus quadrangularis	14	0.21	1.5	1.28	0.97	1.38	3.62
Ageratum conyzoides	10	0.19	1.9	0.91	0.87	1.75	3.54
Plumbago zeylanica	12	0.19	1.58	1.09	0.87	1.46	3.43
Sida acuta	8	0.15	1.88	0.73	0.69	1.73	3.15
Boerhavia diffusa	9	0.15	1.67	0.82	0.69	1.54	3.05
Physalis minima	9	0.14	1.56	0.82	0.64	1.43	2.9
Leucas aspera	9	0.12	1.33	0.82	0.55	1.23	2.6
Merremia tridentata	5	0.07	1.4	0.46	0.32	1.29	2.07
Total	**1098**	**21.7**	**108.4**	**100**	**100**	**100**	**300**

3.12.6.1 Biodiversity indices

The value of biodiversity index increases both when the number of types increases and when evenness increases. For a given number of type of species, the value of a biodiversity index is maximised when all type of species are equally abundant. Biodiversity indices values are given in the table 3.23.

TABLE 3-23 BIODIVERSITY INDICES OF THE STUDY AREA

Community	Buffer area	
	Shannon-Wiener Index (H)	**Simpson Diversity Index (1/D)**
Trees	2.69	0.9
Shrubs and climbers	3	0.94
Herbs	3.55	0.96

Faunal observations

As the core area is not isolated from its surroundings by any barrier, there are no chances for any kind of isolation or restriction of any wild animal to the core area or the buffer area.

As they are capable of moving from place to place either for food or shelter or mate. Hence, common lists are prepared based on available secondary data and on the basis of direct observation, indirect or circumstantial evidence such as foot prints, feathers, skin, hair, hooves etc. The area of survey and study extends up to a radius of 10 km in case of terrestrial fauna. As there are no dense forests or wildlife reserves or other protected areas around the mine lease area and as the area is surrounded by croplands and villages. Among the mammals, monkeys, squirrels and rats were found. There were no attacks on sheep or goat though sheep and goat rearing is very common. Many terrestrial birds such as Indian Ring dove, Minnows, Finches, Crows, Sparrows, Parrots, Mynas, Swifts, Doves, Pigeons, Egrets and Weaver birds etc were common. A list of birds either spotted or reported from the study area is given in Table 3.24. None of the species listed in Schedule I of the Indian Wildlife (protection) Act was found in the study area.

TABLE 3-24 CHECKLIST OF FAUNA RECORDED IN THE STUDY AREA

S.No.	Scientific name	Common name	IWPA, 1972
Amphibians			
1	*Bufo melonostrictus*	Common Indian Toad	Schedule IV
2	*Duttaphrynus melanostictus*	Asian common toad	Schedule IV
3	*Microhyla ornata*	Ornate narrow mouth frog	Schedule IV
4	*Polypedates leucomystax*	Common tree frog	Schedule IV
5	*Rana cyanophlyctis*	Indian Skipper Frog	Schedule IV
6	*Rana limnocharis*	Asian grass frog	Schedule IV
7	*Acanthodactylus cantoris*	Indian Fringe-fingered Lizard	Schedule IV
8	*Ahaetulla nasuta*	Common Vine snake	Schedule II
9	*Argyrogena fasciolata*	Banded Racer	Schedule II
10	*Bungarus caeruleus*	Common Krait	Schedule II
11	*Calotes versicolor*	Garden lizard	Schedule IV
12	*Chamaeleon zeylanicus*	Indian Chameleon	Schedule IV
13	Cnemaspis indica	Indian day gecko	Schedule IV
14	*Dryophis nasutus*	Whip Snake	Schedule II
15	*Dryophis pulverulentus*	Tree Snake	Schedule II
16	*Eublepharis macularius*	Common leopard gecko	Schedule IV
17	*Eutropis carinata*	Common keeled skink	Schedule IV
18	*Hemidactylus brookii*	Brook,s House Gecko	Schedule IV
19	*Hemidactylus frenatus*	Asian house gecko	Schedule IV
20	*Hemidactylus prashadi*	Wall lizard	Schedule IV

21	*Ptyas mucosus*	Rat snake	Schedule II
22	*Typholops braminus*	Blind Snake	Schedule II
23	*Varanus bengalensis*	Monitor lizard	Schedule II
Mammals			
24	*Bandicota bangalensis*	Field Rat	Schedule V
25	*Funambulus palmarum*	Three Striped Squirrel	Schedule IV
26	*Golunda*	Indian bush Rat	Schedule IV
27	*Herpestes javanicus*	Small Indian Mongoose	Schedule IV
28	*Herpestes edwardsi*	Common Mongoose	Schedule IV
29	*Macaca mulatta*	Rhesus monkey	Schedule II
30	*Rattus rattus*	House Rat	Schedule IV
31	*Rousettus leschenaulti*	Fruit bat	Schedule V
32	*Suncus murinus*	Musk shrew	Schedule V
33	*Sus scrofa*	Wild Boar	Schedule III
34	*Hyaena hyena*	Indian striped Hyna	Schedule III
35	*Axis axis*	Spotted deer	Schedule III
36	*Gazella bennettii*	Chinkara	Schedule IV
37	*Lepus nigricollis*	Black naped hare	Not listed
Avi fauna			
38	*Acedo atthis*	Common kingfisher	Schedule IV
39	*Acrocephalus dumetorum*		Schedule IV
40	*Actitis hypoleucos*	Common sandpiper	Schedule IV
41	*Actitis macularia*	Spotted sandpiper	Schedule IV
42	*Alcedo atthis*	Small blue kingfisher	Schedule IV
43	*Amandava amandava*	Red munia	Schedule IV
44	*Anthus hodgosoni*	Oriental tree pipit	Schedule IV
45	*Anthus novaeseelandiae*	Paddy field Pipit	Schedule IV
46	*Ardea cinerea*	Grey heron	Schedule IV
47	*Ardeola grayii*	Indian pond Heron	Schedule IV
48	*Aythya ferina*	Common pochard	Schedule IV
49	*Bubulcus ibis*	Cattle egret	Schedule IV
50	*Butorides striatus*	Little green heron	Schedule IV
51	*Caprimulgus asiaticus*	Common Indian nightjar	Schedule IV
52	*Centropus sinensis*	Crow pheasant	Schedule IV
53	Ceryle rudis	Lesser Pied Kingfisher	Schedule IV
54	*Chaetornis striatus*	Bristled grass bird	Schedule IV
55	*Charadrius 14lexandrines*	Kentish plover	Schedule IV
56	*Charadrius dubius*	Little ringed plover	Schedule IV
57	*Chrysomma sinense*	Yellow eyed babbler	Schedule IV

58	*Chloropsis aurifrons*	Green Bulbul	Schedule IV
59	*Clamator jacobinus*	Pied crested cuckoo	Schedule IV
60	*Claridris temminckii*	Temmincks stint	Schedule IV
61	*Columba livia*	Blue rock pigeon	Schedule IV
62	*Copsychus saularis*	Oriental magpie robin	Schedule IV
63	*Coracena melanopetra*	Black headed cuckoo shrike	Schedule IV
64	*Coracias benghalensis*	Blue Jay	Schedule IV
65	*Coracina macei*	Large cuckoo shrike	Schedule IV
66	*Corvus macrorhyncos*	Jungle crow	Schedule IV
67	*Corvus splendens*	House crow	Schedule IV
68	*Cosmerodius albus*	Large egret	Schedule IV
69	*Coturnix coturnix*	Common grey quail	Schedule IV
70	*Cuculus micropterus*	Indian cuckoo	Schedule IV
71	*Culicicapa ceylonensis*	Grey headed flycatcher	Schedule IV
72	*Cyorns tickelliae*	Tickells blue flycatcher	Schedule IV
73	*Cypsiurus parvus*	Palm swift	Schedule IV
74	*Dendrocitta vagabunda*	Indian tree pie	Schedule IV
75	*Dendrocopos mahrattensis*	Yellow fronted pied woodpecker	Schedule IV
76	*Dendrocopos nanus*	Brown capped pigmy woodpecker	Schedule IV
77	*Dicaeum erythrorhynchos*	Blyth's reed warbler	Schedule IV
78	*Dicrurus asimilis*	Black drongo	Schedule IV
79	*Dicrurus paradiseus*	Greater Rocket tailed drongo	Schedule IV
80	*Dinopium benghalense*	Golden backed woodpecker	Schedule IV
81	*Egretta garzeta*	Little egret	Schedule IV
82	*Egretta intermedia*	Intermediate egret	Schedule IV
83	*Eudynamys scolopacea*	Asian koel	Schedule IV
84	*Falco tinnunculus*	Common kestrel	Schedule IV
85	*Francolinus pondicerianaus*	Grey Partridge	Schedule IV
86	*Gallinago gallinago*	Common snipe	Schedule IV
87	*Gallinula chloropus*	Common moorhen	Schedule IV
88	*Halcyon smyrnensis*	White breasted kingfisher	Schedule IV
89	*Hemiprocne coronata*	Crested tree swift	Schedule IV
90	*Himantopus himantopus*	Black winged stilt	Schedule IV
91	*Hippolais caligata*	Booted warbler	Schedule IV
92	*Hirundo daurica*	Striated swallow	Schedule IV
93	*Hirundo rustica*	Common swallow	Schedule IV
94	*Hirundo smithii*	Wire tailed swallow	Schedule IV
95	*Hydrophasianus chirurgus*	Pheasant tailed jacana	Schedule IV

96	*Limosa limosa*	Black tailed godwit	Schedule IV
97	*Lochura striata*	White rumped munia	Schedule IV
98	*Lonchura malabarica*	Silver billed munia	Schedule IV
99	*Lonchura puctulata*	Spotted munia	Schedule IV
100	*Luscinia svecica*	Blue throat	Schedule IV
101	*Megalaima haemocephala*	Copper smith	Schedule IV
102	*Melophus lathami*	Crested bunting	Schedule IV
103	*Merops etanus*	Chestnut headed bee eater	Schedule IV
104	*Merops orientalis*	Small green bee-eater	Schedule IV
105	*Merops persicus*	Blue cheeked bee eater	Schedule IV
106	*Merops philippinus*	Blue tailed bee eater	Schedule IV
107	*Mesophoyx intermedia*	Median egret	Schedule IV
108	*Metopidious indicus*	Bronze winged jacana	Schedule IV
109	*Microternus brachyurus*	Rufous Woodpecker	Schedule IV
110	*Milvus migrans*	Black kite	Schedule IV
111	*Monticola solitarius*	Blue rock thrush	Schedule IV
112	*Motacilla alba linnaeus*	White wagtail	Schedule IV
113	*Motacilla cinerea tunstall*	Grey wagtail	Schedule IV
114	*Motacilla flava linnaeus*	Yellow wagtail	Schedule IV
115	*Motacilla maderaspatensis*	White browed wagtail	Schedule IV
116	*Nectarinia asiatica*	Purple sunbird	Schedule IV
117	*Nectarinia lotenia*	Long billed sunbird	Schedule IV
118	*Nectarinia zeylonica*	Purple rumped sunbird	Schedule IV
119	*Numenius arquata*	Eurasian curlew	Schedule IV
120	*Nyticorax nyticorax*	Night heron	Schedule IV
121	*Orthotomus sutorius*	Common tailorbird	Schedule IV
122	*Parus major*	Great tit	Schedule IV
123	*Passer domesticus*	House sparrow	Schedule IV
124	*Pelargopsis capensis*	Spot billed kingfisher	Schedule IV
125	*Pericrocotus erythropygius*	White bellied minivet	Schedule IV
126	*Petronia xanthocollis*	Yellow throated sparrow	Schedule IV
127	*Pitta bracyura*	Indian pitta	Schedule IV
128	*Ploceus philippinus*	Baya weaver	Schedule IV
129	*Prinia hodgsonii*	Franklins prinia	Schedule IV
130	*Prinia inornata*	Plain prinia	Schedule IV
131	*Prinia socialis*	Ashy prinia	Schedule IV
132	*Psittacula krameri*	Rose ringed parakeet	Schedule IV
133	*Pycnonotus cafer*	Red vented bulbul	Schedule IV
134	*Rhipidura aureola lesson*	White browed fantail fly catcher	Schedule IV

135	*Rhodonesa rufina*	Red crested pochard	Schedule IV
136	*Rostratula benghalensis*	Greater painted snipe	Schedule IV
137	*Saxicola caprata*	Pied bush chat	Schedule IV
138	*Saxicola torquata*	Common stonechat	Schedule IV
139	*Saxicoloides fulicata*	Indian robin	Schedule IV
140	*Sterna acuticauda*	Black bellied tern	Schedule IV
141	*Streptopelia chinensis*	Spotted dove	Schedule IV
142	Streptopelia decaocto	Indian Ring dove	Schedule IV
143	*Sturnus contra*	Asian pied myna	Schedule IV
144	*Sturnus pagodarum*	Brahminy starling	Schedule IV
145	*Sylvia curruca*	Lesser white throat	Schedule IV
146	*Tachybaptus ruficollis*	Little grebe	Schedule IV
147	*Tephrodornis pondicerianus*	Common wood shrike	Schedule IV
148	*Tringa glareola*	Wood sandpiper	Schedule IV
149	*Tringa ochropus*	Green sandpiper	Schedule IV
150	*Tringa stagnatilis*	Marsh sandpiper	Schedule IV
151	*Turdoides caudatus*	Common babbler	Schedule IV
152	*Turdoides malcolmi*	Large grey babbler	Schedule IV
153	*Turdoides striatus*	Jungle babbler	Schedule IV
154	*Turnix suscitator*	Common buttonquail	Schedule IV
155	*Upupa epops*	Hoopoe	Schedule IV
156	*Vanellus malabaricus*	Yellow wattled lapwing	Schedule IV
157	*Zosterops palpebrosus*	Oriental white eye	Schedule IV

3.12.7 AQUATIC ECOLOGY

Aquatic life is an integral component of stream and rivers which are not only the best sources of food and animal protein for the human population but also provides base for ecosystem functioning. The impact of pollution on aquatic ecosystem manifests itself first on the biotic aquatic communities. The species composition of aquatic organisms in natural communities is directly influenced by ambient water quality. The responses of plants to pollutants, when measured quantitatively give an insight about the conditions of existing aquatic ecosystem.

3.12.8 METHODOLOGY

3.12.8.1 Phytoplankton

Few horizontal hauls were made to collect plankton samples using plankton nets with a mesh size of 50µm and 120 µm. Samples were immediately transported to the laboratory

and preserved using 40% formalin. After thoroughly shaking the concentrate sample, an aliquote sub-sample (1 ml), was transferred on to a microscopic slide examined. On an average, five such replicates were taken and the results computed for 1 ml of the concentrated sediment samples and identified using Edmondson (1959), Anand (1988).

3.12.8.2 Zooplankton

For the qualitative and quantitative analysis of zooplankton, an aliquote sub sample (2 ml) was taken from the concentrated sample, after thoroughly shaking and ensuring uniform distribution of the plankton, were qualitatively enumerated. Five such enumerations were made and averages calculated for 1 ml of each sample (Battish 1992).

3.12.8.3 Aquatic flora

The core area is in part of River Brahmani and there are several small village tanks on all sides within the 10 Km buffer zone. Most tanks were either totally or partially dry during the period of survey. The present survey is confined to fresh water environment only. Apart from the River and the tanks, the aquatic environment is also represented by paddy fields and a few stagnant water ponds. In addition to these village tanks, drains, and paddy fields provide the aquatic habitat for a variety of very common aquatic plants and animals. All the aquatic plant species listed in Table 3.25 is found in the study area only.

TABLE 3-25 AQUATIC FLORA OBSERVED IN THE STUDY AREA

Scientific name	Family	Status
Aponogeton natans	Aponogetonaceae	Common
Blyxa octandra	Hydrocharitaceae	Sporadic
Ceratophyllum demersum	Ceratophyllaceae	Widespread
Cyperus exaltatus	Cyperaceae	Locally abundant
Cyperus pangorei	Cyperaceae	Scattered
Eichhornia crassipes	Pontederiaceae	Extensive and widespread
Hydrilla verticillata	Hydrocharitaceae	Widespread
Ipomoea aquatica	Convolvulaceae	Extensive and widespread
Limnophila heterophylla	Scrophulariaceae	Common
Limnophila indica	Scrophulariaceae	Common
Nechamandra alternifolia	Hydrocharitaceae	Sporadic
Nelumbo nucifera	Nelumbonaceae	Very common

Nymphaea nauchali	Nymphaceae	Widely scattred
Nymphaea stellata	Nymphaceae	Widely scattred
Numphoides hydrophylla	Nymphaceae	Scattered
Nymphoides indica	Nymphaceae	Scattered
Ottelia alismoides	Hydrocharitaceae	Widely scattred
Paspalidium geminatum	Poaceae	Common
Phragmites karka	Poaceae	Dominant along boundaries
Pistia stratiotes	Araceae	Widespread
Salvinia auriculata	Salviniaceae	Widespread
Salvinia cucullata	Salviniaceae	Common
Schoenoplectus articulatus	Cyperaceae	Occasional
Typha angustata	Typhaceae	Extensive and widespread
Urticularia flexuosa	Lentibulariaceae	Sporadic
Utricularia stellaris	Lentibulariaceae	Sporadic
Vallisneria spiralis	Hydrocharitaceae	Widespread

3.12.8.4 Planktons

Protecting the environment and making efficient use of natural resources are two of the most pressing demands in the present stage of social development. The task of preserving the purity of the atmosphere and water basins is of both national and global significance since there are no boundaries to the propagation of anthropogenic contaminants in the water. An essential pre requisite for the successful solution to these problems is to evaluate ecological impacts from the baseline information and undertake effective management plan. In order to get a clear picture and to assess the various parameters of water, three aquatic ecological sampling locations were identified for sampling. A qualitative study of these indicator groups provides the knowledge of aquatic flora and fauna to understand the community features such as taxonomic composition of species, and assemblages which vary with the physical and chemical attributes of the ecosystem.

3.12.8.5 Phytoplankton

Phytoplanktons are the major primary producers of organic matter in the aquatic ecosystem and especially oceans whose 90% productivity is from the planktons. Collectively, they directly or indirectly support the entire animal population. When the water column becomes shallow in spring, phytoplanktons are exposed to higher light intensity in the upper sunlight. Light is one of the major abiotic factors that favour the

growth of phytoplankton. The massive build up of phytoplankton in spring directly contributes new organic carbon to support the Zooplankton, which, in turn, benefits larger aquatic animals including fish, crustaceans, molluscs, birds. Phytoplankton were concentrated by centrifugation and analysed microscopically in laboratory. The checklist of phytoplankton shown in Table 3.26.

TABLE 3-26 PHYTOPLANKTON OBSERVED IN THE STUDY AREA

Family	Phytoplankton species	μM³/Ml
Bacillariophyceae	*Navicula* sp	13240.8
	Diatoms sp	5500.1
	Synedra sp	4894.98
	Cyclotella sp	5460.2
	Gomphonema sp	1066.5
	Nitischia sp	2151.56
Cyanophyceae	*Chlorella* sp	1330.1
	Scenedesmus sp	4750.42
	Nostoc sp	1224.25
Chlorophyceae	*Merismopidia*	1124.4
Euglenophyceae	*Euglena* sp	1560.25

3.12.8.6 Zooplankton

The significance of Zooplanktons is found in their role in transferring biological production from phytoplankton to larger organisms in the food web. A large number of phytoplankton species are grazed upon by the microscopic protozoans, tunicates, copepods and other cruastaceans. These in turn become food for the other animals further linking the food web. Therefore, variability in the production of planktons would affect the survival of young fish that depend on them. The result of the Zooplankton analysis is tabulated in Table 3.27.

TABLE 3-27 ZOOPLANKTON SPECIES IN THE STUDY AREA

Family	Phytoplankton species	μM³/Ml
Rotifera	*Brachinous* sp	6680.3
Arthropoda	*Nauplius* sp	2290.6

	Acroperus sp	6890.5
	Macrothrix sp	1250.5
	Ceriodaphnia sp	1423.9
	Simocephalus sp	2350.59

Fishes

The primary study reveals that, potential fishing activities do not exist in the study area during summer season as water gets dry in stagnant water bodies and ponds during summer. The aquatic habitats consist of Nandir Jhor and Brahmani River, Ditches and water logged areas were represented by fin-fish (fishes), shell-fish (mollusk) and prawns (crustaceans) of seasonal varieties. Some commercial fishing takes place in the Brahmani River and collected stock is small and sold in the local market. *Mastacembelus armatus* and *Puntius ticto* has been recorded from Brahmini River in a fish catch of local fisherman. As per information collected from the Fishery Department, Commercial fish fauna found in the area is I) Catla (*Catla catla*) ii) Rohu (*Labeo rohita*) iii) Mrigal (*Cirrhinus mrigala*) and iv) Kalbasu (*Labeo kalbasu*). Total fishes listed in the Table 3.28.

TABLE 3-28 CHECKLIST OF FISHES IN THE STUDY AREA

Common name	Scientific name	Use
Catla	*Catla catla*	Edible
Rohu	*Labeo rohita*	Edible
Murrel	*Channa striatus*	Edible
Wallago	*Wallago attu*	Edible
Cat fish	*Mystus vittatus*	Edible
Cat fish	*Hetyeropneustes fossilis*	Edible
Spiny eel	*Mastesembalus armatus*	Edible
Prawn	*Macrobrachium rosenberghii*	Edible
Prawn	*Macrobrachium malcolmsonii*	Edible
Giant prech	*Lates calcarifer*	Edible
Silonia	*Silonia silonia*	Skin & Liver
Pearl spot	*Etroplus suratensis*	Skin & Liver
Eel	*Anguilla* sp	Edible
Gobies	*Glassogobius giuris*	Edible
Mrigal	*Cirrhinus mrigala*	Edible

3.13 SOCIO-ECONOMIC ENVIRONMENT

Environment is a whole complex of physical, social, economic, cultural and aesthetic dimensions which affects individual, communities and ultimately determines their forms, characters, relationships and survivals. As such it becomes imperative to integrate the components of socio-economic environment in impact assessment study related to environment conservation, protection and management. The social environment refers to demographic structure of the area incorporating population dynamics, infrastructure resource base and health status of the community, while economic environment refers to land utilization pattern, land values, employment generation, industrial development and sustainability of the project in financial term. The aesthetic environment refers to scenic value of the area, tourist attraction, forest, and wildlife, historic and cultural monuments. The study of these parameters helps in identification, prediction and evaluation of likely impacts on socioeconomics and parameters of human interest due to proposed project.

The data collection for evaluation of the impact of the proposed for proposal of Brahmani river sand quarry, Kantio-Putasahi over total lease area of 12.50 acers 5.06ha. At Kantio-Putasahi Taluka Kamakhyanagar, district Dhenkanal on socioeconomic aspects in the study area has been done through a primary data and through the analysis of secondary data available for the study area.

To assess impact on socio-economic environment latest available data has been compiled to delineate the baseline socio- economic profile in study area. The database thus generated in this study includes:

- Demographic structure
- Infrastructure base
- Health status
- Economic attributes
- Cultural attributes
- Awareness and opinion of people about the proposed project

3.13.1 SAMPLING METHOD

A judgmental and purposive sampling method was used for choosing respondents of various sections of the society i.e. Sarpanch, adult males and females, teachers, medical

practitioners, businessmen, agriculture laborers, fishermen, unemployed group etc. Judgmental and purposive sampling method includes the right cases from the total population that helps to full fill the purpose of research needs. Observations are restricted to this group and conclusions from these observations are generalized to the total population. Judgment or purposive sampling is very precarious, because stronger assumption can be made about the population and sampling procedure than required while employing probability sampling.

Data Collection Method

In order to assess and evaluate the likely impacts arising out of any developmental projects on socio-economic environment, it is necessary to gauge the apprehensions of the people in the project area. For the process of data collection through primary and secondary sources certain methods are used among that are:

Field Survey and Observations

Field survey and observations are made at each sampling village and the quality of life of that region is estimated. Visits are made at hospitals, primary health centers and sub-centers to know the health status of the region. Various government organizations such as statistical department, department of census operations are visited to collect the population details of that region.

Interview Method

Structured interview method is used to collect data regarding the awareness and opinion from the sample selected of the various socio- economic sections of the community. Structured interviews involve the use of a set of predetermined questions that includes fixed and alternative questions. The questionnaire mainly highlights the parameters such as income, employment and working conditions, housing, food, clothing, water supply, sanitation, health, energy, transportation and communication, education, environment and pollution to assess the quality of life of that particular region and general awareness and opinion of the respondents about the project.

The respondents were asked for their awareness/opinion about the project and also their opinion about the impacts of the project on job opportunities, education, healthcare, housing, transportation facility and economic status etc.

The salient observations recorded during survey in the study area are:

- All villages are having Anganwadi facilities. Most of the villages having Grampanchyat.
- Though, Primary Health center (PHC) is available in most of the villages, but only nurse is present, doctors are not available all the time.
- Most of the people are engaged in agricultural and livestock activities. Farming is the main occupation.
- Many respondents within the study area have mentioned that they are expecting better road infrastructure facilities and primarily job opportunities.
- A road approach is mainly both kaccha and pakka road.
- For travelling purpose government bus service and auto are sources available for villagers in this region.
- Tap water, Bore well, tank water, well are the main source of drinking water supply in the region.
- Sanitation facilities are good condition.
- Electricity is available in almost all the villages. Most of the villages having irrigation facility through electricity. Electricity use for all purpose in the study area.
- LPG gas and Wood is major fuel for cooking purpose; kerosene is also used in some villagers.
- Self Help Group (SHG) is actively strong in maximum villages.
- Most of the tourist places situated in Pune. Nearby villagers prefer to go in Pune for entertainment and enjoyment.

Public Awareness and Opinion

- However, respondents have expressed favorable opinion about the project. This favorable opinion can also be attributed to proposed improvement in transportation and communication as well as the welfare activities in the study area
- Employment facilities for local youth may be increased

Majority of respondents are not aware about the proposed project activity

DEMOGRAPHIC STRUCTURE

The demographic structure of the study area was derived primarily from Census data records, covering Dhenkanal district and 9 Taluka of Odisha State. The summarized demographic details of the study area as per Census 2011 is given in **Table 3.31.**

TABLE 3-29 DEMOGRAPHIC STRUCTURE OF POPULATION DETAILS

S.NO	Name	Area	Household	Total Population	Total Male	Total Female	Population SC	Male SC	Female SC	Population ST	Male ST	Female ST
Dhenkanal - Parajang												
1	Gengutia	118	145	626	301	325	152	68	84	0	0	0
2	Batasinga	369	379	1550	760	790	672	338	334	0	0	0
3	Chauliajharana	0	28	158	78	80	0	0	0	158	78	80
	Total	487	552	2334	1139	1195	824	406	418	158	78	80
	Kamakshyanagar											
4	Tentulisingha	117	142	585	302	283	246	131	115	166	85	81
5	Mahulapal	809	480	1961	998	963	310	145	165	578	286	292
	Total	926	622	2546	1300	1246	556	276	280	744	371	373
	Kankadahad											
6	Jamuchakada	98	73	332	183	149	0	0	0	287	157	130
7	Mahidharpur	52	1	2	1	1	0	0	0	0	0	0
8	Khuribhanga	0	29	149	76	73	0	0	0	138	69	69
	Total	150	103	483	260	223	0	0	0	425	226	199
	Gandia											
9	Chudakhiakateni	173	55	257	136	121	0	0	0	257	136	121

	Total	173	55	257	136	121	0	0	0	257	136	121
	Nihalprasad											
10	Karadabani	334	239	1115	555	560	199	99	100	147	77	70
	Total	334	239	1115	555	560	199	99	100	147	77	70
	Tumusingha											
11.	Nayakateni	43	1	2	1	1	0	0	0	0	0	0
12.	Gangijodi	459	894	3299	1686	1613	570	289	281	7	3	4
13.	Kantapal	593	492	2280	1173	1107	424	220	204	11	5	6
14.	Srimula (Sirimula)	285	415	1701	888	813	307	160	147	0	0	0
15.	Dhobabahali	360	224	911	448	463	241	111	130	0	0	0
16.	Arnnapurnapur (Kha)	1606	168	730	373	357	65	32	33	170	80	90
17.	Tumusingha	1791	869	3426	1792	1634	853	442	411	40	22	18
18.	Kantiokateni	1288	1007	4351	2238	2113	808	418	390	108	43	65
19.	Salapada	155	170	675	340	335	170	84	86	0	0	0
20.	Kusumajodi	639	524	2257	1172	1085	218	111	107	46	24	22
21.	Analabereni	638	405	1799	925	874	390	196	194	350	169	181
22.	Aghiragoda(L)	36	55	230	115	115	0	0	0	98	48	50
23.	Aghiragoda	89	67	298	157	141	45	24	21	159	90	69
24.	Kotarapali	95	8	44	21	23	0	0	0	44	21	23
25.	Jamujhara	273	117	528	265	263	31	16	15	326	154	172

26.	Khatuahata	361	241	1046	551	495	282	149	133	141	78	63
27.	Khuntabati	186	148	659	335	324	103	48	55	0	0	0
28.	Kantioputasahi	1079	1001	4267	2216	2051	746	384	362	186	102	84
29.	Jaka	156	131	570	293	277	75	41	34	18	5	13
30.	Dadhikhai	127	122	539	281	258	54	24	30	26	18	8
31.	Mandukhura	74	8	32	14	18	0	0	0	0	0	0
32.	Pandua	158	71	317	151	166	295	142	153	0	0	0
33.	Dakhinapasi	30	2	7	3	4	1	1	0	6	2	4
34.	Machhia	243	130	596	292	304	97	49	48	0	0	0
35.	Mahulagoda	85	51	209	109	100	103	56	47	67	33	34
36.	Sogarkateni	177	66	255	137	118	161	88	73	83	42	41
37.	Sukapada	139	113	476	268	208	20	10	10	0	0	0
38.	Kamagarapatana	6	139	691	365	326	113	68	45	0	0	0
39.	Salia	68	43	226	115	111	67	35	32	0	0	0
40.	Kotagara	191	307	1391	732	659	240	118	122	62	26	36
41.	Rainarasinghpur sasan	456	294	1153	581	572	282	146	136	1	0	1
42.	Srirampur	35	139	548	279	269	548	279	269	0	0	0
43.	Sidhapada	52	61	275	138	137	185	97	88	89	40	49
44.	Godabhanga	192	17	82	42	40	78	40	38	0	0	0

45.	Kanapal	212	56	207	114	93	94	50	44	0	0	0
46.	Upara Jhagadapada	190	156	672	344	328	486	245	241	0	0	0
	Total	12567	8712	36749	18954	17795	8152	4173	3979	2038	1005	1033
	Motunga											
47.	Nadhara	6	356	1370	719	651	96	56	40	0	0	0
48.	Ekagharia	165	228	893	469	424	99	44	55	8	4	4
49.	Bangurasinga	293	696	2838	1506	1332	704	368	336	239	122	117
50.	Jarada	90	108	484	256	228	66	29	37	92	45	47
51.	Nuara	9	18	103	54	49	0	0	0	0	0	0
52.	Sridihi	266	171	686	340	346	252	128	124	219	104	115
53.	Bachhuribanka	128	135	520	271	249	177	92	85	16	8	8
54.	Chheliabedha	96	57	273	127	146	0	0	0	0	0	0
55.	Paneilo	62	195	766	394	372	512	266	246	91	47	44
56.	Odapada	464	655	2891	1520	1371	577	309	268	340	162	178
57.	Zukateni	12	2	2	2	0	0	0	0	0	0	0
58.	Ratnapravapodapada	592	496	1996	1007	989	385	194	191	317	162	155
59.	Gundei	405	361	1583	807	776	319	154	165	248	116	132
60.	Mohadia	358	311	1164	586	578	17	8	9	206	90	116
61.	Belapada	201	266	1017	525	492	420	218	202	0	0	0
62.	Gailo	115	71	288	142	146	106	46	60	0	0	0

	Total	3262	4126	16874	8725	8149	3730	1912	1818	1776	860	916
	Rasol											
63.	Bedapada	893	840	3541	1853	1688	510	263	247	104	50	54
64.	Babandha	1819	749	3144	1553	1591	1094	546	548	185	88	97
65.	Bahandei	712	232	993	513	480	620	329	291	31	15	16
66.	Kaduamada	252	27	117	66	51	65	36	29	29	17	12
67.	Kutunia	993	217	827	402	425	128	64	64	199	97	102
68.	Kharidali	598	281	1152	577	575	276	142	134	138	65	73
69.	Guagaria	357	148	648	335	313	190	99	91	126	61	65
	Total	5624	2494	10422	5299	5123	2883	1479	1404	812	393	419
	Dhenkanal Sadar											
70.	Kaunriapal	193	285	1162	624	538	233	114	119	0	0	0
71.	Pasasinga	168	112	512	256	256	48	25	23	0	0	0
72.	Rasasinga	227	178	744	395	349	76	43	33	0	0	0
73.	Tentuliapada	286	270	1044	547	497	212	106	106	83	40	43
74.	Badabaulapur	184	300	1281	679	602	509	265	244	0	0	0
75.	Baulapurpatana	8	282	1286	658	628	65	33	32	0	0	0
76.	Sanabaulpur	168	123	541	272	269	109	59	50	0	0	0
77.	Sadasivapur	674	445	1977	1002	975	1083	549	534	0	0	0
78.	Barada	307	603	3061	1721	1340	418	214	204	38	24	14

79.	Gengutia	249	529	2482	1318	1164	671	351	320	108	58	50
80.	Dudhapal	53	18	81	40	41	0	0	0	0	0	0
81.	Gurujanga	208	130	664	359	305	0	0	0	0	0	0
82.	Kandhapal	24	64	244	128	116	244	128	116	0	0	0
83.	Sankulei	232	381	1634	862	772	425	233	192	210	108	102
84.	Haladibari	40	66	261	136	125	42	22	20	104	50	54
85.	Kenchuabereni	46	30	111	64	47	0	0	0	0	0	0
86.	Ranapasi	132	178	775	397	378	179	92	87	99	47	52
87.	Kasipada	31	8	33	18	15	0	0	0	0	0	0
88.	Sambarpatia	56	2	5	4	1	0	0	0	0	0	0
89.	Janhitaila	102	58	264	138	126	0	0	0	0	0	0
90.	Kankadobala	10	12	12	0	12	0	0	0	10	0	10
91.	Tubhinali	67	73	232	119	113	191	96	95	0	0	0
92.	Tentulinali	24	4	14	9	5	0	0	0	0	0	0
93.	Jharagadia	91	57	204	107	97	157	83	74	0	0	0
94.	Sankarpratappur	320	165	679	352	327	231	117	114	150	75	75
95.	Gadasila	80	269	1144	568	576	101	47	54	114	58	56
96.	Sainbiri	990	351	1573	815	758	303	152	151	88	38	50
97.	Mahendrapur	111	140	590	300	290	55	30	25	0	0	0
98.	Siminoi	210	692	3008	1542	1466	186	88	98	99	47	52

99.	Nilambarpur	3	10	57	29	28	0	0	0	0	0	0
100.	Nilambarpursasan	3	47	203	107	96	0	0	0	0	0	0
101.	Kasiadihi	787	591	2553	1329	1224	385	207	178	259	133	126
102.	Balarampur	975	633	2927	1540	1387	918	495	423	249	131	118
103.	Sariapada	106	310	1457	781	676	541	296	245	0	0	0
104.	Dengabereni	156	164	771	412	359	191	101	90	18	12	6
105.	Chhatia	159	234	949	474	475	122	53	69	0	0	0
106.	Ankarantipur	143	424	1935	1023	912	55	29	26	127	69	58
107.	Pansapada	27	2	11	7	4	5	3	2	0	0	0
108.	Krushnapur	11	90	314	163	151	2	1	1	72	31	41
109.	Patta	41	24	109	54	55	0	0	0	0	0	0
110.	Gundichapada	382	346	1490	775	715	64	34	30	164	84	80
	Total	**8084**	**8700**	**38394**	**20124**	**18270**	**7821**	**4066**	**3755**	**1992**	**1005**	**987**
	Grand Total	**31607**	**25603**	**109174**	**56492**	**52682**	**24165**	**12411**	**11754**	**8349**	**4151**	**4198**

TABLE 3-30 LITERACY POPULATION DETAILS

S.NO	Name	Total Population	Population Literacy	Male Literacy	Female Literacy
	Dhenkanal Parajang				
1.	Gengutia	626	449	247	202
2.	Batasinga	1550	1047	560	487
3.	Chauliajharana	158	81	49	32
	Total	2334	1577	856	721
Kamakshyanagar					
4.	Tentulisingha	585	444	255	189
5.	Mahulapal	1961	1446	823	623
	Total	2546	1890	1078	812
	Kankadahad				
6.	Jamuchakada	332	263	159	104
7.	Mahidharpur	2	2	1	1
8.	Khuribhanga	149	44	27	17
	Total	483	309	187	122
Gandia					
9.	Chudakhiakateni	257	137	81	56
	Total	257	137	81	56
10.	Nihalprasad				
11.	Karadabani	1115	751	410	341
	Total	1115	751	410	341
Tumusingha					
12.	Nayakateni	2	2	1	1
13.	Gangijodi	3299	2473	1336	1137
14.	Kantapal	2280	1620	930	690

15.	Srimula (Sirimula)	1701	1184	683	501
16.	Dhobabahali	911	624	347	277
17.	Arnnapurnapur (Kha)	730	498	283	215
18.	Tumusingha	3426	2424	1418	1006
19.	Kantiokateni	4351	3193	1794	1399
20.	Salapada	675	455	268	187
21.	Kusumajodi	2257	1536	858	678
22.	Analabereni	1799	1111	627	484
23.	Aghiragoda(L)	230	131	70	61
24.	Aghiragoda	298	204	128	76
25.	Kotarapali	44	31	21	10
26.	Jamujhara	528	222	138	84
27.	Khatuahata	1046	640	379	261
28.	Khuntabati	659	503	277	226
29.	Kantioputasahi	4267	3242	1801	1441
30.	Jaka	570	401	222	179
31.	Dadhikhai	539	471	245	226
32.	Mandukhura	32	28	12	16
33.	Pandua	317	226	122	104
34.	Dakhinapasi	7	0	0	0
35.	Machhia	596	414	220	194
36.	Mahulagoda	209	138	83	55
37.	Sogarkateni	255	121	77	44
38.	Sukapada	476	336	200	136
39.	Kamagarapatana	691	462	281	181
40.	Salia	226	174	94	80

41.	Kotagara	1391	1090	605	485
42.	Rainarasinghpur sasan	1153	955	494	461
43.	Srirampur	548	350	212	138
44.	Sidhapada	275	195	112	83
45.	Godabhanga	82	60	31	29
46.	Kanapal	207	161	98	63
47.	Upara Jhagadapada	672	475	280	195
	Total	36749	26150	14747	11403
Motunga					
48.	Nadhara	1370	1103	606	497
49.	Ekagharia	893	713	406	307
50.	Bangurasinga	2838	2031	1171	860
51.	Jarada	484	372	212	160
52.	Nuara	103	78	43	35
53.	Sridihi	686	506	285	221
54.	Bachhuribanka	520	372	210	162
55.	Chheliabedha	273	196	102	94
56.	Paneilo	766	490	276	214
57.	Odapada	2891	2262	1259	1003
58.	Zukateni	2	2	2	0
59.	Ratnapravapodapada	1996	1403	789	614
60.	Gundei	1583	1161	640	521
61.	Mohadia	1164	879	491	388
62.	Belapada	1017	770	444	326
63.	Gailo	288	232	120	112
	Total	16874	12570	7056	5514

	Rasol				
64.	Bedapada	3541	2473	1414	1059
65.	Babandha	3144	2222	1225	997
66.	Bahandei	993	717	394	323
67.	Kaduamada	117	63	43	20
68.	Kutunia	827	570	312	258
69.	Kharidali	1152	747	418	329
70.	Guagaria	648	310	179	131
	Total	10422	7102	3985	3117
Dhenkanal Sadar					
71.	Kaunriapal	1162	774	447	327
72.	Pasasinga	512	376	206	170
73.	Rasasinga	744	608	327	281
74.	Tentuliapada	1044	711	398	313
75.	Badabaulapur	1281	947	531	416
76.	Baulapurpatana	1286	1056	554	502
77.	Sanabaulpur	541	428	235	193
78.	Sadasivapur	1977	1395	775	620
79.	Barada	3061	2387	1441	946
80.	Gengutia	2482	1879	1039	840
81.	Dudhapal	81	61	32	29
82.	Gurujanga	664	535	295	240
83.	Kandhapal	244	148	91	57
84.	Sankulei	1634	1094	599	495
85.	Haladibari	261	207	112	95
86.	Kenchuabereni	111	98	57	41

87.	Ranapasi	775	588	324	264
88.	Kasipada	33	28	16	12
89.	Sambarpatia	5	3	3	0
90.	Janhitaila	264	206	119	87
91.	Kankadobala	12	0	0	0
92.	Tubhinali	232	181	102	79
93.	Tentulinali	14	11	7	4
94.	Jharagadia	204	157	89	68
95.	Sankarpratappur	679	423	248	175
96.	Gadasila	1144	1002	512	490
97.	Sainbiri	1573	1205	665	540
98.	Mahendrapur	590	518	270	248
99.	Siminoi	3008	2294	1267	1027
100.	Nilambarpur	57	48	25	23
101.	Nilambarpursasan	203	184	97	87
102.	Kasiadihi	2553	1948	1051	897
103.	Balarampur	2927	2174	1203	971
104.	Sariapada	1457	1196	665	531
105.	Dengabereni	771	550	316	234
106.	Chhatia	949	763	393	370
107.	Ankarantipur	1935	1480	836	644
108.	Pansapada	11	7	6	1
109.	Krushnapur	314	251	138	113
110.	Patta	109	91	48	43
111.	Gundichapada	1490	1115	621	494
	Total	**38394**	**29127**	**16160**	**12967**
	Grand Total	**109174**	**79613**	**44560**	**35053**

TABLE 3-31 EMPLOYMENT PATTERN

Sr. No	Villages	Total Worker	Main Worker	Marginal Worker	Non Worker
Block Parajang, District Dhenkanal					
1.	Khalibahal	123	103	20	415
2.	Lodhani	1193	243	950	1843
3.	Palasahi	366	330	36	917
4.	Dihakamar	88	19	69	198
5.	Patarapada	965	291	674	2104
6.	Sankamar	216	39	177	441
7.	Gailo	268	35	233	586
8.	Kundandeipur	171	71	100	427
9.	Panibhandar	353	331	22	776
10.	Badakamar	174	69	105	347
11.	Katabahal	1138	546	592	1234
12.	Mendhapada	508	351	157	613
13.	Analakata	267	9	258	563
14.	Basantapada	469	198	271	222
15.	Ria	113	79	34	318
16.	Kumusi	1023	854	169	1502
17.	Alekhapatana	59	1	58	59
18.	Kankili	1073	700	373	2105
19.	Tulasipasi	166	20	146	178
20.	Sanda	2843	1677	1166	4272
21.	Kantio-Putasahi	423	332	91	846
22.	Roda	667	538	129	1523
23.	Renthapat	82	40	42	177
24.	Tarahata	73	21	52	89
25.	Siarimalia	295	51	244	293
26.	Chandapur	590	497	93	1060
27.	Soratanali	99	47	52	263

28.	Batasinga	553	414	139	997
29.	Chauliajharana	68	26	42	90
30.	Khajurinali	65	38	27	106
Total		**14491**	**7970**	**6521**	**24564**
Block Tumusingha, District Dhenkanal					
31.	Nayakateni	2	2	0	0
32.	Gangijodi	1556	466	1090	1743
33.	Kantapal	1127	117	1010	1153
34.	Srimula (Sirimula)	1058	645	413	643
35.	Dhobabahali	535	518	17	376
Total		**4278**	**1748**	**2530**	**3915**
Block Motunga, District Dhenkanal					
36.	Kurunti	1423	1317	106	1487
37.	Kochilamada	342	191	151	772
38.	Charadagadia	300	243	57	535
39.	Tulasidihi	15	13	2	1
40.	Ghantalapasi	16	2	14	4
41.	Motunga	880	527	353	1003
42.	Kharagprasad	1444	977	467	3063
43.	Kharagprasadpatna	484	464	20	1212
44.	Suravi	244	209	35	521
45.	Bido	376	327	49	1031
46.	Taladanga	125	120	5	313
47.	Ranjasinga	600	415	185	656
48.	Rangathali	23	13	10	29
49.	Nagari	289	137	152	651
50.	Chintapokhari	219	200	19	556
51.	Malibido	205	146	59	469
52.	Binakarkateni	168	135	33	419
53.	Budhapanka	263	237	26	406
54.	Brajabiharipur	74	65	9	156

55.	Salapada	17	17	0	46
56.	Kunjabiharipur	300	10	290	231
57.	Nadhara	342	322	20	1028
58.	Ekagharia	312	272	40	581
59.	Bangurasinga	1084	702	382	1754
60.	Jarada	177	101	76	307
61.	Nuara	28	28	0	75
62.	Talabaghalunda	255	142	113	650
63.	Uparbaghalunda	288	229	59	667
64.	Nayabhagirathipur(East)	397	381	16	857
65.	Nayabhagirathipur(West)	518	422	96	509
66.	Kalusahukateni	184	184	0	569
67.	Haladibahali	540	470	70	1122
68.	Budhipahad	187	105	82	305
69.	Uperpal	151	115	36	269
70.	Meramandali	482	459	23	895
71.	Nimidha	937	848	89	2181
72.	Ranibania	224	220	4	448
73.	Badalo	396	389	7	959
74.	Artasantrakateni	514	486	28	749
75.	Murdangapali	333	319	14	629
76.	Balaramprasad	1049	992	57	2188
77.	Bautiragada	11	9	2	19
78.	Handifuta	268	195	73	402
79.	Ghodadian	588	587	1	760
80.	Naraharipur	81	80	1	156
81.	Sridihi	188	51	137	498
82.	Bachhuribanka	167	155	12	353
83.	Chheliabedha	80	28	52	193
84.	Paneilo	280	200	80	486
85.	Odapada	877	652	225	2014

86.	Zukateni	2	2	0	0
87.	Ratnapravapodapada	608	441	167	1388
88.	Belapada	308	300	8	709
89.	Gailo	99	91	8	189
Total		**19762**	**15742**	**4020**	**37470**
Block Balimi, District Dhenkanal					
90.	Gandijhara	62	10	52	156
91.	Galapada	575	179	396	647
92.	Bhanupada	94	67	27	199
93.	Chitipada	92	77	15	164
94.	Nimabahali	320	92	228	647
95.	Kothalu	196	95	101	183
96.	Jhadabandha	595	356	239	1040
97.	Madhupur	33	33	0	93
98.	Nua	641	382	259	1609
99.	Thokar	510	238	272	1211
Total		**3118**	**1529**	**1589**	**5949**
Grand Total		**41649**	**26989**	**14660**	**71898**

TABLE 3-32 MAIN WORKER EMPLOYMENT PATTERN

S.No	Villages	Main Cultivator	Main Agriculture	Main Household	Main Others
Block Parajang, District Dhenkanal					
1.	Khalibahal	5	70	3	25
2.	Lodhani	68	39	14	122
3.	Palasahi	154	13	2	161
4.	Dihakamar	1	0	0	18
5.	Patarapada	37	200	10	44
6.	Sankamar	11	1	0	27
7.	Gailo	24	2	2	7
8.	Kundandeipur	14	2	2	53

9.	Panibhandar	160	101	2	68
10.	Badakamar	24	9	0	36
11.	Katabahal	238	107	19	182
12.	Mendhapada	49	28	15	259
13.	Analakata	0	1	0	8
14.	Basantapada	99	56	21	22
15.	Ria	24	40	7	8
16.	Kumusi	135	319	22	378
17.	Alekhapatana	0	0	0	1
18.	Kankili	393	154	15	138
19.	Tulasipasi	1	0	0	19
20.	Sanda	215	669	107	686
21.	Kantio-Putasahi	84	97	38	113
22.	Roda	92	86	113	247
23.	Renthapat	5	8	0	27
24.	Tarahata	0	0	1	20
25.	Siarimalia	17	4	1	29
26.	Chandapur	212	132	6	147
27.	Soratanali	2	31	0	14
28.	Batasinga	214	92	3	105
29.	Chauliajharana	14	2	2	8
30.	Khajurinali	14	20	0	4
Total		**2306**	**2283**	**405**	**2976**
Block Tumusingha, District Dhenkanal					
31.	Nayakateni	0	2	0	0
32.	Gangijodi	267	128	2	69
33.	Kantapal	14	19	2	82
34.	Srimula (Sirimula)	66	170	82	327
35.	Dhobabahali	52	232	0	234
Total		**399**	**551**	**86**	**712**
Block Motunga, District Dhenkanal					

36.	Kurunti	160	34	21	1102
37.	Kochilamada	12	89	12	78
38.	Charadagadia	19	7	1	216
39.	Tulasidihi	1	0	0	12
40.	Ghantalapasi	0	0	0	2
41.	Motunga	163	94	7	263
42.	Kharagprasad	53	37	60	827
43.	Kharagprasadpatna	9	3	50	402
44.	Suravi	42	8	2	157
45.	Bido	111	7	31	178
46.	Taladanga	21	3	0	96
47.	Ranjasinga	75	49	16	275
48.	Rangathali	0	0	0	13
49.	Nagari	40	11	58	28
50.	Chintapokhari	42	9	0	149
51.	Malibido	15	12	8	111
52.	Binakarkateni	17	16	1	101
53.	Budhapanka	26	82	83	46
54.	Brajabiharipur	1	22	1	41
55.	Salapada	3	1	0	13
56.	Kunjabiharipur	0	0	0	10
57.	Nadhara	78	53	2	189
58.	Ekagharia	80	8	13	171
59.	Bangurasinga	49	177	28	448
60.	Jarada	9	11	0	81
61.	Nuara	3	5	0	20
62.	Talabaghalunda	22	9	8	103
63.	Uparbaghalunda	39	58	7	125
64.	Nayabhagirathipur(East)	39	39	13	290
65.	Nayabhagirathipur(West)	104	19	3	296
66.	Kalusahukateni	123	42	0	19

67.	Haladibahali	131	78	6	255
68.	Budhipahad	0	1	0	104
69.	Uperpal	21	7	1	86
70.	Meramandali	95	13	2	349
71.	Nimidha	73	12	3	760
72.	Ranibania	10	92	0	118
73.	Badalo	79	0	13	297
74.	Artasantrakateni	10	292	4	180
75.	Murdangapali	26	5	0	288
76.	Balaramprasad	45	15	23	909
77.	Bautiragada	0	2	0	7
78.	Handifuta	34	48	0	113
79.	Ghodadian	87	7	5	488
80.	Naraharipur	22	0	4	54
81.	Sridihi	24	0	0	27
82.	Bachhuribanka	42	5	7	101
83.	Chheliabedha	2	1	2	23
84.	Paneilo	4	68	16	112
85.	Odapada	77	90	50	435
86.	Zukateni	0	0	0	2
87.	Ratnapravapodapada	75	3	3	360
88.	Belapada	53	169	3	75
89.	Gailo	7	48	0	36
Total		**2273**	**1861**	**567**	**11041**
Block Balimi, District Dhenkanal					
90.	Gandijhara	2	0	0	8
91.	Galapada	25	6	64	84
92.	Bhanupada	2	3	14	48
93.	Chitipada	18	0	1	58
94.	Nimabahali	9	12	8	63
95.	Kothalu	14	2	10	69

96.	Jhadabandha	185	8	40	123
97.	Madhupur	10	22	0	1
98.	Nua	135	73	0	174
99.	Thokar	78	9	4	147
Total		**478**	**135**	**141**	**775**
Grand Total		**5456**	**4830**	**1199**	**15504**

3.13.2 INFRASTRUCTURE RESOURCES

According to 2011 censes record, the infrastructure resources in the study area with reference to education, medical facility, water supply, postal, transportation, communication and power supply are available however, which needs to be strengthened. The details of infrastructure resources have been abstracted from housing, household amenities and assets VD 2011 of Dhenkanal District (Odisha). The description of infrastructure resources attributes are:

1. Education Facilities

Literacy rate found to be quite encouraging within the study area as the education level in the villages is comparatively good, i.e. more than 71.00% people are literate. Primary education and high schools are available within the villages.

2. Health Facilities

According to 2011 censes record, mostly villages having medical facilities in the study area. In the study area having Primary Health Centre [PHC], Sub primary health center and Family welfare center available in the study area for better medical treatment, people move to nearby town and district place.

3. Water and Sanitation facilities

According to 2011 censes record, villages having tap water, wells, all village having Hand pump and tank water facility. Regarding sanitation only some villages having closed drainage facility and other villages having open drainage facility.

4. Power Supply

According to 2011 censes record, electricity facility is available in the region. All villagers are using electricity for different proposes like domestic, agriculture and commercial.

5. Communication and Transportation

Transport plays a vital role between men, material and ideas in any region. It always supports for developing markets centres in rural area. Without an efficient transport market will not perform effectively. The mobility of goods and people from place to place is largely governed by efficient means of transport and communication. The availability of transport in region plays a key role in reducing an imbalanced development in study region. The road transport in study region plays dominant role in the origin and development of market centres. The study region has national and state highway, major district road, other district road and village roads.

3.13.3 ECONOMIC ATTRIBUTES

The major economic structure of the study area is classified into the workers details, economic and industry details are as follow, etc.

1. Occupational Pattern

The economic activity can be considered as one of the measures of economic development engaged in primary, secondary and tertiary activities. The working force ratio to total population reveals the gravity of problem of ever-growing population pressure on land causing unemployment. In study region, mostly populations are engaged in farming either as cultivators or agriculture labours. The Planning Commission of India in 1951 has classified population into three occupational structures, namely, total, main workers, non-workers and marginal workers. These main workers have been further classified into three categories, namely, cultivators, agricultural labours and other workers (Fig.-). Main workers mean those who are engaged in economic productive activity for the major part of the preceding year (at least six months or 180 days) while marginal workers mean those who work for some time but not for the entire year. Other workers consist of those who are engaged in livestock, forestry, fishing, hunting, plantation, orchard, mining, quarrying, manufacturing, processing, servicing, construction work, trade and commerce and other services.

- The total population of Total worker, main worker, marginal worker and non-worker categories are 41649 (36.67%), 26989 (23.76%), 14660 (12.91%) and 71898 (63.32%) respectively.

- The total cultivator worker, agriculture worker, household worker and main other worker population is 5456 (20.21%), 4830 (17.89%), 1199 (4.44%) and 15504(57.44%).

Cultural and Archaeological

There are various culturally and aesthetically important places in the Dhenkanal district nearby study area. Details regarding tourist place in study area is as follow; The Source of information regarding tourist place is Internet.

❖ **Dhenkanal town**

Dhenkanal town, east-central Odisha state, eastern India. The town is named for Dhenka, a medieval chieftain of the Savara people. It is a marketplace for Rice, Oilseeds and Timber and is a center of Handloom weaving. Dhenkanal was formerly the capital of the princely state of Dhenkanal, which was incorporated in 1949 into what became Odisha state in 1950. With a long, rich history of strong rulers that date back to the 15th and 16th centuries, Dhenkanal is filled with imposing palaces and forts, and intriguing archaeological remains of eras gone by. Much of the region is covered in dense foliage and gushing rivers, such as the Brahmani and Mahanadi and is home to myriad species of Flora and Fauna. These areas are bound to excite travelers who have a penchant for wildlife and natural wonders. A number of temples also dot this scenic city, notching up its Tourism quotient quite high.

❖ **Kapilash**

It is one of the famous Saiva Pitha of Odisha and also a well-known tourist place. This place is allegedly known as Second Kailash. The way to the temple consists of 1352 steps.

The temple was constructed in 1246 AD by King Narasinghdeva-I. Marichi kunda & Payamruta kunda exist on the right and left side respectively of the main temple. A number of festivals are celebrated here at Kapilas. But the celebration of Maha Shivaratri is a festival to watch.

❖ Joranda

Famous as the religious headquarters of Mahima Dharma, Joranda houses the Samadhi of Mahima Gosain, the preacher and propounder of the Mahima Cult. The other sacred temples are the Sunya Mandira, Dhuni Mandira and Gadi Mandira. Pilgrims in large numbers pour into the Joranda fair for celebrations.

❖ Saranga

At this place, you will find an Anantasyi image of Lord Vishnu, on the rocky bed of the river Brahmani at Saranga. The hoods of Ananta, the serpent king spread over the head of Lord Vishnu as the crown and cover. The primal lotus, housing Brahma, the creator originates from Vishnu's navel, the Supreme Being enjoying the deep delight of his cosmic sleep in the waters of the river Brahmani.

❖ Dandadhar Dam

67 km from Dhenkanal, Dandadhar is the site of an irrigation project on the river Ramial - an ideal place for outings. Its blue expanse of sparkling waters caged in a sun-bathed valley is a thrill for the searching eyes.

❖ Saptasajya

A place of scenic beauty, Saptasajya is situated at a distance of about 11 km to the south of Dhenkanal town. According to legends, 'Pandavas' spent some days of their incognito life(Agnuata vasa) in these hills. The temple of Raghunath, built in honor of Lord Rama, Laxman and Sita by Rani Ratnaprava Devi of Dhenkanal attracts large crowds every year on the day of Ramanavami, in the month of March-April. A small spring flowing close by enhances the beauty of the place. It is an ideal place for picnic and relaxation.

4 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 GENERAL

Any human activity in any environment produces impact, modifying it to a status which is considered adverse or beneficial according to the damage or improvement it brings about in physical, biological and socio-economic status of baseline environment. Depending on the nature of activities and existing status, the impacts are assessed for their importance. On the basis of the impact analysis, the mitigating action and future monitoring requirement are focused in the Environmental Management Plan for countering or minimizing adverse impacts.

The following parameters are of significance in the EIA and are being discussed in detail:

- Land Environment
- Water Environment
- Air Environment
- Noise Environment
- Biological Environment
- Socio-Economic Environment

4.2 LAND ENVIRONMENT

On River Bed: The river mining does not involve any overburden/ waste. Thus, no waste dump sites are needed. Main aspects are excavation, loading and transportation activities.

On Agriculture Field: Since the dry sand mining will be carried out in the river bed, no impacts on surrounding agriculture lands is envisaged.

Anticipated Impacts	Mitigation measures
▪ Obstruction in river flow / course. ▪ Erosion of channel bed and banks.	▪ Mining of minerals will be started from dip side towards rise at the centre and also laterally in 1.0-m slice. Unwanted material or spillage (if any) will not be stacked by the side of the excavation voids created. Excavation will be carried out in a manner so that water flow / course will

Anticipated Impacts	Mitigation measures
▪ Increase in channel slope ▪ Change in channel morphology. ▪ Impact on stream's physical characteristics such as channel geometry, bed elevation in stream roughness of the bed, flow velocity, discharge capacity, sediment transportation capacity etc. ▪ Impact on ecological equilibrium of riverine regime.	not be obstructed. ▪ Mining is to be done leaving safety barrier or offset on both sides and maximum barrier should be on concave side of river preferably the flow channel (excavation void created) should be kept straight so as to help avoid erosion as side cutting or collapsing. ▪ Safety zone or buffer area will be created from the river banks to minimize the instability & erosion and to increase the stability of structures. These safety zones will not be mined out. ▪ Quantities will be strictly limited so that sand accumulation rates are sufficient to avoid extended impacts on channel morphology. ▪ Mining will be carried out as per approved Mine Plan in scientific and systematic way. ▪ Sand mining will be restricted down to 3.0m below river bed or 1.0m above the ground water table, whichever less. Therefore, the mining will not intersect the ground water table. ▪ Loss of habitat is minimized because the river bed mining will be carried only in dry bed which will not disturb the riverine ecosystem. ▪ The mine working will remain confined to river bed only and in no case mining will disturb any surface area outside the river bed which may affect topography or drainage. ▪ The mining from river bed will not have impact on natural

Anticipated Impacts	Mitigation measures
	drainage of surrounding areas as the excavated sand from river bed is filled with first heavy flow in river during monsoon season.

4.3 WATER ENVIRONMENT

Anticipated Impacts	Mitigation measures
▪ Flow pattern might be changed due to river bed mining. ▪ Mining activities depth will be increased, which may result in increase of flow velocity.	▪ No diversion is proposed. There will not be any adverse impact on flow pattern, surface hydrology and ground water regime. ▪ Mining activities will be restricted to 3.0m depth, which will not cause much change in flow pattern of the river. ▪ An offset of 20m will be left from both sides of river, which will minimize the chances of bank failure.
Change in surface water quality and ground water quality.	▪ There will be no change in surface water quality as river is seasonal. ▪ Ground water quality will not be affected due to mining activities as it is restricted to 3.0m depth and the water level is 4-14 m bgl below the surface of river bed. ▪ A safety zone of 50m around the wells will be created and it will be left un-mined. ▪ The mining will not be allowed below the water table. ▪ Regular monitoring of water samples will be done as precautionary measures.

Impact on ground water recharge potential as the thickness of the natural filter materials (sediments) is reduce causing less infiltration.	Mining will be done as per approved Mine Plan and applicable Rules & Regulation, so that there is no damage on ground water recharge potential due to sand mining.
Waste water discharge.	Portable Bio-tiolets will be used; hence no sewage / liquid effluent will be generated and contamination is also not expected due to percolation.

4.4 AIR ENVIRONMENT

Air Quality Impact Prediction (AQIP)

The major sources of air pollution from the mine are dust generation due to loading & transportation of minor mineral and wind erosion of exposed material. In this present study, United States Environmental Protection Agency (USEPA – 42 series) approved mathematical equations, have been used to predict emission rates for different operations in mining including the mineral transportation. Air dispersion modelling is the mathematical simulation of how air pollutants disperse in the ambient atmosphere.

Mathematical model used in modeling for Sand Mining

Impact through Mathematical Modeling: For Sand Mining Project As explained in the previous chapter, the ambient air quality monitoring results show that all the parameters such as PM10, SO2, NOx and CO are within the limits prescribed by CPCB for "Industrial and Mixed use" areas as well as areas meant for "Residential and Rural" areas. The major contribution of air pollution is by river bed mining, such as excavation, loading, transportation, hauling operation and handling of sand. This will lead to momentary rise in the particulate matter (PM10).

Air Pollution Modeling: The impact of the sand mining on the air quality has been predicated using Fugitive Dust model (FDM), which is a computerized air quality model specifically designed for computing concentration and deposition impacts from fugitive dust sources. The sources may be point, line or area sources. The model has not been

designed to compute the impacts of buoyant point sources; thus, it contains no plume rise algorithm. The model is generally based on the well-known Gaussian Plume formulation for computing concentrations, but the model has been specifically adapted to incorporate an improved gradient transfer deposition algorithm. Emissions for each source are apportioned by the user into a series of particle size classes. A gravitational setting velocity and a deposition velocity are calculated by FDM for each class. The emission factors considered for emission load estimation are given in **Table-4.1**

TABLE 4-1 EMISSION FACTORS USED FOR MODELING

Sl. No.	Activity	Emission Factor Equations	Emission Factor
1	Excavators on ORE	EF = 1.56 x 0.0596 x $M^{-0.9}$	0.0099 kg/t
2	Unloading ORE	EF = 0.74 x 0.0016 x $(u/2.2)^{1.3}$ x $(M / 2)^{-1.4}$	0.0001 kg/t
3	Wheel generated dust on unpaved roads	EF = 2.82 x $(Ss/12)^{0.8}$ x $(W / 3)^{0.5}$ x $(Ms / 0.2)^{-0.4}$	4.0 kg/VKT
Where M – Moisture Content of ore/mineral, s- Silt content of ore/mineral, u- Mean Wind Speed, d- Hole Diameter, f- Holes/day, A- Area of blasting, D- Hole dia, Ss- Surface silt content, W-Vehicle gross weight, Ms- Surface moisture content.			

The predicted ground level concentrations when added to Baseline scenario, the overall scenario levels of PM10, NOX and CO are well within the permissible limits as specified by NAAQ Standards. The predicted incremental GLC's are given below in detailed:

RESULTANT CONCENTRATIONS DUE TO INCREMENTAL GLC's

Pollutant	Baseline Concentration	Incremental Concentrations due to Proposed Project	Resultant Concentration	NAAQ Standards
PM10 (µg/m3)	63.0	0.71	63.71	100
PM2.5 (µg/m3)	27.0	0.21	27.21	60
NOx (µg/m3)	27.0	0.037	27.03	80
CO (mg/m3)	0.01	0.143	0.153	2.0

FIGURE 4-1 ISOPLETH FOR 1ST HIGH 24-HR AVERAGE INCREMENTAL CONCENTRATION OF PM10

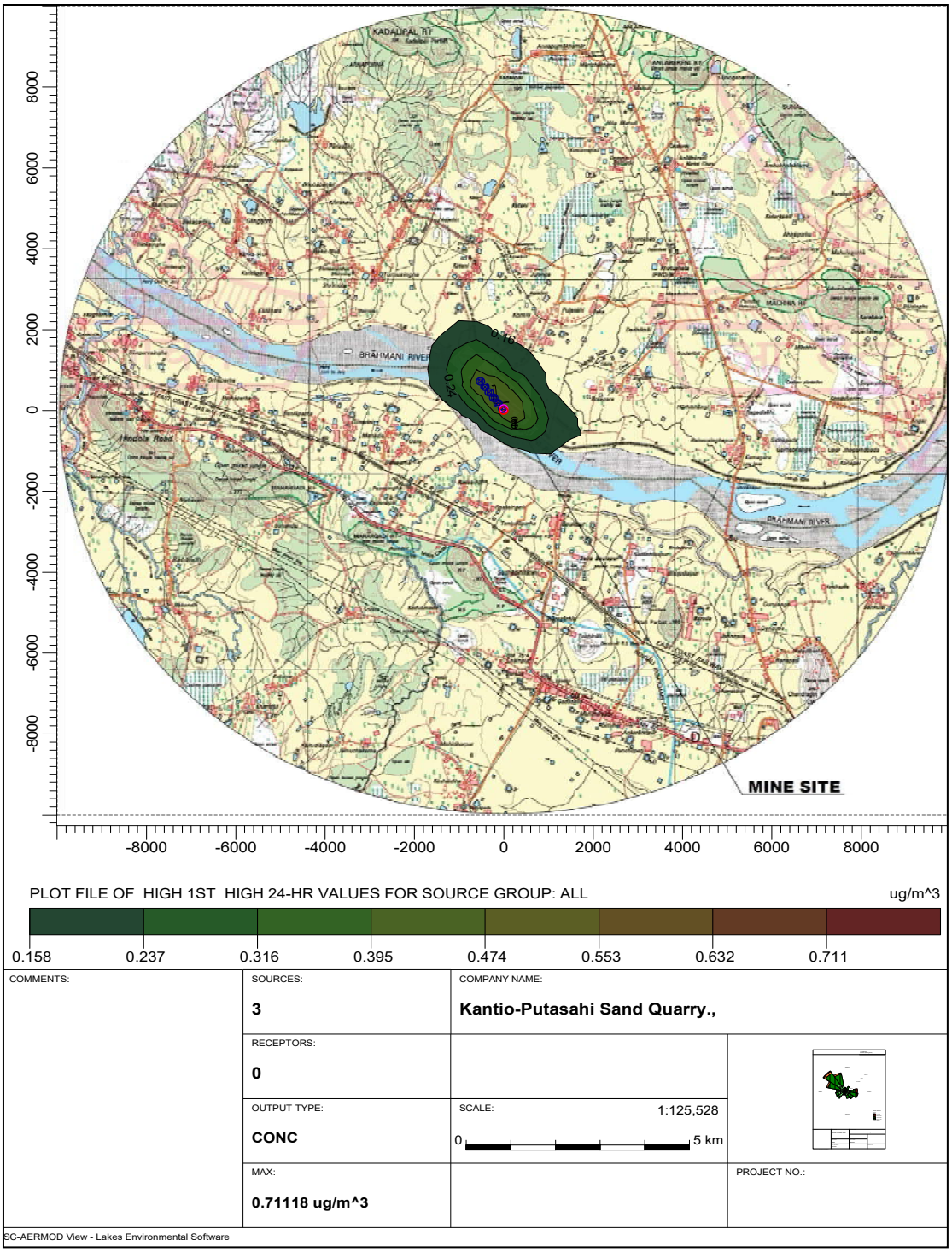
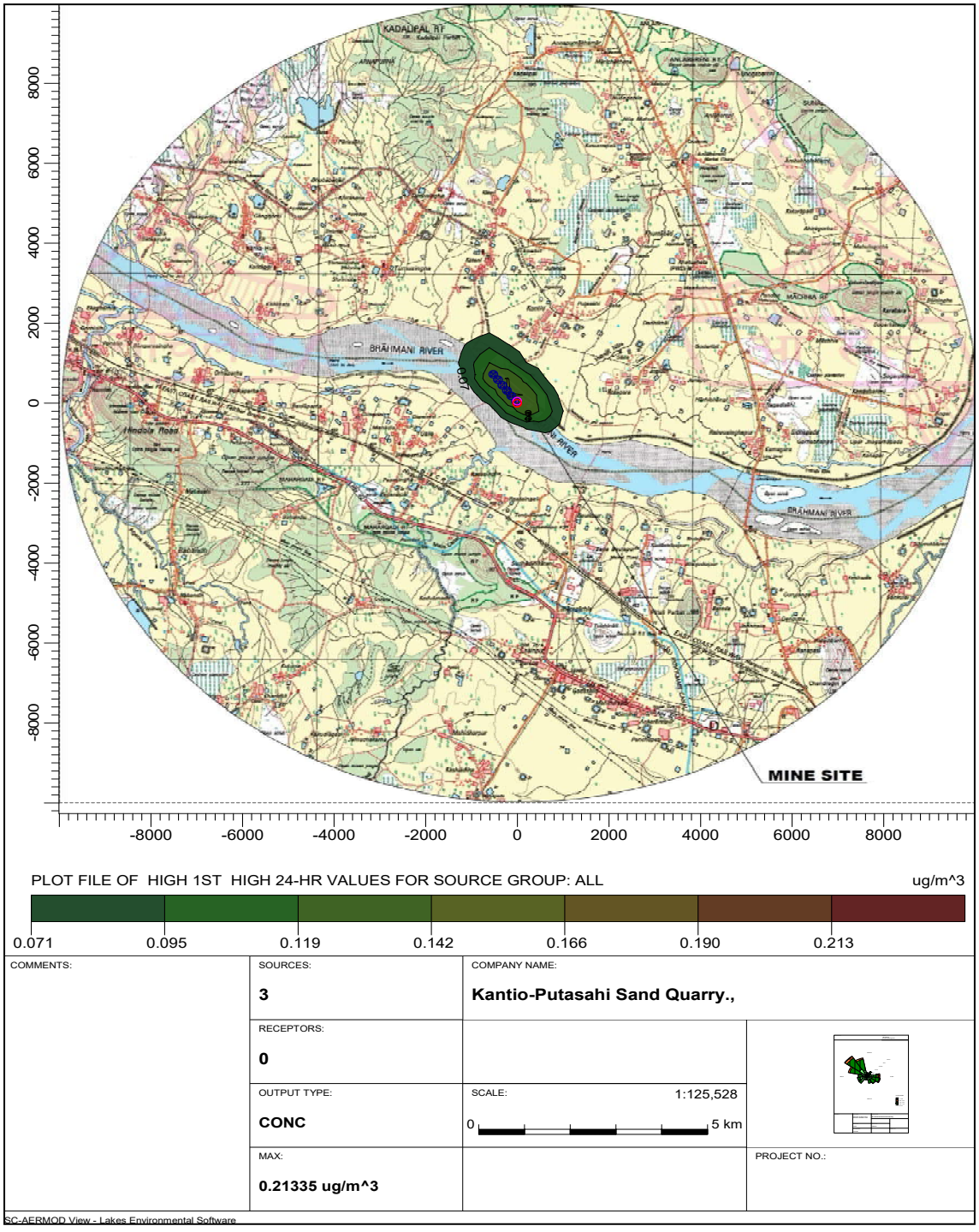


FIGURE 4-2 ISOPLETH FOR 1ST HIGH 24-HR AVERAGE INCREMENTAL CONCENTRATION OF PM2.5



Results and Conclusions

The ground level concentrations are computed for 24-hr average. The maximum ground level concentrations of Particulate matter from the different mining activities for study period were observed to be 63.71 μg/m^3. The maximum GLC's were falling within the pit area/lease area for the given meteorological and topographical conditions.

From the above, it could be clearly seen that due effective implementation of various control measures as discussed in the proposed mine plan, there will not be any significant impact on the ambient air quality in the region as the resultant concentration of AAQ are much below the standard of 100 μg/m^3.

Mitigation Measures

- Water sprinkling will be done on the haul roads twice in a day.
- Plantation will be carried out on approach roads.
- Planning transportation routes of mined material so as to reach the nearest paved roads by shortest route. (minimize transportation over unpaved road);
- Dust mask provided to the workers engaged at dust generation points like excavations loading and unloading points.
- Speed limit will be enforced to reduce airborne fugitive dust from vehicular traffic.
- Deploying PUC certified vehicles to reduce their noise emission.
- Spillage from the trucks will be prevented by covering tarpaulin over the trucks.

4.5 NOISE ENVIRONMENT

Since the mining operations are non-mechanised, there will not be any noise and vibrations related impacts. However, only noise generating activities are the truck movement carrying sand from mining lease area. The noise sources shall not generate sound levels above 90 dB(A).

From the above we find that if the noise source of dBA, each at 400m from a receptor, converges at the receptor, their components would be 30 dBA respectively. With the resultant value being less than the ambient noise levels, there is no likelihood of excess addition of noise, from the mine operation, on the surrounding background noise level. As derived above and due to the fact that there are no human settlement within 600m, no

impact of noise on habitation is likely. The same is brought out by the noise measurements carried out which indicate that the noise levels in the vicinity are within limits.

Impacts	Mitigations
▪ Noise Impact due to mining activities. ▪ Noise impact due to vehicular movement. ▪ Auditory impact	▪ The noise levels from all these sources are periodical and restricted to particular operation. ▪ The noise measurement data indicated that present noise levels in the study area is within the permissible limits of National Ambient Noise Quality Standards. ▪ Periodical monitoring of noise will be done. ▪ No other equipments except the transportation vehicles will be allowed. ▪ Noise generated be these equipments will be intermittent and does not cause much adverse impact. ▪ Proper maintenance of all equipments/ machines will be carried out which help in reducing noise during operations. ▪ Plantation will be taken up along the approach roads and vicinity of river bank. The plantation minimizes propagation of noise and also arrests dust. ▪ Ear muffs will be provided while working on mining equipments. ▪ Regular health check-ups will be conducted for any such health implications.

4.6 BIOLOGICAL ENVIRONMENT

Aspect	Impact	Mitigation
Temporary Road	Short-term disturbance in habitats of wildlife populations from noise (impacts usually local and short-term)	▪ Do not cut trees that are larger in diameter than local regulations permit, or in the absence of regulations, greater than 90-cm ▪ Minimize clearing of vegetation. Leave in place smaller vegetation, topsoil, root, stock, seeds and endangered or protected species and species used by local ▪ Communities for commercial or subsistence use.
Infrastructure	▪ Erosion and changes in surface hydrology. ▪ Vegetation cleared, disturbing local habitats.	▪ ''Minimize the footprint'', use existing infrastructure to the extent possible to avoid or reduce clearing. ▪ In clearing vegetation, use hand-cutting techniques to the extent possible, thereby avoiding the use of heavy machinery.
Drainage	▪ Erosion and changes in surface hydrology, causing short and possible long-term changes in local habitats.	▪ Take topography, natural drainage and site runoff patterns into account. ▪ Ensure adequate drainage away from streams, river and other waterways.

Aspect	Impact	Mitigation
Top soil loss	▪ Impedes ability of habitats to revegetate, causing possible long-term damage to affected area. ▪ Siltation of waterways, with negative impacts on surrounding environments.	▪ Take topography, natural drainage and also site runoff patterns into accounts. ▪ Ensure adequate drainage. ▪ Stabilize all slopes, revegetating with native species to reduce/avoid erosion. ▪ Break-up compacted surfaces and replace topsoil, brash, seed source, leaf litter, etc.
Traffic	▪ Short-term disturbance of habitats from traffic; short term disturbance of wildlife populations from noise. ▪ Compaction of soils and changes in surface hydrology. ▪ Killing of local wildlife.	▪ Keep traffic to the absolute minimum requirements. ▪ Impose and enforce speed limits and provide driving guidelines for vehicle operators. ▪ Treat (water) road surfaces to manage dust. ▪ Allow only authorized employee access to site(s) transportation.

4.7 SOCIO-ECONOMIC ENVIRONMENT

Aspect	Impact	Mitigation measure
Habitation	No loss of habitation	▪ The nearest habitation is beyond 4 km. ▪ All necessary measures are being taken, so that there is no

Aspect	Impact	Mitigation measure
		disturbance to the normal life of persons.
Employment Generation	▪ Direct employment to 225 persons. ▪ Indirect employment to about 100 persons. ▪ Improved income expenditure. ▪ Improved micro investments – savings patterns.	▪ Local people will be employed. ▪ Training will be provided to non-workers and unskilled workers. ▪ Awareness programme to motivate people for savings and investment.
Health Implications	▪ No health-related problems were reported during the primary survey. ▪ No significant health implications to the workers due to mining activities.	▪ Regular health camps will be organized for the local people. ▪ Adequate numbers of medical facilities are situated in the area.
Health impacts on mental, physical, and social well-being.	▪ The proposed project will not adversely impact the mental, physical and social well-being. It will improve the well-being of the people and the area.	▪ Expectations in fair pay, employee care, social responsibility commitments etc. will be timely met. Grievance redressal mechanism is made to handle complaints from the study area.
Loss / gain of self esteem	▪ A rise in the self-esteem due to increase rate of economic	▪ Immigration in search of employment will be

Aspect	Impact	Mitigation measure
	growth in the region. Higher degree of self-satisfaction and contentment.	controlled.
Loss/ gain of culture and religion	▪ The proposed project will follow universal respect for, and observance and protection of, human rights and fundamental freedoms for all.	▪ The proposed project will promote neither selective, nor relative, but universal respect through contribution in various festivities, equal observance and protection among employees and societies at large in all CSR activities.
Corporate Environment Responsibility		
The proposed project is a river bed sand mine and is providing to their employees all basic facilities.	▪ The mine will promote girl child education, women empowerment, scholarship to encourage the student and give donation to built toilet for sanitation. ▪ Community development will be designed and programmed by engaging with the panchayats and local authorities.	▪ The mine will give boost to local population. Monetary gains, education, health, sanitation, water conservation, plantation and improvement in general environment will lead to positive growth.

5 ANALYSIS OF ALTERNATIVES

5.1 ALTERNATE TECHNOLOGY

Manual opencast method is being involved in this mining. No alternative technology will be envisaged for this proposed enhancement project.

5.2 PROPOSED METHOD OF MINING

The mining operations will be carried open excavation with manual method only.

A. Over Burden Removal

No overburden is anticipated.

B. Loading

The ordinary Sand will be loaded by manually by labours.

C. Hauling

Ordinary Sand is transported through tractors with trailers.

D. Stock Yard

There will be no generation of the sub grade material in the area and the entire sand will be dispatched for domestic uses.

5.3 ALTERNATE SITE

The mineral deposits are site specific in nature; hence question of seeking alternate site does not arise.

5.4 CONNECTIVITY

The area under discussion is featured in Survey of India Topo Sheet No – (73H/09) and is bounded between the Latitude -20° 45’ 44.86” N to 20° 45’ 54.35” N & Longitude – 85° 30’ 05.03” E to 85° 30’ 18.05” E. The Lease area is located at a distance of 15 kms from Dhenkanal town, 19km from Tahasil Kamakhyanagar and 66 kms from the State Capital Bhubaneswar. Sadashibapur Railway Station is the nearest railway station located at a distance of 3.0 kms from the lease area. Nearest Road Bridge is at a distance of 5.90 kms from the mining lease. Darajang road connecting to the lease area with the District road is at distance of 5.18kms. NH – 42 is the nearest major district road which is at distance of 4.35 km. SH 64 is the nearest State Highway which is at a distance of 30.16 kms.

6 ENVIRONMENTAL MONITORING PROGRAMME

6.1 INTRODUCTION

Regular monitoring of environmental parameters is of immense importance to assess the status of environment during project operation. The knowledge of baseline conditions, the monitoring program will serve as an indicator for any deterotriation in environmental conditions due to operation of the project, to enable taking up suitable mitigatory steps in time to safeguard the environment. Monitoring is an important as that of control of pollution since the efficiency of control measures can only be determined by monitoring.

An impact assessment study is carried over short period of time and the data cannot bring out all variations induced by the natural or human activities. Therefore, regular monitoring programme of the environmental parameters is essential to take into account the changes in the environmental quality.

6.2 ENVIRONMENTAL MONITORING AND REPORTING PROCEDURE

Monitoring will conform that commitments are being met. This may take the form of direct measurement and recording of quantitative information, such as amount and concentrations of discharges. The objectives of the monitoring are:-

a. Very effectiveness of planning decisions;
b. Measure effectiveness of operational procedures;
c. Conform statutory and corporate compliance; and
d. Identify unexpected changes.

6.3 ENVIRONMENTAL MONITORING CELL

A centralized Environmental Monitoring Cell will be established for monitoring of important and crucial environmental parameters which are of immense importance to assess the status of environment during mine operation. With the knowledge of initial parameters, deviations in environmental conditions due to operation of the mine will be assessed and suitable mitigation steps will be taken to safeguard the environment. The routine monitoring program will be implemented under the project monitoring as per CPCB & MoEF & CC guidelines.

The core responsibilities of the Environmental Monitoring Cell will be:-

a. The organization and interpretation of the environmental monitoring data to establish a record of change associated with the implementation of a project or the operation of an organization.
b. The process of verification that all or selected parameters measured by Environmental Monitoring Program are in compliance with regulatory requirements, internal policies and standards, and established environmental quality performance limits.
c. The assessment of the effectiveness of the environmental management system, practices and procedures.
d. The environmental monitoring and audit work will be carried out by qualified personnel.
e. A summary of non-compliance of the environmental quality performance limits.
f. To implement and monitor the control and protective measures based on the EMP.
g. To coordinate the environment related activities to the top management within as well as with outside concerned agencies.
h. To provide of health check up of workers and the people living in nearby villages.
i. To develop greenbelt in the nearby villages, schools, Govt. offices and transportation routes.

6.4 ENVIRONMENTAL MONITORING SCHEDULE

Environmental monitoring schedules will be prepared covering various phases of project advancement, such as Mining and regular operational phase.

S.no.	Potential Impact	Parameters for Monitoring	Frequency of Monitoring	Location
1.	Air Emission	PM10, PM2.5, SO2, NO_2, CO & Free Silica	As per CPCB / MoEF & CC requirement i.e. 24 hourly monitoring for one month in each season except monsoon season.	One location in the core mining area and four in buffer area.
2.	Noise	Spot Noise level recording Leq (day),Leq (night), Leq (dn)	Periodic / As per CPCB norms i.e. quarterly	One location in the core mining area and four in

				buffer area.
3.	Water Quality	As per drinking water standards	Four times in a Year	One location in the core mining area and four in buffer area.
4.	Health	Total health parameters	Initial Medical Examination (IME) and Periodic Medical Examination – Once in a five year as per Mines Rules, 1955.	All employees

6.5 MONITORING SCHEDULE DURING OPERATIONAL PHASE

During operational phase, dust will be the main pollutant which arises from different mining activities. The major attributes which merit regular monitoring based on the environmental setting and nature of project activities are listed below:

- ✓ Source emission and ambient air quality;
- ✓ Ground water levels and ground water quality;
- ✓ Water and waste water quality;
- ✓ Soil quality;
- ✓ Noise levels (equipment and machinery noise levels, occupational exposures and ambient noise levels); and
- ✓ Ecological preservation and a forestation

6.6 MONITORING METHODS

6.6.1 MONITORING OF AMBIENT AIR QUALITY WORKSPACE MONITORING

The concentration of air borne pollutants in the workspace / work zone environment will be monitored periodically. If concentrations higher than threshold limit values will be observed, the source of fugitive emissions will be identified and necessary measures will be taken as detailed in EMP.

Ambient Air Quality Monitoring

The ground level concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO in the ambient air will be monitored at regular intervals. Any abnormal rise will be investigated to identify the causes and appropriate actions will be initiated. Greenbelt will be developed for minimizing dust propagation.

6.6.2 MONITORING OF WATER QUALITY

Monitoring of Ground Water

The monitoring of groundwater is the most important tool to find out the depletion/increase in level of water table. Water table will be monitored at regular interval to check the behavior pattern of the water table. It is suggested to collect water samples and analyze. Records of analysis will be maintained.

Monitoring of Surface Water

Samples will be collected from well-mixed section of the river (main stream) and will be analyzed.

6.6.3 MONITORING OF NOISE LEVELS

Noise levels in the work zone environment shall be monitored. The frequency will be once in three months in the work zone. Similarly, ambient noise levels near habitations will also be monitored once in three months. Audiometric tests will be conducted periodically for the employees working close to the high noise sources.

6.7 REPORTING SCHEDULES OF THE REPORTING DATA

It is proposed that voluntary reporting of environmental performance with reference to the EMP will be undertaken.

The Environmental Monitoring Cell will co-ordinate all monitoring programs at site and data thus generated will be regularly furnished to the State regulatory agencies. The frequency of reporting will be on six monthly bases to the office of State Pollution Control Board and to the Regional Office of MoEF&CC. The Environmental Audit reports will be prepared for the entire year of operations and will be regularly submitted to regulatory authorities as per EC conditions.

6.8 CONCLUSION

Post Environmental monitoring is an essential step in the EIA process if the predicted impacts, the efficiency of mitigation measures and the shortcomings of prediction methods, measures and even regulations are to be verified and EIA practice improved. Environmental indicators could contribute to designing and evaluating monitoring programs, thus improving establishment of the cause effect relationship and the reporting and communication of environmental data.

The Environmental Monitoring Cell will co-ordinate all monitoring programs at site and data thus generated will be furnished as per statutory requirements. The frequency of reporting will be on half yearly basis to the Odisha State Pollution Control Board and to Regional Office of MoEF&CC. The Environmental audit reports will be prepared for the entire year of operations and will be regularly submitted to regulatory authorities.

7 ADDITIONAL STUDIES

7.1 INTRODUCTION

The proposed project is for the mining (removal of sand), from the river bed of Brahmani river by opencast Manual method of mining. Risk assessment & social impact assessment due to project has to be addressed, which are as follows:

7.2 RISK ANALYSIS

Risk analysis is the systematic study of uncertainties and risks encountered in various areas. Risk analysis is to identify the risks involved in mining operations at various phases. Potential locations and activities around the proposed site are identified and probable risks are estimated on a person, business and Govt. establishment.

7.3 RISK PRIORITIZATION BASED ON HAZARDS IN SAND MINING

Sand mining is done by open cast manual method. Mining is done only within the Brahmani River stretch located near revenue village Kantio-Putasahi of Kamakhyanagar Tahasil, Dhenkanal district. The lease area is 5.06 ha. There is no land degradation due to mining activities as mining is done only on river bed surface. There will be no over Burden or waste generation as the sand is exposed in the river bed. There will be neither any stacking of soil nor creation of OB dumps. So, no dumping area as well as stock piling area is required. Therefore, there is no chance of failure of dumps and no slope failure due to Over Burden dump and stock piling.

However, there are various factors, which can create unsafe working conditions/ hazards in mining of sand (minor minerals) from river bed. The following types of hazards are identified during the sand mining operations:-

1. Accident during sand/mineral loading, unloading, transportation and dumping/piling
2. Accident due to vehicular movement
3. Inundation/ Flooding
4. Quick Sand Condition

7.4 MITIGATION MEASURES

Measures to prevent accidents during loading

The following activities will be done to minimize the risk are: -

- ✓ The truck would be brought to a lower level so that the loading operation suits to the ergonomic condition of the workers.
- ✓ The workers will be provided with gloves and safety shoes during loading.
- ✓ Opening of the side covers (pattas) should be done carefully and with warning to prevent injury to the loaders.
- ✓ Operations during daylight only.

Measures to prevent accidents during vehicular movement & transportation

The following activities will be done to minimize the risk are: -

- ✓ The truck will be covered with tarpaulin and maintained to prevent any spillage.
- ✓ To avoid danger while reversing the trackless vehicles especially at the embankment and tipping points, all areas for reversing of Lorries should be made man free as far as possible.
- ✓ The vehicles must be maintained in good repairs and checked thoroughly at least once in a week.
- ✓ All transportation within the main working will be carried out directly under the supervision and control of the management.
- ✓ Overloading should not be permitted and the maximum permissible speed limit should be ensured.
- ✓ The truck drivers should have proper driving license.
- ✓ A statutory provision of the fences, constant education, training etc. will go a long way in reducing the incidents of such accidents.

Measures to prevent incidents during Inundation/ Flooding

The following activities will be done to minimize the risk are:-

- ✓ During monsoon months and heavy rains the mining operations are ceased.
- ✓ There should be mechanism/ warning system of heavy rains and discharges from the Up-stream dams.
- ✓ Inundation of flooding is expected and beneficial for these mines as during this time only the mineral reserve gets replenished.

7.4.1 PRECAUTIONARY MEASURE FOR SUDDEN RELEASE OF WATER FROM UPSTREAM DAM

The following activities will be done to minimize the risk are:-

- ✓ The mining should be done only during the dry season and under strict supervision.
- ✓ Mining activities should be avoided during monsoon season.
- ✓ No go zones should be clearly marked and made aware to the mine workers.
- ✓ Deep water areas must be identified.

7.4.2 MEASURES TO PREVENT SUDDEN INCREASE IN WATER LEVEL

The following activities will be done to minimize the risk are:-

- ✓ The mining activities will be restricted to 1m depth from river bed surface.
- ✓ Mining activities will be avoided during monsoon season.
- ✓ Mining will be done as per the approved Mining Plan and it will also be conformed to avoid the ponding effect.

7.5 DISASTER MANAGEMENT PLAN

This should deal with action plan for high-risk accidents like landslides, subsidence, flood, Inundation in mines, fire, seismic activities, tailing dam failures etc. and emergency plan proposed for quick evacuation, ameliorative measures to be taken etc. The capability of lessee to meet such eventualities and the assistance to be required from the local authorities should be described.

- ✓ The shallow depth of activities in river bed mining will not involve any high-risk accident due to side falls/collapse.

- ✓ The complete mining operation will be carried out under the Management and control of experienced and qualified Mines Manager having Certificate of Competency to manage the mines granted by DGMS.
- ✓ All the provisions of Mines Act 1952, MMR 1961 and Mines Rules 1955 and other laws applicable to mine will strictly be complied with.
- ✓ During heavy rainfall the mining activities will be closed.
- ✓ All persons in supervisory capacity will be provided with proper communication facilities.
- ✓ Proper coordination with Irrigation Department will be maintained so that at the time of releasing water, if any, from the dam suitable warning/information is given in advance.

7.6 OCCUPATIONAL HEALTH HAZARDS

Dry- pit mining by open cast method involves dust generation by excavation, loading and transportation of mineral. At site, during excavation and loading activity, dust is main pollutant which affects the health of workers whereas environmental and climatic conditions also generate the health problems.

Addressing the occupational health hazard means gaining an understanding of the source (its location and magnitude or concentration), identifying an exposure pathway (e.g. a means to get it in contact with someone), and determination of likely a receptor (someone receiving the stuff that is migrating).

Occupational hazard due to sand mining mainly comes under the physical hazards. Possible physical hazards are as below mention: -

7.6.1 PHYSICAL HAZARDS DUE TO MINING OPERATIONS

Following health related hazards were identified due to riverbed sand mining operations to the workers: -

- ✓ **Light: -** The workers may be exposed to the risk of poor illumination or excessive brightness. The effects are eye strain, headache, eye pain and lachrymation, congestion around the cornea and eye fatigue.

- ✓ **Heat and Humidity:** - The most common physical hazard is heat. The direct effects of heat exposure are burns, heat exhaustion, heat stroke and heat cramps; the indirect effects are decreased efficiency, increased fatigue and enhanced accident rates. Heat and humidity are encountered in hot and humid condition when temperatures and air temperatures increase in summer time up to 49^0C or above in the river bed mining area.
- ✓ **Eye Irritation: -** During the high windy days in summer the sand could be the problems for eyes like itching and watering of eyes.
- ✓ **Respiratory Problems: -** Large amounts of dust in air can be a health hazard, exacerbating respiratory disorders such as asthma and irritating the lungs and bronchial passages.
- ✓ **Noise Induced Hearing Loss: -** Transportation vehicles are the main source of noise pollution at the mine site.

7.7 MANAGEMENT OF HEALTH HAZARDS

Particulars	Control Measures
Heat & Light	❑ The mine site will have adequate drinking water supply so that workers do not get dehydration. ❑ Lightweight and loose fitting clothes having light colors will be preferred to wear. ❑ Rigorous exercise and more physical activities will be avoided in hot weather.
Noise	❑ Noise exposure measurements will be taken to determine the need for noise control strategies. ❑ The personal protective equipment will be provided for each mine workers. ❑ Supervisor will be instructed for reporting any problems with hearing protectors or noise control equipment. ❑ At noisy working activity, exposure time will be minimized.

Respiratory	❑ PPE like face mask etc. will be provided during mining activity. ❑ Periodic medical examinations will be provided for all workers. ❑ Awareness program will be organized for workers.

7.8 SOCIO-ECONOMIC IMPACT ASSESSMENT

7.8.1 INTRODUCTION

Socio-Economic Impact Assessment (SEIA) refers to systematic analysis of various social and economic characteristics of human being living in a given geographical area. The geographical area is often called Study Area or Impact Area. SEIA is carried out simultaneously with Environment Impact Assessment (EIA). The objectives of the SEIA are as follows:

- ✓ To identify and assess socio-economic activities, which are significantly influenced by mining activities.
- ✓ To examine the perceptions of local communities' how mining activities can impact the socio- economic life of the people
- ✓ To suggest interventions that can assist in mitigating the negative impacts of mining

7.8.1.1 SCOPE OF THE PROPOSED STUDY

1. Collection of baseline data of the study area
2. To comprehend socio-economic status of people living in the study area
3. To assess likely impact of the project on social and economic life of the people in the study area
4. To measure the impact of the project on Quality of life of the people living in the study area
5. To ensure sustainability of positive impacts
6. To recommend mitigation measures on adverse impacts.

7.8.1.2 STUDY AREA

The study area, also known as Impact Area has been defined as sum total of core and buffer area with a radius of 10km from the periphery of the project site. The study area includes all the land marks both natural and manmade, falling therein.

The Sand Mining area is located in the Brahmani River. The lease area is devoid of any vegetation. It is a Government land exclusively allotted for open cast sand mining. Land adjoining to lease area is private agricultural land growing various crops.

7.8.2 IMPACT ON POPULATION COMPOSITION

In general, no impact is envisaged on the population composition of the study area as there will be no in-migration or out-migration of villagers. Since all the workers will be recruited locally in-migration of people in search of job in the proposed mining project is not expected. Similarly, chances of out migration of people due to environmental degradation resulting from mining activities are remote as sand is not so lethal even if it is handled loosely. Hence, there will be no negative impact on the population composition of the study area. If on the other hand, the project proponent is compelled to recruit few highly skilled workers from outside the study area the impact on population composition will be insignificant.

7.8.3 IMPACT ON EMPLOYMENT

For removal of Sand from the river bed the project proponent intends to recruit the local people. The total number of people to be recruited will depend upon quantity of minerals to be extracted over a period of time. In the initial period the number of such people will be less but gradually it will go up when the extraction of minerals will pick up. It is definitely a positive impact of the proposed mining project.

It has been proposed that the mining will be carried out by open cast semi mechanised method and also by manual means. The labours are mainly required for excavating of sand. It has been calculated that a total of 13 nos. manpower will be required for the purpose. Hence, there will be an overall improvement of socio-economic status of the people in the surrounding areas.

It is expected that total number of workers in the study area will increase, when the project will be in operation. Though, the percentage increase in employment generation is negligible but it is definitely a positive impact of the proposed mining project.

7.8.4 SCOPE FOR DEVELOPMENT AND MAINTENANCE OF ROADS IN THE AREA

Movement of trucks, dumpers and other vehicles to and fro the quarry site is expected to increase substantially, when the mine will start operation. The existing approach roads connecting the quarry with the national and state highways are narrow and uneven. There will be mud slides and traffic bottle necks if the road is not widened and their surface conditions are not improved to support heavy truck dumper traffic. Hence, there is a scope for development and maintenance of roads in the area. This is a positive impact of the project.

7.8.5 FLOOD CONTROL & PROTECTION TO LIFE AND PROPERTY

The study area is exposed to annual flood resulting to destruction of life and property. Due to proposed mining the river channel will become deep enough to hold the excess water that flows into the river during the rainy season. This will stop overflowing of the river submerging the fertile land on both sides of the river bank. In this way the proposed riverbed mining will save the standing crops and thousands of people and their property from the vagaries of annual floods. This is a positive impact of the project.

7.8.6 IMPROVEMENT IN QUALITY OF LIFE OF THE LOCAL PEOPLE

The mining project proposes to provide gainful employment to 72 people direct and indirect employment to about 6 people. This will add to their household income, and bring a positive change in their consumption pattern. The quality of life will improve to those households who will be benefitted by getting employment in the above mining project. This is a positive impact of the project.

7.8.7 IMPACT ON STATE INCOME

The upcoming mining project will make positive impact on state's economy as state's revenue will increase due to higher collection of royalty, dead rent, taxes and fees. This has been worked out by multiplying the sale price of mineral by rate of royalty (in percentage)

and total quantity of mineral produced/ dispatched. It is a positive and direct impact of the project on State's Gross Domestic product (SGDP).

7.8.8 IMPACT ON LAW & ORDER

As local people will be deployed to run the quarry, no law & order problem is envisaged. It is expected that the workers will attend to their duties from their residences and return to their homes after the day's work is over. There would have ethnic issues and subsequent law & order problem if the workers were migrants and lived-in shanties close to the mining area. However, to meet any untoward incident a police post may be set up close to the project area.

7.8.9 CHECK ON ILLEGAL MINING

Illegal sand extraction in the riverbed has far reaching impacts on the society as it creates disturbances in the social well-being of the people. There are instances of indiscriminate violation of 'Illegal Mining Rules' framed by various state governments. This has resulted to increase in the instances of conflicts in the area. Majority of the people who are engaged in illegal sand mining activities are outsiders with criminal backgrounds. They force the local people in different ways to sell their lands for extraction of sand and those who oppose them are physically attacked. Conflict between the criminal groups for the monopoly of sand mining is a usual scene in many areas across the country and in many cases it is fatal. In such cases the common people are helpless as they are often threatened by the mafias. Further, illegal mining brings windfall gain to the sand mafias resulting to conspicuous expenditures especially on drinking, which again causes law and order problem in the mining area and its surrounding areas. Thus illegal mining not only bring loss to the Government revenue but also create law and order problems in the mining area. The proposed mining project has legal backing since the lease has been granted by the Government and the miner will start operating the mine after the receipt of environment clearance and other permissions from the Government. Such projects with legal backing are expected to put a check on illegal mining and siphoning of government revenue.

7.8.10 IMPACT ON HEALTH

Mining is always a health hazard and extraction of Sand is no exception to that. The major health problem originates from mining of sand is the generation of dust and other pollutants. It exposes communities to airborne particulate matter that damages lungs of infants, children, elderly persons and those with existing health problems. This must be checked when mine starts operating, otherwise it will lead to permanent respiratory diseases.

TABLE 7-1 SOCIAL & ECONOMIC IMPACTS OF SAND MINING PROJECT

Sr. No.	Characteristics	Impact Type				
		Positive Impact		Negative Impact		No Impact
		Direct	In-direct	Direct	In-direct	
1	Population Composition	-	-	-	-	Yes
2	Formal Employment Generation	Yes	-	-	-	-
3	Informal Employment Generation	Yes	-	-	-	-
4	Increased Supply of sand for end users	Yes	-	-	-	-
5	Scope for promotion of sand based industries in the study area.	-	Yes	-	-	-
6	Scope for development and maintenance of roads in the area	-	Yes	-	-	-
7	Impact on Agriculture	-	-	-	-	Yes
8	Flood Control & protection to life and property	Yes	-	-	-	-
9	Improvement in Quality of life of the local people	-	Yes	-	-	-

10	Increase in State Income	Yes	-	-	-	-
11	Impact on Law & Order	-	-	-	-	Yes
12	Check on illegal Mining	Yes	-	-	-	-
13	Impact on Health	-	-	Yes	-	-

It may be seen from the above table that the up-coming mining project at Kantio-Putasahi will yield positive impact in most cases, negative impact on two cases and no impact on one case.

7.9 SUGGESTIONS

Under community health programmes, the mine operators will be encouraged to invest in the building of healthcare infrastructure like hospitals, clinics, health education resources, emergency response personnel and equipment, doctors, nurses and hygienists. Given below are few steps to be taken by the mine operator to meet any health hazard during the course of mining practices.

7.9.1 SAFE WORK ENVIRONMENT

The project proponent ensures health and safety of all the employees at work. He intends to provide and maintain a safe work environment and ensures that the machinery and equipment in use will be safe for employees. He further ensures that work arrangements will be non-hazardous to employees.

7.9.2 PROVISION OF FIRST AID:

There will be provision for First Aid and the first aiders will be well trained in handling patients working in mines.

7.9.3 REGULAR HEALTH EXAMINATION:

Periodical medical examination as per Mines Rule 1955 will be undertaken for all the mine workers. Regular health examination will be compulsory for all workers engaged in extraction of minerals. The regular health examination will cover treatment of serious back injury; existing asthma or respiratory diseases, existing skin diseases, lung function test

(pre and post ventolin), Audiograms, Chest X- ray, for detection of Silicosis as per mines Act. etc.

7.9.4 NO WORK FOR TEMPORAL DISABILITIES:

The workers having temporary disability will stop doing the job till he/she recovers from disabilities.

7.9.5 HEALTH EDUCATION:

Adequate health education and information related to the job will be provided to the workers. Baseline health information will be recorded for future references.

7.9.6 TIE UP WITH THE NEAREST HOSPITAL FOR MEDICAL HELP

To meet the medical needs of the mine workers tie-ups with nearest hospitals will be made. Efforts will be made to reserve few beds in the above hospitals for the workers of the upcoming mining project. This will ensure timely medical aid to the affected persons.

7.9.7 SUPPLY OF MASK, GLOVES ETC.

The workers in the sand mine are subject to respiratory diseases. For protection from dust it will be made compulsory for all workers to wear masks and gloves, while working in the mine.

7.9.8 ADMINISTRATION OF ANTI-VENOM INJECTIONS

Provision of Anti-venom therapy will be made available for administration to the workers in case of snake, spider and insect bites, while working in the mine.

7.9.9 SPECIAL TELEPHONE NUMBER

A special telephone number will be made available to the workers in case of emergency so that they can dial the same for medical assistances. Further, efforts will be made to provide vehicles to the patients in short duration for shifting to the health institutions.

7.9.10 SPECIAL GROUP INSURANCE SCHEME

All the mine workers will be covered under a Group Insurance Scheme of LIC or any other Insurance company to achieve economic objectives and social obligations.

7.10 CORPORATE ENVIRONMENTAL RESPONSIBILITY

Corporate Environmetnal Responsibility (CER) refers to responsibility of a company to ensure positive impact on environment, consumers, employees, communities, stakeholders and all other members of public sphere. CER is seen more as a responsibility towards society / Environment rather than a business promotion activity. It is the need of the day for expansion of occupational welfare. The project proponent of the upcoming sand mining project in village Kantio-Putasahi, has already identified the activities, which are proposed to be undertaken for the benefits of the local community. This will not only improve the socio-economic status of the people but also enhance the reputation of the project proponent among the general public. The project proponent proposes to spend about Rs. 1.0 Lakhs. The list of activities proposed to be taken up by the project proponent list indicated below.

- ✓ Health camps for local community
- ✓ Financial assistance to schools for construction and maintenance of toilets separately for males and females.
- ✓ Repair of village roads
- ✓ Construction of Vats for dumping of garbage
- ✓ Repair of wells, tube wells and hand pumps

7.11 CONCLUSION

During the course of the study some factors were identified that may influence the socio-economic life of the people in the study area. Except one all of them are positive impacts, which are expected to increase the quality of life of the local people. Beside the above the mining will bring revenue to the government.

The implementation of the quarry will generate both direct and indirect employment for the local jobseekers. Besides the above it will bring a check on illegal mining in the district. Since the quarries have been allotted by the Government on lease basis, mining operation will be legally valid It is expected that intending entrepreneurs will venture to set up micro and small scale units in the near future making the area a mixed society, dependent on industry, trade and business. At present agriculture is the main occupation of the people. With

the implementation of the proposed mining project the occupational pattern of the people in the area will change making more people engaged in industrial and business activities rather in agriculture. Thus, there will be a gradual shifting of population from agriculture to mining and industry. It thus proves that "Sand Mining activities have significant socio-economic impacts on livelihoods of local communities.

However, care has to be taken to discourage illegal mining that results to social tension, conflicts and alcoholism that may pose a threat to the well being of the people living in the neighborhoods of the mining area.

8 PROJECT BENEFITS

8.1 GENERAL

The demand of Sand has been rising in the state as a result of rising in construction activities and development of the proposed project aims to fulfill the supply of Sand. Hence, the fine quality of mineral will be used further for development. The sediment in the form of river bed material (RBM) deposited is of critical importance in civil and other infrastructural activities. The proposed project lies on the river bed of Yamuna. The quality of Sand is fine and appropriate for the mega infrastructural activities. The demand for Sand is ever growing with the growth of the infrastructure sector in our country. The mineral is used mainly in the construction activities like buildings, bridges etc. The requirement for the mineral is always high in the nearby cities and towns. Therefore, there is always a good demand of the mineral in the domestic market. The local region demand is increasing; hence newer areas for Sand reserves are approached.

This will also generate much needed employment to the local people. Economy of the area will get a boost and there will be overall growth of the region in terms of education, health, training, transport, automobile, industry. The standard of living accordingly will also get an upliftment on the positive side.

8.2 EMPLOYEMENT

8.2.1 DIRECT EMPLOYMENT

During the operational phase, about 13 people will be employed directly. Considering that some of the skilled personnel to be employed for the project will be from outside the area and unskilled/ semiskilled personnel will be from within the study area, the project will add to the well being of the area. In addition to the workforce the indirect employment will also be generated for local persons. It will help in bringing prosperity to the area.

8.2.2 INDIRECT EMPLOYMENT

The project will also provide some indirect employment to the people of nearby area of mine site. Some people will get engaged in some shops like tea shop, vehicle repair center etc. It will also provide some need based opportunity to the local public. The project will provide following indirect employment to the local people:-

- ✓ The SAND available will provide agency employment in the value chain analysis, for place utility and retail.
- ✓ Transportation and warehousing in the region required to transfer the mineral will eventually be needed and therefore trucks and jobs in logistical activities will come up.
- ✓ There will be development of externalities for the mine workers petty shops (tea, repair stations for trucks etc.) as supporting services.
- ✓ As there would-be vocational training camps and Technical Training of mining to the regional people, hence there will be potential manpower available for the proposed and surrounding mines of the Tehsil.
- ✓ This would create Indigenous Technologies for sustainable development.

8.3 IMPROVEMENTS IN PHYSICAL AND SOCIAL INFRASTRUCTURE

The proposed project will enhance the socio-economic activities in the adjoining areas. This will result in following benefits:

- ✓ Improvements in physical infrastructure.
- ✓ Improvements in social Infrastructure.
- ✓ Increase in employment potential.
- ✓ Contribution to the exchequer.
- ✓ Prevention of illegal mining which will help in sustaining the river and its aesthetic value.
- ✓ Post-mining enhancement of green cover.

8.4 IMPROVEMENTS IN SOCIAL INFRASTRUCTURE

There will be some obvious changes in various environmental parameters due to mining activity. Increase socio-economic activities, creation of new employment opportunities, infra-structural development, better educational and health facilities.

Following are the benefits in specific area of social domain: -

Socio-Economic: - There will be positive impact in socio-economic area due to increased economic activities, creation of new employment opportunities, infrastructural development and better educational and health facilities.

Health Care Facilities: - Company will undertake awareness program and community activities like health, camps, family welfare camps, AIDS awareness program etc.

Employment Potential: - There is a possibility of creation of direct and indirect employment opportunities due to working of this mine.

8.4.1 THE MINE WILL CONTRIBUTE TO THE EXCHEQUER OF STATE AND CENTRAL GOVERNMENT AS PER NORMS.

The lease area is in the river bed and devoid of any vegetation. Mining activities will not cause any harm to riparian vegetation cover as the working will not extend beyond the offset left against the banks. Plantation will be carried out as social forestry programme in villages, school and the areas allocated by the Panchayat / State authorities.

Plantation has been proposed on both sides of the roads as greenbelt to provide cover against dust dissemination. A massive plantation will be done nearby the mine area to mitigate the ill-effects of mining and to improve environment of its surrounding area

Plantation work will be carried out at the safety zone of the lease area. 50 number of saplings proposed during plan period will be planted. Plantation shall be done with suitable local species like teak, mango, jammu, jhaun, neem etc. per year and also along the approach road during the plan period.

8.5 HEALTH

Periodic medical checkups as per Mines Act / Rules and other social development and promotional activities will be undertaken. All this will assist to lift the general health status of the residents of the area around mines.

8.6 OTHER BENEFITS

The other tangible benefits include metrics and improvements demonstrating process and system cost savings, compliant inspections and customer audits, faster product approvals and manufacturing throughput, less rejected material, reduced nonconformance issues, and more efficient continuous improvement and project implementation. Intangible benefits include improved staff morale, quick, more accurate and transparent decision making,

increased staff accountability and an enhanced culture of quality throughout the organization.

9 ENVIRONMENTAL COST & BENEFIT ANALYSIS

Not applicable as this chapter is needed if recommended at the scoping stage

10 ENVIRONMENTAL MANAGEMENT PLAN

10.1 INTRODUCTION

A project specific Environmental Management Plan has been formulated subsequent to an EIA study as per the requisite Terms of Reference to ensure that the appropriate environmental management practices are followed in compliance with the environmental legislation.

It has been evaluated that the study area has not been affected adversely with the proposed activity and likely to get new economical fillip, not only for the study area but also for the region as a whole.

Environmental Management for the mining activity is discussed for environmental impact pertains to the operational phase. Even though is reversible in nature all the impacts will be visible only during operational phase. The EMP will therefore be initiated during operational phase.

10.2 CRITICAL ACTIVITIES FOR EMP IMPLEMENTATION

1. Training and Environmental Awareness;
2. Documentation and record keeping;
3. Reporting Procedures;
4. Stakeholder/ Project Proponent engagement;
5. Auditing;
6. Responding to Non-compliance.

10.3 ENVIRONMENTAL MANAGEMENT PLAN

S.No.	Particular	Management Plan
1.	Land Environment	➢ 50m offset will be left against the banks to protect from side collapse. ➢ Soil quality will be monitored from strategic locations and analysis will be done once in every two years. ➢ To prevent erosion, moving the road or footpath will be kept

		away from the river's edge. ➢ Care will be taken to ensure that ponding is not formed in the river bed.
2.	Water Environment	Based on baseline data, corrective measures will be taken. ➢ Measurement of water level fluctuations to assess impact of mining activity on the water table depletion in close proximity of dug wells and bore wells. ➢ Rainwater harvesting (percolation tank) has been proposed for augmenting ground water resources and for arresting/ reversing the declining trends of ground water levels. ➢ Regular monitoring and analysis of water samples at strategic locations will be carried out to monitor the water quality of the area.
3.	Air Environment	**Unpaved Roads** ➢ Water sprinkling will be done for dust suppression. ➢ Leveling of roads will be done to maintain the uniform speed of the trucks/tippers. **Paved Roads** ➢ The roads will be maintained. ➢ Regular cleaning will be done to reduce the chances of road dust to become airborne. ➢ Water sprinkling will be done on a fixed stretch of paved road passing through the villages. ➢ Adequate transportation routes will be decided to transport the mineral and will be maintained properly. ➢ Speed breakers will be constructed to restrict the speed of transporting vehicles. However, limiting of vehicular speed will be adopted. **Transportation** ✓ The vehicles will be maintained to control the air emissions. ✓ The speed of the vehicles will be maintained uniform. ✓ PUC certified vehicles will be used.

		✓ The loaded vehicles will be covered with tarpaulin. ✓ Over loading will be avoided.
4.	Noise Environment	Regular inspection and maintenance of vehicles and equipment will be performed to ensure efficiency and worn parts will be replaced. ➢ Limited numbers of equipments will be used on-site. ➢ The vehicles will be maintained in good condition and overloading will be avoided. ➢ Speed limits will be enforced in relation to road conditions and on-route communities. ➢ Road surfaces will be maintained in good condition to reduce tyre noise and to assure continuous traffic flow to avoid prolonged idling. ➢ Noise monitoring will be conducted on a regular basis to determine compliance with noise criteria. ➢ Personal protective devices i.e., earmuffs and earplugs will be provided to workers, working in high noise areas. ➢ Periodical medical checkup will be organized for all workers to check any noise related health problems.
5.	Occupational Health and Safety	**Heat & Light** ➢ The mine site will have adequate drinking water supply so that workers do not get dehydrated. ➢ Lightweight and loose fitting clothes having light colors will be preferred to wear. ➢ Rigorous exercise and more physical activities will be avoided in hot weather. **Noise** ➢ Noise exposure measurements will be taken to determine the need for noise control strategies. ➢ The personal protective equipment will be provided for mine workers. ➢ Supervisor will be instructed for reporting any problems with hearing protectors or noise control equipment.

		➢ At noisy working activity, exposure time will be minimized. ➢ Machineries will be labeled with noise levels. **Dust Control** Dust generating sources will be identified and proper control measure will be adopted. ➢ Face mask will be provided during mining activity. ➢ Periodic medical examinations will be provided for all workers. ➢ Awareness program will be organized for workers.
6.	Biological Environment	➢ Mining activities will not cause any harm to riparian vegetation cover as the working will not extend beyond the offset left against the banks. ➢ The lease area is devoid of any vegetation. Hence, It is proposed to develop social forestry in the approach villages at public places like School, PHC's, Panchayat Bhawan with due permission from Panchayat and in consultation with Forest Department/ local authorities. ➢ The green belt development will be carried out by Project Proponent and maintenance will be done by the villagers/NGO's with their active participations.
7.	Socio-Economic Aspect	➢ Direct employment to the local people which help to sustain their livelihood. ➢ During the operational phase by the implementation of certain CER activities indirect employment will also generate. ➢ Improved livelihood. ➢ Training will be provided to the local persons ➢ Awareness programme will be organized.

10.4 ENVIRONMENTAL MANAGEMENT PLAN

The Project Proponent is quite conscious of its responsibility for maintaining clean and a healthy environment. The management is also keen to modify and make more efficient measures towards suppression of pollution sources. Adequate fund for Pollution Control

Measures is provided as a part of overall project financing to ensure the availability of proper treatment facilities. This cost will be spending phase wise along with the growth of project.

The estimated cost of the project is Rs. 40.00 Lakhs. A budget of Rs 2.50 Lakhs as capital cost and Rs. 6.0 lakhs as recurring cost is allocated for environment protection measures. The details are given below:

TABLE 10-1 EMP COST DETAILS

S. No	Particulars	Capital Cost (INR)	Recurring Cost (INR)
1	Air pollution Control: Dust Suppression/ Water Sprinking	1,00,000	1,00,000/-
	Road Maintanace	50,000	2,00,000/
	Greenbelt	1,00,000	50,000/-
2	Personal Protective Equipment	-	50,000/-
3	Environmental monitoring	-	1,00,000/-
4	Social Welfare Measures	-	1,00,000
Total		**2,50,000/-**	**6,00,000/-**

10.5 CONCLUSION

Various aspects of mining activities were considered and related impacts were evaluated. Considering all the possible ways to mitigate the environmental concerns Environmental Management Plan was prepared and fund has been allocated for the same. The EMP is dynamic, flexible and subjected to periodic review. For project where the major environmental impacts are associated, EMP will be under regular review.

Senior Management responsible for the project will conduct a review of EMP and its implementation to ensure that the EMP remains effective and appropriate. Thus, the proper steps will be taken to accomplish all the goals mentioned in the EMP and the project will bring the positive impact in the study area.

11 SUMMARY & CONCLUSION

11.1 BACKGROUND OF THE PROJECT

Brahmani River Sand Quarry, Kantio-Putasahi is a sand mining project over an area of 12.50acres/ 5.06Ha. Located in village - Kantio-Putasahi, Tahasil - Kamakhyanagar in District - Dhenkanal of Odisha. The mining lease granted by Tahasildar, Kamakhyanagar, Dhenkanal will be auctioned and leased out to the successful bidder after obtaining statutory clearances by Tahasildar Kamakhyanagar, District- Dhenkanal. The mining lease will be granted on for long term basis for 5 years and the lease period will start from the date of registration of executed lease deed and attached as **Annexure-I.** The Mining Plan has been approved on dated 29.04.2020 with vide letter no. 421/DZ by the approving authority, Office of the Joint Director, Geology, Zonal Survey, Dhenkanal and attached as an **Annexure-II**. It is relevant to mention here that approval of Mining Plan has been conferred under section 2 of Rule 28 (4) of OMMC, 2016 as per clause 5. As per EIA notification 2006 and subsequent amendments, the project is coming under B1 Category and the lease area is more than 5.0 Ha.

The Brahmani River Sand quarry, Kantio-Putasahi is on Khata no- 857, Plot no- 6980 of Kisam Nadi at village Kantio-Putasahi in Kamakhyanagar Tahasil in Dhenkanal District of Odisha. The mining lease area is listed as an identified sand minor mineral in the DSR Serial No-52, of the Dhenkanal district. The sand quarry lies on river bed Brahmani.

Brahmani River Sand Quarry, Kantio-Putasahi, is a minor mineral project for exploitation of river sand. The average production is proposed to be 18210 cum/year and 91050cum is the total production during the plan period. This sand would be mainly used for civil works in major projects and infrastructures development so as to meet the market potential.

As per the Environmental Impact Assessment (EIA) Notification dated 14th September 2006 and its subsequent amendments, the proposed Brahmani River Sand Quarry project falls under 'Category B1', since the project is more than 5.0 Ha.

11.2 PURPOSE OF THE REPORT

The purpose of the report is to identify environmental aspects, impacts and mitigation measures arising out from the proposed project and to prepare EIA report as per the Terms of Reference (ToR) finalized by State Level Expert Appraisal Committee of Odisha vide The ToR application submitted to SEIAA, Odisha on 23.11.2020 with proposal No. SIA/OR/MIN/58509/2020. SEIAA meeting was held on 11.12.2020. ToR was issued with F.No.10259/SEIAA dated: 17.12.2020. ToR letter is enclosed as **Annexure –III** for the preparation of EIA/EMP report.

Tahasildar, Dhenkanal as part of the compliance from SEIAA has appointed Environmental Consultants who are accredited by National Accreditation Board for Education and Training (NABET), Quality Council of India (QCI), New Delhi.

The total extent of area is 5.06ha for which Environmental Clearance is required with proposed 18210cubic meters /year and total production capacity 91050M^3 for five years. The total project cost is Rs. 40 Lakh only.

11.3 LOCATION OF THE PROJECT

The total extent area of the lease for this quarry is 5.06Ha at Kantio-Putasahi Village, Kamakhyanagar Tahasil, Dhenkanal District and Odisha State and has been granted by Tahasildar, Kamakhyanagar. In this proposal, Tahasildar Kamakhyanagar is the applicant and the lease will be auctioned and granted to the successful bidder after obtaining statutory clearance for a period of total 5 years. The area under discussion is featured in Survey of India Topo Sheet No – (73H/9) and is bounded between the Latitude -20° 45’ 44.86” N to 20° 45’ 54.35” N & Longitude – 85° 30’ 05.03” E to 85° 30’ 18.05” E. The Lease area is located at a distance of 15 kms from Dhenkanal town, 19km from Tahasil Kamakhyanagar and 66 kms from the State Capital Bhubaneswar. Sadashibapur Railway Station is the nearest railway station located at a distance of 3.0 kms from the lease area. Nearest Road Bridge is at a distance of 5.90 kms from the mining lease. Darajang road connecting to the lease area with the District road is at distance of 5.18kms. NH – 42 is the nearest major district road which is at distance of 4.35 km. SH 64 is the nearest State Highway which is at a distance of 30.16 kms.

TABLE 11-1 PROJECT SUMMARY & SALIENT FEATURES OF PROJECT

S.No.	Particulars	Details
21.	Land use at the Project Site	Mining will be carried out at the site for ordinary sand as construction material (Aggregate)
22.	Nearest Highway	Nearest Road bridge is at a distance of 5.90 kms from the mining lease. Darajang road connecting to the lease area with the District road is at distance of 5.18kms. NH – 42 is the nearest major district road which is at distance of 4.35 km. SH 64 is the nearest State Highway which is at a distance of 30.16 kms.
23.	Nearest Railway station	Sadashibapur Railway Station, 3.0 Km (S)
24.	Nearest Village	Kantio-Putasahi is 1.2 km from the proposed area in NE direction
25.	Nearest Major Settlement	Kantio-Putasahi is 1.2 km from the proposed area in NE direction
26.	Nearest Major Town	Kamakhyanagar is 18 km from the proposed area in NE direction.
27.	Communication Network	Amenities like Telephone, Post and Telegraph Office, Police Station, Primary Health Center etc., are available at Kantio-Putasahi.
28.	Education	Primary School Education is available at nearby village. Higher Education are available at Kantio-Putasahi.
29.	Medical Facility	RMP Doctor is available at Kantio-Putasahi, Nursing Homes and Hospitals are located at

		Kantio-Putasahi.
30.	Availability of Water	The ground water level is about 4m to 14m below sand level.
31.	Availability of Electricity	Electricity is available in all human settlements
32.	Hills/Valleys	Nil
33.	Ecologically Sensitive Zone (Wild Life Sanctuaries)	Nil
34.	Reserved Forests	➢ Machhia Reserved Forest, 4 km, NE ➢ Korian Reserved Forest, 9 km, SE ➢ Maharagadi R.F, 3 km, in SW direction ➢ Alnabereni R F, 9 km, N
35.	Water Bodies	➢ Bega Nadi, 0.1m, SW direction ➢ Indrajit Nadi, 0.2km, N direction ➢ Agana Nadi, 8km,SW direction
36.	Defence Installation/ Historical Monuments/ Archaeological/ Ports	Charbatia Air Base, Cuttack is the nearest defense installations from the mining lease located at a distance of 46.0 kms.
37.	Historical Places	Nil
38.	Areas occupied by sensitive man-made land uses (Hospitals, schools, places worship, community facilities)	The mining lease is at a distance from areas occupied by sensitive man-made land uses – There is a temple at a distance of 1.3 km from the mining lease. Schools and RMP doctors are available at Kantio-Putasahi village.
39.	Nearest River	Brahmani River
40.	Areas susceptible to natural hazard which could cause the project to present	The area is not sensitive to earthquakes, subsidence, landslides, erosion, flooding or

	environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions) similar effects	extreme or adverse climatic conditions. Zone-II (Least Active)

11.4 SIZE OR MAGNITUDE OF OPERATION

In this mining lease area only 5.06 hectare area is available for mining as per Terms of Reference approved by SEIAA; Odisha for the Proposed production capacity around 18210 M^3 for five years. It is an open cast mine and it is proposed to do mining by manual method.

Existing land use pattern:

Type of land use	Area (Ha.)
Water channel area	0.315
Left over area adjacent to water channel	0.176
Quarry Safety zone area	0.514
Water logged area	Nil
Potential Mineable surface area within the plan period	4.055
Total	**5.06**

Life of the Mine

Life of the Quarry = 5 YEARS

11.5 MINING & METHOD OF MINING

The mining operations will be carried open excavation with manual method only.

11.5.1 PRODUCTION FOR THE THREE YEARS PLAN PERIOD

It is proposed to produce the ordinary sand and from the Southern boundary of sand reach area during the plan period.

Year	Production in m^3
1st	18210
2nd	18210
3rd	18210

4th	18210
5th	18210
Total	**91050**

11.5.2 EXTENT OF MECHANIZATION

Manual Method will be used in sand open excavation without affecting the ground water table.

11.6 WATER REQUIREMENT

Water requirement for the project will be 2.5 KLD. Water required in the project will be for drinking purpose and dust suppression, which will be sourced from water tanker.

11.7 POWER REQUIREMENT AND SOURCE

Power Requirement will not be required for operations as the mining will be worked out during day time only. Minimal power required for office shall be taken from the general electric supply of the area.

11.8 MAN POWER REQUIREMENT

Employment Generation from the project is 13 nos. of people. OMS has been assumed to be 5.41 cum. Indirect employment through creation of shops/ stalls, hired vehicles, etc. also can be generated to full fill the day-to-day requirements of the mining personals.

11.9 SITE SERVICES

All the site services and other facilities including regular & periodic health checkup, Eye camp, Adult & Female education & training programmes shall be provided outside nearer to the lease.

11.10 PROJECT COST

Project cost of the project is 40 Lakh.

11.11 SUMMARY OF ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION

The summary of anticipated adverse environmental impacts and mitigation measures are given in Chapter -4.

11.12 CONCLUSIONS

The proposed dry sand mining project will have marginal impacts on the local environment with proper mitigation measures with the effective implementation of the environment management measures as suggested in the EIA/EMP report and as recommended by MoEF&CC/ SEIAA, CPCB and State Pollution Control Board, the negative impacts will be minimized to a great extent. However, development of this project has beneficial impact/effects in terms growth in regional economy, transform the region's economy from predominantly mega infrastructure development and construction activities, increase Government earnings and revenues and accelerate the pace of development in the region.

The proposed project will provide employment to number of personnel. This project will also generate indirect employment to a considerable number of families, who will render their services for the employees of the project.

The project will also encourage ancillary industries in the region, which will not only increase the employment potential but also the economic base of the region will be further strengthened.

Thus, in view of considerable benefits from the project, the proposed project is advantageous to the region as well as to the nation.

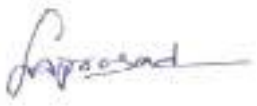
12 DISCLOSURE OF CONSULTANT

Declaration by Experts contributing to the Draft EIA of Kantio-Putasahi Sand Mining of Brahmani River over an area of 5.06 Hectares in Khata No:.875, Plot No.6980,Kisam: Nadi, Kantio-Putasahi Village, Kamakhyanagar Tahasil, Dhenkanal District, Odisha.

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

EIA coordinator: Name:

P. Hari Prasad

Signature: 

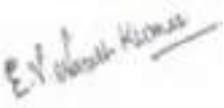
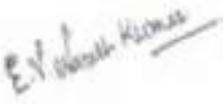
Period of involvement: September - 2019 - Till date

Contact information: M/s Rightsource Industrial Solutions Pvt. Ltd. Plot No: 203, H.No:5-36/203, Prashanthi Nagar, IDA, Kukatpally, Hyderabad –500072.

Ph: 040-23070602, 23075699.info@rightsource.co.in, peddihari@gmail.com

Functional Area Experts:

S. No.	Functional areas	Name of the expert/s	Involvement (period and task**)	Signature
1	AP	Yarlagadda V. Prasad	Task: Selecting ambient air monitoring sites based on IMD data, Review of the meteorological data, Process emissions and AAQ data, suggesting air pollution control measures.	
2	WP	P. Chiranjeevi Rao	Task: Identification of water monitoring sites, estimating water requirement, Suggesting Recycling of water, waste water treatment methods & disposal schemes.	
3	SHW*	P.S.N. Murthy	Task: Inventorization of Hazardous waste, Solid wastes, etc., suggesting treatment options viz., landfill, incineration, recycling, and stabilization.	

4	SE	Setti VR Bhaskara Rao	Task: Generating primary SE data, livestock inventory and impacts, conducted focused group discussions, taken public opinion on the project. Identified villages wise amenities and needs	
5	EB	Dr. K. Bayapureddy	Task: Collected secondary data from forest/ agricultural/ fisheries department, generation of primary flora and fauna data from study area & core area, ground truthing for ecological assessment, development of status report, suggested species for greenbelt development.	
6	SC	Dr. K. Bayapureddy	Sampling, analysis and characterization of soil for duggesting suitable soil conservation measures.	
7	HG	E. V. Naresh Kumar	Task: Measurement of ground water levels from the existing wells present in and around project site, observation of surface water bodies, establishing groundwater flow direction and its gradient and evaluation of rainfall data and suggesting suitable depth for secured land fill base, and identification of development of monitoring wells.	
8	GEO	E. V. Naresh Kumar	Task: Observations made towards the Identification of country rock, development of porosity, thickness and extent of weathered formations, area seismicity and evaluation of soil permeability for suggesting suitable civil structures.	
9	AQ	P. Praveen Kumar	Task: Meteorological & Air Pollution dispersion studies, suggesting environmental management plan for air pollution control measures	

10	NV	Yarlagadda V. Prasad	Task: Monitoring of noise / vibration levels using instrument, processing and analysis of Data for suggesting suitable noise mitigating measures	
11	LU	Dr. Y. Rama Mohan	Task: Collection of GPS readings from the project site and prepared layout, preparation of TOPO map through SOI 1:50,000 scale TOPO sheet. Collections of ground through data from the field. Preparation of LU map through Satellite imagery, SOI, Google map & Ground through data.	
12	RH	P.S.N. Murthy	Task: Identification of Hazards and Hazardous substances from process & warehouse, storage tanks .Risks and consequence analysis using software and lethality damages, DMP and EPP for onsite & offsite were provided	

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

I, Yarlagadda V. Prasad, hereby, confirm that the above-mentioned experts prepared the Draft EIA of Kantio-Putasahi Sand Mining of Brahmani River over an area of 5.06 Hectares in Khata No:.857, Plot No.6980, Kisam : Nadi, Kantio-Putasahi Village, Kamakhyanagar Tahasil, Dhenkanal District, Odisha State. I also confirm that the consultant organization shall be fully accountable for any mis-leading information mentioned in this statement.

Signature: 

Name: Yarlagadda V. Prasad

Designation: Managing Director

Name of the EIA consultant organization: **M/s Rightsource Industrial Solutions Pvt. Ltd.**

NABET Certificate No. & Issue Date: NABET Accreditation No: NABET/EIA/1821/RA 0100, September, 07,2018.

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DI-23/12/2020

24/12/2

State Environment Impact Assessment Authority, (SEIAA), Odisha

Qr. No. 5RF-2/1, Unit – IX, Bhubaneswar – 751022, Tel: 0674-2540669

No. 10259/SEIAA

Dt. 17.12.2020

SEIAA File No. SIA/OR/MIN/58641/2020

To

The Tahasildar
Kamakhyanagar Tahasil
Dist- Dhenkanal

Sub: Proposal for EC for Kantio-Putasahi Sand Quarry over an area of 12.50 acres/ 5.06 Ha. at - Kantio-Putasahi, Tahasil – Kamakhyanagar in the district of Dhenkanal of Tahasildar, Kamakhyanagar - Terms of Reference Reg.

Ref: 1) Your online application dated 27.11.2020 for issue of ToR vide Proposal No: SIA/OR/ MIN /58641/2020

2. SEIAA meeting held on 11.12.2020.

Sir,

This has reference to the online proposal submitted in the Ministry of Environment, Forest and Climate Change (SEIAA, Odisha) to prescribe the Terms of Reference (TOR) for undertaking detailed EIA study for the purpose of obtaining Environmental Clearance in accordance with the provisions of the EIA Notification, 2006. For this purpose, the proponent had submitted online information in the prescribed format. (Form-1) along with Pre-feasibility Report and Approved Mining Plan.

In this regard, under the provisions of the EIA Notification 2006 as amended, the Standard ToR for the purpose of preparing environment impact assessment report and environment management plan for obtaining prior environment clearance is prescribed with public hearing is enclosed along with specific ToR as mentioned below.

Specific ToRs

1. Whether it is an existing mine? If yes, submit the copy of Environmental Clearance and compliance to EC conditions from the Regional Office, SPCB. The year which last operated.

   1(a) The project proponent has to carry out by engaging appropriate consultant, a study of the annual replenishment rate of sand by collecting pre monsoon &

post monsoon data from the field to know the quantum or volume of sand deposited /replenished & extracted in the mining lease area. The detailed comparison of both pre monsoon and post monsoon elevation data shall be included in the study report. The replenishment rate of sand may be studied as per the procedure laid down in the Enforcement and Monitoring Guidelines for Sand Mining, 2020 (www.moef.gov.in) issued by the MoEF&CC, Govt. of India. The finding of the study shall be submitted to SEIAA along with the final EIA / EMP report to assess the rate of replenishment of mined out sand.

2. Area of the 'no mining zone' specially demarcated within the list out area for safety of the river bank / any bridge or such other structure nearby; and the dimensions and geo-co-ordinates of this zone w.r.t lease boundary.
3. Any approach road existing or will be constructed inside the safety zone?
4. Mitigation measures to be taken to ensure not to disturb free flow of river.
5. Distance of the river bank / embankment form the lease boundary. It is a river bank or embankment?
6. Any ramp existing or will be constructed on the river bank / embankment for movement of vehicles to reach the nearest road.
7. Distance of the village road / city road / district road / public road for the river bank. Is this road single road / double road?
8. No. of village (s) and name of village (s) or the city (s) or urban place (s) or semi urban place (s) through which the sand carrying vehicles will ply and the distance of it from the river bank or embankment whether there is any forest land in the intervening area through which the sand carrying trucks will ply.
9. Whether schools / colleges / hospitals / health centers / bus stops / religious places existing nearby and if so, the distances of it from the bank or the road through which the vehicle will ply or existing alongside the road?
10. Any plantation done in the safety zone or embankment in case of an existing mines and if so, the area of plantation, number of species.? If not, the plan for it to arrest bank erosion.
11. Any stone packing in the river bank / embankment existing in case of existing mines and if not, the plan for it.
12. Whether, any alternative mine exists or explored or can be explored if this mine is otherwise found unsuitable? Please furnish details.
13. (i) Whether permission taken or will be taken from Water Resource Authority or the concerned Authority of the roads to be used for plying of vehicles loaded with sand or empty vehicles for the same after the river bank.
    (ii) Responsibility of perennial perpetual maintenance of these roads and the mechanism for the same.
14. No and type of vehicles to be used daily and the frequency for the purpose of transportation and the time and duration of such transportation. Whether permission taken or will be taken for the appropriate authority for the purpose.
15. Intersection point of the haulage roads with the main SH / NH / public road and the traffic density study at appropriate locations by domain expert with remedial measures for decongestion and road safety.
16. (i) Any bridge (road / rail) existing and the distance of it from the lease boundary.
    (ii) Any culvert or small bridge will be used by the plying vehicles carrying the sand minerals.

17. Any High Transmission Electric line existing and if yes, the distance of the same from the boundary of the lease.

Yours faithfully,

16.12.2020
Member Secretary

Memo No. 10260/SEIAA Dated 17.12.2020

Copy forwarded to

1. The ADM & Collector, Dhenkanal for information and necessary action.
2. The Deputy Secretary, of MM&S Branch of Revenue and DM Department, Govt. of Odisha Bhubaneswar for information.

16.12.2020
Member Secretary

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

Terms of Reference (TOR) for preparation of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for "Mining of Minerals" as per the EIA Notification, 2006 has been devised to improve the quality of the reports and facilitate decision-making transparent and easy. TOR will help the project proponents to prepare report with relevant project specific data and easily interpretable information. TOR for mining of minerals is expected to cover all environmental related features.

Mining of minerals plays a positive role in the process of country's economic development. In addition to the contribution towards economic growth, mining can also be a major source of degradation of physical as well as social environment, unless it is properly managed. Environmental impacts can arise during all activities of the mining process. Minimizing the damage due to mining operations depends on sound environmental practices in a framework of balanced environmental legislation. The potential adverse effects of mining activities include air pollution, surface and groundwater pollution, noise and vibration, damage to local ecology, natural topography and drainage, depletion of water resources etc. All these environmental components are required to be considered while selecting a proper methodology of mining, mitigation measures to reduce pollution load, conservation of natural resources etc.

The projects of mining of minerals as stated in the schedule require prior environment clearance under the EIA notification, 2006. Category 'A' Projects are handled in the MoEF&CC and Category 'B' projects are being handled by the respective State Environment Impact Assessment Authorities (SEIAAs) notified by MoEF&CC and following the procedure prescribed under the EIA Notification, 2006. As per this Notification, as amended, the projects of mining of minor minerals with mining lease area equal to or greater than 50 hectare are to be handled at the level of the MoEF&CC for grant of EC. Such projects with mining lease area less than 50 hectare are to be handled by the respective State Environment Impact Assessment Authority (SEIAA).

1(a):STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR NON-COAL MINING PROJECTS AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

1) Year-wise production details since 1994 should be given, clearly stating the highest production achieved in any one year prior to 1994. It may also be categorically informed whether there had been any increase in production after the EIA Notification 1994 came into force, w.r.t. the highest production achieved prior to 1994.

2) A copy of the document in support of the fact that the Proponent is the rightful lessee of the mine should be given.

3) All documents including approved mine plan, EIA and Public Hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management, mining technology etc. and should be in the name of the lessee.

4) All corner coordinates of the mine lease area, superimposed on a High Resolution Imagery/ toposheet, topographic sheet, geomorphology and geology of the areashould be provided. Such an Imagery of

the proposed area should clearly show the land use and other ecological features of the study area (core and buffer zone).

5) Information should be provided in Survey of India Toposheet in 1:50,000 scale indicating geological map of the area, geomorphology of land forms of the area, existing minerals and mining history of the area, important water bodies, streams and rivers and soil characteristics.

6) Details about the land proposed for mining activities should be givenwith information as to whether mining conforms to the land use policy of the State; land diversion for mining should have approval from State land use board or the concerned authority.

7) It should be clearly stated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large,may also be detailed in the EIA Report.

8) Issues relating to Mine Safety, including subsidence study in case of underground mining and slope study in case of open cast mining, blasting study etc. should be detailed. The proposed safeguard measures in each case should also be provided.

9) The study rea will comprise of 10 km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine / lease period.

10) Land use of the study rea delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.

11) Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area, distance from mine lease, its land use, R&R issues, if any, should be given.

12) A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees.

13) Status of forestry clearance for the broken up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished.

14) Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.

15) The vegetation in the RF / PF areas in the study area, with necessary details, should be given.

16) A study shall be got done to ascertain the impact of the Mining Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly, detailed mitigative measures required, should be worked out with cost implications and submitted.

17) Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar site Tiger/ Elephant Reserves/(existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlifeand copy furnished.

18) A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled-I fauna found in the study area, the necessary plan 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.

19) Proximity to Areas declared as 'Critically Polluted' or the Project areas likely to come under the 'Aravali Range', (attracting court restrictions for mining operations), should also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB or State Mining Dept. Should be secured and furnished to the effect that the proposed mining activities could be considered.

20) Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the mine lease w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Mining Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).

21) R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the mine lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects should be discussed in the Report.

22) One season (non-monsoon) [i.e. March-May (Summer Season); October-December (post monsoon season) ; December-February (winter season)]primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given.

23) 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.

24) The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated.

25) Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided.

26) Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided.

27) Impact of the Project on the water quality, both surface and groundwater, should be assessed and necessary safeguard measures, if any required, should be provided.

28) Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed Hydro Geological Study should be undertaken and Report furnished. The Report inter-alia, shall include details of the aquifers present and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished.

29) Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be brought out.

30) Information on site elevation, working depth, groundwater table etc. Should be provided both in AMSL and bgl. A schematic diagram may also be provided for the same.

31) A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the Project. Phase-wise plan of plantation and compensatory afforestation should be charted clearly indicating the area to be covered

under plantation and the species to be planted. The details of plantation already done should be given.The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to pollution.

32) Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered. Project Proponent shall conduct Impact of Transportation study as per Indian Road Congress Guidelines.

33) Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report.

34) Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA report.

35) Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed.

36) Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.

37) Measures of socio economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.

38) Detailed environmental management plan (EMP) to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if any, occupational health impacts besides other impacts specific to the proposed Project.

39) Public Hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan with budgetary provisions to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.

40) Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.

41) The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.

42) A Disaster management Plan shall be prepared and included in the EIA/EMP Report.

43) Benefits of the Project if the Project is implemented should be spelt out. The benefits of the Project shall clearly indicate environmental, social, economic, employment potential, etc.

44) Besides the above, the below mentioned general points are also to be followed:-

a) All documents to be properly referenced with index and continuous page numbering.

b) Where data are presented in the Report especially in Tables, the period in which the data were collected and the sources should be indicated.

c) Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the Project.

d) Where the documents provided are in a language other than English, an English translation should be provided.

e) The Questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry shall also be filled and submitted.

f) While preparing the EIA report, the instructions for the Proponents and instructions for the Consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) dated 4th August, 2009, which are available on the website of this Ministry, should be followed.

g) Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation.

h) As per the circular no. J-11011/618/2010-IA.II(I) dated 30.5.2012, certified report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project, should be obtained from the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.

i) The EIA report should also include (i) surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area.

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OFFICE OF THE JOINT DIRECTOR, GEOLOGY

ZONAL SURVEY, DHENKANAL, ODISHA

No. 424 /DZ/ Dt. 29.04.2020

To

The Tahasildar,
Kamakhyanagar.

Sub: APPROVAL OF MINING PLAN OF THE KANTIO-PUTASAHI SAND QUARRY, OVER 5.06 HA. OR 12.50 ACRES IN KANTIO-PUTASAHI VILLAGE UNDER KAMAKHYANAGAR TAHASIL OF DHENKANAL DISTRICT, ODISHA.

Sir,

In inviting a reference to the final copy of the mining plan submitted by the RQP, it is informed that the mining plan is hereby approved as per clause 5 of Rule 28 of OMMC, Rule -2016 in respect of the above mentioned sairat subject to the conditions mentioned below:

1. The mining plan is approved without prejudice to any other law applicable to the quarry from time to time, whether made by Central Government, State Government or any other authority.
2. The mining plan is approved without prejudice to any order or direction from the court of competent jurisdiction.
3. The approval of the mining plan is based on the information provided by the RQP and if anything is found to be concealed in the contents, the approval shall be deemed to have been withdrawn with immediate effect.
4. This mining plan has been based on the present resource of minor mineral available within the lease area.
5. The boundary pillars of the quarry area shall be maintained in good order throughout the subsistence of the lease.

6. The concerned Tahasildar shall monitor the commitments made by the lessee in the mining plan.

7. The boundary pillars of the quarry area shall be maintained in good order throughout the subsistence of the lease.

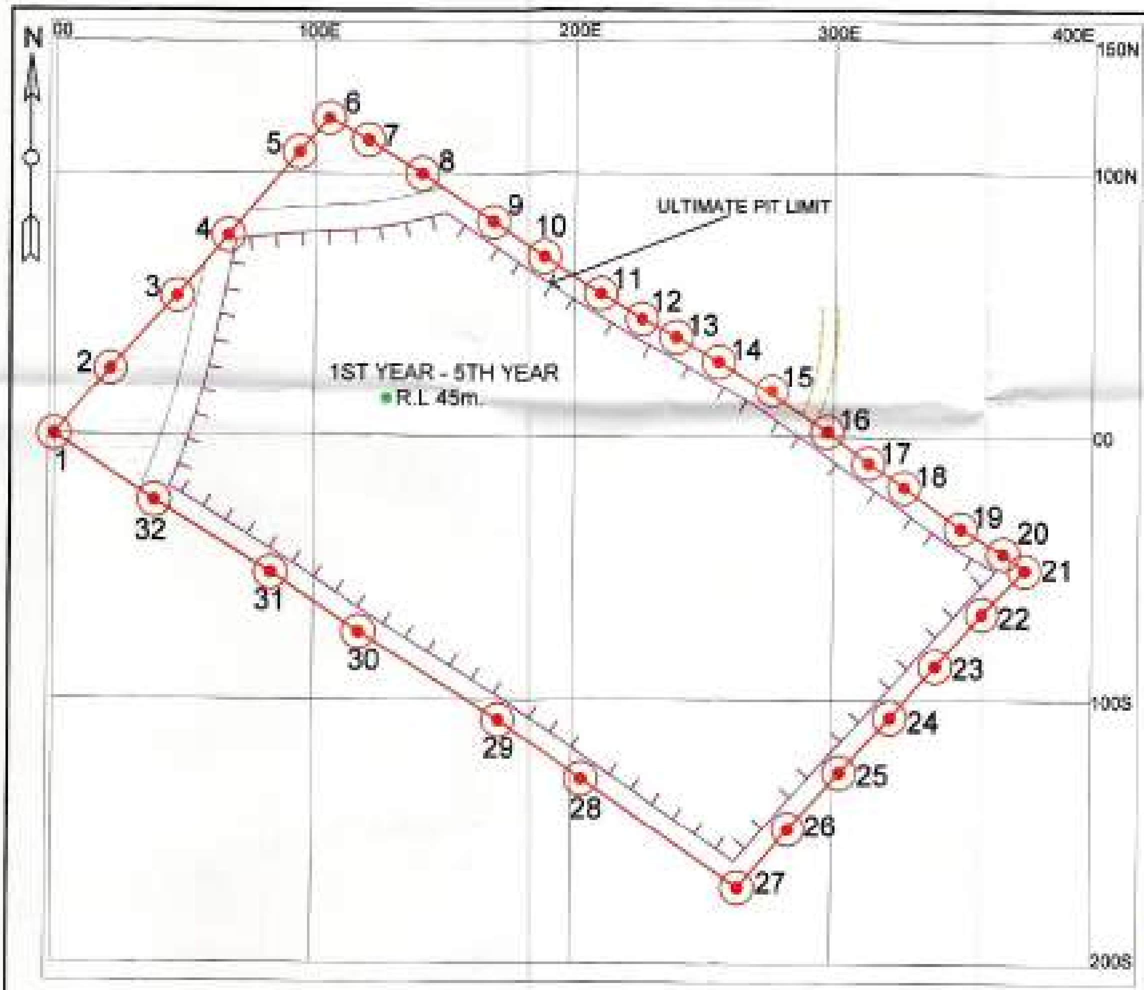
Yours faithfully,

(M R Panda)
Joint Director, Geology,
Zonal Survey, Dhenkanal.
(Authorised officer)

Memo No._____/DZ, Dt._____

Copy to Sri Bipin Behari Khandual, RQP, M/s Geo Consultants Pvt. Ltd. 853, Gobind Prasad (Medical Lane), in front of Reliance fresh (Radhika Complex) Bhubaneswar-751006 along with one copy of the approved mining plan.

(M R Panda)
Joint Director, Geology,
Zonal Survey, Dhenkanal.
(Authorised officer)



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TOPOGRAPHICAL FEATURES

- QUARRY LEASE AREA
- SAFETY ZONE
- APPROACH ROAD
- WATER

APPROVED

Joint Director of Geology
Zonal Survey, Dhenkanal

GEOLOGICAL FEATURES

- POTENTIAL AREA FOR SAND DEPOSITION
- ULTIMATE PIT LIMIT

PROPOSED FEATURES

- AREA OF EXCAVATION DURING 1ST YEAR - 5TH YEAR
- R.L 45m. PROPOSE R.L

(DATE OF SURVEY - 15.02.2020)

PLATE-V

BRAHMANI RIVER SAND BED, KANTIO-PUTASAHI
OVER 5.06 HECT./12.50 ACRE
IN DHENKANAL DISTRICT, ODISHA.

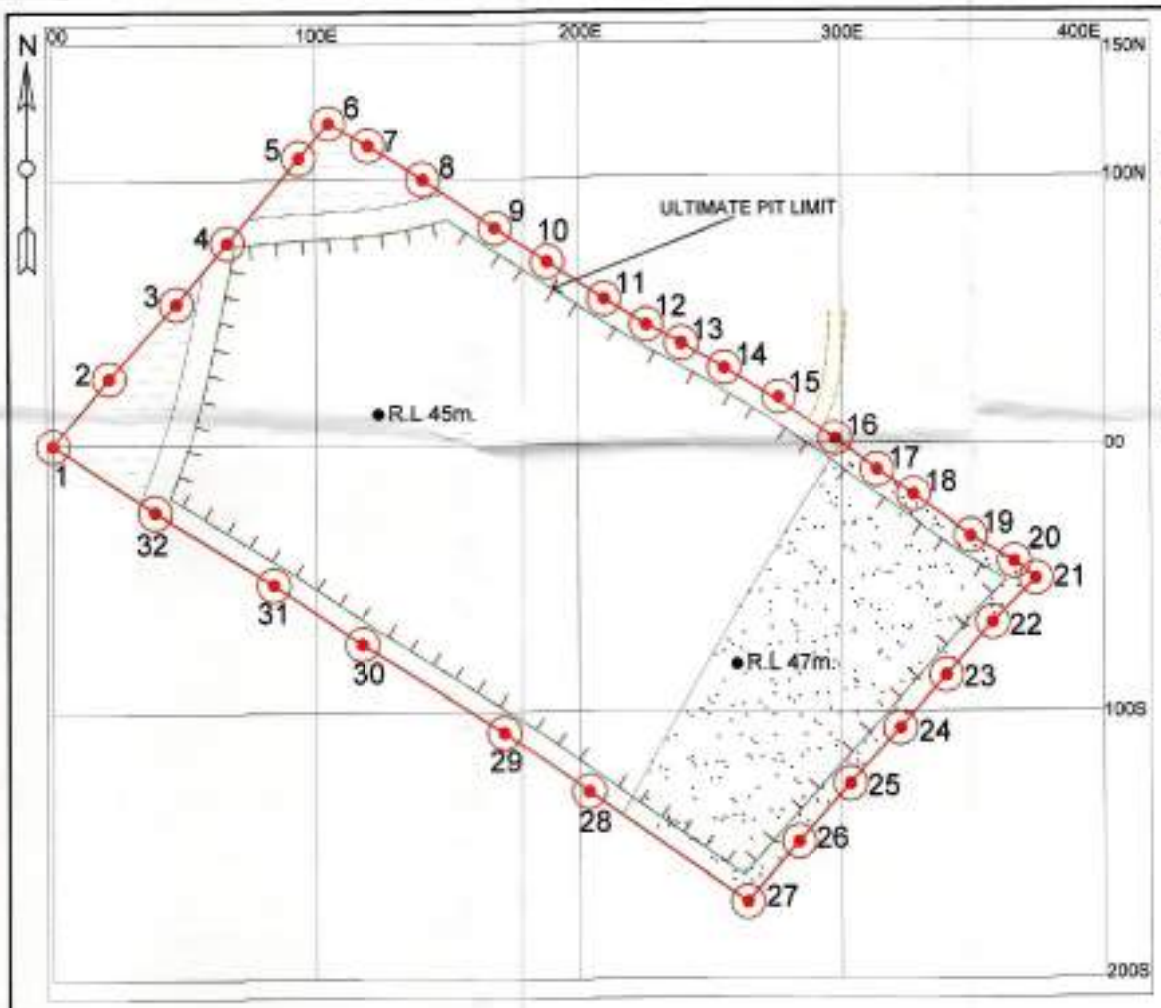
DEVELOPMENT PLAN

R.F.1:2,000 (scale: 20 0 40 80 120 160 200)

APPLICANT:- TAHASILDAR, KAMAKHYANAGAR

IT IS HERE BY CERTIFIED THAT THE PLATE IS CORRECT ...

BIPIN BEHARI KHANDUAL



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- ●R.L 47m. SPOT RL

APPROVED
Deputy Director of Geology
Zonal Survey, Dhenkanal

GEOLOGICAL FEATURES

- EXISTING SAND DEPOSIT
- POTENTIAL AREA FOR SAND DEPOSITION
- ULTIMATE PIT LIMIT

(DATE OF SURVEY - 15.02.2020)

PLATE-IV

BRAHMANI RIVER SAND BED, KANTIO-PUTASAHI
OVER 5.06 HECT./12.50 ACRE
IN DHENKANAL DISTRICT, ODISHA.

GEOLOGICAL PLAN

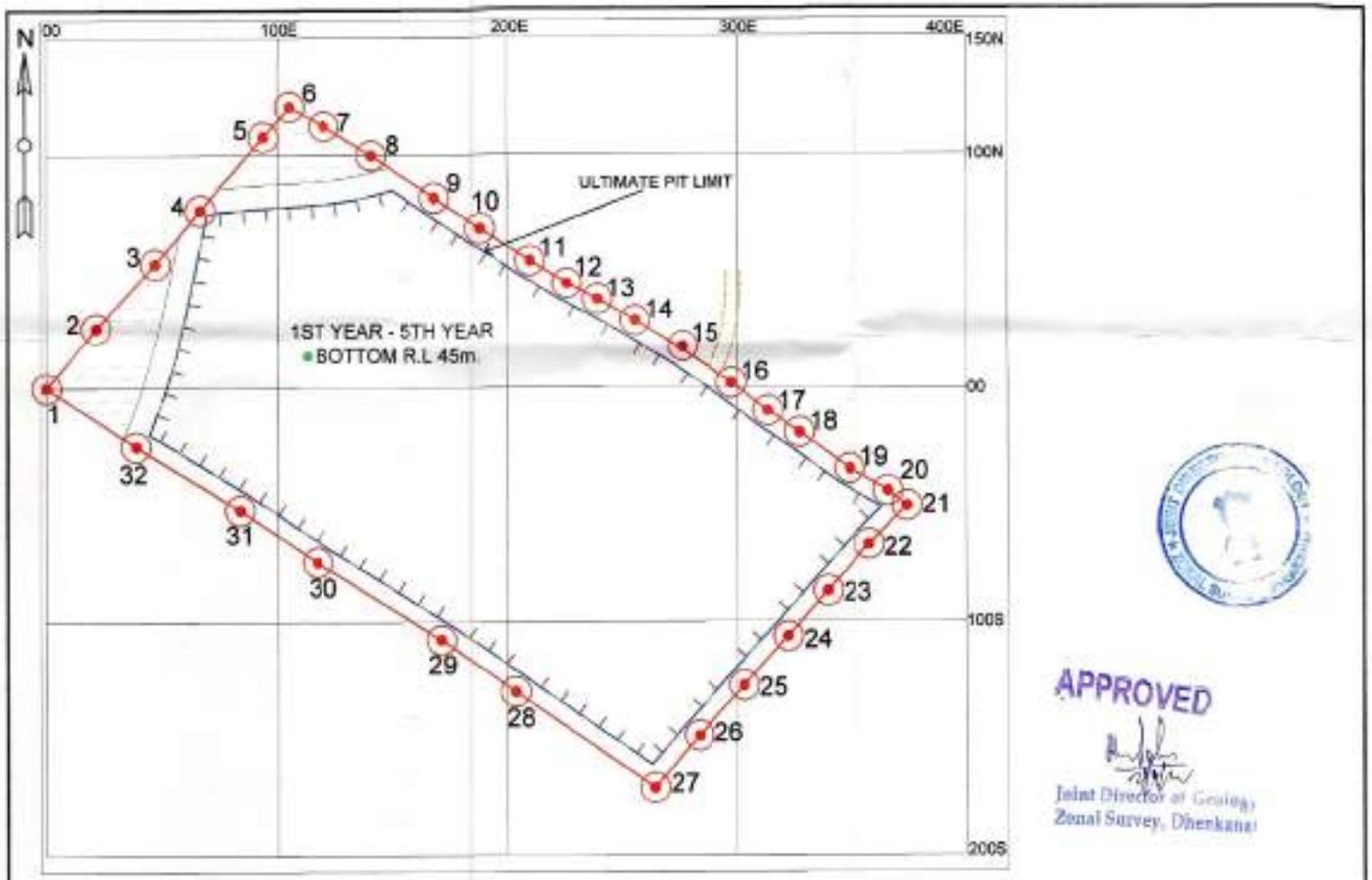
R.F.1:2,000

20 0 40 80 120 160 200

APPLICANT:- TAHASILDAR, KAMAKHYANAGAR

IT IS HERE BY CERTIFIED THAT THIS
PLAN IS CORRECT AND UP TO DATE

BIPIN BEHARI KHANDUAL
RQP/OD/049/2011



APPROVED

Joint Director of Geology
Zonal Survey, Dhenkanal

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- QUARRY LEASE AREA
- SAFETY ZONE
- APPROACH ROAD
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- R.L 45m. PROPOSE R.L
- ULTIMATE PIT LIMIT
- AREA OF EXCAVATION DURING 1ST YEAR - 5TH YEAR

(DATE OF SURVEY - 15.02.2020)

PLATE-VI

BRAHMANI RIVER SAND BED, KANTIO-PUTASAHI
OVER 5.06 HECT./12.50 ACRE
IN DHENKANAL DISTRICT, ODISHA.

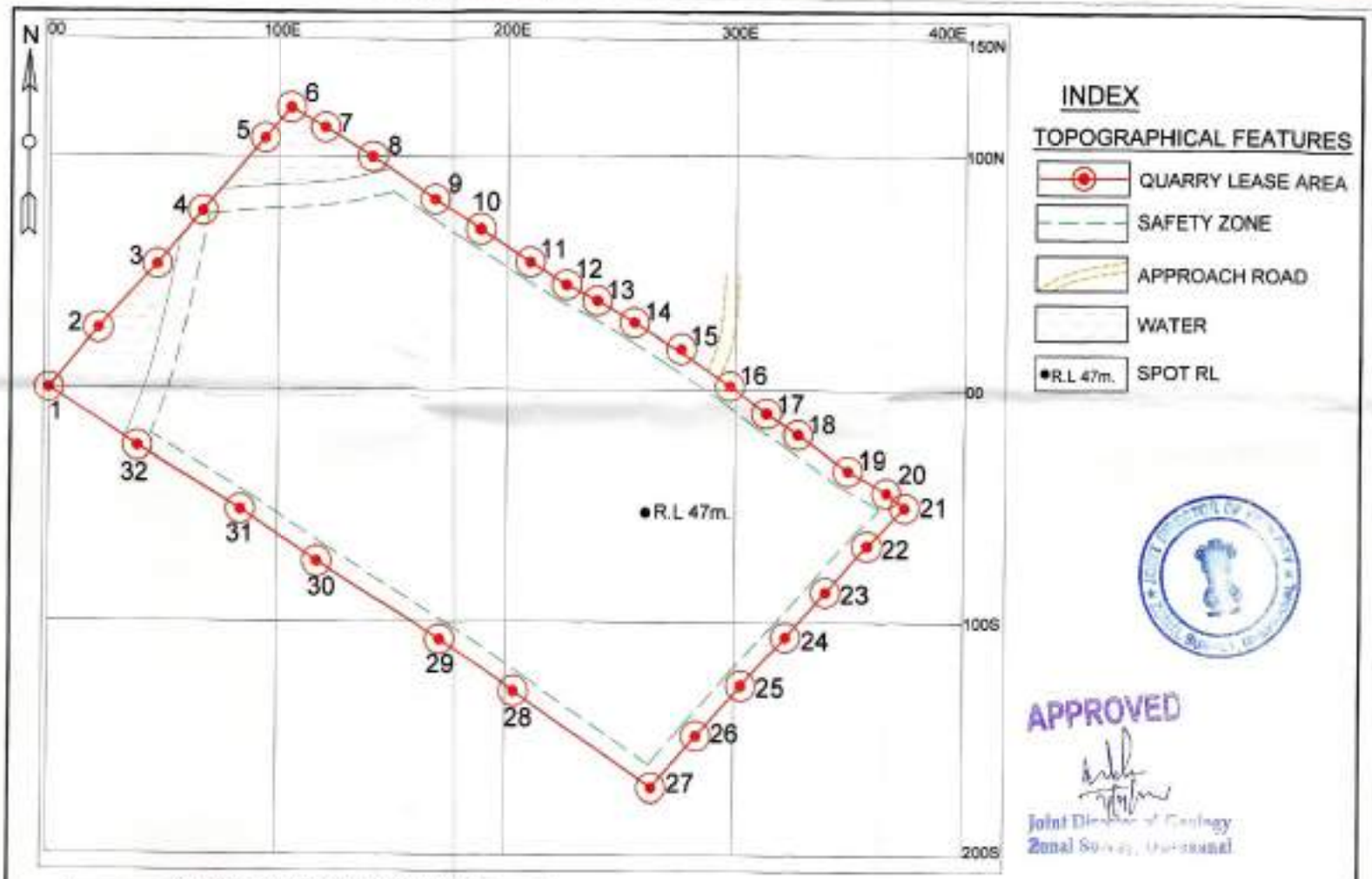
PROGRESSIVE MINE CLOSURE PLAN

R.F.1:2,000 (20 0 40 80 120 160 200)

APPLICANT:- TAHASILDAR, KAMAKHYANAGAR

IT IS HERE BY CERTIFIED THAT THIS PLATE IS CORRECT AND UP TO DATE

BIPIN BEHARI KHANDUAL



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APPROVED

Joint Director of Geology
Zonal Survey, Dhenkanal

KANTIO-PUTASAHI BND_CO-ORDINATES

Pillar No	Longitude	Latitude
1	85°30'05.03"	20°45'50.38"
2	85°30'05.77"	20°45'51.23"
3	85°30'06.66"	20°45'52.13"
4	85°30'07.31"	20°45'52.88"
5	85°30'08.25"	20°45'53.62"
6	85°30'08.85"	20°45'54.30"
7	85°30'09.19"	20°45'54.09"
8	85°30'09.91"	20°45'53.68"
9	85°30'10.86"	20°45'53.10"
10	85°30'11.56"	20°45'52.69"
11	85°30'12.31"	20°45'52.24"
12	85°30'12.86"	20°45'51.92"
13	85°30'13.35"	20°45'51.70"
14	85°30'13.89"	20°45'51.40"
15	85°30'14.61"	20°45'51.00"
16	85°30'15.36"	20°45'50.53"
17	85°30'15.91"	20°45'50.15"
18	85°30'16.40"	20°45'49.85"
19	85°30'17.16"	20°45'49.38"
20	85°30'17.74"	20°45'49.07"
21	85°30'18.05"	20°45'48.84"
22	85°30'17.47"	20°45'48.28"
23	85°30'16.85"	20°45'47.63"
24	85°30'16.25"	20°45'46.98"
25	85°30'15.80"	20°45'46.31"
26	85°30'14.94"	20°45'45.60"
27	85°30'14.25"	20°45'44.86"
28	85°30'12.13"	20°45'46.18"
29	85°30'11.01"	20°45'46.90"
30	85°30'09.14"	20°45'47.97"
31	85°30'07.96"	20°45'48.67"
32	85°30'06.40"	20°45'49.54"

(DATE OF SURVEY - 15.02.2020)

PLATE-III

BRAHMANI RIVER SAND BED, KANTIO-PUTASAHI OVER 5.06 HECT./12.50 ACRE IN DHENKANAL DISTRICT, ODISHA.

SURFACE PLAN

R.F.1:2,000 (20 0 40 80 120 160 200)

APPLICANT:- TAHASILDAR, KAMAKHYANAGAR

IT IS HERE BY CERTIFIED THAT THIS PLATE IS CORRECT AND UP TO DATE

BIPIN BEHARI KHANDUAL

ROPICUL [illegible]

JOINT DIRECTOR OF GEOLOGY ★ ZONAL SURVEY, DHENKANAL ★

MINING PLAN

(Prepared under Rule 28 (4) of the Odisha Minor Mineral Concession Rules, 2016)

OF

KANTIO- PUTASAHI SAND QUARRY

OVER 5.06 HECT OR 12.50 ACRES IN VILLAGE KANTIO- PUTASAHI UNDER KAMAKHYANAGAR TAHASIL OF DHENKANAL DISTRICT, ODISHA

APPLICANT -: TAHASILDAR, KAMAKHYANAGAR

PREPARED BY

SRI BIPIN BEHARI KHANDUAL

RQP/OD/049/2016

APPROVED

Joint Director of Geology
Zonal Survey, Dhenkanal

GEO CONSULTANTS PVT LTD,

BHUBANESWAR

CONSENT LETTER FROM APPLICANT

The Mining Plan of the Brahmani River Sand Quarry, Kantio-Putasahi in respect of the Quarry Lease area over an area of 5.06 Ha or 12.50 Acres in village Kantio-putasahi under Kamakhyanagar Tahasil of Dhenkanal District, Odisha, has been prepared by Sri Bipin Behari Khandual, Consulting Geologist, Regn. No. RQP/OD/049/2016. I request the Authorised Officer, O/o The Joint Director of Geology, Dhenkanal, Odisha, to make further correspondence regarding final approval of the mining plan, with the said recognised person in his following address.

Geo Consultants Pvt. Ltd.

853, Gobind Prasad (Medical Lane)

In front of Reliance fresh (Radhika Complex)

Bhubaneswar-751006

Phone - 0674-2575702

Email - consultants_geo@yahoo.co.in

Mobile - +91-9437019019

I hereby undertake that all modifications so made in the mining plan by the said recognised person be deemed to have been made with my knowledge and consent and shall be acceptable to me and binding on me in all respect.

Name of the applicant
Tahasildar
Kamakhyanagar
Tahasildar, Kamakhyanagar

Place : Kamakhyanagar

Date : 04.01.20

UNDERTAKING

JOINT DIRECTOR OF GEOLOGY ★ ZONAL SURVEY, DHENKANAL ★

This is to undertake that the financial assurance related to the Progressive Mine Closure Plan of the Mining Plan in respect of Brahmani River Sand Quarry, Kantio-Putasahi in respect of the Quarry Lease area over an area of 5.06 Ha or 12.50 Acres in village Kantio-Putasahi under Kamakhyanagar Tahasil of Dhenkanal District, Odisha, will be submitted by the successful auction holder in the form of bank guarantee from any nationalized bank as and when required by the competent authority.

Name of the applicant

Tahasildar
Kamakhyanagar

Tahasildar, Kamakhyanagar

Place : Kamakhyanagar

Date : 04.04.20

JOINT DIRECTOR OF GEOLOGY * ZONAL SURVEY, DHENKANAL *

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APPROVED

Joint Director of Geology
Zonal Survey, Dhenkanal

BIPIN BEHARI KHANDUAL
ROP/OD/049/2016

JOINT DIRECTOR OF GEOLOGY * ZONAL SURVEY, DHENKANAL *

LIST OF PLATES

Plate No	Description	Scale (R F)
I	Key Plan	1 : 50,000
II	Lease plan	16" = 1 mile
III	Surface Plan	1 : 2,000
IV	Geological plan	1 : 2,000
V	Composite development plan	1 : 2,000
VI	Progressive Mine Closure Plan	1 : 2,000

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RQP/OD/049/2016

JOINT DIRECTOR OF GEOLOGY * ZONAL SURVEY, DHENKANAL *

LIST OF ANNEXURES

DESCRIPTION	ANNEXURE NO.
Copy of letter of Tahasildar to prepare mining plan	I
Copy of RQP certificate	II

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Joint Director of Geology
Zonal Survey, Dhenkanal

BIPIN BEHARI RTANDUAL
RQP/OD/049/2016

CHAPTER -0.0

JOINT DIRECTOR OF GEOLOGY ★ ZONAL SURVEY, DHENKANAL ★

Introduction:

The area over 12.50 Ac. or 5.06 Ha. under reference is located in village Kantio-Putasahi of Kamakhyanagar Tahasil in Dhenkanal district of Odisha. Quarry lease for minor mineral (River sand) has been proposed to be granted by the Tahasildar, Kamakhyanagar to the applicant (successful bidder) for minor mineral (River Sand) for five years **(Annexure I)** after auction.

The area under reference is featured in the Survey of India Toposheet no. (73H/9) and bounded between the latitudes of 20°45'44.86"N to 20°45"54.35"N and longitudes of 85°30'05.03"E to 85°30'18.05"E. The area is located at a distance of 20.5 Km from the district head quarters Dhenkanal and is at a distance of 80.8 Km from the state capital Bhubaneswar.

In the absence of boundary description of the area by the competent authority, the co-ordinates of boundary pillar / corner points of the area as furnished in the granted mining plan has been taken for field study/observation over the area and data has been collected to prepare this mining plan. Accordingly, the area has been surveyed by the RQP through hand held GPS for obtaining other required co-ordinates as well as the existing RL's of the required points.

BIPIN BEHARI KHANDUAL
RQP/OD/049/2016

The co-ordinates of boundary corner points are listed in the Surface Plan (***Plate NO III***) and given as follows.

Kantioputasahi Lease Pillar Coordinate		
Pillar No	**Longitude**	**Latitude**
1	85°30'05.03"	20°45'50.36"
2	85°30'05.77"	20°45'51.23"
3	85°30'06.66"	20°45'52.13"
4	85°30'07.31"	20°45'52.88"
5	85°30'08.25"	20°45'53.92"
6	85°30'08.65"	20°45'54.35"
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28	85°30'12.13"	20°45'46.18"
29	85°30'11.01"	20°45'46.90"
30	85°30'09.14"	20°45'47.97"
31	85°30'07.96"	20°45'48.67"
32	85°30'06.40"	20°45'49.54"

JOINT DIRECTOR OF GEOLOGY * ZONAL SURVEY, DHENKANAL *

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Joint Director of Geology
Zonal Survey, Dhenkanal

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RQP/OD/049/2016

FORM-O

[See Rule 28 (4) of the Odisha Minor Mineral Concession Rules, 2016]

MINING PLAN FOR WINNING OF RIVER SAND FROM BRAMHANI RIVER UNDER KANTIO- PUTASAHI VILLAGE IN KAMAKHYANAGAR TAHASIL OF DHENKANAL DISTRICT.

CATEGORY: B2
As specified by MoEF Notification 2006 & Subsequent Notification

CHAPTER -1

1. Name & Address of the Lessee	: Tahasildar, Kamakhyanagar has asked to prepare the mining plan of the area after which the sairat will be auctioned for leasing purpose **(Annexure –I).**
2. Particulars of the area(Acreage, Boundary Description& Land Schedule): (Attach location map and surface plan showing the existing features of the area with contours at 2m interval) :	: Kantio- Putasahi Sand source. Area- 12.50 acres or 5.06 hectares. Land schedule mentioned on plan provided by revenue Authority and attached as ***Plate no –II.*** Location Map- Ref. ***Plate no- I***, Surface Plan - Ref. ***Plate no- III.***
3.Status of the Lessee(Private individual/ Private Company/ Public sector Undertaking / Joint sector Under taking/ Others)	: The sairat will be leased out by the Tahasildar, Kamakhyanagar after obtaining statutory clearances.
4. Period of Concession	: Five years
5. Mineral intended to be won	: River Sand

BIPIN BEHARI KHANDUAL
RQP/OD/049/2016

6. Name, Address & Regd. No. of RQP preparing the mining plan with validity of Recognition	: Bipin Behari Khandual Geo Consultants Pvt. Ltd. 853, Gobind Prasad (Medical Lane) In front of Reliance fresh (Radhika Complex) Bhubaneswar-751006 Phone - 0674-2575702 Email - consultants_geo@yahoo.co.in Mobile - 9437019019 Registration No -RQP/OD/049/2016 Valid up to- 02.08.2026
7. Order No. & date of competent Authority granting the Concession (copy of the Order to be attached)	: Not applicable as the area is yet to be leased out.
8. If, forest area, whether forest clearance Obtained (attach copy of forest clearance)	: The total area is non-forest Govt. land as envisaged from the land schedule provided by the revenue authority. Hence, Forest clearance is not required.

JOINT DIRECTOR OF GEOLOGY ZONAL SURVEY, DHENKANAL

APPROVED

Joint Director of Geology
Zonal Survey, Dhenkanal

BIPIN BEHARI KHANDUAL
RQP/OD/049/2016

CHAPTER -2

9. Reserve (Estimation to be based on the Exploration, If any, carried out in the area or on local Parameters):

The reserve is estimated based on local parameters. The lease area belongs to recent quaternary River bed deposits consisting of sand, silt, clay, gravel and alluvial deposits.

a. Physiography:

The Sand bed is on the river Bramhani. The Kantio- Putasahi sand bed deposit represents a gently sloping to almost flat terrain with highest altitude of 47 mRL towards southern part. The general slope is towards north. Vegetation is scanty with small bushes existing in the auction hold area. There is no human settlement within the area.

b. Regional Geology:

Gondwana Group Palaeozoic-Mesozoic Upper Mahanadi valley basin which is in this basin, the Gondwana sediments unconformably overlie the Precambrian basement; the latter comprising migmatitic granitic gneiss, amphibolite, schist and quartzite traversed by pegmatite and quartz veins. Era (Upper Carboniferous – Early Permian) - Glacio-lacustrine and fluvial sediments were deposited in linear basins along faulted troughs over the Precambrian basement. These sediments, characterized by fluvial assemblages of interbeded sandstone-shale sequence. While the Lower Gondwana rocks are a vast repository of coal, the Upper Gondwana witness sandstones of Palaeozoic-Mesozoic era. Gondwana rocks are exposed over a large area along NW-SE trending linear belt in the Mahanadi valley rift/graben in three major basins (Talcher, Ib river & Athgarh). Beside these, a number of small patches outliers) of Gondwana rocks occur in Angul, Dhenkanal districts and others. The lower Gondwana

rocks have vast resources of coal. The Stratigraphic successions are as below:

Stratigraphic set-up

Upper Gondwana	Migmatitic granitic gneiss, amphibolite, schist and quartzite	Palaeozoic-Mesozoic
	Conglomerate, sandstone, shale fireclay	Lower Cretaceous
Middle Gondwana	Conglomerate, ferruginous sandstone, red shales	Lower to Middle Triassic
~~ Un-conformity ~~~~~~~~~~~~~~~~~~~		
Lower Gondwana	Fine to medium grained sandstone, siltstone, clay-beds, coal	Upper Permian
	Sandstone, shale, clay, ironstone shale	Middle Permian
	Conglomerate, sandstone, shale, fireclay, coal	Lower Permian
~~ Un-conformity ~~~~~~~~~~~~~~~~~~~		
	Boulder Bed, green shale, sandstone, marlstone	Upper carboniferous to lower Permian
~~ Un-conformity ~~~~~~~~~~~~~~~~~~~		
	Grinite, greisses, amphibolites, migmatites	Precambrian

BIPIN BEHARI KHANDUAL
RQP/OD/049/2016

c. Local Geology :

The sand deposit in Bramhani River near Kantio- Putasahi belongs to recent to sub recent deposits of Holocene age. Beach Sand, younger and older alluvium also belongs to the same age. The proposed area is occupied by a gently sloping to almost flat deposits of sand. The basement consists of Tertiary deposits and the sequence of litho-units encountered in the auction hold area is as follows:

Sand

Alluvium

d. Lithology:

The characteristic features of the litho units of the area are described below:

Sand: The area under reference is covered with grey to white sand deposits with average probable thickness of 2 m within the lease area. Sand by definition is a loose, incoherent mass of mineral materials and is a product of natural processes. These processes are the disintegration of rocks and corals under the influence of weathering and abrasion. When sand is freshly formed, the particles are usually angular and sharply pointed, but they grow gradually smaller and more rounded as they become constantly worn down by the wind or water. Sand particles tend to settle quite rapidly because of their shape, density and size.

The composition of sand is highly variable in nature, depending on the local rock types/sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide or SiO_2), usually in the form of quartz which because of its chemical inertness and considerable hardness, is the most common mineral resistant to weathering.

Alluvium: Decomposed vegetal materials admixed with clay and soil constitutes alluvium which is underlain by the sand bed with some clayey matter.

BIPIN BEHARI CHANDUAL
RQP/OD/049/2016

e. Reserve

The Geological reserve has been estimated by considering the following parameters.

i) Outcome of geological mapping: The particular area is a new source. Fresh patches of unexploited river sand occurrences are also observed within the area. The maximum RL of the surface sand zone is around 47 m.

ii) It is observed that, the difference in elevation between the highest and lowest points is much less. Gradient of the river is also very low. Therefore, Surface area method has been adopted for estimation of reserve for this river bed sand.

iii) Thickness of sand zone: The mRL of the surface sand zone is around 47m. Considering the observations of thickness of sand bed of the area the maximum possible thickness of sand bed that can be mined out i.e. 2m is assumed as the thickness of sand over the area for estimation of reserve.

iv) The Quarry lease area is a new source. Quarry lease for minor mineral (River sand) has been proposed to be granted by the Tahasildar, Kamakhyanagar to the successful bidder for minor mineral (River Sand) for five years after auction and the present document is being prepared in favour of Tahasildar, Kamakhyanagar and the process would require at least 2 to 3 months from now. At that point of time the position and quantity of the present resource of river sand within the area cannot be calculated now. Also, the pattern of sand deposition in the ensuing years of the lease period is impossible to ascertain right now. To overcome this, the total lease area has been considered as potential zone for sand deposition excluding the water channel areas, if any located within the area **(Plate No IV)** and Geological resource has been calculated based on this area and the present thickness of sand deposit.

BIPIN BEHARI KHANDUAL
RQP/OD/049/2016

In the absence of any monitored database, it is assumed that 100% of the above calculated resource would be replenished cumulatively within the total QL period of 5 years. Considering the above, the total geological Resource of the QL area for the lease period has been calculated by doubling the above calculated resource.

v) The resource of river sand over the area has been categorized as probable reserve.

vi) The foreign particles in the sand such as wood and other floating waste have been considered as waste. However, the volume of waste is negligible in quantity and in practice the waste will not be separated during mining. So recovery factor has been taken as 100% for sand.

vii) Total volume of excavation of sand is saleable.

Mineable Reserve:

viii) The sand resource within Safety Zone area of 7.5 m barrier all along the proposed area boundary and 10 m barrier around the water channel (if any) present within the proposed area have been excluded from the above calculated geological resource for computation of mineable reserve **(Ref. Plate No IV).** Besides, 60% of the above computed mineable reserve as above has been taken as available mineable reserve over the area as per MoEF Notification dated 25.07.2018 which can be extracted during the total span of the plan period.

Calculation of Reserve:

Based on the above considerations, site specificity & chosen local parameters, the reserve has been calculated for river bed sand zone by surface area method.

BIPIN BEHARI KHANDUAL
RQP/OD/049/2016

Formula adopted for calculation of volume of river sand is **V = A x T x R**

Where,

V is total volume of river sand in m^3

A is the surface area of potential sand patch.

T is the average thickness of sand bed in m

R is the replenishment factor for the QL period of five years

The total geological resource has been estimated as **189796 Cum.**

Similarly, the extractable mineable reserve of river bed sand is worked out to be **53014 Cum.**

The geological reserve and mineable reserve of Bramhani River sand bed, Kantio-Putasahi calculated under various categories are given in table no.1 & 2 respectively as follows:

Table.No.1

CATEGORY WISE GEOLOGICAL RESERVE OF SAND BED

GEOLOGICAL RESOURCE CALCULATION OF QL FOR THE PERIOD FIVE YEAR				
AREA OF POTENTIAL SAND ZONE (m^2)	THICKNESS OF SAND (m)	REPLENISHMENT FACTOR (100%)	GEOLOGICAL REOURCE OF SAND (m^3)	CATEGORY
A	B	C	D= A X B X C	E
47449	2	2	189796	PROBABLE
TOTAL			189796	

Table No.2

CATEGORY WISE MINEABLE RESERVE OF SAND BED

MINEABLE RESERVE CALCULATION OF QL FOR THE PERIOD FIVE YEAR					
AREA OF POTENTIAL SAND ZONE EXCLUDING SAFETY ZONE (m^2)	THICKNESS OF SAND (m)	REPLENISHMENT FACTOR (100%)	MINEABLE RESERVE OF SAND (m^3)	EXTRACTABLE MINEABLE RESERVE	CATEGORY
A	B	C	D=A X BXC	E= D X 0.6	F
40550	2	2	162200	97320	PROBABLE
TOTAL			162200	97320	

Right now, the sand resource available within the source is 11955m^2 x 2m = 23910 m^3 which is more than the MGQ provided by the Tahasildar.

APPROVED
Joint Director of Geology
Zonal Survey, Dhenkanal

BIPIN BEHARI KHANDUAL
RQP/OD/049/2016

CHAPTER -3

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10. Mining

a. **Whether manual or semi-mechanized or mechanized**

Semi-mechanized only:

Mining shall be undertaken to extract sand, mainly through an open pit spread over the river course devoid of water or nominal water that may be encountered below.

Mining Method:

The mode of the deposit, geomorphology of the area and its hydrological condition are some of the factors that favours the open cast method of mining.

Mining will be done with semi-mechanized method of excavation & loading into transporting vehicles like hywa, tippers etc. and transported from Kantio-Putasahi sand bed to the users/destination through transporting vehicles. The mining will be undertaken on single shift basis. The local man power shall be engaged in the mine.

b. **If semi-mechanized or mechanized, number, type and capacity of machines to be used:**

Excavation & loading of sand into the transporting vehicles like hywa, tippers etc. will be done by semi-mechanized means. The transportation from the Kantio-Putasahi sand bed site to respective users/destinations shall be achieved by transporting vehicles. The no. of fleets with their capacity is as below:

Sl. no	Name	Capacity	No. of Fleet
1	Excavators	0.9 Cum	1
2	Transporting vehicles	13Cum/6Cum	4/8
3	Safety gears Helmets, safety shoes, Goggles,& Hand gloves	----------	As required

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c. **Whether drilling and blasting will be made use of, If yes, state monthly quantity of explosive consumed:**

As such the river bed sand are loose. No drilling & blasting is required.

d. **Benching pattern (Height x Width):** Benching pattern is not feasible in case of sand, as the angle of repose of sand is 35°, based on this the Ultimate pit slope Limit has been taken as 35°. The maximum depth of mining will be of 2 m or up to water table whichever is less.

e. **Face lay out (attached development plan):**

There will be no existing quarry within the proposed area after replenishment. Total available mineable reserve over the area has been estimated considering the probable zone of occurrence of river sand bed within the proposed area as revealed during field visit and assuming uniform rate of year wise replenishment over the area. Year wise development of quarries for five year plan period will be decided depending upon the occurrences of sand bed over the proposed area during the respective year to achieve the target production. Therefore, quarry lay out will be over the whole proposed area depending upon the probable sand bed after replenishment leaving stipulated safety zones **(Ref. Plate V).**

f. **Quarry Floor Level (RL) at the end of the year or period of the concession:**

45 mRL or up to water table whichever is less. The present level of the lease area is 47mRL. During plan period, the quarry floor will be 45 mRL or up to water table whichever is less. The proposed pit lay out have been shown in the development plan and also in Progressive Mine Closure Plan ***(Ref Plate-V & Plate–VI).***

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g. Quantity of mineral to be won (Annual Level of Production)

Total available mineable reserve over the area has been estimated considering the probable zone of occurrence of river sand bed within the proposed area which will be extracted year wise during the plan period. Based on the total extractable mineable reserve, the MGQ has been fixed by the competent authority and this much quantity of sand has been planned to be extracted each year from the source as mentioned below:

Table No.3
YEAR WISE PRODUCTION OF SAND DURING PLAN PERIOD

YEAR	PRODUCTION (m^3)
1ST YEAR	18210
2ND YEAR	18210
3RD YEAR	18210
4TH YEAR	18210
5TH YEAR	18210
TOTAL	**91050**

In case the lessee finds the resource of sand is not sufficient to stick to the production program of this plan, he may modify the plan within the QL period after seeking permission of the competent authority. But this exercise can be done just after the monsoon any substantiating year of the QL period before undertaking any excavation within the area.

h. Quantity of overburden to be removed (Show location of such disposal in development plan) :

Since the river bed sand deposit is devoid of any over burden, development for over-burden does not arise.

i. Whether heavy blasting to be adopted: If yes, location of nearest habitation (to be shown in the surface plan)

No blasting is required for sand mining.

j. Safety precautions to be adopted:

No safety measures are required as there will no blasting operations.

k. Brief description on the method of Procurement and storage of explosives:

Not applicable.

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CHAPTER -4

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11. **Waste disposal:**

(a) Location (show it in the development plan): No dump has been proposed as there will be no generation of waste in this case.

(b) Area covered: Not applicable as no dump has been proposed.

(c) Environment safeguards for such disposal: Not applicable as no dump has been proposed.

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CHAPTER -5

12 **Mine drainage :**

(Give details of total make of water during dry and rainy season and its method of handling)

The shallow depth excavation on dry/nominally wet sand has been proposed, which will have negligible or no impact on drainage. Abandoned stream channels on terrace and inactive flood plains have been preferred rather than active channels.

Water that might percolate (if any) into excavation area has to be pumped out to channelize to river course during excavation. Stream will not be diverted to form inactive channels. Mining below subterranean water level will be avoided as a safeguard against any water contamination. Source has been finalized avoiding concave side of river bank/ channel to prevent bank erosion.

It is observed from the dug well in the adjacent plain area and in the nearby villages that the ground water table varies between 4m to 14 m from the surface level depending upon seasonal variations. During dry season the water table falls to 14m from the surface where as during rainy season the water table remains at 4m from the surface. As the mining activities presently proposed are maximum up to 2 m that to within the river course and the total mining operation will be achieved through manual means, so there will be no effect on ground water table.

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CHAPTER -6

13. **Mineral Processing : (Give details of processing including sizing, Sorting, generation of rejects/fines etc)**

Sand excavation from the river bed mining is not required to be processed as the end consumer will purchase the sand as such for their requirement.

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CHAPTER -7

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14. a) **No. of trees to be uprooted due to mining operation:**

There is no tree within the auction area on the river-bed sand and hence not applicable.

b) **Programme of Plantation:**

It is proposed for planting @50 saplings of suitable species per annum by the lessee in vicinity of the river bank as avenue plantation which is to be undertaken in consultation with the concerned authority.

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CHAPTER -8

15. **Manpower:**

a) Supervisory (inclusive of statutory personnel's) :

1(one) number of supervisory personnel preferably Mining Mate with Certificate of Competency from DGMS will be employed.

b) Non- Supervisory (skilled, semi-skilled & unskilled):

Skilled: 5

Semi-skilled-5

Unskilled-2

Total- 12+1=13

c) OMS :

Total production during plan period	: 91050 Cum
Average ore production /annum	: 18,210 Cum
Working days in the year	: 200 days (on an average)
Production per day	: 18,210/200= 91.05Cum

Output per man shift (OMS)=91.05/13=7.00 Cum

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Zonal Survey, Dhenkanal

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CHAPTER -9

16. Use of Mineral : (Specification and monthly quantity to be dispatched be furnished)

a) **For domestic use:** For construction purpose the sand of Bramhani River will be used. 18,210 Cum of sand per annum is likely to be dispatched by the lessee (auction holder) to domestic and commercial users. It is suggested to cover the loaded vehicle of river sand very securely by tarpaulin sheet before transportation to the dispatch point.

b) **For export:** No material will be exported at present. However, if required the sand excavated may be exported to different states or countries within the ambit of prevailing law.

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Zonal Survey, Dhenkanal

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CHAPTER -10

17. Mine Closure Plan:

a) Describe the process/activities to be undertaken for reclamation and Rehabilitation in respect of the following:

i) **Mined out land:** During plan period the probable mined out land will be **4.055 ha.**

The Bramhani River sand bed (Kantio- Putasahi sand source) comprises of 12.50 acres or 5.06 hectares under Kamakhyanagar Tahasil of Dhenkanal district. The entire area is of river bed and devoid of any forest growth. Since it is a River sand bed and the total mining activities will be confined to the river sand bed, no reclamation measure is proposed for mine closure. Therefore, only avenue plantation has been proposed @50 saplings per annum on the river bank adjacent to this leasehold.

The existing land use as well as proposed land use of the area is given as below:

Type of land use	Area (Ha)
Water channel area	0.315
Left over area adjacent to water channel	0.176
Quarry Safety zone area	0.514
Potential Mineable surface area within the plan period	4.055
Total	**5.06**

ii) **Waste/reject dump**: Does not arise as there will be no generation of waste.

iii) **Topsoil stack and its utilization**: There will be no generation of top soil in this quarry since the mining for sand will be carried out within the river bed

b) Financial assurance: (To be furnished as a bank guarantee in respect of the area to be put to use).

The area to be put to use will be 4.055 Ha in the present plan period. Hence the financial assurance as decided by the competent authority would be submitted by the auction holder on demand. Also, the auction holder has to pay 5% of the royalty towards environment management fund.

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Zonal Survey, Dhenkanal

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CERTIFICATE

JOINT DIRECTOR OF GEOLOGY * ZONAL SURVEY, DHENKANAL *

18.0

I Sanjay Kumar Rout Tahasildar, Kamakhyanagar hereby solemnly affirm that the plans and programmes in this mining plan will be scrupulously implemented by the auction holder of the lease of Brahmani River Sand Quarry, Kantio-Putasahi in respect of the Quarry Lease area over an area of 5.06 Ha or 12.50 Acres in village Kantio-Putasahi under Kamakhyanagar Tahasil of Dhenkanal District, Odisha, and will be strictly held responsible for any deviation thereof.

I also hereby certify that the provisions of Mines and Minerals (Development & Regulation) Act, 1957, and the Mines Act, 1952 and Rules and Regulations made under these Acts, along with the provisions of Odisha Minor Mineral Concession Rules, 2016 will be strictly adhered to by the auction holder while implementing this Mining Plan and wherever specific permissions will be required the auction holder will approach the concerned authorities of Directorate General of Mines Safety and the State Government as the case may be.

Name of the applicant
Tahasildar
Tahasildar, Kamakhyanagar

Place : Kamakhyanagar

Date : 04.04.20

ANNEXURE – I

OFFICE OF THE TAHASILDAR, KAMAKHYANAGAR
(Touzi Section)

No. 819 / dt. 19/2/20

E-mail id: tah.kamakhya-od@nic.in
Ph. No: 06769-271426

JOINT DIRECTOR OF GEOLOGY * REGIONAL SURVEY, DHENKANAL

To

Sri Chandrabhanu Das,
Recognised Qualified person
O/o Geo Consultants Pvt Ltd
Bhubaneswar.

Sub: Preparation and approval of mining plans and obtaining Environmental clearances of the below mentioned sources required for auction.

Ref: This office letter no. 705/ dt. 13.02.2020.

Sir,

In continuation to this office letter under reference, I am to say that you have been requested vide this office letter under reference for preparation and approval of mining plans and obtaining Environmental clearances against the following sources which have been approved by the Collector, Dhenkanal. However, no communication in this regard has been made from your end for which the undersigned is being unable to carry forward the auction process. As the process is to be completed by 31st March, 2020 it is necessary that your report should reach the undersigned at the earliest for completion of the auction process in time.

Hence, you are once again requested to prepare the mining plans through RQPs of your office and get those approved from appropriate Govt Authorities at the earliest to enable us for auction of these sources. You are also requested to prepare required documents for Environment clearance and obtain the clearance from appropriate authority.

Sl No	Name of the source	Nam of Minor mineral	Status of the source (Continuing / New)	Area in (Ha)	Mouza	Khat No	Plot No	Kisam	Placed in DSR	MGQ approved in Cum
1	Cluster	Sand	New	1.21	Baligorada	361	3768/5973	Nadi	Sl. 21	18939.2
	Ramial River Baligorada									
	Ramial River Hatuari			2.02	Hatuari	243	526	Nadi	Sl. 22	
	Ramial River, Lokanathpur			2.02	Lokanathpur	139	2031	Nadi	Sl. 37	
2	Brahmani River Talajhagadapada	Sand	New	5.06	Talajhagadapada	47	953/982, 953/983	Nadi	Sl. 23	16054

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3	Brahmani River Baruan	Sand	New	5.06	Baruan	328	3586	Nadi	Sl. 24	16025
4	Brahmani River Kantio-Putasahi	Sand	New	5.06	Kantio-Putasahi	857	6980	Nadi	Sl. 25	18210
5	Brahmani River Kateni	Sand	New	5.06	Kateni	834	9860	Nadi	Sl. 26	18210
6	Brahmani River Kantapal	Sand	New	5.06	Kantapal	538	5204	Nadi	Sl. 27	18210
7	Brahmani River Gangijodi	Sand	New	5.06	Gangijodi	426	6638/ 6856	Nadi	Sl. 28	18210
8	Brahmani River Tumusinga	Sand	New	5.06	Tumusinga	886	10154	Nadi	Sl. 29	18210
9	Ramial River Goradia	Sand	New	8.09	Goradia	462	3125/ 3142	Nadi	Sl. 30	21852

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This may please be treated with top priority.

Yours faithfully

19/2/2020

Tahasildar
Kamakhyanagar

Memo No. 820 **/dt.** 19/2/20

Copy submitted to Collector, Dhenkanal / Sub-Collector, Kamakhyanagar for favour of kind information.

19/2/2020

Tahasildar
Kamakhyanagar

BIPIN BEHARI KHANDUAL
RQP/OD/049/2016

ANNEXURE – I I

JOINT DIRECTOR OF GEOLOGY ★ ZONAL SURVEY, DHENKANAL ★

GOVERNMENT OF ODISHA
DEPARTMENT OF STEEL AND MINES
DIRECTORATE OF MINES

CERTIFICATE OF RECOGNITION AS QUALIFIED PERSON

(Under sub-rule (2) of rule 20 of Odisha Minor Mineral Concession Rules, 2004)

Sri Bipin Behari Khandual, S/o Nabaghana Khandual, At/P.O. Dhunpur, Via: Tiran, Dist: Jagatsinghpur – 754138, whose photograph and signature are affixed herein, having given satisfactory evidence of his qualification and experience, is hereby recognised under sub-rule (2) of rule 20 of Odisha Minor Mineral Concession Rules, 2004 as a **qualified person** to prepare Mining Plans for Minor Minerals within the State of Odisha, India.

Bipin Behari Khandual

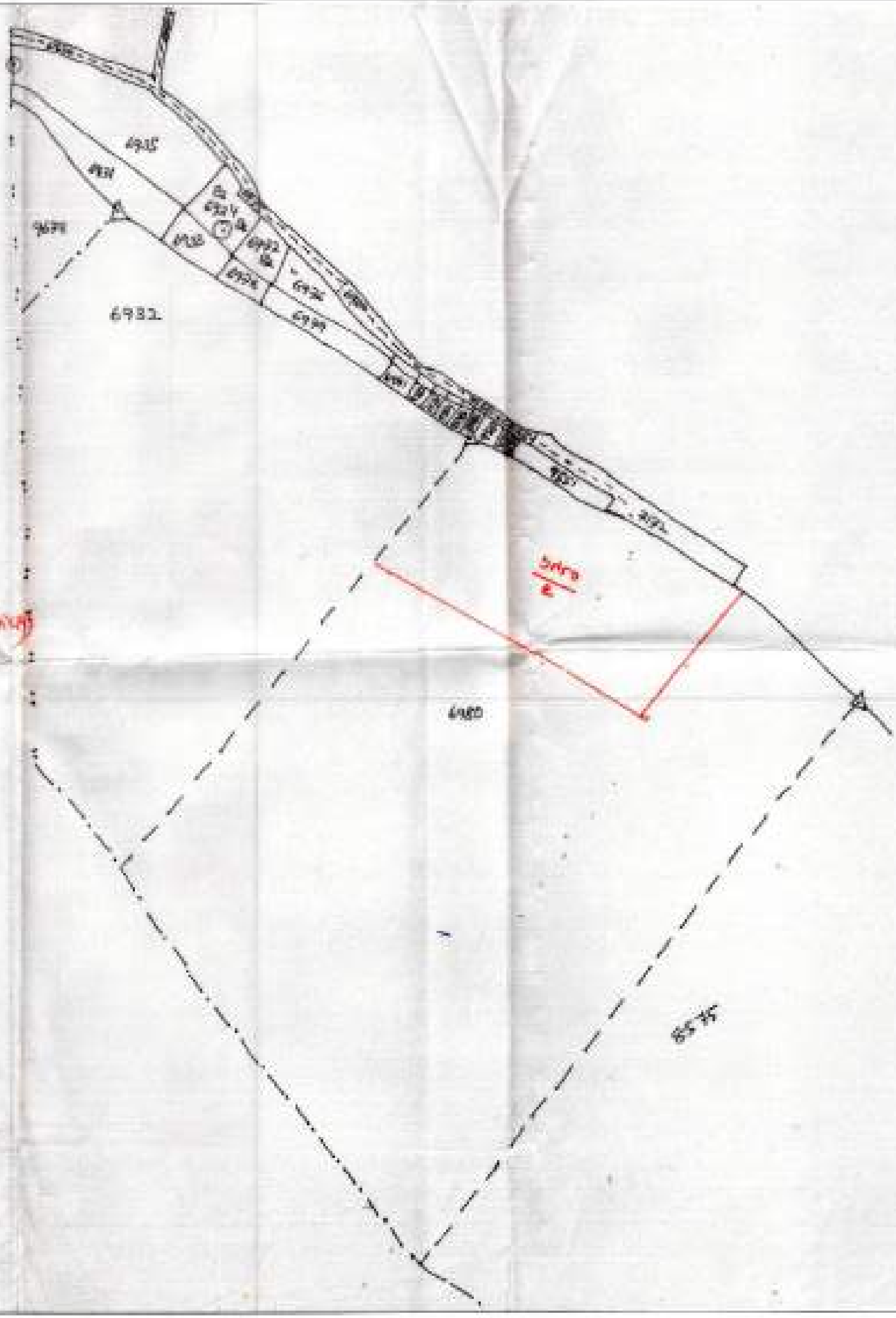
His Registration No. is **RQP/OD/049 /2016**

This Recognition is valid for a period of 10 years ending on 02.08.2026. This certificate will be liable to be withdrawn/ cancelled in the event of furnishing wrong information/ documents in the Mining Plans to be submitted by him.

Place: Bhubaneswar
Date: 03.08.2016

3/8/2016
DIRECTOR OF MINES, ODISHA
BHUBANESWAR

BIPIN BEHARI KHANDUAL
RQP/OD/049/2016



N

S

APPROVED

Joint Director ...
Zonal Survey, ...

BIPIN BEHARI KHANDUAL
RQP/OD/849/2016

Tahasildar
Kamakhyanagar

03-01-2020
Ravi Tumusingha