

ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

FOR

DRAFT

**Enhancement in Production of Coal from
1.00 million TPA to 3.00 million TPA**

FROM

GANGARAMCHAK & GANGARAMCHAK-BHADULIA MINE
(ML Area: 186.42 hectare)

in Village Bastabpur, Tehsil - Khoyrasole, Dist.- Birbhum, West Bengal

PROJECT PROPONENT

M/s West Bengal Power Development Corporation Ltd.

Bidyut Unnayan Bhaban.

Plot No. 3/C, IInd Floor, LA Block,

Sector-III, Salt Lake City, Kolkata - 700098

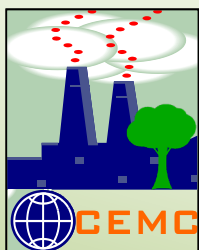
ToR Granted vide Letter No. J-11015/375/2006-IA-II(M), Dt. 29.11.2022

BASELINE DATA COLLECTION PERIOD: March 2022 to May 2022

COLLECTED BY : Noida Testing Laboratory

(NABL Certificate No. TC- 6814, valid till 01.12.2023)

December 2022



Centre for Envotech and Management Consultancy Pvt. Ltd.

AN ISO 9001: 2015, ISO 45001:2018 & ISO 14001:2015 certified company,
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Accredited by NABET, Quality Council of India for EIA studies

As Category "A" Consultant Organization

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CHAPTER-1

INTRODUCTION

1.0 INTRODUCTION:

The Mining industry in India is a major economic activity which contributes significantly to the economy of India and one of the major contributors to the GDP growth of India. Because mining is at the begin mining of the value chain and has the capacity to kick start economic development that few other businesses offer. However, the extraction of mineral reserves has always resulted in varying degrees of environmental Resource degradation and social impacts, including displacement. Furthermore, mining industry being 'location specific', the site cannot be shifted away from the mineral deposits. Hence, the mining companies have to take enough precautions and responsibility to minimize the environmental damage during mining operations and restoring those areas after mining activity is over. While acknowledging that no mining can be entirely free from all negative impacts, there is sufficient ground to suggest that Environmental Impact Assessment (EIA) is a formal process to predict the environmental consequences (positive or negative) of a plan, policy, program or project prior to the implementation decision. It proposes measures to bring down impacts to acceptable levels or to investigate new technological solution. Although it can lead to difficult economic decisions, strong political and social commitments, but it protects environment with sounds basis for effective and sustainable development.

An Environmental Management Plan (EMP) is usually prepared as part of EIA report. It translates recommended mitigation and monitoring measures into specific actions that will be carried out by the proponent. Cost of measures for environmental safeguards should be treated as an integral component of the project cost and environmental aspects should be taken into account at various stages of the project. EMP is a site-specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment and comply with environmental legislation. It provides the answers to the following important questions:

- What are the likely environmental issues for the site?
- What likely harm these issues can cause to the surrounding environment?
- How will these issues be managed to minimize harm to the environment?

1.2 PURPOSE OF REPORT:

Environmental Clearance is the permission from the Govt. for setting of certain projects like mining, which may impact environment considerably. Any new mining projects or existing mining projects going for enhancement in capacity require environmental clearance either from Ministry of Environment, Forest & Climate Change (MoEF& CC), Govt. of India for the matters falling under Category 'A' (as the schedule of notification number S.O. 1533 (E), date 14th September 2006) or at state level in the State Environment Impact Assessment Authority (SEIAA) for the matters falling under Category B.

The Lease area of Gangaramchak and Gangaramchak Bhadulia Coal Mine is spread over an area of 186.42 ha in village Bastabpur, Khoyrasole Tehsil under Birbhum district of West Bengal. The mine is reallocated to M/s West Bengal Power Development Corporation Limited vide vesting order no. 103/8/2015//NA dated 31.03.2015. The said block is spread over an area of 194 ha, out of which 149.42 ha is Projected Area and additional 37 ha is for OB and infrastructure development mining lease grant order for which has already been obtained from the State Government West Bengal. Thus the project area considered for formulation of this EIA report preparation is 186.42 ha. The mine is operating with a rated capacity of 1.00 MTPA at present for which Environmental Clearance and other statutory permits are in place. The project has already been appraised in the EAC for augmentation upto 1.50 MTPA as per the provision stated in the MOEF & CC OM dated 11th April, 2022. Due to excessive coal shortage in the recent past, WBPDCCL has decided to augment this mining capacity to 3.00 MTPA for which Mining Plan has already been approved by Ministry of Coal (**Annexure I**). The present proposal is a category B project as far as area is concerned, however due to the close proximity (>5 KM) of State Boundary of Jharkhand, the project is treated as Category A. Application for obtaining Terms of reference for 3.00 MTPA was applied to MOEF & CC and a standard terms of reference (TOR) was issued by MOEF&CC vide letter no. J-11015/375/2006-IA-II(M) dated 29.11.2022. This report (Draft EIA/EMP) is prepared in accordance to the Standard Terms of Reference to conduct the public hearing/public consultation as per the provision of EIA Notification 2006:

Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project has obtained Environmental clearance (EC) for 1.00 MTPA from MoEF& CC vide letter no-. J-11015/375/2006-IA-II. (M) dated 17th May 2007 (**Annexure II**) and further Transfer of Environmental clearance on 20th December 2018 (**Annexure III**) from M/s Bengal Emta Coal Mines Ltd. (BECML) to M/s The West Bengal Power Development Corporation Limited (WBPDCCL).

The current Draft EIA/EMP report is prepared as per latest stipulations of MoEF& CC, Government of India in relation to Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining and on the basis of Standard ToR. This report focuses on following aspects:

- Identification of the project and understanding of the impact of mining operation after enhancement of production capacity from 1.00 MTPA to 3.00 MTPA.
- Existing environmental scenario in and around the identified coal block covering 10 km radius as study area in terms of air environment, water environment, land environment, ecological environment, socio-economic environment, etc.

- To evaluate the anticipated pollution for enhancement capacity and prepare Environmental Management Plan (EMP) by describing various control measures to be adopted for mitigation of adverse impacts.
- To prepare a post-project monitoring programme for checking and regulating the environmental quality within the limits stipulated by State Pollution Control Board, Central Pollution Control Board and Ministry of Environment, Forests and Climate Change (MoEF&CC).
- To address all the aspects stipulated by MoEF& CC in the Standard ToR.

1.3 IDENTIFICATION OF PROJECT & PROJECT PROPONENT:

The Gangaramchak Block represents an isolated narrow elongated strip of coal bearing sediments of about 9 km in length in Trans-Hingla area of the Raniganj Coalfield in the district of Birbhum, West Bengal. The block is defined by the latitudes 23°48'20.812"N to 23°49'28.016"N and longitudes 87°12'20.292"E to 87°13'52.172"E. It is included in the Survey of India Toposheet No. 73M/1 and in the Sheet No. 16 of the geological map of the Raniganj Coalfield published by the Geological Survey of India.

Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project comprise both forest and non-forest lands. It has obtained Environmental clearance for 1.00 MTPA from MoEF& CC vide letter no-.J-11015/375/2006-IA-II. (M) dated 17th May 2007 and further Environmental clearance has been transferred to M/s The West Bengal Power Development Corporation Limited (WBPDC) from M/s Bengal Emta Coal Mines Ltd. (BECML) on 20th December 2018. The project area of the block is 186.42 ha which includes Mine lease area of 149.42 Ha. The project is located in village Basantpur, Tehsil Khoyrasole, Dist-Birbhum of West Bengal State. Forest clearance for 101.77 Ha. was obtained by WBPDC from MoEF&CC vide letter no 8-45/2018-FC dated 29th October 2018 (Stage I) &F.No-8-45/2018 dated 10th April 2019 (Stage II) attached as **Annexure IV**.

Shri Chanchal Goswami, Director Mining, is authorized person as applicant on behalf of M/s West Bengal Power Development Corporation Ltd. (WBPDC) for all the matters related to Environmental Clearance (EC) and he is also authorized to sign all the letters, documents, reports etc. related to Environmental Clearance of Gangaramchak &Gangaramchak Bhadulia Block Opencast Coal Mining Project. The detail of the Authorised Person is as follows (Table No. C1 - 1):

Table No. C1 - 1: Information about the Authorized Person:

Name	Designation	Contact No. & E-mail	Address for Correspondence
Shri. Chanchal Goswami	Director, Mining	c.goswami@wbpdcl.co.in	The West Bengal Power Development Corporation Ltd., Bidyut Unnayan Bhaban, Plot no- 3/C, LA-Block, Sector-III, Floor -II, Salt lake city, Kolkata- 700098.

Detail exploration is undertaken at Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project and Geological Report is already in place.

The coal of Gangaramchak & Gangaramchak-Bhadulia Mine is for utilisation in End Use Plants of WBPDCCL situated at STPS, Santaldih, Purulia district, KTPS, Mecheda, Purba Medinipur district, BKTPP, Bakreswar, Birbhum district, BTPS, Tribeni, Hoogly district, SgTPP, Manigram, Murshidabad district.

Name of Specified End Use Plants	Address	Configuration	Capacity	Existing or Proposed
Santaldih Thermal Power Station.	Santaldih, Purulia, West Bengal – 723146.	2 x 250 MW	500 MW	Existing
Kolaghat Thermal Power Station.	Mecheda, Medinipur, West Bengal – 721137.	6 x 210 MW	1260 MW	Existing
Bakreswar Thermal Power Plant.	Birbhum, West Bengal – 731104.	5 x 210 MW	1050 MW	Existing
Bandel Power Station.	Tribeni, Hoogly, West Bengal – 712503.	4 x 60=240 MW 1 x 210=210 MW	450 MW	Existing
Sagardighi Thermal Power Plant; Unit 1 & 2.	Manigram, Murshidabad, West Bengal – 742237.	2 x 300 MW	600 MW	Existing
Sagardighi Thermal Power Plant– Unit 3 & 4.	Manigram, Murshidabad, West Bengal – 742237.	2 x 500 MW	1000 MW	Existing

Estimated gross geological reserve of the mine is about 13.68 Million tonne and net geological Reserve of the block is 10.58 million tonne. Out of which mineable as well as extractable reserve of the mine is 9.15 million tonne and remaining reserve is 5.7250 Million Tonne (as on 1st April, 2022). Around 3.425 Million Tonne of coal reserve already depleted during FY 2019-20, FY2020-21, FY2021-22 and FY 2022-23 (Till 1st April, 2022). Thus remaining extractable reserve is 5.7250 Million Tonne. With the rated production capacity of 3.0 MTPA of coal, the life of the mine shall be around 3 years.

Table No. C1-2: The Salient Feature of the Project:

Sl. No.	Parameters	Description
1.	Name of the project	Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project
2.	Project Proponent	The West Bengal Power Development

		Corporation Ltd. (WBPDCCL)
3.	Details of allotment/ vesting Order	Ministry of Coal, GOI, vide its letter No. 103/8/2015/NA dated 31.03.2015 has allotted the Coal block to WBPDCCL.
4.	Life of the mine	3 years
5.	Method & type of Mining	Opencast Mechanized
6.	Slopes of Benches	70°
7.	Maximum Bench height	10 m
8.	Working Bench width	30 m
9.	Non- working Bench width	20 m
10.	Depth of Excavation	10 m to 73m
11.	Average Stripping Ratio (Cum: te)	5.2297
12.	Total Lease area	The project area of the block is 186.42 which includes Mine Lease area of 186.42 Ha.
13.	Net Geological Reserve	10.58 million tonne
14.	Remaining Mineable coal reserves	5.725 MT (as on 1 st April, 2022)
15.	Production	Targetted Production – 3.0 MTPA Peak Rated Production – 4.50 MTPA

1.4 BRIEF DESCRIPTION OF NATURE, SIZE, LOCATION AND ACCESSIBILITY OF THE PROJECT:

Nature of the Project

The Gangaramchak and Gangaramchak Bhadulia coal block was initially allotted to M/s Bengal Emta Coal Mines Limited in the year of 2003. The authorized mine operator brought this mine into production in the year of 2003. The Hon'ble Supreme Court of India vide its judgement dated 25th August 2014 and order dated 24th September 2014 cancelled the allocation of all 204 coal blocks which included the Gangaramchak and Gangaramchak Bhadulia block.

Subsequently this block/mine has been reallocated by the Ministry of Coal (MoC) to WBPDCCL vide allotment order no 103/8/2015/NA dated 31.03.2015 As per the provisions of the Coal Mines Special Provisions Act, 2015. The coal of Gangaramchak & Gangaramchak-Bhadulia Mine is being utilized at End Use Plants of WBPDCCL situated at STPS, Santaldih, Purulia district, KTPS, Mecheda, Purba Medinipur district, BKTPP, Bakreswar, Birbhum district, BTPS, Tribeni, Hoogly district, SgTPP, Manigram, Murshidabad district. M/s Bengal Emta Coal Mines Ltd. has obtained Environmental clearance for 1.00 MTPA from MoEF&CC vide letter no- . J-11015/375/2006-IA-II. (M) dated 17th May 2007 and further Environmental clearance of the block has been transferred to M/s The West Bengal Power Development Corporation Limited (WBPDCCL) from M/s Bengal Emta Coal Mines Ltd. (BECML) on 20th December 2018. It is an operating opencast mechanized mining project and the present proposal is for enhancement of production capacity of coal from 1.00 MTPA to 3.0 MTPA.

Size of the Project

The project area and Mining Lease area are same and in a tune of 186.42 ha. The project is located in village Bastabpur, Tehsil Khoyrasole, Dist-Birbhum Of West Bengal state. Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project comprise both forest and non-forest lands. Forest clearance for 101.77 Ha was obtained by WBPDCCL from MoEF&CC vide letter no 8-45/2018-FC dated 29th October 2018 (Stage I) & F.No-8-45/2018 dated 10th April 2019 (Stage II). The project has already obtained Environmental Clearance for production of 1.00 MTPA of coal. The current EIA study is conducted for obtaining Environmental clearance for production capacity i.e. 3.00 MTPA (Targetted Production).

Location of the Project

The Gangaramchak Block represents an isolated narrow elongated strip of coal bearing sediments of about 9 km in length in Trans-Hingla area of the Raniganj Coalfield in the district of Birbhum, West Bengal. The block is defined by the latitudes 23°48'20.812"N to 23°49'28.016"N and longitudes 87°12'20.292"E to 87°13'52.172"E. It is included in the Survey of India Topo Sheet No. 73M/1. Administratively the Block falls under Khayrasole Police Station of Birbhum district.

Communication

The area is approachable by road only. The Khayrasole-Panchra road connects the block with the Raniganj - Suri Road, (NH-14) at Panchra. Another unmetalled road connects both Gangaramchak and Bhadulia Collieries, at Khayrasole. Raswan Railway Station, on the Andal-Palasthali section of the Eastern Railway, is located about 4 km south west of the block. Kazi Nazrul Islam Airport is situated about 22 km (aerial distance) away from the project site. The district head quarter is at Suri which is located about 45 km away (aerial distance).

Importance to the country & region

To overcome the power demand of the country, India needs several power projects to be implemented. Till date, India's 60% power demand is fulfilled through thermal power generation. The growing demand of power for development of the other core segment such as Steel and Aluminum sector need for implementation of new power plants are inevitable. Coal produced from this project is linked to STPS, Santaldih, Purulia district, KTPS, Mecheda, Purba Medinipur district, BKTPP, Bakreswar, Birbhum district, BTPS, Tribeni, Hoogly district, SgTPP, Manigram, Murshidabad district as discussed above. Enhancement of coal production up to 50% from this project will reduce the gap between the demand and supply and will contribute to rise the GDP of the West Bengal State as well as country.

The national economy will gain to the extent of several crores by the way of wages payable to about 270 numbers of employees for another 3 years and it is expected that around 10 numbers of additional persons will get indirect employment for this expansion.

There is huge demand of coal in West Bengal for Power generation and other utility. Thus, winning of coal at the rate of 3.0 MTPA from this project is highly essential.

1.5 LEGAL AND REGULATORY FRAMEWORK

EIA Notification 2006 is the principal legislation governing EIA in India. Besides this, the Government of India under Environment (Protection) Act 1986 issued a number of notifications, which are related environmental impact assessment. The MoEF & CC is the nodal agency to set up policy and standards for the protection of environment, along with the Central Pollution Control Board (CPCB). This includes air, noise, water & hazardous waste standards. The relevant regulation & standards, which are of significance to this expansion project, are discussed in Table No. C1-3.

Table No. C1-3: Environmental Regulations

Name of Regulation	Scope and Objective	Operational Agencies / Key Players
Environment Protection Act 1986; Environment Protection Rules 1989	To provide protection and improvement of environment	Central Govt. MoEF&CC, can delegate power to Dept. of Environment
EIA Notification, New Delhi 14th September, 2006 and its amendments	To provide Guideline for EIA Study	Central Government, Nodal Agencies MoEF&CC, State Governments

Air (Prevention and Control of Pollution) Act 1981	To provide for the prevention and control of air pollution. Permission obtained prior to establishment of operation	Central and State Pollution Control Boards
Water (Prevention and Control of Pollution) Act 1974	To provide for prevention & control of water pollution and enhancing water quality. Permission obtained prior to establishment of operation.	Central and State Pollution Control Boards
Noise Pollution (Prevention & Control) Rules 2000	To control and take measures for abatement of noise and ensure that level does not cross standard	Central Government, Nodal agencies MoEF&CC, State Governments
Forest (Conservation) Act, 1980	To provide protection and improvement of forest	Central Government, MoEF&CC, State Governments
Wildlife Protection Act, 1972 & amendments of 2002, 2006	To provide protection and improves the habitats of Wildlife	Central Government, MoEF&CC, State Governments
Solid Waste Management Rules, 2016	To prescribe procedures for handling and disposal of solid waste	Central Government, agencies MoEF&CC, State Governments Nodal
Hazardous Waste (Management, Handling & Trans boundary Movement) Rules, 2016	To impose restrictions and prescribe procedures for management, handling and disposal of hazardous waste	Central and State Pollution Control Boards
E-waste Management Rules, 2016 & amendment 2018	To prescribe procedures for handling and disposal of e-waste	Central and State Pollution Control Boards
Mines Act, 1952 Mine Rules - 1955, The Coal Mines (Special Provisions) Act, 2015. Coal Mines Regulations, 2017	An Act to provide for allocation of coal mines and mine infrastructure together with mining leases	Directorate-General of Mines Safety (DGMS) under the Union Ministry of Labour & Employment (MOL&E)
Colliery Control Rules 2004	Permission for opening of the seams in the colliery	The Coal Controller, Ministry of Coal.
NOC for abstraction of Ground Water	Permission for abstraction of Ground water.	Central Ground water Authority, Ministry of Jal Shakti, GOI.
NOC for Surface Water withdrawal	Permission for withdrawal of water from surface water body for industrial use.	Water Resources Department, Jharkhand

Consent to Establish & Operation	To issue consent for establishing & carrying out the operations	State Pollution Control Board
Explosive (Amendment) Rules, 2018	Permission to use the specific explosives mentioned in the license.	Controller of Explosives,

Particulars of statutory licenses, permits, permission, approvals of consents already obtained for existing capacity i.e. 1.00 MTPA are furnished in Table no-C1-4.

Table No. C1 – 4: Particulars of statutory licenses, permits, permission, approvals of consents already obtained

S. NO	Statutory Clearance	Ministry/ Agency	Letter No.	Date
1.	Environment Clearance- Integrated Gangaramchak Gangaramchak-Badulia Block Opencast Coal Mine Project (1 MTPA) of M/s Bengal Emta Coal Mines Ltd., Located in village Bastabpur, Tehsil Khoyrasole, District- Birbhum West Bengal- was later on transferred to WBPDCCL	Ministry of Environment and Forests	J- 11015/375/2006-IA.II(M) J- 11015/375/2006-IA.II (M)	17.05.2007 20.12.2018
2.	Forest Clearance – Stage1 and Stage2	Ministry of Environment and Forest	letter no 8-45/2018-FC (Stage I) & F.No-8-45/2018 (Stage II)	dated 29 th October 2018 and dated 10 th April 2019
3.	Approval of Mine Plan for 3 MTPA	Coal Controller Organization, Ministry of Coal	Gangaramchak Gangaramchak-Badulia Coal Mine WBCWB003/APPO 0222/2022	16.11.2022

1.6 DETAILS OF REGULATORY SCOPING CARRIED OUT

The proposed expansion project is designated to be developed under the Environmental Impact Assessment (EIA) Notification and amendments under Environment (Protection) Act (EPA), 1986. Proposed project falls under "Category A" as per the notification issued on 14th September 2006 by MOEF as expansion of environmental clearance procedure and amended thereof.

Study area : 10km zone around the mine lease from lease periphery Study

period : March 2022 to May 2022 for expansion capacity

As per the standard TOR (**Annexure V**), the scope of work for the fieldwork under environmental baseline survey includes the following:

Air Quality

Ambient air quality (AAQ) was monitored at eight (8) stations representing the study area. The monitoring stations were selected based on the predominant wind direction of the area as recorded by IMD in past (Climatological Table: 1951-80), sensitive places, human settlements, forest area etc. The monitoring was carried out as per standard guidelines of Central Pollution Control Board, GOI, New Delhi.

Meteorology

Meteorological station was set up at one (01) no. location within the lease area to collect primary information which is core zone of the project site. Parameters collected were wind speed, wind direction, temperature, relative humidity and rainfall on hourly basis for 24 hours during the study period.

Noise level

Measurement of ambient noise levels within the study was carried out at six (6) locations at regular intervals, once during the study period to determine the frequency of peak levels for 24 hours during the study period

Water Quality

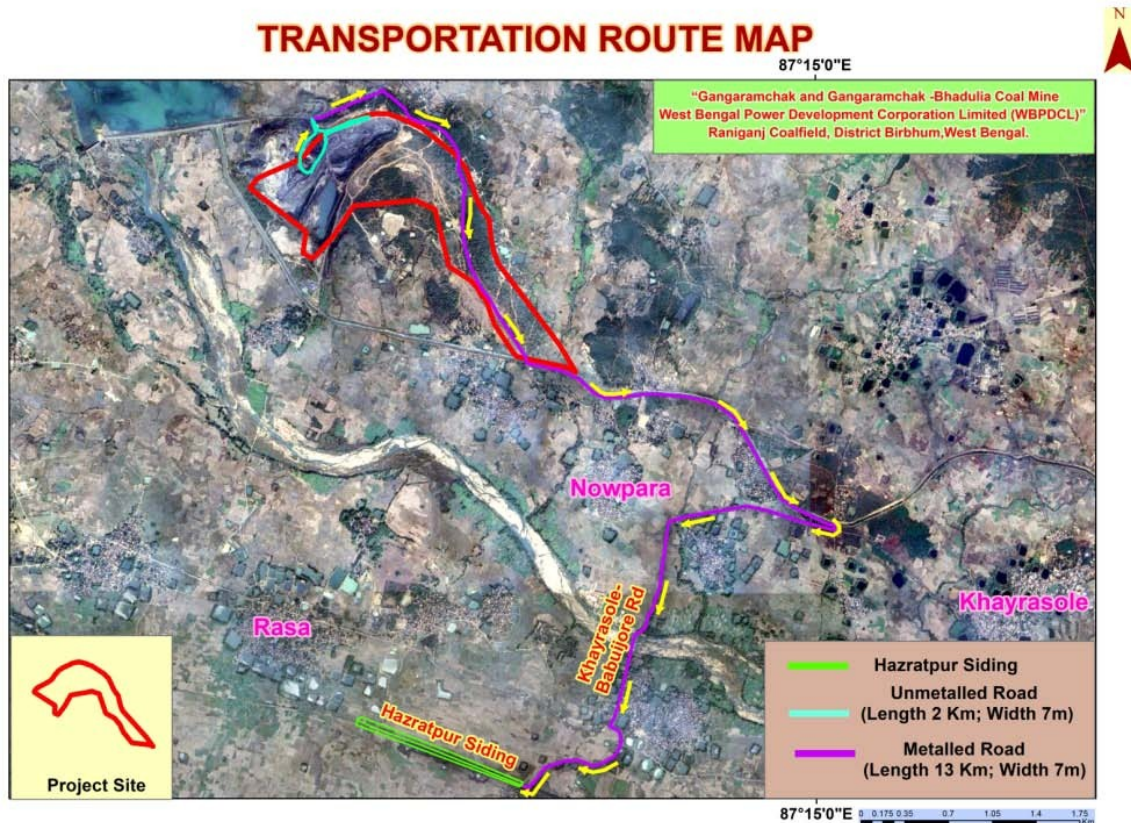
For the present EIA study, Six (6) numbers of grab water samples (surface water three (3) and groundwater three (3) from the study area were collected, once during the study period as per standard guidelines. The samples are analyzed for physical, chemical and bacteriological parameters as per the standard guideline.

Soil Quality

Testing of soil samples were carried out from five (05) locations within the study area for the current EIA study

Traffic Density

Coal of -100mm size is being dispatched to the Power plants of WBPDCL by road and rail mode. The siding is situated at Hazarathpur village which is nearly 15 km away from the mines. The coal is being transported to the siding by deploying 70 to 80 trucks duly covered by tarpaulin during night hours. 2 no of Water sprinklers are being used during the Transportation for spraying water in the road. In order to transport 3.0 Million tons per annum additional 200 trucks would be required.



Flora & Fauna

Survey for flora and fauna has been carried out in the study area as per the standard guideline. Species of flora have been listed as agricultural crops, commercial crops, plantation, natural vegetation, grasses, endangered, endemic and others. Flora and fauna identified during the study period are mentioned in the EIA report

Remote Sensing Study

This study has been carried out based on the satellite imageries of the study area to assess the land use pattern.

Socio-economic Survey

Socio-economic survey in the study area has been carried out to assess the status of demographic pattern, cropping pattern and general amenities available based on the Census 2011, secondary information available with different government agencies. Detailed R & R study is carried out.

Dump & Pit Stability Study

The study has been carried out by Dr. Indrajit Roy of Birla Institute of Technology, Ranchi for design of pit configuration, ultimate pit slope, dump slope and to suggest methods of monitoring the slope stability including precautionary measures to maintain dump & pit stability.

Hydro- Geological Study

Detail Hydrogeological study for Gangaramchak &Gangaramchak Bhadulia Block Opencast Coal Mining Project has been carried out by Central Mining Research Institute, Dhanbad.

1.7 DETAILS OF COURT CASE OR LITIGATION

There is no court case or any other litigation pending at any statutory bodies in relation to Gangaramchak &Gangaramchak Bhadulia Block Opencast Coal Mining Project of WBPDC.

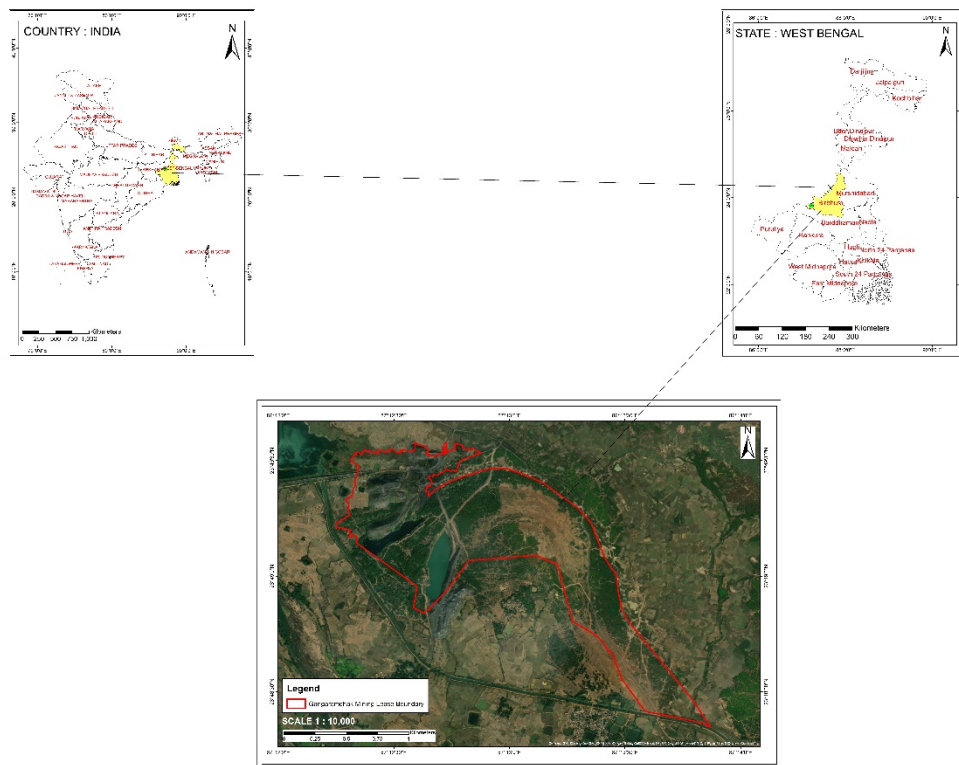


Figure: C1-1: Location of the Project

*Draft EIA/EMP Report for Enhancement in Coal Production from
Gangaramchak and Gangaramchak -Bhadulia Coal Mine*

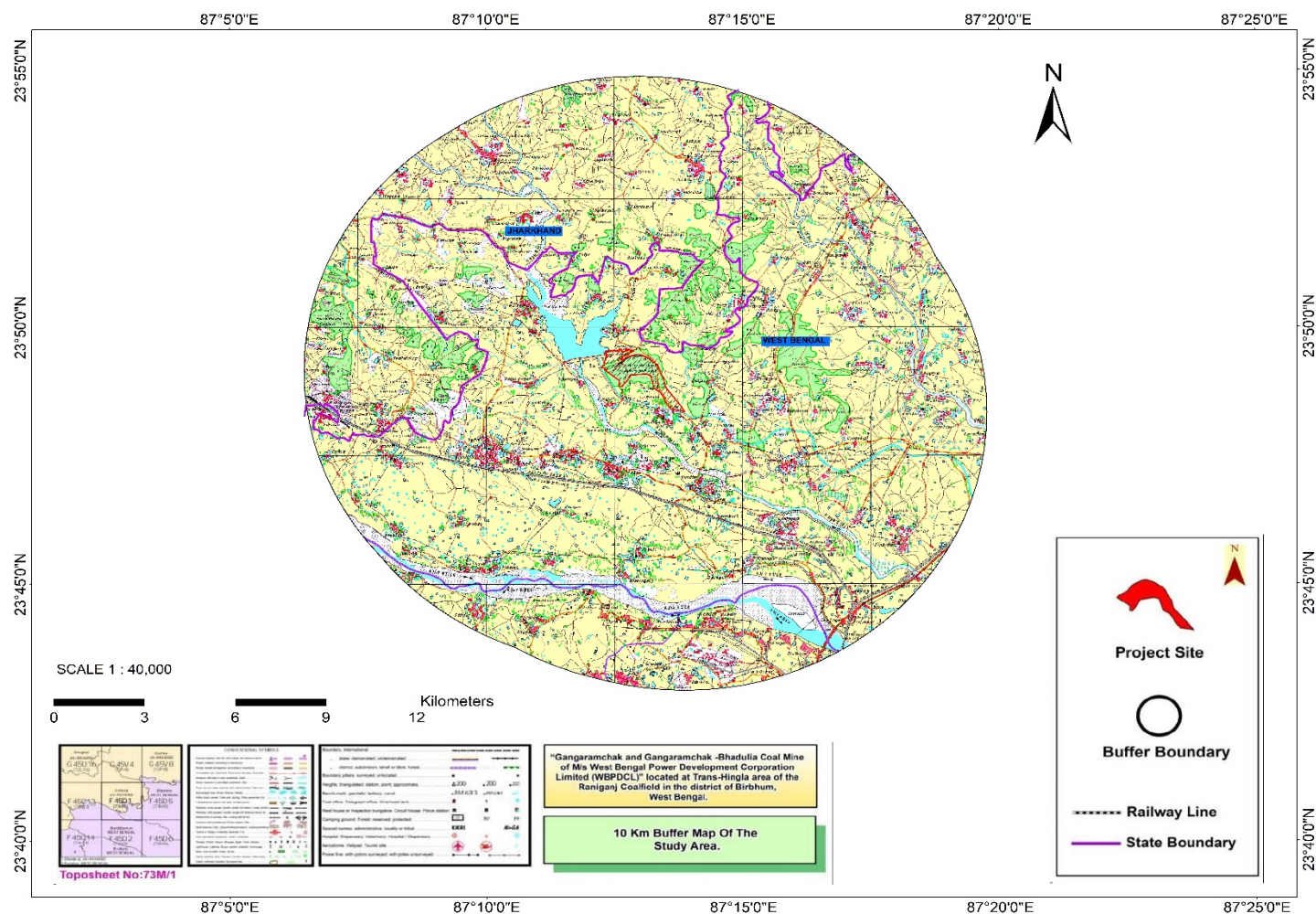


Figure: C1-2: 10 KM buffer map of the project

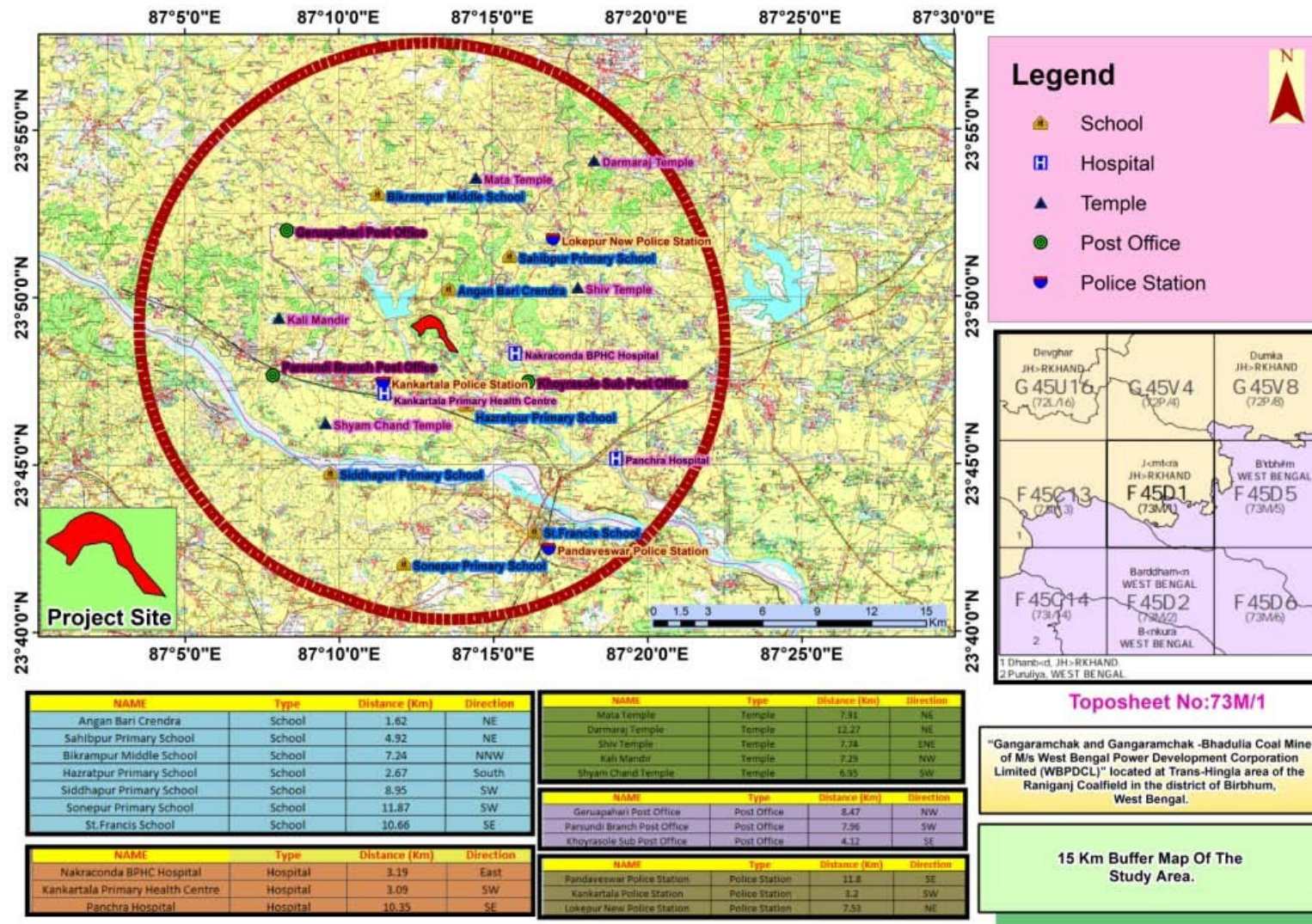


Figure: C1-3: 15 KM Sensitivity around the project site

Table No. C1-5: Standard ToR Compliance

1	An EIA-EMP Report would be prepared for MTPA rated capacity in an ML/project area of ha based on the generic structure specified in Appendix III of the EIA Notification 2006.	EIA-EMP has been prepared for 3.0 MTPA for Project area 186.42 Ha. EIA report is prepared on the basis of Appendix III of EIA notification 2006.
2	An EIA-EMP Report would be prepared for MTPA rated capacity to cover the impacts and management plan for the project specific activities on the environment of the region, and the environmental quality encompassing air, water, land, biotic community, etc. through collection of data and information, generation of data on impacts including prediction modeling for..... MTPA of coal production based on approved project/Mining Plan for.....MTPA. Baseline data collection can be for any season except monsoon.	EIA-EMP has been prepared for 3.0 MTPA for Project area 186.42 Ha. EIA report is prepared on the basis of Appendix III of EIA notification 2006. Modelling has been done for 3.0 MTPA. Base line data has been collected in the month of March-May 2022. Please refer Chapter 4 of the EIA report.
3	A map specifying locations of the State, District and Project location	The details regarding location of the project given in chapter 1 of the EIA report. Please refer Figure C1-1 .
4	A Study area map of the core zone and 10 km area of the buffer zone (1: 50,000 scale) clearly delineating the major topographical features such as the land use, surface drainage pattern including rivers/streams/nallahs/canals, locations of human habitations, major constructions including	Refer Chapter 3 of Draft EIA/EMP Report

	railways, roads, pipelines, major industries/mines and other polluting sources. In case of ecologically sensitive areas such as Biosphere Reserves/National Parks/WL Sanctuaries/ Elephant Reserves, forests (Reserved/Protected), migratory corridors of fauna, and areas where endangered fauna and plants of medicinal and economic importance found in the 15 km study area should be given.	
5	Land use map (1: 50,000 scale) based on a recent satellite imagery of the study area may also be provided with explanatory note on the land use.	Land use map has been given in chapter 3 of the EIA report. Please refer Figure C3-5 for land use Map. Please refer section 3.6.1 for land use/land cover pattern details.
6	Map showing the core zone delineating the agricultural land (irrigated and un-irrigated, uncultivable land as defined in the revenue records, forest areas (as per records), along with other physical features such as water bodies, etc should be furnished.	Land use map has been given in chapter 3 of the EIA report. Please refer Figure C3-5 for land use Map.
7	A contour map showing the area drainage of the core zone and 25 km of the study area (where the water courses of the core zone ultimately join the major rivers/streams outside the lease/project area) should also be clearly indicated in the separate map.	The drainage pattern of the region is dendritic in nature. A number of ephemeral nalas drain the area to the Hinglow River flowing to the south and west of the block boundary of Gangaramchak and Gangaramchak- Bhadulia Coal Block. The details regarding Drainage pattern has been given in section 3.4.2 of Chapter 3 of the EIA report. Please refer Figure C3-3 for contour map showing the area drainage of the core zone and 25 km of the study area.

8	A detailed Site plan of the mine showing the proposed break-up of the land for mining operations such as the quarry area, OB dumps, green belt, safety zone, buildings, infrastructure, CHP, ETP, Stockyard, township/colony (within and adjacent to the ML), undisturbed area -if any, and landscape features such as existing roads, drains/natural water bodies to be left undisturbed along with any natural drainage adjoining the lease /project areas, and modification of thereof in terms of construction of embankments/bunds, proposed diversion/re-channelling of the water courses, etc., approach roads, major haul roads, etc should be indicated.	Refer Chapter 2 of Draft EIA/EMP Report.
9.	In case of any proposed diversion of nallah/canal/river, the proposed route of diversion /modification of drainage and their realignment, construction of embankment etc. shouldalso be shown on the map as per the approval of Irrigation and flood control Department of the concerned state.	There is no diversion of Nallah/canal/river has beenproposed.
10	Similarly if the project involves diversion of any road/railway line passing through the ML/project area, the proposed route of diversion and its realignment should be shown in the map.	Refer Chapter 2 of Draft EIA/EMP Report
11	Break up of lease/project area as per different land uses and their stage of acquisition should be providedLanduse Details For Opencast Project	Break up of lease/project area as per different land uses has been given in Chapter 2 of the EIA report.
12	Break-up of lease/projectarea as Per mining operations should be provided	Break up of lease/project area as per different land uses has been given in Chapter 2 of the EIA report. Please refer Table C2-2 Pre-Mining Land Distribution as per Mine Closure Plan.
13	Impact of changes in the land use due to the project, if much of the land being acquired is predominantly agricultural land/forestland/grazing land.	There is no change in landuse as Lease is alreadyoperational and its has been proposed for expansion.

14	One-season (non-monsoon) primary baseline data on environmental quality - air (PM10, PM2.5, SOx, NOx and heavy metals such as Hg, Pb, Cr, As, etc), noise, water (surface and groundwater), soil - along with one-season met data coinciding with the same season for AAQ collection period should be provided.	Monitoring has been carried out during March-May 2022. The details regarding the same has been provided in Chapter 3 of the EIA report. Please refer section 3.8, 3.9, 3.10, 3.11, 3.12 of chapter 3 for primary baseline data on environmental quality.
15	Map of the study area (1: 50, 000 scale) (core and buffer zone clearly delineating the location of various sampling stations superimposed with location of habitats, other industries/mines, polluting sources should be provided. The number and location of the stations in both core and buffer zones should be selected on the basis of size of lease/project area, the proposed impacts in the downwind (air)/downstream (surface water)/groundwater regime (based on flow). One station should be in the upwind/upstream/non-impact/non-polluting area as a control station. The monitoring should be as per CPCB guidelines and parameters for water testing for both ground water and surface water as per ISI standards and CPCB classification wherever applicable. Values should be provided based on desirable limits.	All monitoring location has been marked and has been addressed in chapter 3 of EIA report. Please refer table C3-11 and Figure C3-8 for Air monitoring location, refer table C3-15 and Figure C3-9 for Noise sampling locations, refer table C3-18 and Figure C3-10 for Water Quality Monitoring Stations, refer table C3-21 and Figure C3-11 for Soil Sampling Locations.
16	Study on the existing flora and fauna in the study area (10km) should be carried out by an institution of relevant discipline. The list of flora and fauna duly authenticated separately for the core and study area and a statement clearly specifying whether the study area forms a part of the migratory corridor of any endangered fauna should be given. If the study area has endangered flora and fauna, or if the area is occasionally visited or used as a	EB study has been carried out and given in section 3.13 of chapter 3 of EIA report.

	habitat by Schedule-I fauna, or if the project falls within 15 km of an ecologically sensitive area, or used as a migratory corridor then a Comprehensive Conservation Plan should be prepared and submitted with EIA-EMP Report; and comments from the CWLW of the State Govt. should also be obtained and furnished.	
17.	Details of mineral reserves, geological status of the study area and the seams to be worked, ultimate working depth and progressive stage-wise working scheme until the end of mine life should be provided on the basis of the approved rated capacity and calendar plans of production from the approved Mining Plan. Geological maps and sections should be included. The Progressive mine development and Conceptual Final Mine Closure Plan should also be shown in figures.	This has been given in section 2.4, 2.5, 2.6, 2.7 & 2.8 of chapter 2 of the EIA report. Please refer Fig C2- 1 of Chapter 2 for Geological Plan. Please Refer Figure C4-9 of Chapter 4.
18	Details of mining methods, technology, equipment to be used, etc., rationale for selection of specified technology and equipment proposed to be used vis-à-vis the potential impacts should be provided	This has been given in section 2.6, 2.7 & 2.8 of chapter 2 of the EIA report.
19.	Impact of mining on hydrology, modification of natural drainage, diversion and channeling of the existing rivers/water courses flowing through the ML and adjoining the lease/project and the impact on the existing users and impacts of mining operations thereon	This has been given in chapter 4 & 7.
20	Detailed water balance should be provided. The break-up of water requirement for the various mine operations should be given separately	Water balance has been given at chapter 2 of the EIA report.
21	Source of water for use in mine, sanction of the competent authority in the State Govt. and impacts vis-à-vis the competing users should be given.	Refer Chapter 2 & 4 of Draft EIA/EMP Report.

22	Impact of mining and water abstraction use in mine on the hydrogeology and groundwater regime within the core zone and 10 km buffer zone including long-term monitoring measures should be provided. Details of rainwater harvesting and measures for recharge of groundwater should be reflected in case there is a declining trend of groundwater availability and/or if the area falls within dark/grey zone.	A detailed Hydrogeological study has been carried out by Central Mining Research Institute, Dhanbad. Refer Chapter 4 & 7.
23	Impact of blasting, noise and vibrations should be given	The details regarding the same has been given in chapter 4 & 7 of the EIA report.
24	Impacts of mining on the AAQ and predictions based on modeling using the ISCST-3 (Revised) or latest model should be provided.	AEROMOD software has been used for modeling. Details has been given in section 4.3 of chapter 4 of the EIA report.
25	Impacts of mineral transportation within the mining area and outside the lease/project along with flow-chart indicating the specific areas generating fugitive emissions should be provided. Impacts of transportation, handling, transfer of mineral and waste on air quality, generation of effluents from workshop, management plan for maintenance of HEMM, machinery, equipment should be given. Details of various facilities such as rest areas and canteen for workers and effluents/pollution load emanating. from these activities should also be provided.	Impact has been identified and given in chapter 2 and 4 of EIA report.
26	Effort to be made to reduce/eliminate road transport of coal inside and outside mine and for mechanized loading of coal through CHP/ Silo entirely wagons and into trucks/tippers.	The coal is carried by tipping trucks to the nearer Hazarathpur railway siding through the PWD road via Sarsa More and Nowpara Bridge. Hazarathpur railway siding is on Bhingarh-Palasthali section of Asansol division of Eastern railway at a distance of 4.77 km from the mine. Please refer section 1.4.6 for transportation route map.

27	Details of waste OB and topsoil generated as per the approved calendar programme, and their management shown in figures as well explanatory notes tables giving progressive development and mine closure plan, green belt development, backfilling programme and conceptual post mining land use should be given. OB dump heights and terracing based on slope stability studies with a max of 28° angle as the ultimate slope should be given. Sections of final dumps (both longitudinal and cross section) with relation to the adjacent area should be shown.	Has been given in chapter 2 of the EIA report.
28	Efforts be made for maximizing progressive internal dumping of O.B., sequential mining , external dump on coal bearing area and later rehandling into the mine void.-to reduce land degradation	Detail has been in the chapter 2 EIA Report.
29	Impact of change in land use from mining operations and whether the land can be restored to agriculture use post mining	Impact on land use has been addressed in EIA report. Details has been given in chapter 2, table C2-12 regarding Land utilization Plan. Please refer section 4.9 of chapter 4 of the EIA report Impact on Topography & Land Use.
30	Progressive Green belt and ecological restoration /afforestation plan (both in text, figures and in the tabular form as per the format of MOEF&CC given below) and selection of species (native) based on original survey/land use should be given. Table:-1	Progressive Greenbelt Development Plan has been given in chapter 4 of the EIA report.
31	Conceptual Final Mine Closure Plan and post mining land use and restoration of land/habitat to the status pre- mining should be provided. A Plan for the	Conceptual Final Mine Closure Plan and post mining land use Plan has been given in chapter 4 of the EIA report.

	ecological restoration of the mined out area and post mining land use should be prepared with detailed cost provisions. Impact and management of wastes and issues of rehandling (wherever applicable) and backfilling and Progressive mine closure and reclamation should be detailed.	
32	Flow chart of water balance should be provided. Treatment of effluents from workshop, township, domestic wastewater, mine water discharge, etc. should be provided. Details of STP in colony and ETP in mine should be given. Recycling of water to the max. possible extent should be accorded?	Water balance has been given at chapter 2& 4 of the EIA report.
33	Occupational health issues. Baseline data on the health of the population in the impact zone and measures for occupational health and safety of the personnel and manpower in the mine should be given.	Details regarding Occupational Health & Safety is given in section 4.18 in chapter 4 of EIA report.
34	Risk Assessment and Disaster Preparedness and Management Plan should be provided	Details regarding Risk Assessment and Disaster Preparedness and Management Plan Has been given in chapter 7 of the EIA report.
35	Integration of the Env. Management Plan with measures for minimising use of natural resources - water, land, energy, etc. should be carried out.	Details regarding the same has been given in chapter 9 of the EIA report.
36	Cost of EMP (capital and recurring) should be included in the project cost and for progressive and final mine closure plan	EMP Cost has been included in the project cost. EMP cost has been given in chapter 6 .

37	Details of R&R. Detailed project specific R&R Plan with data on the existing socio-economic status of the population (including tribals, SC/ST, BPL families) found in the study area and broad plan for resettlement of the displaced population, site for the resettlement colony, alternate livelihood concerns/employment for the displaced people, civic and housing amenities being offered, etc and costs along with the schedule of the implementation of the R&R Plan should be given.	There is no R & R plan involved.
38	CSR Plan along with details of villages and specific budgetary provisions (capital and recurring) for specific activities over the life of the project should be given.	The organization has a defined CSR policy integrated with the Power Generation Units and undertake from Corporate Level. The mine is situated in the district Birbhum where BTPS generation unit is situated and CSR is being undertaken as per policy. Refer Chapter of Draft EIA/EMP Report.
39	Corporate Environment Responsibility The Company must have a well laid down Environment Policy approved by the Board of Directors. The Environment Policy must prescribe for standard operating process/procedures to bring into focus any infringements/deviation/violation of the environmental or forest norms/conditions. The hierarchical system or Administrative Order of the company to deal with environmental issues and for ensuring compliance with the environmental clearance conditions must be furnished. To have proper checks and balances, the company should have a well laid down system of reporting of non-	Company has well laid down Environmental Policy. Please refer Annexure VII & Chapter 9 of Draft EIA/EMP Report.

	compliances/violations of environmental norms to the Board of Directors of the company and/or shareholders or stakeholders at large.	
40	Details on Public Hearing should cover the information relating to notices issued in the newspaper, proceedings/minutes of public hearing, the points raised by the general public and commitments made by the proponent and the action proposed with budgets in suitable time frame. These details should be presented in a tabular form. If the Public Hearing is in the regional language, an authenticated English Translation of the same should be provided	Shall be complied after conducting Public Hearing
41	In built mechanism of self-monitoring of compliance of environmental regulations should be indicated.	Has been addressed in Environmental Policy.
42	Status of any litigations/ court cases filed/pending on the project should be provided.	There is no court case pending.
43	Submission of sample test analysis of Characteristics of coal: This should include details on grade of coal and other characteristics such as ash content, S and heavy metals including levels of Hg, As, Pb, Cr etc	Characteristic of coal has been given in Chapter 2 of Draft EIA//EMP report.

44	Copy of clearances/approvals such as Forestry clearances, Mining Plan Approval, mine closer plan approval. NOC from Flood and Irrigation Dept. (if req.), etc. wherever applicable	Information provided in Chapter 1; Table C1-4.

CHAPTER- 2

PROJECT DESCRIPTION

2.0 TYPE OF PROJECT:

The Gangaramchak and Gangaramchak-Bhadulia Coal mine is an existing open cast coal mine of Raniganj Coalfield. Opencast mechanized mining methodology is implemented here. Overburden is loosened through conventional drilling and blasting. Removal of overburden is done through hydraulic shovel in conjunction with rear dumpers while coal is through environment friendly surface miner. The present proposal is an expansion proposal for increase in production of coal. The proposed targeted production is aimed at 3.00 MTPA with Peak rated capacity of 4.50 MTPA of coal.

2.1 NEED FOR THE PROJECT:

To overcome the power demand of the country, India needs several power projects to be implemented. Till date, India's 60% power demand is fulfilled through thermal power generation. The Gangaramchak and Gangaramchak-Bhadulia Coal Block is a project of M/s WBPDC, allotted for captive use of coal. This is an existing operative coal mine supplying coal to End Use Plants of M/s WBPDC. Details of the Power plants are tabulated below (Table No. C2-1).

Table C2-1: Detail Configuration & Plant Capacity Of The Thermal Power Station

Sl. No.	Name of End Use Plants	Address	Configuration	Capacity	Distance From Gangaramchak Mines
1.	Santaldih Thermal Power Station	Santaldih, Purulia, West Bengal - 723146	2 x 250 MW	500 MW	75 km
2.	Kolaghat Thermal Power Station	Mecheda, Medinipur, West Bengal - 721137	6 x 210 MW	1260 MW	163 km
3.	Bakreswar Thermal Power Plant	Birbhum, West Bengal - 731104	5 x 210 MW	1050 MW	18 km
4.	Bandel Thermal Power Station	Tribeni, Hoogly, West Bengal - 742237	4 x 60 MW 1 x 210 MW	450 MW	148 km
5.	Sagardighi Thermal Power Plant- Unit 1 & 2	Manigram, Murshidabad, West Bengal - 742237	2 x 300 MW	600 MW	104 km

6.	Sagardighi Thermal Power Plant- Unit 3 & 4	Manigram , Murshidabad, West Bengal - 742237	2 x 500 MW	1000 MW	104 km

2.2 LOCATION OF THE PROJECT AREA:

The Gangaramchak Block represents an isolated narrow elongated strip of coal bearing sediments of about 9 km in length in Trans-Hingla area of the Raniganj Coalfield in the district of Birbhum, West Bengal. Administratively the Block falls under Khayrasole P.S. of Birbhum district. The project area falls in the part of Survey of India Topo Sheet No. 73M/1 and bounded by coordinates:

Latitude: 23° 48' 30" N-23° 49' 25" N

Longitude: 87° 12' 30" E-87° 13' 50" E

The coal block is covered within six villages of Birbhum district namely Gangarampur, Bastabpur, Bhadulia, Sahepur, Sagarbhangra and Ahmedpur. Location Map over Survey of India toposheet depicting 1 km buffer zone from the lease boundary, 5km buffer zone from the lease boundary & 10km buffer zone from the lease boundary is depicted in Fig. no. C2 -1. The altitude of the Block is ranges from 94 m to 121 m above MSL.

The area is approachable by road only. The Khayrasole-Panchra road connects the block with the Raniganj - Suri Road, (NH-14) at Panchra. Another unmetalled road connects both Gangaramchak and Bhadulia Collieries, at Khayrasole. Raswan Railway Station, on the Andal-Palasthali section of the Eastern Railway, is located about 4 km south west of the block. Kazi Nazrul Islam Airport is situated about 22 km (aerial distance) away from the project site. The district head quarter is at Suri which is located about 45 km away (aerial distance).

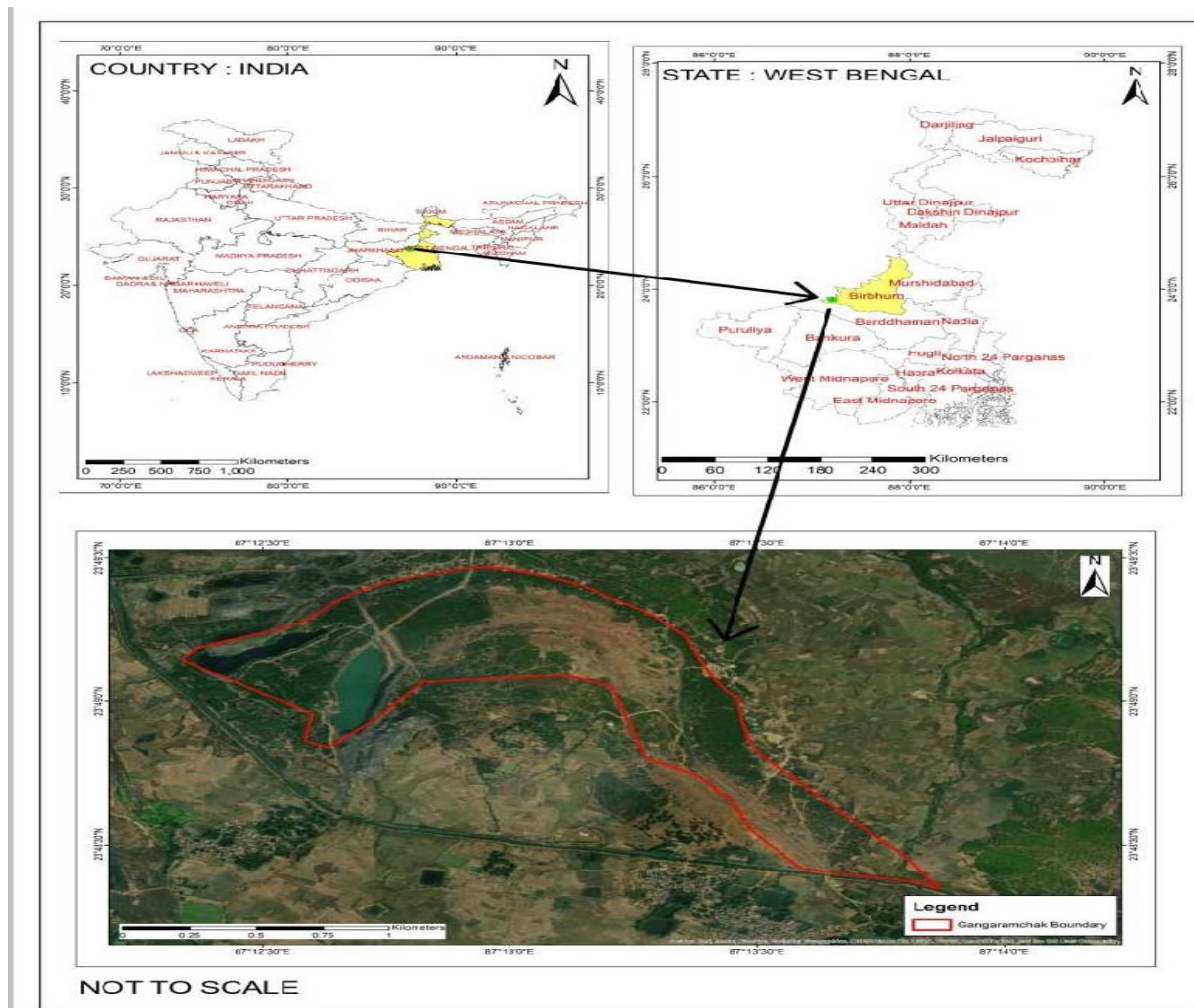


Fig C2- 1: Location of the Mine

2.3 LAND USE PLAN:

The lease area has been conceptualized as 149.42 ha, whereas the project area has been considered as 186.42 ha. The process of lease of 37 ha has been in progress. Out of total 186.42 ha, 101.77 ha falls under forest land and remaining 84.65 ha of land falls under non-forest category. Pre-mining land distribution is given in the table C2-2.

Table C2-2: Pre-Mining Land Distribution As Per Mine Closure Plan

SL. No.	Mouza Name	Land Type	Area in Ha	Lease Status
1	Ahmedpur	Non-Forest	0.31	Lease Already transferred to WBDCL.
2	Sahebpur	Non-Forest	10.21	
3	Bhadulia	Non-Forest	16.8	
4	Gangarampur	Non-Forest	20.33	
A	Sub-Total		47.65	
5	Gangarampur	Forest	27.41	Stage-II FC Obtained, Lease granted to
6	Bastabpur	Forest	61.81	
7	Bhadulia	Forest	5.46	

8	Sahebpur	Forest	4.52	WBPDCL.
9	Ahmedpur	Forest	2.57	
B	Sub-Total =		101.77	
10	Gangarampur	Non-Forest	28.11	Lease already allotted.
11	Sagarbhanga	Non-Forest	8.89	
C	Sub-Total		37.00	
	Total Project Area		186.42	

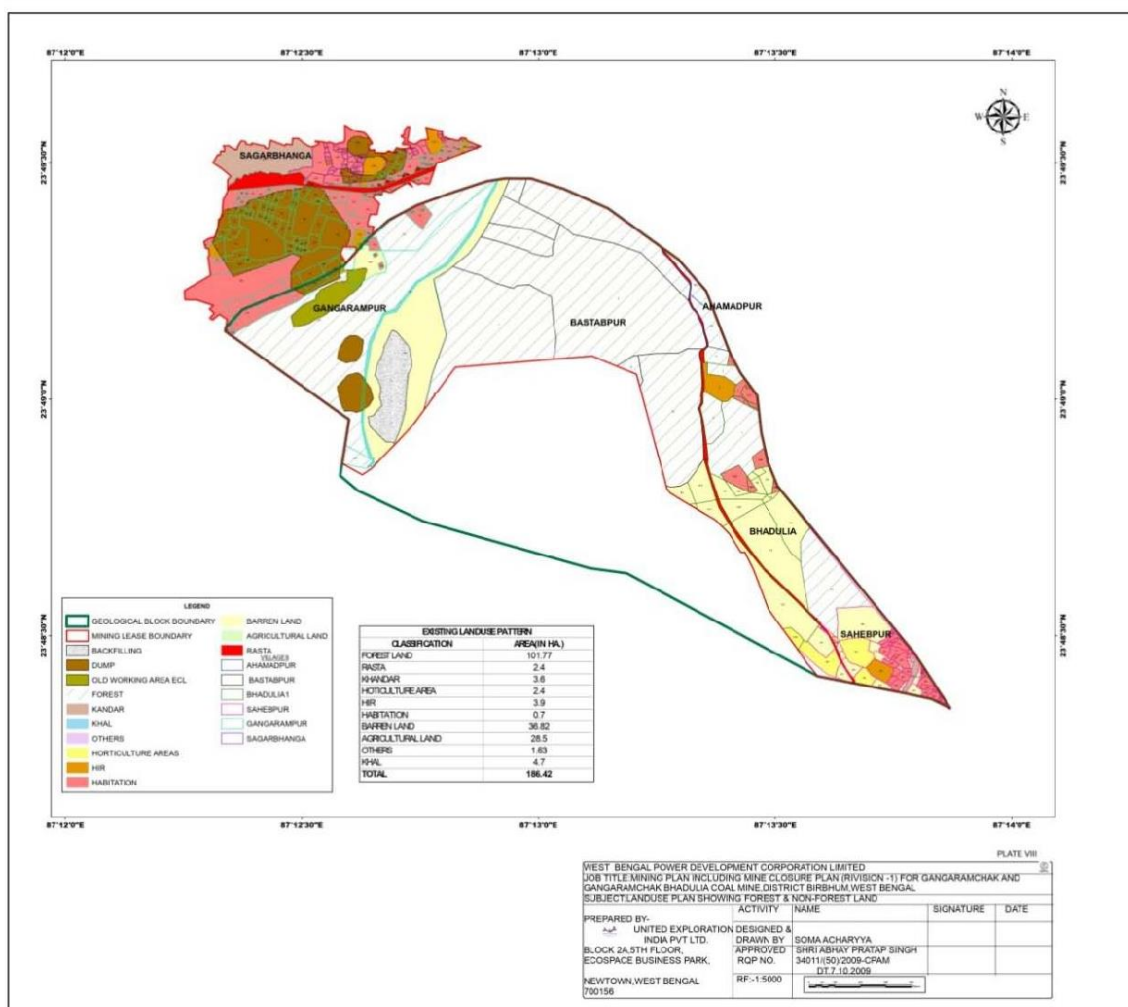


Fig C2- 2: Land Use Plan

SIZE AND MAGNITUDE OF OPERATION:

Earlier the environmental clearance is granted over 150 ha for 1 MTPA coal production. As per the approved mining plan, at the end of the mine life, an area of around 14 ha will remain as mined out void while an area of 127.90 ha will be reclaimed. Dumping of overburden is planned as concurrent back filling within the mined out pit. Targetted Production Capacity of the Mine as per approved Mining Plan including Mine Closure Plan shall be 3.00 MTPA while the peak rated capacity of the Mine shall be 4.50 MTPA . The ultimate depth of the mine as envisaged in the approved mining plan is 90 meter from the average ground level.

GEOLOGY OF GANGARAMCHAK COAL BLOCK:

The Gangaramchak coal mine block is an elongated strip of coal bearing sediments in Trans-Hingla area in the Raniganj coalfield in the district of Birbhum, West Bengal. With detailed exploration it is found to have a coal bearing area of 1.94 sq. km.

The major part of the block is concealed under soil. Few laterite, sandstones and metamorphics outcrops are present. The coal bearing formation in the block belongs to Barakar Formation of the Lower Gondawanas.

The lone workable seam named Kasta occurs as a single composite section with thickness varying from 0.95m to 8.90m in borehole named GRC12 and in GRC28 respectively.

Table C2-3: Stratigraphic Sequences Of Raniganj Coal Field

Age	Formations	Lithology
Recent		Alluvium/soil
Sub-recent & Quaternary	Unconformity Intrusives (Dykes & Skills)	Laterite, lateritic gravels, clays, etc. Dolerite & mica-peridotite.
	Supra-Panchets	Red sandstones & clays.
<i>Unconformity</i>		
	Panchet Formation	Greenish grey sandstones, red clays & khaki green shales.
	Raniganj Formation	Micaceous sandstones, shales & coal seams.
	Barren Measures (Kulti Formation)	Greenish shale, carb. Shale and argillaceous sandstone, greenish in colour. Dark grey/ black shales with clays & iron-stone bands.
	Barakar Formation	Feldspathic sandstones, shales & coal
	Talchir Formation	Greenish sandstones, olive green shales & Boulder bed.
<i>Unconformity</i>		

ARCHAEANS		Gneisses, granites & schists

2.4 DESCRIPTION OF FORMATIONS:

The stratigraphic succession of the formation is as follows:

Archeans: The metamorphics exposed all around the block dominantly consist of gneisses, mica-schist and quartzites. Megascopically gneiss is massive in nature and consists mainly of quartz, feldspar and mica. Quartzite wherever exposed is highly jointed. During drilling of boreholes metamorphic occur immediately after the Barakar Formation, suggesting overlapping of the Archeans by the Barakars.

Talchir Formation: The Talchir Formation is not exposed anywhere in the block, however, the same has been intersected in only one borehole namely GRC-3. It is represented by greenish shale.

Barakar Formation: The Barakar overlies the Talchirs and Archeans and are represented by pebbly to coarse grained ferruginous sandstones in the outcrop region. Usually it consists of coarse to fine grained grey sandstone, shales, carbonaceous shales and their intercalations besides coal seams. Only one persistent coal horizon locally named as Kasta seam is developed in this block. However a thin coal band is found to be developed occasionally below the seam in the western part of the block. The seam incrops are in an arcuate pattern to the north and east of the block. In the north-western part incrop is disturbed by a fault.

Barren Measures: Overlying the Barakar Formations are the Barren Measures, represented by dark to black sideritic shales with occasional thin bands of fine grained sandstone. The formation is not exposed anywhere in the block but occurs in small patch in the western fringe of the block around boreholes.

Quaternary & Recent Formation: The blanket of soil that covers the block ranges in thickness from 1.50 m to 14.00 m. Lateritic soil occurs in a number of isolated patches of various dimensions usually restricted to central and eastern part of the block.

Weathered Mantle: The detail or weathered mantle consists of alluvium, sandy soil, lateritic soil, running sand, clays and weathered Barren measures and Barakar Formation. Its thickness varies from 5.00m to 22.50 m.

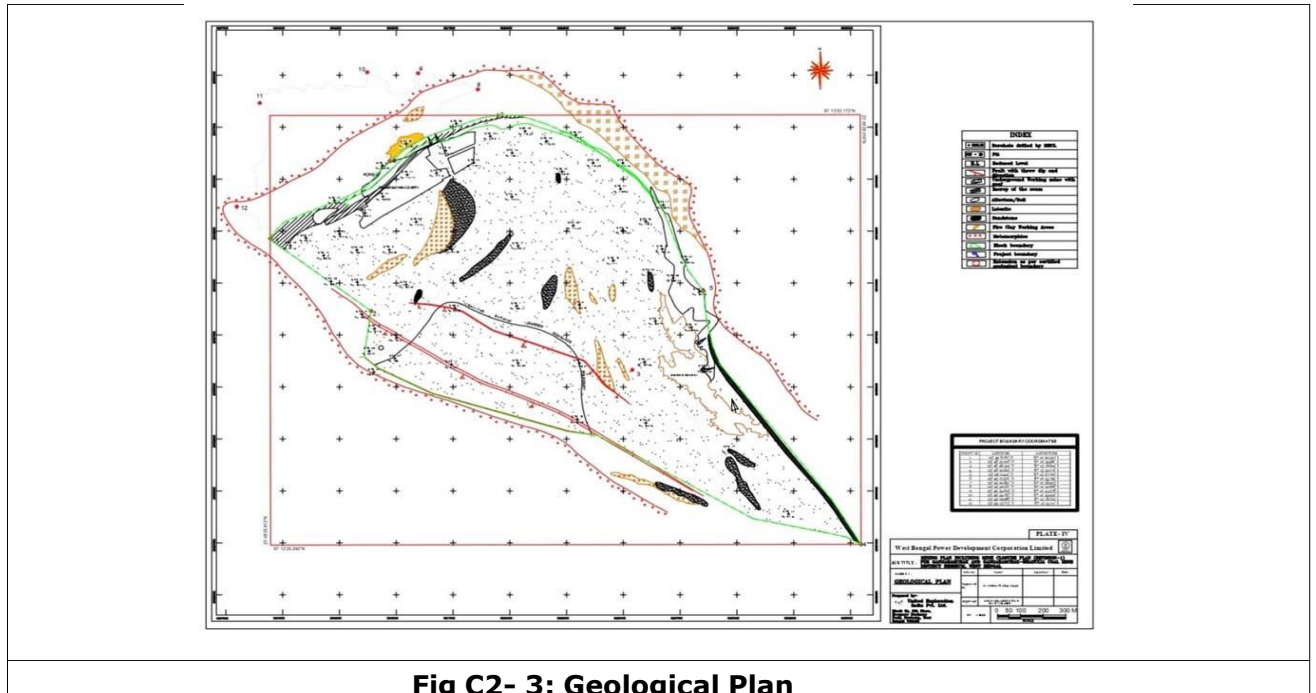


Fig C2- 3: Geological Plan

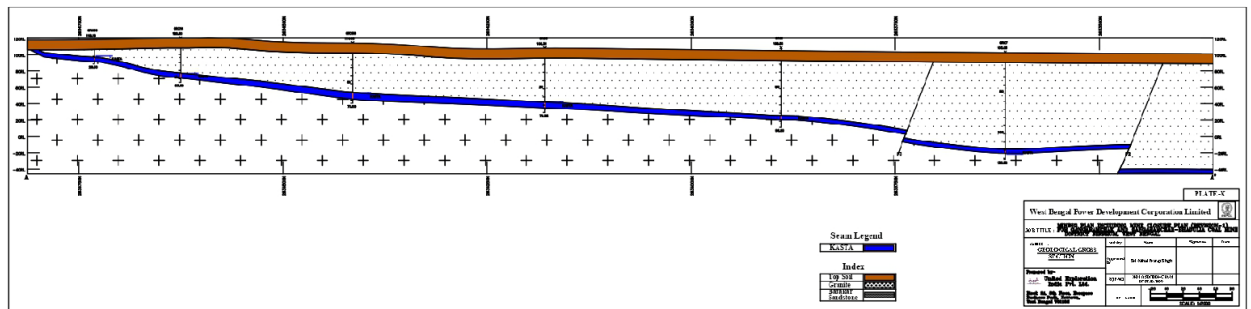


Fig C2- 4: Geological Cross Section

2.5 DETAILS OF COAL SEAMS:

The lone workable seam named Kasta occurs as a single composite section with thickness varying from 0.95m to 8.90m in borehole named GRC12 and in GRC28 respectively. The occurrence of this seam varies from 11.00 m to 124.77 m.

Table C2-4: Salient Features Of Seam Kasta Occurring At Gangaramchak -GangaramchakBhadulia Coal Mine.

Sl. No.	Features		Specifications
1	Seam Name		Kasta
2	Borehole Intersections	Nos.	49
3	Depth Range	M	
i	Shallowest		11.00
ii	Deepest		124.77
4	Seam Thickness in Meters	M	
i	Minimum		0.95
ii	Maximum		8.90
iii	Average		5.35
iv	Average above 1.0 Meter		5.44
6	Immediate Roof		Dark grey shale
7	Immediate Floor		Carb Shale & Dark grey shale
8	Dirt Bands	Nos.	2
	Range of Thickness of individual Bands (m)	M	0.03 - 0.60
	Range of Cumulative Thickness (m)		0.03 -0.60
	No. of Boreholes where seam is devoid of dirt bands (% of Total Boreholes.)	%	29 (48.33%)
	Lithology		Shale, Dark grey shale, Shaly Sandstone, Sandy shale
9	Quality Parameters (Incl. of Calculated Values) – I ₃₀ basis		
	Moisture %	Wt. %	3.54-5.00
	Ash%	Wt. %	29.2 -43.80
	V.M. %	Wt. %	22.7-29.00
10	Net Proved+Indicated reserve in Million Tons	MT	
	Opencast		9.15

	UG		4.53
	Total		13.68

Table C2-5: Summarized Proximate Analysis Figures For Kasta Seam Of Gangaramchak andGangaramchak-Bhadulia Coal Block.

Coal Seam	Proximate Analysis at 60% RH & 40°C			GCV (K.Cal/kg)	Grade Range	Usual Grade
	M%	Ash %	VM%			
Kasta	3.54-5.00	29.2 - 43.80	22.7- 29.00	3918-5005	G8-G12	G11

Geological Structures:

- **Strike and Dip:** The strike has an arcuate pattern with convexity towards north-east. The strike of the beds is NE-SW in the north-western part of block but gradually swings to nearly E-W in the north, then to NW-SE in the north-east and becomes almost NNW-SSE in the south-eastern fringe of the block with minor variations locally. The structure depicts a basinal configuration, the south-western half of which is truncated by the fault. The dip usually varies between 4° and 6° towards south-east in the north-western and gradually swings to south in the northern area, then to west in the eastern and south-west in south-eastern part of the block. In general, the dip is gentler in the fringe area of the basin.
- **Incrop of Kasta Seam:** The incrop of the seam has been interpreted after taking into account the floor of the seam as well as the floor of the weathered mantle and further supplemented by the presence of the quarries along this zone. The arcuate and dissected pattern of the in-crop is mainly because of the swinging nature of the strike and the displacement of seam due to faulting.
- **Faults:** Altogether 3 normal faults have been deciphered within the block. The faults have been designated as F1-F1', F2-F2' and F3-F3' from south west to north east. Fault F1-F1' has a general NW-SE trend and runs sub- parallel to fault F2-F2' near GRC-10 and further continuation of this fault southward is not precisely known. It has a throw of 55 m towards north east. Near GRC-61. The absence of Kasta Seam in GRC-61 and steepening of the beds are indicative of the presence of this fault. This fault brings metamorphics in juxtaposition with Barakars. Fault F2-F2' also has a general NW-SE trend with throw of around 30 m. towards north east but possibly increases southward. It has been intersected in GRC-10, GRC-11 and GRC-30 resulting in the omission of Kasta Seam and reduction of the overall thickness of the Barakar sediments. Fault F3-F3' has a general NW-SE trend and runs sub- parallel to fault F2-F2' and it has a throw of 20 m towards north east.

2.6 RESERVE & RESOURCE

During the first approved Mining Plan of The Gangaramchak and Gangaramchak-Bhadulia Coal mines, the quarriable reserves has been estimated as 10.58 million tons out of 13.68 million reserve. Remaining 3.10 million tonne of coal reserve have been kept for underground provisions.

Basic considerations for estimating the geological reserve within 149.42 ha of mining boundary were as follows:

- Estimation of reserves was restricted up to workable limits of the seams. The workable seam thickness was taken as 1.0 m.
- Shaly coal and Carbonaceous shale Low (having ash and moisture more than 40% and up to 65%) occurring at the roof and/or floor of a coal seam has been considered as part of the seam while arriving at the effective thickness for estimating the Reserve.
- Reserves have been calculated based on the in-band thickness (I-100) of seams. In-band (I-100) thickness of seam has been delineated including combustible bands (Ash +Moisture >65% to <75%) up to 100 cm.
- The areas of heave zones of faults have been excluded from the estimation of Reserve.
- Since Kasta seam shows non-coking characteristics, the reserve has been determined on the basis of GCV values determined for the seam overall samples.
- For the purpose of tonnage estimation, grade wise specific gravity as defined in the ISP 2017 has been considered.
- The geological reserve within 149.42 ha of quarriable area based on the above consideration comes to about 10.58 Million Tons. Grade wise distribution of this reserve in million tons is given below tables C2-6.

Table C2-6: Grade Wise Distribution Of Coal

Seam Name	G8	G9	G10	G11	G12	Total in MT
Kasta	1.7363	5.9625	2.5875	-	0.2938	10.5801

Based on the Geological reserve of 149.42 ha of quarriable area, the minable and extractable reserve estimation is given in the table c2-7.

Table C2-7: Estimation of Geological and Mineable Reserve

Sl. No	Particulars	Reserve (in Million Tons)
1	Geological reserve of the block	13.86
2	Gross Geological reserve in the dip side not considered in the approved mining plan	3.10
3	Net Geological Reserve of the block (150 ha)	10.58
4	Blocked Geological reserve under Safety Zone	0.28
5	Reserved reduced for Goafs and Old Workings	0.45
6	Reserved blocked under quarry batters	0.7
7	Mineable Reserve	9.15
8	Mining losses- Nil (As per AMP and AMCP)	0
9	Extractable Reserve	9.15
10	Coal already produced by prior allottee	3.425
11	Remaining Extractable reserve	5.725

2.7 LIFE OF MINE

Estimated gross geological reserve is 13.86 and net geological Reserve of the block is 10.58 million tonne. Mineable reserve is 9.15 million tonne out of which 3.425 million tons is extracted by the allottee till 2021-22. Therefore, remaining extractable reserve is 5.725 million tonnes. With the proposed rated capacity of 3.0 MTPA (normative), remaining life of the mine will be around 3 years.

2.8 MINING METHOD:

The mineable occurrence of Coal seams by opencast mining method has been established upto a depth of 73 meter through detail exploration of the Block. Opencast mining method is selected in view of varying thickness of coal seams. The mechanized opencast method is described below. Possibility of higher size hydraulic shovel or rope shovel or drag line has been ruled out due to varying thickness of seam as well due to less reserve and shorter project life. Applicability of surface miner also considered due to limited reserve and short life. Electrically operated machineries are not considered due to reliable power supply in the area.

OB will be loosened through conventional drilling and Blasting. Removal of OB will be done through Hydraulic shovel in conjunction with rear dumpers. Coal will be won through Surface Miner. Pay loader and Tippers will be used for coal removal and transportation to the stock yard. However, due to operational restrictions, there are few areas where surface miner operation could not be carried out. To increase the recovery of coal from those areas, occasional drilling and blasting is also suggested in coal.

Geo-Mining Parameters:

There will be no change in the mining system and mythologies. The parameters specified in the approved mining plan are followed in the planned period of the Revision-1 of the mining plan including Mine closure plan. However, during this planned period, surface miner will be introduced for coal winning.

The Geo-Mining characteristics are tabulated in the following table C2-8.

Table C2-8: Geo-Mining Characteristics of the Project

Sl.No	Parameters	Specifications
1	Seam Considered for Mining	Kasta
2	Average Coal Thickness	4.58 m
3	Average OB Thickness	42 m
4	Dip of the Seam	4°-6°
5	Grade of Coal	G8-G12
6	Excavation Category	Category-III
7	Nature of floor	Carbonaceous Shale; Dark Grey
8	Area of the Block	194 ha
9	Area of Excavation	141.42 ha
10	Safety Zone	7.08 ha
11	Area not considered for opencast mining under this revision of the mining plan	44 ha
12	Depth of Excavation	10 m to 90 m
13	Total Project area	186.42 m

2.9 SEQUENCE OF MINING OPERATION:

- **Excavation of Overburden:**

OB is loosened through conventional drilling and blasting. Transportation of OB is being done through 35 T dumper dumpers in conjunction with 4-4.5 Cum and 3-3.5 Cum Hydraulic shovel.

- **Coal Winning:**

Coal once exposed through removal of the overburden is being mined through surface miner and removed through pay loaders-tipper combination. However, occasionally coal will be excavated by drilling and blasting and removed through shovel dumper combination in strategic location. Coal is transported through 3-3.5 Cum hydraulic shovel in conjunction with 25T tippers.

- **Transportation:**

The coal is carried by tipping trucks to the nearer Hazarathpur railway siding through the PWD road via Sarsa More and Nowpara Bridge. Hazarathpur

railway siding is on Bhimgarh-Palasthali section of Asansol division of Eastern railway at a distance of 4.77 km from the mine. Sized and picked coal is loaded into rail wagons by pay loader. Distances of different end use plants with respect to Bankura and Durgapur railway stations are given below table C2-9:

Table C2-9: Distance of the Different End Use Plant Of WBPDCCL

Name of the End Use Plants	Distance in km
Santaldih TPS	75.25
Kolaghat TPS	163.32
Bakreswar	17.83
Bandel	147.77
Sagardighi TPP, Unit 1 & 2	104.21
Sagardighi TPP, Unit 3 & 4	104.21

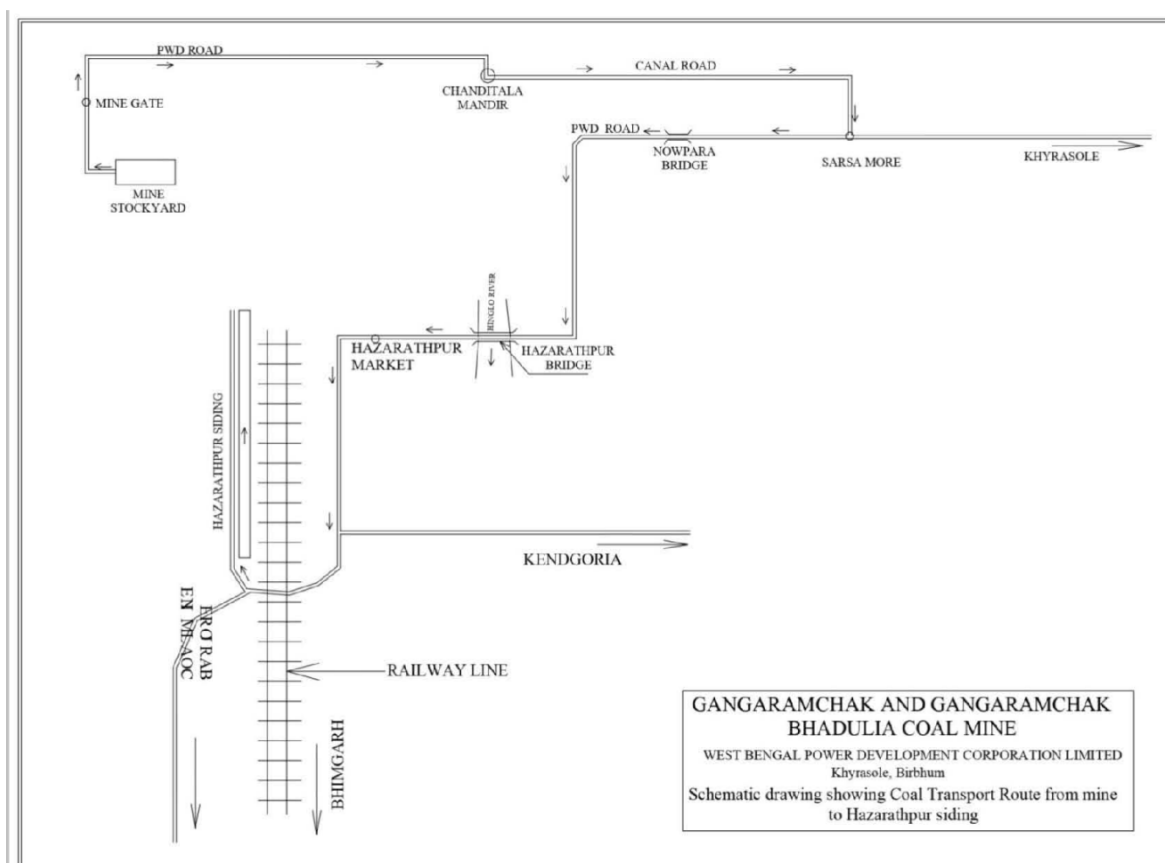


Fig C2- 5: Coal Transportation Route

- **Top soil Storage:**

Except the top surface of the OB, top soil in this block is not very common. An average top soil thickness has been considered as 0.60 meter. This stored top soil has been spread over the reclaimed areas 3rd year onward.

- **Drilling & Blasting:**

The uppermost layer of soil (about 2-3 m) is relatively soft and was not require drilling and blasting. So, it was directly excavated by the excavators. The top soil is kept separately in temporary top soil dump for the reclamation purpose. The total area of 1.17 Ha has been earmarked for top soil dump in the north of the quarry boundary. The remaining hard overburden and partings is being drilled and blasted before excavation. Wet drilling operation has been adopted. Coal is usually won through surface miner but occasionally also be excavated through drilling and blasting method and removal is envisaged with Shovel- Dumper combination.

- **Production Schedule:**

Production capacity of this mine is 1.0 MTPA as per approved mining plan. Now currently it will be increased 1.5 MTPA. The calendar program is given below in Table no C2-10.

Table C2-10: Production Schedule Of Coal And Ob As Per Approved Mining Plan

Serial Year	Calendar Year	Coal		Overburden		Stripping (Cum/Te)		Ratio
		Year Wise	Cumulati ve	Year Wise	Cumulati ve	Year Wise	Cumulati ve	
1	2019-20	1.00	1.00	2.90	2.90	2.90	2.90	
2	2020-21	1.00	2.00	5.20	8.10	5.20	4.05	
3	2021-22	1.00	3.00	5.20	13.30	5.20	4.43	
4	2022-23	1.00	4.00	5.20	18.50	5.20	4.63	
5	2023-24	1.00	5.00	5.20	23.70	5.20	4.74	
6	2024-25	1.00	6.00	5.20	28.90	5.20	4.82	
7	2025-26	1.00	7.00	5.20	34.10	5.20	4.87	
8	2026-27	0.75	7.75	5.20	39.30	6.93	5.07	
9	2027-28	0.50	8.25	4.50	43.80	9.00	5.31	
10	2028-29	0.48	8.73	2.26	46.06	4.76	5.28	
Total		8.725		46.06		5.28		

Table C2-11: Details of Production of Coal and Ob

Year	Calendar Year	Coal (MT)		Overburden (MCum)		Stripping Ratio (MCum/MT)
		Year Wise	Cumulative	Year Wise	Cumulative	
1	2023-24	1.500	1.500	7.90	7.90	5.2667
2	2024-25	3.000	4.500	15.70	23.60	5.2333
3	2025-26	1.225	5.725	6.34	29.94	5.1755
Total		5.725		29.930		

- **Coal Evacuation:**

The sorted coal is carried by tipping trucks to the nearer Hazarathpur railway siding on Bhimgarh-Palasthali section of Asansol division of Eastern railway at a distance of 4.77 km. Sized and picked coal is loaded into rail wagons by pay loader.

2.10 LAND UTILIZATION PLAN

The total project area is 186.42 ha (149.42 Ha of Geological Block area+37 Ha of outside area of Geological Block area)out of which proposed quarry area as per approved mining plan is 141.9 ha. Mining and allied activities shall be carried out over this land and status of land use will change from its present level. The land utilization plan due to the mining and allied activities shall be as follows.

Table C2-12: Land Utilization Plan

Type of land use	Existing Land use (in ha.)	At the end of Conceptual Period (in ha)
Area under excavation	40.50 (Backfilled □ 20.55 ha. + Void □ 19.95 ha.)	141.9 (Backfilled □ 127.90 ha. + Void □ 14.00 ha.)
Overburden dump	12.78	12.78
Top soil	5.80	5.80
Road & Infrastructure (Office, canteen, rest shelter, weigh bridge, etc)	2.24	2.24
Garland drain & Settling Pond	0.44	1.44
Green belt in safety zone	8.01	8.01
Sub-Total	69.77	172.17
Untouched area	116.65	14.25
Total	186.42	186.42

At the end of the mine life, an area of around 14 ha will remain as mined out void while an area of 127.90 ha will be reclaimed.

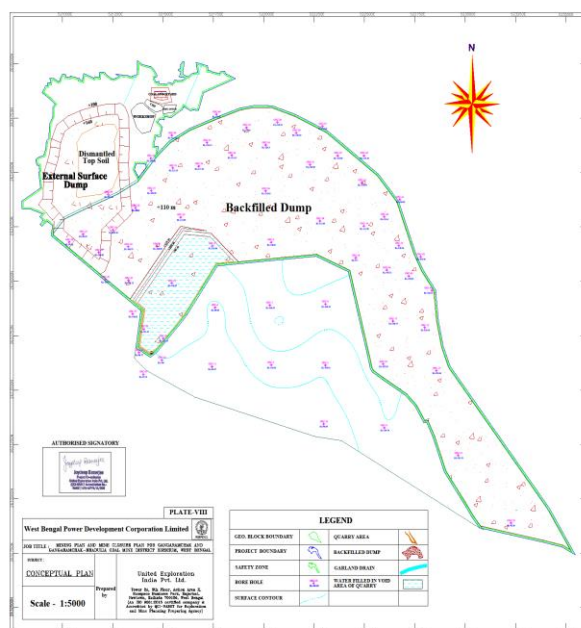


Fig C2-7: Land Utilization and Green Belt Development Plan

2.11 USE OF MINERAL

The Gangaramchak and Gangaramchak-Bhadulia Coal Block is a project of M/s WBPDCCL, allotted for captive use of coal. This is an existing operative coal mine supplying coal to End Use Plants of M/s WBPDCCL. Coal from this project is linked to the thermal power stations of Santaldih, Kolaghat, Bakreswar, Bandel and Sagardighi.

MANPOWER REQUIREMENT

For the smooth implementation of the project, sufficient number of manpower has been provided in this report and remains unchanged from the numbers and distribution as provided in the approved mining plan.

Considering the operation of various plant and machineries and their maintenance, skilled personnel of various trades have been considered. Similarly, adequate strength of personnel has been suggested for the common services also.

For the annual output of 3.0 MTPA coal, manpower needed for this project has been worked out to be 380. The strength is considering the leave and absenteeism.

Table C2-13: Break-Up Of Total Manpower Requirement

Sl. No	Particulars	Existing	Proposed
1.	Unskilled	20	30
2.	Semi Skilled	10	20
3.	Skilled	95	125
4.	Highly Skilled	140	170
5.	Statutory Personnel	20	20
6.	Executives	15	15
	Total	300	380

2.12 EXTENT OF MECHANIZATION

Selection of equipment has been largely guided by the volume and type of rocks including their physical characteristics. HEMM as suggested in the approved mining plan has been kept unchanged as far as possible except in case of coal movement where the tipper capacity considered both 15 and 25 T. details of HEMM to be deployed in Gangaramchak and Gangaramchak Bhadulia Coal Mine is furnished in tableno C2-14.

Table C2-14: HEMM Details of Gangaramchak and Gangaramchak Bhadulia Coal Mine

SL. No.	Equipment	Capacity & Unit	No.
Overburden			
1	Diesel Hyd. Shovel	3.1 Cum	13
2	Diesel Hyd. Shovel	3.5 – 3.8 Cum	2
3	Dump Trucks	35 T	60
4	Diesel Drill	160mm	3
5	Dozer (D-85)	165 & 200 HP	6
Coal			
1	Surface Miner	2200 Series	1
2	Front End Loader	3-5 Cum	4
3	Tippers	15 – 25 T	15
4	Drill	160mm	1
5	Dozer	D-85 & 200 hp	1
6	Dump Trucks	30 T	5

2.13 FUEL REQUIREMENT:

The details of fuel consumption of major mining equipment are given in Table No. C2-15.

TABLE C2- 15: FUEL REQUIREMENT FOR MAJOR MINING EQUIPMENT

S.L. No.	Equipment	Capacity	Maximum Population	Lt/hr	Annual working hour	Annual Diesel consumption
Overburden						
1	Diesel Hyd. Shovel	3.1 Cum	13	35	4320	1965600
2	Diesel Hyd. Shovel	3.5 - 3.8 Cum	2	40	4320	345600
3	Dump Trucks	35 T	60	15	4320	3888000
4	Diesel Drill	160mm	3	25	3240	243000
5	Dozer (D-85)	165 & 200 HP	6	40	4320	1036800
Coal						
1	Surface Miner	2200 Series	1	65	5400	351000
2	Front End Loader	3-5 Cum	4	25	4320	432000
3	Tippers	15 - 25 T	15	12	4050	729000
4	Drill	160mm	1	25	2700	67500
5	Dozer	D-85 & 200 hp	1	40	3780	151200
6	Dump Trucks	30 T	5	15	3780	283500
Common						
1	Grader	120 - 150 hp	2	25	3240	162000
2	Crane	12T	2	10	1620	32400
3	Diesel Backhoe	1 cum	1	20	2160	43200
4	Diesel Browser		2	7.5	1620	24300
5	Fire tender		1	7.5	540	4050
6	Boom truck		2	7.5	1080	16200
7	Heavy duty toe truck		1	30	1080	32400
8	Fork lift truck	5T	1	7.5	1080	8100
9	Tipping truck	25 T	3	10	3240	97200
10	Vibratory Compactor		1	20	1620	32400
11	Tyre Handler		1	7.5	3240	24300
12	Water Sprinkler	12 KL	4	10	4860	194400
13	Maintenance Van		1	7.5	4860	36450
14	Farm Tractor		1	10	3240	32400

15	Grader	120 - 150 hp	1	25	3240	81000
16	Dozer	85 HP	1	20	3240	64800
17	Explosive Van		1	10	2700	27000
18	Dozer	165 hp	1	30	3240	97200
19	Dozer	120 hp	1	25	3240	81000

TOTAL	10584000

2.14 WATER REQUIREMENT

Daily 150 KL water shall be required in the mines for the following purpose in Table C2-16. The permission for sinking of well has been obtained from the concerned authority and is enclosed as **Annexure VI**.

Table C2-16: Purpose Wise Water Use

Purpose	Water used (KL)
Drinking and domestic purpose	15
Dust suppression	90
Green belt development	45
Total	150

2.15 INFRASTRUCTURAL FACILITIES TO BE PROVIDED:

Around 380 numbers of persons are likely to be engaged directly in this mining project. There are floating population in the project site such as service providers, contractors etc. To meet the essential needs of the workers necessary welfare facilities as per the provisions of Factories Act, 1948 and amendment thereof will be provided by the company. The facilities are included the following:

- Mechanized washing on specially constructed platform for dumpers and dozers.
- Daily maintenance bays for dumpers and dozers.
- Schedule inspection and lubrication bays for dumpers and dozers.
- Schedule maintenance, medium repair and minor repair facilities for dumpers and dozers.
- Minor repair and replacement of sub-assemblies and assemblies of shovels, drills and otherfield equipment at site by mobile repair team.
- Medium repair of overhauling of sub-assemblies and assemblies of field equipment.

- Machining section.
- Electrical and auto repair section.
- Engine section.
- Repair of hydraulics especially Surface miner.
- Radiator repair section.
- Welding and structural section.
- Tire section.
- Condition monitoring section.
- Shovel repair section.
- Drill repair section.
- Dozer repair shop.
- Pavements for dumper and dozer parking.
- Overhead and u/g water reservoirs.
- Supporting facilities like computer room, electronics room, charge stores, tool room, offices, pump room, cycle stand, canteen, security post, fire fighting facilities, ventilation system etc.
- Material handling facilities
- Machine tools, general and special purpose tools, diagnostic tools, master tool kits etc.
- Refueling station with pump and other necessary accessories.
- Mobile repair and servicing unit

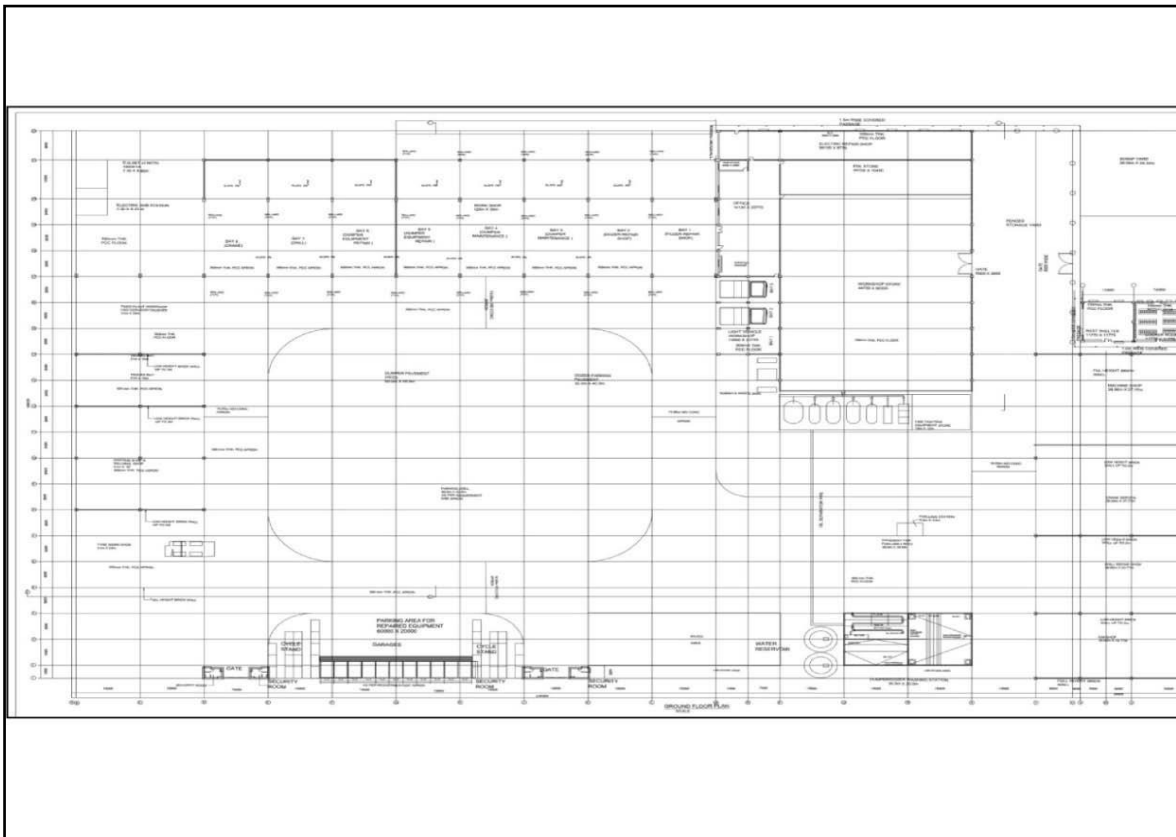


Fig C2-8: Typical Layout diagram for workshop in a mechanized mine.

2.16 POLLUTION CONTROL MEASURES:

Air Pollution Control Measures:

The mining activities involves various processes such as, loading & unloading, transportation, drilling, blasting etc. which are likely to contribute towards air pollution in the area. During the mining operations, impact on air quality will be effectively controlled both by preventive and suppressive measures listed below:

- Usage of drill bits of good conditions.
- Wet drilling to prevent dust generation.
- Well designed blast by effective stemming and use of milli second delay detonators – every blast should be properly designed to see that the optimum breakage occurs without generating fines.
- Avoiding blasting during high wind period.
- Conducting muffled blasting to avoid disturbances.
- Proper maintenance of haul roads.
- Development of extensive green belts/barriers around the mine, coal handling plants, workshops, along the roads, periphery of the mine, OB dumps etc.
- Trucks carrying coal will be covered with tarpaulin sheets to prevent fugitive dust generation.
- Vehicles having 'Pollution under Control (PUC) Certificate' will be engaged in the mines.
- Regular maintenance of HEMMs shall be undertaken to minimize the gaseous emission.
- Wheel washing facilities shall be installed in the mining complex.

With the above management plans, adverse impacts will be minimized.

Water Pollution Control Measures:

Management of water regime mostly comprising silt load, waste waters management arising due to mining activities. Following management plans are suggested:

- Construction of toe walls and garland drain around the existing OB dumps to catch the silt loads likely to come down from dumps.
- Providing bunds at suitable points in the garland drain around external dumps to allow settling of silt.
- Regular cleaning of the silt from these bund areas.
- Early plantation of the external dumps to prevent silt flowing from dumps.

- Mine water will be guided to siltation tanks and decanted water would be put to industrial uses in the mine. Siltation tanks shall be regularly cleaned.
- Maintaining proper gradient for drainage of water on the bench floors and construction of water drains using local material to prevent soil erosion and uncontrolled descent of water.
- Construction of garland drains of suitable size around mine area and external dump with proper gradients to prevent rain water entry into active mine area.
- Construction of settling and sedimentation ponds of adequate size to collect the mine discharge water to settle suspended solids. Treated water will be utilized for dust suppression and plantation use.
- Effluents from workshop, garage or wash areas will be treated through grease & oil traps and then in sedimentation ponds and recycled for use again.
- Separate effluent treatment plant for industrial water will be set up for proper treatment of these and for recycle in workshops etc. and reuse in green belt.

Noise Control Measures:

In the mechanised open-cast mine, mining operations such as drilling, blasting, excavation, loading and unloading, movement of dumpers, etc are expected to generate noise. In this particular mine, the operation will be limited to three shift of eighteen hours duration in a day. Hence, broadly the following measures shall be undertaken.

- Blasting will be carried out during day time and if possible, at a particular time.
- Green belt will be developed around office building and mine to reduce noise level.
- Static diesel engines shall be housed as far as possible (not made of sheet metals or surrounded by baffles). If possible they will be placed on vibration isolators.
- DG Set with acoustic enclosures shall be provided.
- Periodical maintenance of HEMMs shall be carried out.

Protective measures for ground vibration likely by blasting:

Loosening of rock mass will be done by the blasting of 6-8 meters deep and 160/250 mm dia blast holes. Milli second delay detonators have been envisaged to minimize the ground vibrations. Use of non electric detonators will be used wherever required. Blasting will be carried out in periodical manner so as to minimize the impact on the local habitants and the faunal species.

Waste Management:

During the planned period total volume of OB comes to about 46.58 Mcum including 0.84 MCum of TopSoil. The total generated waste will be accommodated

internally through backfilling of mined out voids.

Details of the waste management are being depicted in chapter no. 5 of this mining plan. An area of about

102.50 ha is planned to backfilled during this period. An external dump comprising an area of 12.78 ha is proposed.

Land Reclamation:

According to the mining plan final layout of the dumps in a totality has been worked out. Within this period, stage dumping will be continued to be taken up in the existing dumping ground and part of the mined out areas will backfilled concurrently. Efforts were made to keep the backfilled dumps around ground level for technical and biological reclamation at the end of the closure period, dumping ground will be converted to agricultural and plantation areas. Land reclamation will fully be done except the areas where water harvesting will be carried out in the post closure period. Few infrastructure areas will be handed over the society for public use. Land utilization plan is given in table C2-17.

Table C2-17: Land Utilization Plan

Type of land use	Existing Land use (in ha.)	At the end of Conceptual Period (in ha)
Area under excavation	40.50 (Backfilled □ 20.55 ha. + Void □ 19.95 ha.)	141.9 (Backfilled □ 127.90 ha. + Void □ 14.00 ha.)
Overburden dump	12.78	12.78
Top soil	5.80	5.80
Road & Infrastructure (Office, canteen, rest shelter, weigh bridge, etc)	2.24	2.24
Garland drain & Settling Pond	0.44	1.44
Green belt in safety zone	8.01	8.01
Sub-Total	69.77	172.17
Untouched area	116.65	14.25
Total	186.42	186.42

R & R ACTION PLANS

Not applicable.

PROPOSED IMPLEMENTATION SCHEDULE

Head	Parameters	FY 2022-2023	FY 2023-2024	FY 2024-2025	FY 2025-2026	Closure-1	Closure-2	Closure-3
Progressive Closure	Water Quality Management							
	Air Quality Management							
	Waste Management							
	Ditch and Plant Fencing around dump							
	Biological fencing around the Lease Area							
	Filling of voids							
	Top Soil management							
	Technical and Biological Reclamation of mined out of land and OB dump							
	Plantation over virgin area including green belt							
	Manpower cost and supervision							
	Toe wall around the dump							
	Garland Drain							
	Garland Drain around the dump							
	Any Other Activities							

Dismantling of Infrastructure & Disposal or rehabilitation of Mining Machinery	Dismantling of Workshop							
	Rehabilitation of the dismantled facility							
	Dismantling of pumps and pipes /Other Facilities							
	Dismantling of Stowing bunkers/ provisioning of pumps for borewell pumping arrangement							
	Dismantling of UG equipment							
	Rearranging water pipeline to							
	dump top park / Agricultural land							
	Dismantling of power lines							
Safety & Security	Biological fencing around dumps							
	Biological fencing around the pit							
	Barbed wire fencing with masonry pillars							
	Concrete wall with masonry pillar around the pit							

	Securing air shaft and installation of borewell pump							
	Securing of Incline							
	Concrete wall fencing around the water body							
	Boundary wall around the water body							
	Stabilisation (Viz. Benching, Pitching) of side walls of the water body							
	Toe wall around the dump							
	Garland drain							
	Garland drain around the dump							
	Drainage channel from main OB dump							
Technical & Biological Reclamation of Mined out of land and OB Dump	Filling of void							
	Top Soil management							
	OB rehandling for backfilling.							
	Terracing, Blanketing with soil, and vegetation of External OB dump							
	Peripheral road, gates, view point, cemented steps on bank.							

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	Expenditure on development of agricultural land.							
	Landscaping and plantation.							
Post Closure Management and Supervision	Power Cost							
	Post mining water quality management							
	Post mining air quality management							
	Subsidence monitoring for five years.							
	Waste Management							
	Manpower cost and supervision.							
Others	Enterprenuership development (Vocational/Skill development/training for sustainable income of affected people).							
	Golden Handshake / Retrenchment benefits to OC employees.							
	Golden Handshake / Retrenchment benefits to UG employees.							

	One time financial grant to societies / Institutions/ Organisations which is dependent upon the project.							
	Provide Jobs in other mine of the company.							
	Continuation of other services like running of schools etc.							

2.17 PROJECT COST

The estimated project cost shall be 111.5 Crores to achieve the targeted production capacity

CHAPTER-3

DESCRIPTION OF THE ENVIRONMENT

3.0 INTRODUCTION:

Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project of M/s The West Bengal Power Development Corporation Limited has obtained Environmental clearance from MoEF in the year of 2007 for the capacity of 1.00 MTPA of coal production. In order to evaluate various environmental impacts likely to be caused due to opencast mining activities for excavation of Coal over Project area of 186.42 ha in Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project, an attempt has been made to assess the existing environmental scenario through generation of different baseline data on various environmental attributes. Hence, this Chapter outlines the present environmental setting of the project site & its surroundings.

Study Area: For the purpose of environmental impact assessment, the study area has been divided in two zones, namely,

- The core zone covers the mining lease area, where the mining activities have been carried out i.e. the area of 149.42 ha and the Project area of 186.42 ha
- The buffer zone covers an aerial coverage of around 10km from the core zone periphery.

Study Period: In order to depict the present environmental scenario, data on environment factors like Meteorology, Air, Water, Soil, Flora, Fauna and Socio-economic status have been collected & analyzed during March 2022 to May 2022 for expansion capacity. **The baseline Environmental Data (Meteorology, Air, Water, Noise & Soil) for the summer season 2022 had been generated by M/s Noida Testing Laboratory, Noida which is a NABL Accredited Laboratory is provided by M/s WBPDCCL to prepare the report based on the already monitored data to M/s CEMC Pvt. Ltd.**

Sources of Environmental Data:

Table No. C3-1: Sources of Secondary Data

Sl. No.	Information	Source
1.	Toposheets	Survey of India, Govt. of India
2.	Meteorological data	Indian Meteorological Department, Govt. of India
3.	Geological data	Geological Report and Mine plan of Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project of M/s The West Bengal Power Development Corporation Limited.
4.	Sismic zonation	National Disaster Management Authority, Website.

5.	Reserve Forests, Protected Forests, & Forests Statistics	Public domain and Department of Forests, Govt. of West Bengal
6.	Wildlife Sanctuary/ National Parks/Tiger Reserves	Wildlife Department/ Forest Department, West Bengal and public domain.
7.	Demographic Profile	District Census Handbook, Govt. of India
8.	Legislative Acts and Rules	Department of Economics & Statistics, Govt. of West Bengal, MoEF & CC, Govt. of India
9.	Census Data of 2011	Census of India, Govt. of India

3.1 COMPONENTS OF STUDY:

In general, the important environmental parameters associated with and considered for impact assessment of this mining project are as follows;

- Air quality
- Water quality (both Surface & Ground water quality)
- Noise level
- Soil quality
- Land use
- Forests & Vegetation
- Wildlife
- Public health & safety
- Socio-economics

3.2 METHODOLOGY:

The following methods have been adopted to present the environmental scenario of the study area.

A. Baseline Data Generation:

- *Air Quality, Water Quality, Noise Levels, Soil Quality & Meteorological Parameters*

The topographical information of the study area has been collected. Different air pollutants, namely RPM, SPM, SO₂, NO_x, and CO have been identified as related to the project activities for representing baseline status of ambient air quality within the study area. Hourly micro-meteorological parameters, viz. wind speed, wind direction, temperature, rainfall, barometric pressure and relative humidity have also been measured. Sampling location is shown in Table No. C3-2.

Information on water resources in the study area has been collected. The collected water samples have been analysed for different physico-chemical parameters to assess the quality of the water. Surface and subsurface

samples have been collected at different locations for this physico-chemical analysis.

Excessive noise levels cause adverse effects on human beings. Noise survey has been carried out in the study area as shown in Table No. C3-2. Noise levels were measured at several locations in human settlements around proposed mining area during the day and night time.

Soil samples have been collected randomly from the study area (Table No. C3-2) to represent different categories of soil. Physico-chemical properties of the soil have been determined. Information on land use pattern in the study area has also been collected.

Sampling locations of different pollution parameters are given in below table:

Table No. C3-2: Sampling Location Of Different Pollution Parameters

Name of the Sampling Location	Air	Water	Noise	Soil
	Project Site 1	Well in Gangpur	Project Site 1	Project Site 1
	Project Site 2	Well in Sagarbanga	Bhadulia	Kese
	Bhadulia	Tube well in Bhadulia	Kese	Khayrasole
	Kese	Canal	Khayrasole	Denganja
	Krishna Bandi	Hinglo Dam	Denganja	Lokepur
	Islamkuri	Pond water of Gangpur village	Lokepur	
	Tilshur			
	Lokepur			

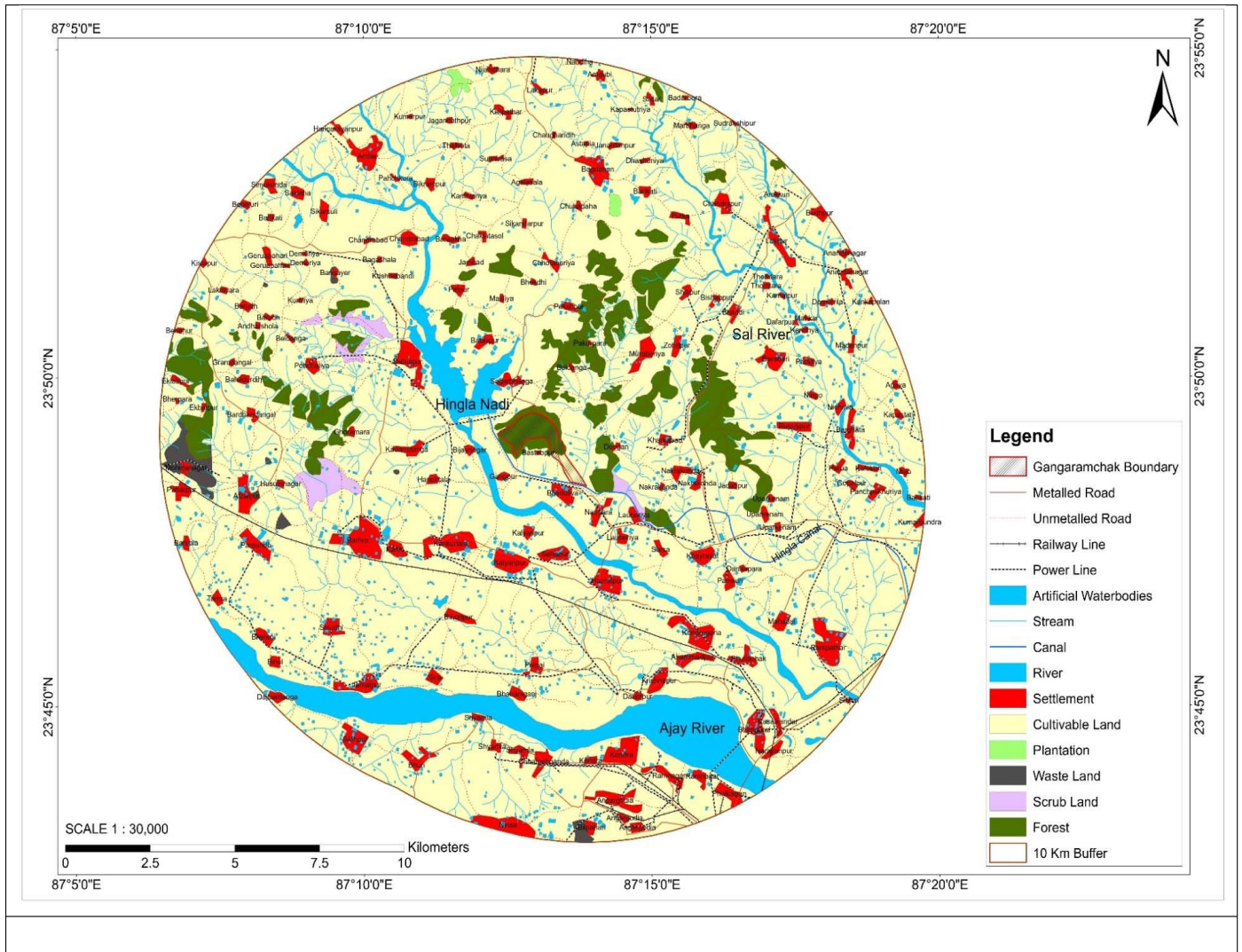


Fig. No. C3-1: Vicinity Map of the Lease Area with 10Km Buffer zone.

➤ *Ecological Studies*

Data have been collected from various Government Departments. The parameters of prime importance to both biotic and abiotic factors have been selected to estimate the structural and functional changes in the eco-system. Detailed survey has been carried out during the field visits.

➤ *Socio-economic & Demographic profile*

Secondary data have been collected from Census Report. A field survey has also been conducted within the study area. The parameters selected under socio economic component were, demography structure of the study area, provision of basic amenities, welfare facilities, health status and quality of life. Relevant information collected from selected villages has been critically analysed.

B. Sample Collection & Analysis Methods:

a. Ambient air samples

AAQ monitoring is already being carried out by the project proponent at 8 locations within Core and Buffer zone of the project. AAQ monitoring report is being duly submitted to Regional Office, MoEF & CC and other concern authorities.

b. Meteorological studies

Meteorological station was set up at one (01) no. location within the lease area to collect primary information which is core zone of the project site. Parameters collected were wind speed, wind direction, temperature, relative humidity and rainfall on hourly basis for 24 hours during the study period.

c. Noise levels

Measurement of ambient noise levels within the study was carried out at six (6) locations at regular intervals, once during the study period to determine the frequency of peak levels for 24 hours during the study period. The noise levels are reported in form of Leq day (Ld) and Leq night (Ln) in dB (A).

d. Water quality

For the present EIA study, six (6) numbers of grab water samples (surface water five (3) and ground water five (3) from the study area were collected, once during the study period as per standard guidelines. The samples are analyzed for physical, chemical and bacteriological parameters as per the standard guideline

e. Soil quality

Soil samples are being collected inside the mine time to time and reported along with the half yearly compliance report. However, testing of soil samples were carried out from six (05) locations within the study area for the current EIA study. Physical and chemical parameters are analysis as per the standard norms.

f. Traffic Density

In order to assess the existing traffic load along the transportation route, traffic density survey was carried out at one strategic location i.e. Sarsa More under three categories of vehicle i.e. Heavy Vehicle, Medium Vehicle and Light Vehicle. The traffic density survey was carried out once during the study period.

g. Flora & Fauna

Survey for flora and fauna has been carried out in the study area as per the standard guideline. Species of flora have been listed as agricultural crops, commercial crops, plantation, natural vegetation, grasses, endangered, endemic and others.

h. Socio-economic status

Socio-economic survey in the study area has been carried out to assess the status of demographic pattern, cropping pattern and general amenities available based on the Census 2011, secondary information available with different government agencies.

i. Remote Sensing Study

This study has been carried out based on the satellite imageries of the study area to assess the land use pattern.

Table No. C3-3: Baseline Data Generation Matrix

<u>Attribute</u>	<u>Parameters</u>	<u>Locations/Source</u>	<u>Frequency</u>
Land Environment	Topography & Drainage	Primary & Secondary data	Once
	Geology	Primary & Secondary data	Once
	Land use	Primary & Secondary data	Once
	Soil Quality	5 Locations/ Primary data	Once
Air Environment	Micro meteorological data	1 location /Primary & Secondary data	Hourly micro-meteorology data for three months
	AAQ Parameters : As per CPCB Notification of 18 Nov., 2009	8 Locations / Primary data	Twice a week
Noise	Noise Level (dB Leq)	6 Locations / Primary data	Hourly basis for a continuous period of 24 hr.
Surface Water	As per IS 2296: 1982	3 Locations /Primary data	Once
Ground Water	As per IS 10500: 2012	3 Locations /Primary data	Once

Biological Environment	Aquatic: Aquatic vegetation, Fishes & aquatic fauna Terrestrial: Vegetation species list, Terrestrial Fauna, Avi fauna; Rare and Endangered plant & animal species	Core and Buffer Zone; Primary data/ Secondary data	Once
Socio-economic	Demographic structure, Infrastructure, resource base. Cultural and aesthetic attributes, Health, Education	Core and Buffer Zone; Primary data/ Secondary data	Once

3.3 SITE DETAILS:

3.3.1 Location of the Project Site:

The Gangaramchak & Gangaramchak Bhadulia Opencast Coal Mining Project represents an isolated narrow elongated strip of coal bearing sediments of about 9 km in length in Trans-Hingla area of the Raniganj Coalfield in the district of Birbhum, West Bengal. The block is defined by the latitudes 23°48'20.812"N to 23°49'28.016"N and longitudes 87°12'20.292"E to 87°13'52.172"E. It is included in the Survey of India Topo Sheet No. 73M/1. Administratively the Block falls under Khayrasole Police Station of Birbhum district.

The coal block is covered within six villages of Birbhum district namely Gangarampur, Bastabpur, Bhadulia, Sahepur, Sagarbhangra and Ahmedpur.

The area is approachable by road only. The Khayrasole-Panchra road connects the block with the Raniganj - Suri Road, (NH-14) at Panchra. Another unmetalled road connects both Gangaramchak and Bhadulia Collieries, at Khayrasole. Raswan Railway Station, on the Andal-Palasthali section of the Eastern Railway, is located about 4 km south west of the block. Kazi Nazrul Islam Airport is situated about 22 km (aerial distance) away from the project site. The district head quarter is at Suri which is located about 45 km away (aerial distance).

There are no mines present adjacent to the Gangaramchak & Gangaramchak Bhadulia Opencast Coal Mining Project.

3.4 TOPOGRAPHY AND DRAINAGE:

Topography:

Core zone:

The area exhibits gently undulating topography with elevation ranging from 94 m to 121 m above mean sea level. The general slope of the area is towards south-west. The ground slope is rather steep both towards east and west. The block has highest elevation of 121 m (contour value) around GRC-16 and GRC-41 in the northern part of the block.

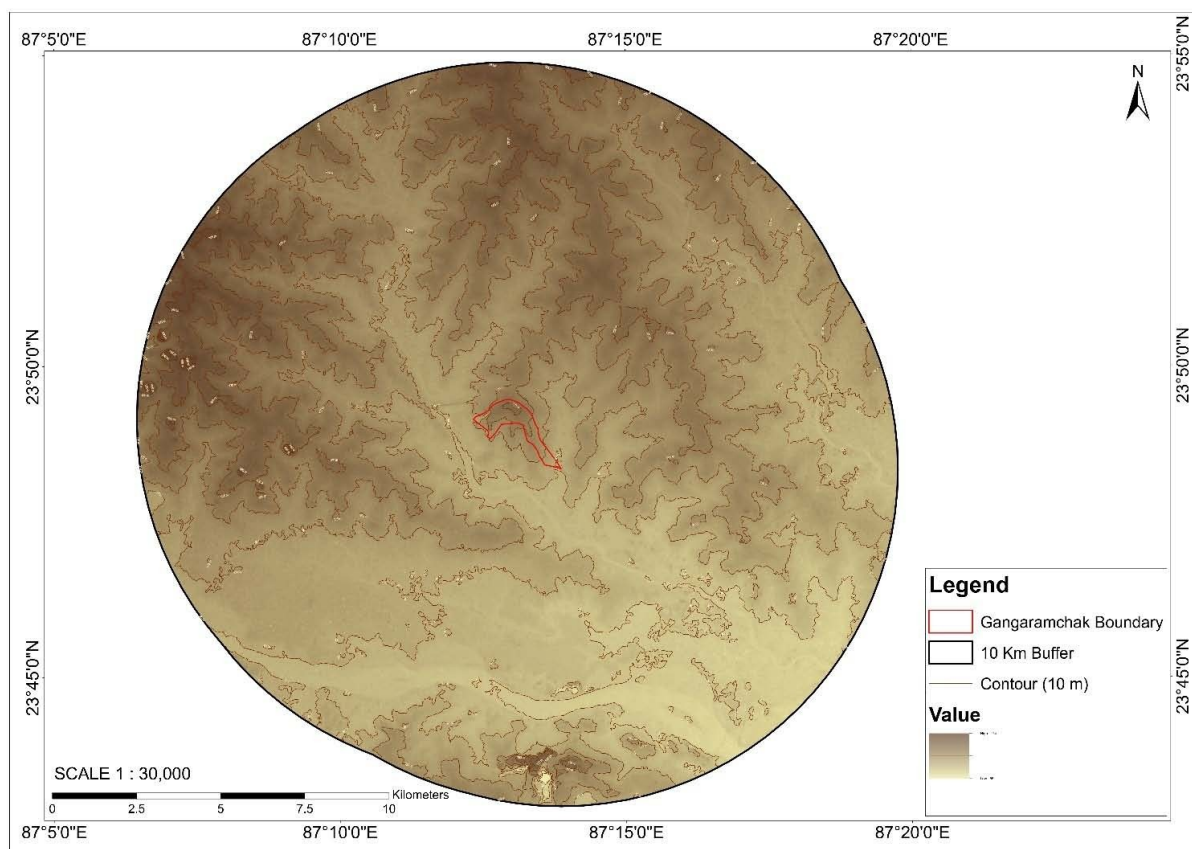


Fig. No. C3-2: Shaded Relief of the Lease Area

Drainage:

The drainage pattern of the region is dentritic in nature; the drainage map is attached as Fig. No. C3-3.

Core zone:

A number of ephemeral nalas drain the area to the Hingla River flowing to the south and west of the block boundary of Gangaramchak and Gangaramchak-Bhadulia Coal Block.

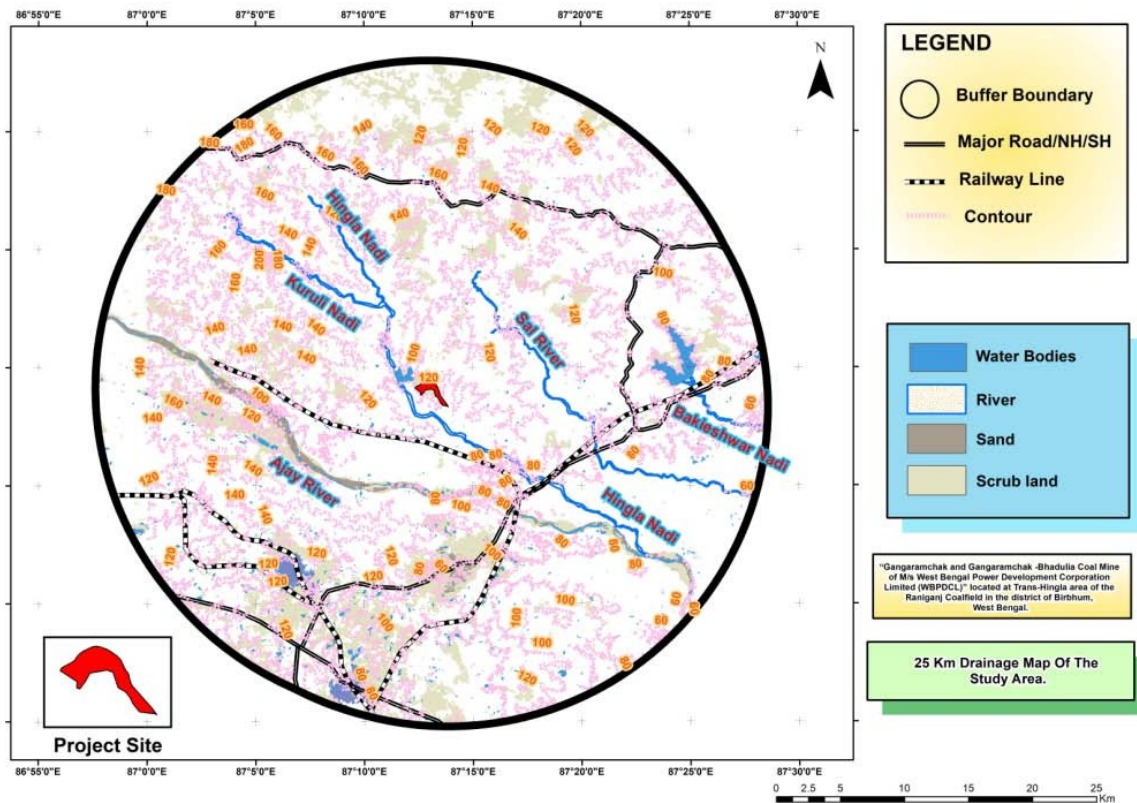


Fig. No. C3-3: Drainage System Map of the Study Area with 25 Km Buffer zone.

Buffer zone:

Ajay River flows north-west to south-east direction towards southern part of the buffer area. The distance of the Ajay River from the core zone is around 30Kms towards southern direction. Hingla River is a tributary of Ajay River flows from north-west to south-east direction towards central part of the buffer area. The distance of the Hingla Nadi from the core zone is around 8Kms towards southern direction. Despite of these two rivers few numbers of ephemeral nalas drain the area to the Hingla River flowing to the south and west of the block boundary of Gangaramchak and Gangaramchak-Bhadulia Coal Block.

3.5 GEOLOGY

The Gangaramchak Block represents an isolated narrow elongated strip of coal bearing sediments of about 9 km in length in Trans-Hingla area of the Raniganj Coalfield in the district of Birbhum, West Bengal, India. The block falls in Kasta Area of eastern Coalfields Ltd. and covers an area of 3.5 sq.Km. However, after detailed exploration, the block area is now limited to 1.94 Sq. km.

Regional Geology

Based on the regional and detailed exploration within the Gangaramchak and Gangaramchak-Bhadulia Coal Block carried out by G.S.I and CMPDIL, the stratigraphic sequence of Raniganj Coalfield is furnished below in table.

Table No. C3-4: Stratigraphic Sequence of Raniganj Coalfield

Age	Formations	Lithology
Recent		Alluvium/soil
Sub-recent & Quaternary	Unconformity Intrusives (Dykes & Skills)	Laterite, lateritic gravels, clays, etc. Dolerite & mica-peridotite.
	Supra-Panchets	Red sandstones & clays.
<i>Unconformity</i>		
	Panchet Formation	Greenish grey sandstones, red clays & Khaki green shales.
	Raniganj Formation	Micaceous sandstones, shales & coal Seams.
	Barren Measures (Kulti Formation)	Greenish shale, carb. Shale and argillaceous sandstone, greenish in colour. Dark grey/ black shales with clays & iron-stone bands.
	Barakar Formation	Feldspathic sandstones, shales & coal
	Talchir Formation	Greenish sandstones, olive green shales & Boulder bed.
<i>Unconformity</i>		
ARCHAEOANS		Gneisses, granites & schists

Following rock formations are reported from Rajmahal coalfield.

- Quaternary & Recent Formation
- Barren Measures
- Barakar
- Talchir
- Archean Basement

Quaternary & Recent Formation:

The blanket of soil that covers the block ranges in thickness from 1.50 m. (GRC-32) to 14.00 m. (GRC-9). Laterite/lateritic soil occur in a number of isolated patches of various dimensions usually restricted to central and eastern part of the block. The lateritic soil contains gravels, nodules and colites of laterite embedded within the reddish brown matrix.

The detrital or weathered mantle consists of alluvium, sandy soil, lateritic soil, running sand, clays and weathered Barren Measures and Barakar Formation. Its thickness varies from 5.00 m. (GRC-8) to 22.50 m. (GRC-4).

❖ **Barren Measures:**

Overlying the Barakar Formation are the Barren Measures, represented by dark to black sideritic shales with occasional thin bands of fine grained sandstones. The formation is not exposed anywhere in the block but occurs in small patch in the western fringe of the block around boreholes.

❖ **Barakar Formation:**

The Barakar overlies the Talchirs and Archaeans and are represented by pebbly to coarse grained ferruginous sandstones in the outcrop region. Usually, it consists of coarse to fine grained grey sandstones, shales, carbonaceous shales and their intercalations besides coal seams. The total column of Barakar Formation as intersected in 59 Boreholes (except 3 faulted boreholes viz., GRC-10, 11 & 30) shows a variation from as low as 5.50 m, in GRC-42 in the east to 114.00m in GRC-4 in the south western part of the block. Only one persistent coal horizon locally known as Kasta seam is developed in this block. However, a thin coal band was found to be developed occasionally below the seam in the western part of the block. The seam incrops are in an arcuate pattern to the north and east of the block.

❖ **Talchir Formation:**

The Talchir Formation is not exposed anywhere in the block, however, the same has been intersected in only one borehole (GRC-3). It is represented by greenish shale.

❖ **Archean Basement:**

The metamorphics exposed all around the block dominantly consist of gneisses, mica-schist and quartzites. Megascopically gneiss is massive in nature and consists mainly of quartz, feldspar and mica. Quartzite wherever exposed is highly jointed. Out of 62 Boreholes, Metamorphics have been encountered in 23 boreholes. They occur immediately after the Barakar Formation, suggesting overlapping of the Archaeans by the Barakars.

A regional Geological map of the Rajmahal coal field area is furnished in Fig no C3 – 4.

Local Geology

The strike has an arcuate pattern with convexity towards north-east. The strike of the beds is NE-SW in the north-western part of block but gradually swings to nearly E-W in the north, then to NW-SE in the north-east and becomes almost NNW-SSE in the south-eastern fringe of the block with minor variations locally. The structure depicts a basinal configuration, the south-western half of which is truncated by the fault. The dip usually varies between 4° and 6° towards south-east in the north-western and gradually swings to south in the northern area, then to west in the eastern and south-west in south-eastern part of the block. In general the dip is gentler in the fringe area of the basin.

The incrop of the seam has been interpreted after taking into account the floor of the seam as well as the floor of the weathered mantle and further supplemented by the presence of the quarries along this zone. The arcuate and dissected pattern of the in-crop is mainly because of the swinging nature of the strike and the displacement of seam due to faulting.

Altogether 2 normal faults have been deciphered within the block. The faults have been designated as F1-F1 and F2-F2 from west to east. Fault F1-F1 has a general NW-SE trend and runs sub-parallel to fault F2-F2 near GRC-10 and further continuation of this fault southward is not precisely known. It has a throw of 55 m. near GRC-61. The absence of Kasta Seam in GRC-61 and steepening of the beds are indicative of the presence of this fault. This fault brings metamorphics in juxtaposition with Barakars. Fault F2-F2 also has a general NW-SE trend with throw of around 30 m. towards north but possibly increases southward. It has been intersected in GRC-10, GRC-11 and GRC-30 resulting in the omission of Kasta Seam and reduction of the overall thickness of the Barakar sediments.

3.6 LAND ENVIRONMENT

LAND USE / LAND COVER PATTERN:

The opencast mining have potentials to cause impact on the environment depending upon the pollution potential of mines and the sensitivity of the receiving environment especially for a opencast mining activity where separate land area are needed for extraction, over burden storage and establishment of colony area etc. Therefore, it is necessary to study the present land use of the project site and its immediate receiving environment i.e. 10 km buffer zone around the site. The process of Land use mapping from satellite imagery is well established. Several parameters like terrain, climatic conditions, socioeconomic trends & environmental influences etc. play a vital role in the existence of various land use categories.

Land use refers to "man's activity and the 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." The Land use/ Land cover map of the study area is prepared based on the recent satellite imagery as well as available secondary information and is enclosed as Fig. No. C3-5. Detailed satellite imagery interpretation was carried out and thematic maps of the

study area were prepared by visual interpretation using tone texture variation from IRS-IC LISS- False Color Composite geo coded images is enclosed as C3-5(a). Digital image processing techniques were used to classify land use, geology, geomorphology, drainage pattern/ watersheds and vegetation cover of the study area.

Land Use Pattern in Buffer Zone:

The various land use/ land cover classes identified and mapped in the study are discussed below:

- **Human Settlement:** It is defined as an area of human habitation developed due to non-agricultural use and that which has a cover of buildings, transport, and communication, utilities in association with water, vegetation and vacant lands. Settlement covers around 6.27% of the buffer zone.
- **Cultivable Land:** Cultivable Land generally refers to an area which can be used for cultivation purpose in some part of the year. Cultivable land covers around 75.41% of the buffer zone.
- **Forest:** It is an area predominantly covered with trees along with some other plant forms like shrubs and herbs. Forest area covers around 5.48% of the buffer zone. Around 0.13% area of buffer zone falls under plantation and 0.68% area falls under Scrub land i.e. land covered by shrubs mainly.
- **Water Bodies:** It may be free flowing like river /nala or canal or stagnant water bodies like pond. River is a natural course of water flowing on land along definite channel; it can be seasonal or perennial. Artificial water bodies cover around 2.25% of the buffer zone. Rivers cover around 6.14% of the buffer zone. Streams cover around 1.61% of the buffer zone and Canals cover around 0.06% of the buffer zone.
- **Road:** Around 1.29 % of area of the buffer zone occupied by metalled & unmetalled roads.
- **Railway Line:** Around 0.16 % of area of the buffer zone occupied by Railway line.
- **Mines Area:** Around 0.07 % area of the buffer zone is covered by Mines area including quarry area, old working area & dump area.
- **Waste Land:** Around 0.47 % of area of the buffer zone occupied by waste land.

The land use pattern of the area around 10km radius of core zone is presented in Table No. C3-5.

Table No. C3-5: Land Use Pattern of the Buffer Zone

SI no	LULC Category	10 KM Buffer (Area Ha)
1	Artificial Waterbody	868.84
2	Scrub Land	262.76
3	Wasteland	179.88

4	Settlement	2418.33
5	Plantation	49.84
6	Forest	2114.37
7	River	2369.09
8	Cultivable Land	29106.24
9	Metalled Road	177.08
10	Unmetalled Road	322.09
11	Railway Line	61.47
12	Stream	620.98
13	Canal	23
14	Dump	17.43
15	Old Quarry	4.04
16	Old Working Area ECL	2.2
	TOTAL AREA	38597.64

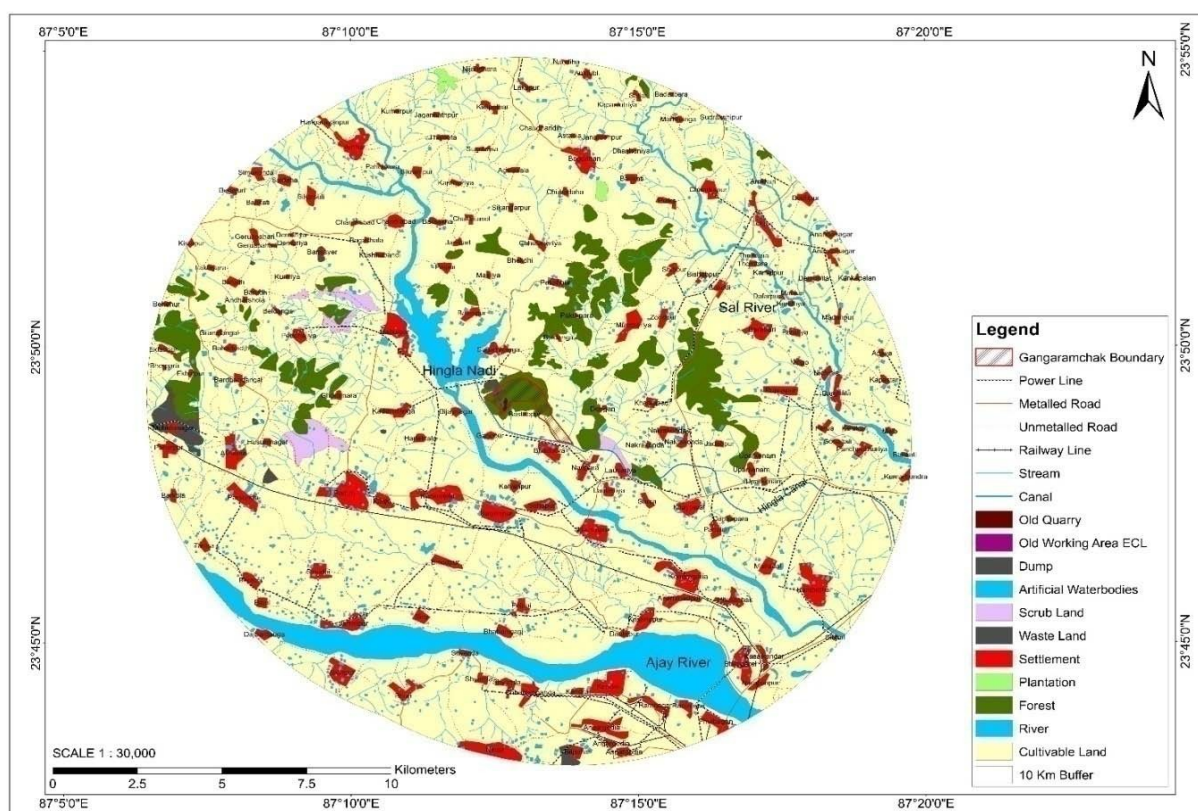


Fig. No. C3-5: Land Use/ Land Cover Map

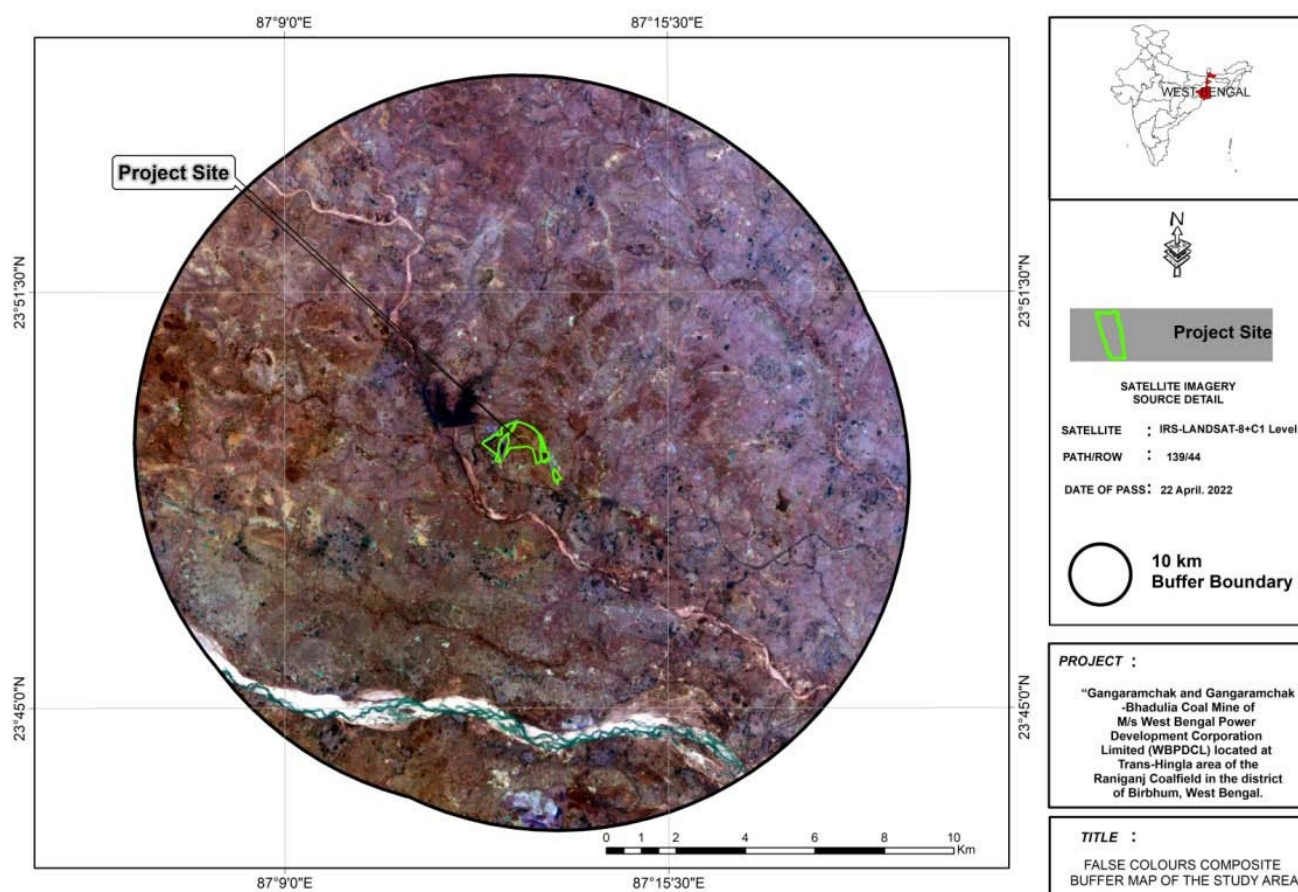


Fig. No. C3-5(a): FCC Land Use/ Land Cover Map

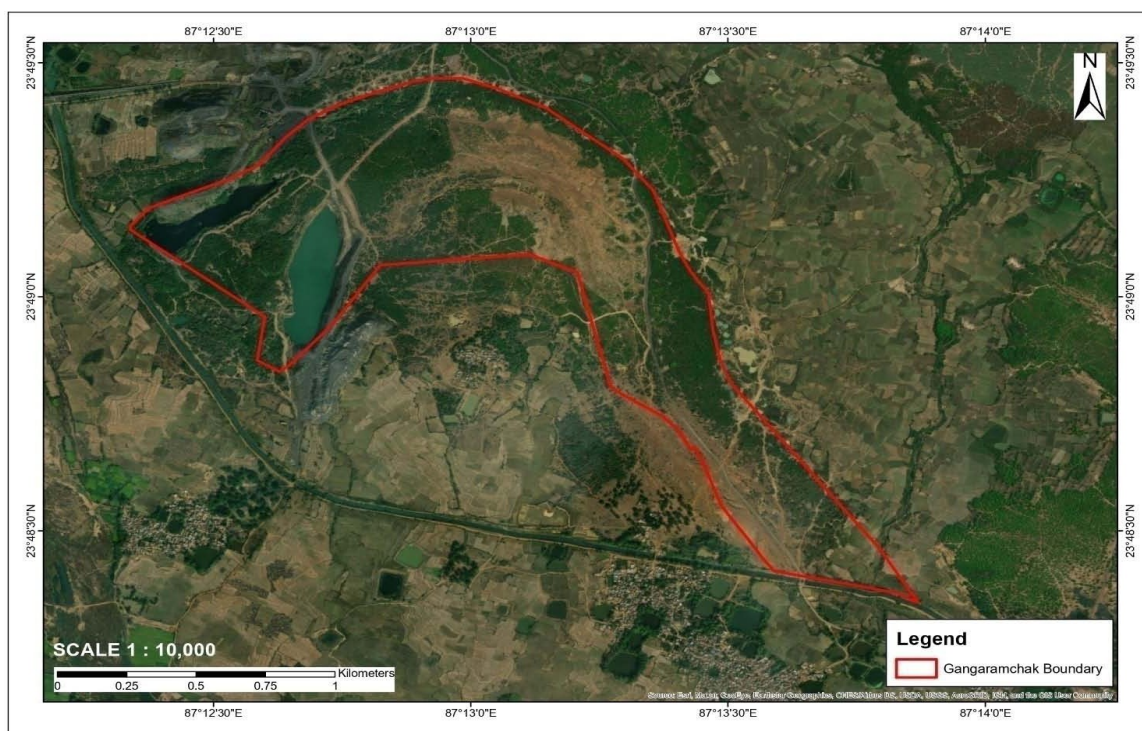


Table No.C3-6: Land Use Pattern Post Closure as per approved Mine Plan and Mine closure Plan

Land Use Pattern in Core Zone:

The details of mining lease area of Gangaramchak-Bhadulia Coal Block is given in below Table:

Table No.C3-7: Land Use Pattern of Core zone.

SL. No.	Mouza Name	Land Type	Area in Ha	Lease Status
1	Ahmedpur	Non-Forest	0.31	Executed
2	Sahebpur	Non-Forest	10.21	
3	Bhadulia	Non-Forest	16.8	
4	Gangarampur	Non-Forest	20.33	
A	Sub-Total		47.65	
6	Gangarampur	Forest	27.41	Stage-II FC Obtained, Lease Applied For.
7	Bastabpur	Forest	61.81	
8	Bhadulia	Forest	5.46	
9	Sahebpur	Forest	4.52	
10	Ahmedpur	Forest	2.57	
B	Sub-Total		101.77	
11	Gangarampur	Non-Forest	28.11	Lease Applied
12	Sagarbhanga	Non-Forest	8.89	
C	Sub-Total		37	
A+B+C	Total Project Area		186.42	

3.7 CLIMATE AND METEOROLOGICAL PARAMETERS

Study of meteorological conditions is an integral part of environmental impact assessment studies. The meteorological data recorded during the study period is very useful for proper interpretation of the baseline information regarding Gangaramchak & Gangaramchak Bhadulia Opencast Coal Mining Project and surrounding area for air dispersion.

Meteorological study of the area depicts the weather condition of a typical summer months and the climate of the area is dry humid and sub-tropical.

The district of Birbhum experiences dry and hot summers with temperatures often rising above normal. During summers, the mercury rises well above 40°C (104°F). As for the direction of the wind, it is always blows from the south-east. The climatic conditions in the western and eastern side of the district are different. While the western side is dry and extreme, it is relatively milder on the eastern side. The summers in Birbhum usually start from middle of March and lasts till the middle of June.

The arrival of the month of June marks the onset of monsoon in Birbhum. The district boasts of a high average rainfall. However, it is observed that the western region of the Birbhum district receives higher rainfall as compared to the eastern region. The difference between the annual average rainfall in Rajnagar (1,405 millimeters) and Nanoor (1,212 millimeters) is an example of this. Monsoon in

Birbhum lasts till the middle of the month of October.

Winters in Birbhum are pleasant and enjoyable, with mercury dropping to about 10°C (50°F). While the day time is pleasingly cool, with the fall of evening temperature lowers further, making the nights chilly and cold. During winters, wind usually blows from the north-west direction. The winter starts from December and last till the month of February. Due to such favorable conditions, winters is deemed as the best time to visit this historic and significant district in West Bengal.

Table No.C3-8: Monthly and Yearly Rainfall Variations in Birbhum District of West Bengal

YEAR	JAN		FEB		MAR		APR	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2014	3.8	-72	35.4	120	28.5	34	0.2	-99
2015	9.1	-32	4.3	-73	35.5	68	69.4	124
2016	24.3	81	14	-13	12.7	-40	2.7	-91
2017	4.6	-66	0	-100	4.8	-77	28	-9
2018	0	-100	0.5	-97	0.8	-96	51.5	67
YEAR	MAY		JUN		JUL		AUG	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2014	80.9	3	177.3	-20	391.6	25	285.7	-4
2015	54.4	-31	321.5	45	698.5	123	296.8	-1
2016	94.9	21	214.6	-3	346.6	10	308.4	3
2017	160.8	104	156.6	-30	487.1	55	238.6	-20
2018	62.6	-20	138.3	-38	258.3	-18	159.7	-47
YEAR	SEPT		OCT		NOV		DEC	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2014	130.2	-52	10.2	-90	0	-100	0.6	-89
2015	144.2	-47	21.1	-80	4.2	-73	0.2	-97
2016	242.4	-11	35.2	-67	0	-100	0	-100
2017	166.5	-39	214.5	104	2.5	-84	4.7	-16
2018	170	-37	37.4	-64	0	-100	25.3	352

Note: (1) The District Rainfall in millimeters (R/F) shown below are the arithmetic averages of Rainfall of Stations under the District.

(2) % Dep. are the Departures of rainfall from the long period averages of rainfall for the District.

**Table No.C3-9: Monthly Temperature Variations In Birbhum District
Of West Bengal**

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	19	21.5	26.9	30.8	30.7	30.7	28.9	28.8	28.8	27.3	23	19.6
Min. Temperature (°C)	12	14.4	19.4	23.7	25.5	26.2	25.7	25.7	25.4	23	17	12.9
Max. Temperature (°C)	26	28.6	34.4	38	35.9	35.2	32.2	32	32.3	31.7	29.1	26.3
Avg. Temperature (°F)	66.2	70.7	80.4	87.4	87.3	87.3	84.0	83.8	83.8	81.1	73.4	67.3
Min. Temperature (°F)	53.6	57.9	66.9	74.7	77.9	79.2	78.3	78.3	77.7	73.4	62.6	55.2
Max. Temperature (°F)	78.8	83.5	93.9	100.4	96.6	95.4	90.0	89.6	90.1	89.1	84.4	79.3
Precipitation / Rainfall (mm)	12	21	24	41	88	239	295	275	170	105	12	5

3.8 MICRO-METEOROLOGY DATA FROM THE LEASE AREA

The micro-meteorological data of the study area have been recorded continuously from the lease area from March, 2022 to May, 2022. This includes wind speed and wind direction, temperature and relative humidity (RH).

Rainfall:

Major rainfall occurs by south-west monsoon with maximum rainfall occurring in the month of August. The average annual rainfall in the area is reported to be 1405 mm and number of rainy days in a year is about 69 days. The wind speed of the area varies from 1.3 to 3.0 ms. The annual wind rose diagram at Gangaramchak for duration of 10 years period is shown in Figure c3-7.

Temperature:

In summer, the temperature rises up to 41.3°C to 44.7°C on some summer days. During winter, the temperature drops down to 10-12°C at times. In the monitored summer months of June 2004, the temperature ranges from 30.1 to 44.7°C. Dust storms are common in dry season (May and June) before the onset of monsoon with increase in temperature and wind speed in the afternoon coupled with low humidity.

Humidity:

The meteorological parameters depict the weather condition of a typical summer months (March-May) and the climate of the area is dry humid and subtropical. It is characterized by hot and dry summer from March to May, rainy season from June to October and cold winter spreading from November to February. The average annual relative humidity is about 67%. In summer months the relative humidity (RH) varies between 55 to 66%.

The summarized monitored micro-meteorological data is given below;

Table No. C3-10: Summarized Meteorological Data at Site

Month	Wind Speed (m/s)		Temperature (°C)			Rainfall (mm)	
		Avg	Max	Min		Avg.	No. of Days
March 2022		2.4	33.4	19.3		33.2	2.4
April 2022		1	33.6	23.3		52	3.5
May 2022		0.5	36.7	25		113.8	6.3

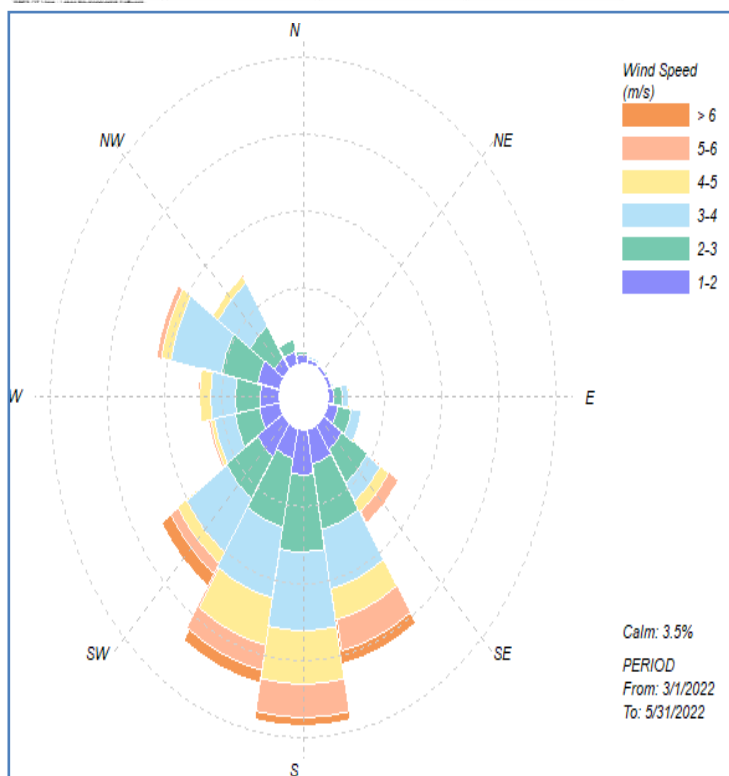
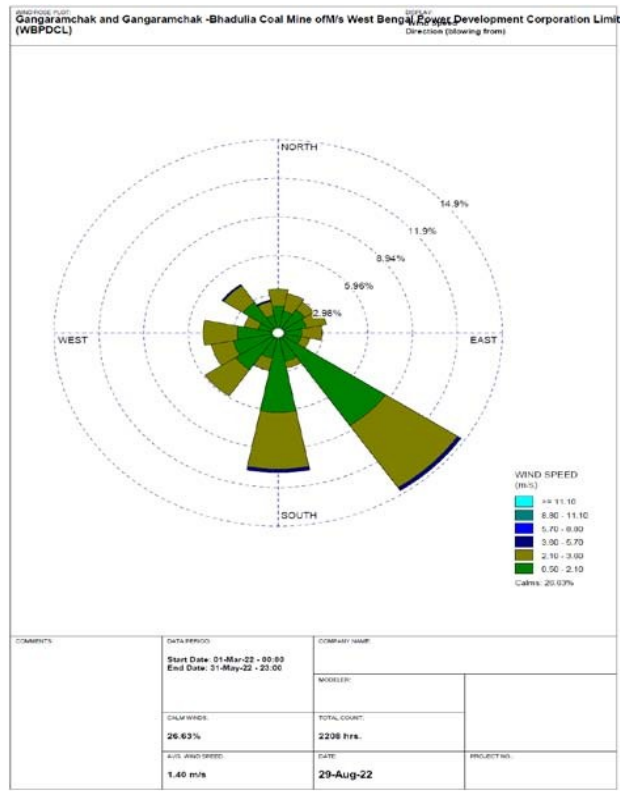


Fig. No. C3-7(a): Wind Rose Diagram at IMD (Shanti Niketan) Fig. No. C3-7(b): Wind Rose Diagram at Site

3.9 AIR QUALITY:

To quantify the impact of the Gangaramchak & Gangaramchak Bhadulia Coal Mining Project on the ambient air quality (AAQ), it is necessary to evaluate the existing ambient air quality. The existing ambient air quality, in terms of Respirable Particulate Matters (RPM), Suspended Particulate Matters (SPM), Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO_x), Carbon monoxide (CO), Lead (Pb) have been measured through a planned field monitoring and analysed. The sampling locations of air, noise and soil environment are depicted in below table:

TABLE NO. C3-11: DETAILS OF AIR SAMPLING LOCATIONS

Stn. Code	Location	Source of Air Pollution	Distance/Direction & Coordinates
Core zone			
A1	Project Site 1	Domestic, Background Pollutants due to agricultural and other domestic works.	23°49'19.95"N 87°12'43.93"E
A2	Project Site 2	Domestic, Background Pollutants due to agricultural and other domestic works.	23°49'0.04"N 87°13'18.27"E
Buffer zone			
A3	Bhadulia	Domestic, Background Pollutants due to agricultural and other domestic works.	1.82 km in SE 23°48'16.24"N 87°13'30.61"E
A4	Kese	Domestic, Background Pollutants due to agricultural and other domestic works.	2.82 km in NW 23°50'31.99"N 87°12'13.94"E
A5	Krishna Bandi	Domestic, Background Pollutants due to agricultural and other domestic works.	5.81 km in NW 23°51'27.28"N 87°10'29.51"E
A6	Islamkuri	Domestic, Background Pollutants due to agricultural and other domestic works.	2.25 km in SW 23°48'53.37"N 87°11'51.81"E
A7	Tilshur	Domestic, Background Pollutants due to agricultural and other domestic works.	3.03 km in N 23°50'53.29"N 87°12'51.74"E
A8	Lokepur	Domestic, Background Pollutants due to agricultural and other domestic works.	8.54 km in NE 23°51'56.31"N 87°17'7.54"E

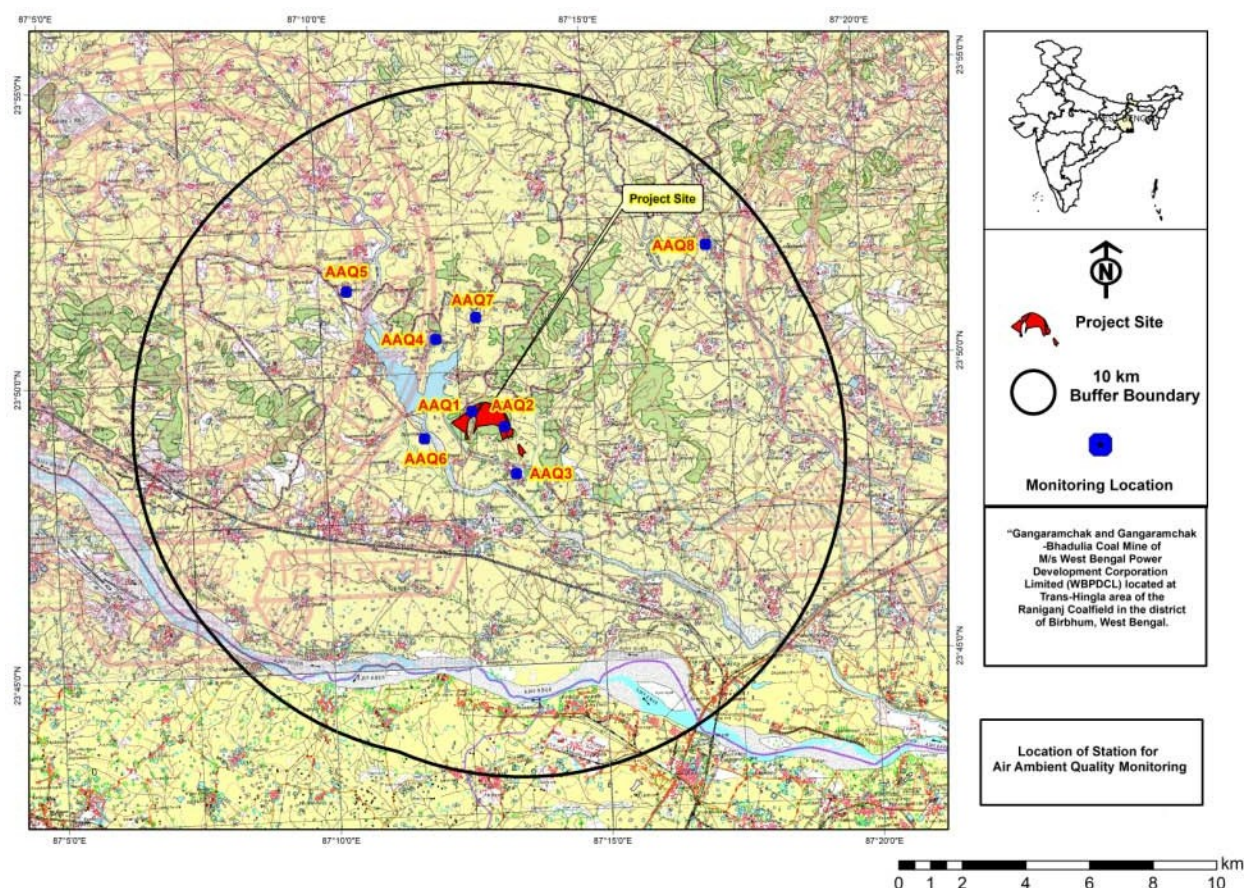


Fig. No. C3-8: Ambient Air Monitoring Locations

Duration of Sampling:

24 hourly sampling has been done for measuring of RPM, SPM, SO₂, NO_x and Pb while 8 hourly sampling has been carried out for CO measurement as per Central Pollution Control Board (CPCB) guidelines for National Ambient Air Quality Standard (NAAQS).

Standards for Air Quality:

Table No.C3-12: STANDARDS FOR COAL MINES

Notification No. GSR 742(E), Dt: 25th September 2000 (Stipulated by Ministry of Environment and Forests (MoEF), New Delhi)

Category	Pollutant	Time weighted average	Concentration in Ambient Air	Method of Measurement
I	Suspended Particulate Matter(SPM)	Annual Average*	360µg/m ³	– High Volume Sampling (Average
New Coal Mines (Coal Mines commenced		24hours**	500µg/m ³	flow rate not less than 1.1 m ³ /min)

operation after the date of publication of this notification)				
	Respirable Particulate Matter (sizelessthan10µm)(RPM)	Annual Average* 24hours**	180µg/m3 250µg/m3	– Respirable Particulate Matter sampling and analysis
	Sulphur Dioxide(SO2)	Annual Average* 24hours**	80µg/m3 120µg/m3	– Improved West and Gaeke method – Ultraviolet fluorescence
	Oxide of Nitrogen as NO2	Annual Average * 24 hours **	80 µg/m3 120 µg/m3	– Jacob & Hochheiser Modified (Na- Arsenic) Method – Gas phase Chemiluminescence

Table No. C3-13: National Ambient Air Quality Standard (as per CPCB Notification of 18 Nov., 2009)

Sl. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, residential, Rural and Other Area	Ecologically Sensitive Area	Methods of Measurement
1	Sulphur Dioxide (SO ₂), µg/m ³	Annual * 24 hours **	50 80	20 80	- Improved West and Gaeke - Ultraviolet fluorescence
2	Nitrogen Dioxide (NO ₂), µg/m ³	Annual * 24 hours **	40 80	30 80	- Modified Jacob&Hoch heiser (Na-Arsenite) - Chemilumin escence
3	Particulate Matter (size < 10µm or	Annual * 24 hours **	60	60	- Gravimetric - TOEM
	PM ₁₀), µg/m ³		100	100	- Beta attenuation
4	Particulate Matter (size < 2.5µm) or PM _{2.5} µg/m ³	Annual * 24 hours **	40 60	40 60	- Gravimetric - TOEM - Beta attenuation
5	Ozone (O ₃), µg/m ³	8 hours ** 1 hour **	100 180	100 180	- UV photometric - Chemilminescence - Chemical Method
6	Lead (Pb), µg/m ³	Annual * 24 hours **	0.50 1.0	0.50 1.0	- AAS/ICP method after sampling on EPM 2000 or equivalent

					filter paper - ED-XRF using Teflon filter
7	Carbon Monoxide (CO), mg/m ³	8 hours ** 1 hour **	02 04	02 04	- Non dispersiveInf ra Red - (NDIR) spectroscop y
8	Ammonia (NH ₃), µg/m ³	Annual * 24 hours **	100 400	100 400	- Chemilumin escence - Indophenol blue method
9	Benzene (C ₆ H ₆), µg/m ³	Annual *	05	05	- Gas - Adsorption followed by GC analysis
10	Benzo(a) Pyrene (BaP)– particulate phase only, ng/m ³	Annual *	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m ³	Annual *	06	06	- AAS/ ICP equivalent filter paper
12	Nickel (Ni), ng/m ³	Annual *	20	20	- AAS/ ICP sampling on EMP 200 0 or Equivalent filter paper.

* Site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly or 01 hourly mentioned values, as applicable, shall be complied with 98% of the time in a year, 2% of the time; they may exceed the limits but not on two consecutive days of monitoring.

Results and Discussions:

The results of air quality monitoring occurred in May-March 2022, is summarized in below table:

TABLE NO. C3-14: AMBIENT AIR QUALITY MONITORING RESULTS

S. No.	Pollutant	Location	No. of observation	Minimum	Maximum	Average	98th Percentile	CPCB Standards
1.	SO ₂ (µg/m ³)	AQ1	24	4.31	9.76	7.82	9.75	80.0
		AQ2		4.82	9.81	7.70	9.78	
		AQ3		6.91	7.98	7.29	7.96	
		AQ4		6.98	8.25	7.43	8.19	
		AQ5		6.96	7.28	7.06	7.27	
		AQ6		6.14	7.25	6.75	7.19	
		AQ7		7.81	8.52	8.04	8.41	
		AQ8		6.05	7.14	6.64	7.13	
2.	NO _x (µg/m ³)	AQ1	24	9.18	17.68	14.56	17.42	80.0
		AQ2		9.23	18.15	14.64	18.13	
		AQ3		12.11	14.23	13.16	14.16	
		AQ4		11.26	15.52	13.80	15.43	
		AQ5		10.28	12.39	11.71	12.37	
		AQ6		10.87	12.2	11.50	12.18	
		AQ7		13.26	16.16	14.22	16.11	
		AQ8		10.19	14.96	12.72	14.96	
3.	PM10 (µg/m ³)	AQ1	24	65.04	89.12	73.96	87.69	100.0
		AQ2		64.58	90.58	74.98	89.92	
		AQ3		51.17	70.48	64.48	70.38	
		AQ4		58.29	74.38	69.10	74.30	
		AQ5		55.25	69.84	62.62	69.56	
		AQ6		51.24	64.28	59.00	64.09	
		AQ7		56.28	70.1	66.09	70.10	
		AQ8		50.12	63.51	58.47	63.40	
4.		AQ1		35.67	57.45	45.56	57.36	

	PM2.5 (µg/m3)	AQ2	24	38.32	58.13	47.39	57.93	60.0
		AQ3		25.36	33.58	29.49	33.57	
		AQ4		25.69	38.57	31.97	37.32	
		AQ5		24.38	33.21	28.96	33.13	
		AQ6		23.52	32.58	26.83	32.09	
		AQ7		22.69	31.85	27.40	31.59	
		AQ8		22.62	30.15	25.92	30.06	
5.	CO (mg/m3)	AQ1	24	0.49	1.98	0.90	1.82	2
		AQ2		0.47	0.61	0.53	0.60	
		AQ3		0.65	0.88	0.75	0.83	
		AQ4		0.38	1.14	0.59	1.02	
		AQ5		0.49	1.72	0.84	1.56	
		AQ6		0.73	0.92	0.82	0.91	
		AQ7		0.25	0.72	0.45	0.68	
		AQ8		0.45	1.29	0.81	1.22	

Baseline Scenario

Suspended particulate matter in general terms is the particulate matter in suspension in ambient air. PM 2.5 refers to particles with a diameter of less than 2.5 microns. These are usually called fine particles and contain secondary aerosols, combustion particles and re-condensed organic metallic vapour, and acid components. Fine particles can reach all the way down to the alveoli in the lungs.

The minimum and maximum level of PM2.5 recorded within the study area was in the range of 22.62 µg/m3 to

58.13 µg/m3 with the 98th percentile ranging between 30.06 µg/m3 to 57.93 µg/m3.

The 24 hourly average values of PM2.5 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., 60 µg/m3 for PM2.5 in rural areas.

a) Suspended Particulate Matter (PM₁₀)

PM₁₀ refers to particles with a diameter less than 10 microns. These are commonly called coarse particles - they contain dust from roads and industries as well as particles formed under combustion. Depending on their size, coarse particles can lodge in the trachea (upper throat) or in the bronchi.

The minimum and maximum level of PM₁₀ recorded within the study area was in the range of 50.12 µg/m³ to 90.58µg/m³ with the 98th percentile ranging between 63.40 µg/m³ to 89.92 µg/m³. The 24 hourly average values of PM₁₀ 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/m³ for PM₁₀ in rural areas.

b) Sulphur Dioxide (SO₂)

Sulphur dioxide gas is an inorganic gaseous pollutant. Sulphur dioxide emissions are expected to be emitted wherever combustion of any fuel containing Sulphur takes place. The Sulphur in the fuel will combine with oxygen to form Sulphur dioxide. The following sources of Sulphur dioxide in the study area are identified: Emissions from domestic/consumption of fuel (coal, diesel etc.)

Sulphur dioxide in atmosphere is significant because of its toxicity; Sulphur dioxide is capable of causing illness and lung injury. Further it can combine with water in the air to form toxic acid aerosols that can corrode metal surfaces, fabrics and the leaves of plants. Sulphur dioxide is an irritant to the eyes and respiratory system. Excessive exposure to Sulphur dioxide causes breathing related diseases as it affects the lungs.

The minimum and maximum concentration of SO₂ recorded within the study area was 4.31 to 9.81 µg/m³ with the 98th percentile ranging between 7.13 µg/m³ to 9.78 µg/m³.

The 24 hourly average values of SO₂ 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/m³ for rural areas.

c) Oxides of Nitrogen (NO₂)

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 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. NO₂ 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.

The minimum and maximum level of NO₂ recorded within the study area was in the range of was 9.18 µg/m³ to 18.15 µg/m³ with the 98th percentile ranging

between 12.18 $\mu\text{g}/\text{m}^3$ to 18.13 $\mu\text{g}/\text{m}^3$. The 24 hourly average values of NO_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 $\mu\text{g}/\text{m}^3$ for rural areas.

d) Carbon Monoxide (CO)

The minimum and maximum level of CO recorded within the study area was in the range of was 0.25 mg/m^3 to 1.98 mg/m^3 with the 98th percentile ranging between 0.60 mg/m^3 to 1.82 mg/m^3 .

The 24 hourly average values of CO 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 2 mg/m^3 for rural areas.

3.10 NOISE ENVIRONMENT

General:

Measurement of sound level may be averaged over two distinctly different periods of time. Steady sound levels and instantaneous levels of variable sound are measured on very short-time scale of 1 sec. or less. Variable sounds can be measured with a much longer time, over period of hours (say 8 hrs which is shift duration) and are expressed in terms of the equivalent continuous pressure level (L_{eq}).

Equivalent continuous sound pressure level (L_{eq}) is that level of steady sound, which over the same interval of time contains the same total energy as the fluctuating sound. Thus, L_{eq} is a scale for the measurement of long- term noise exposure. There is large number of noise scales and rating methods based on average or weighted averages derived from the detailed noise characteristics. Equivalent sound level forms a useful measure of noise exposure and forms basis of several noise indicators. It is defined as $L_{eq} = 10 \log (1/T \int_0^T L_p(t)^2 dt)$ dB(A)

Where $L_p(t)$ is instantaneous sound pressure level and T is time of averaging normally 8 or 24 hours.

Instrument used for Methodology:

Noise level study has been done for monitoring the ambient noise level in the leasehold area. Mip oy integrated sound level meter meeting IEC-197A was used to measure the noise level. Average day and night L_{eq} values have been assessed at each location for four hours duration both during day and night time with the interval of 30 minutes.

TABLE NO. C3-15: DETAILS OF NOISE SAMPLING LOCATIONS.

Stn. Code	Location	Source of Air Pollution	Distance/Direction & Coordinates
Core zone			
NQ1	Project Site 1	Domestic, Background pollutants due to agricultural	23°49'12.76"N 87°13'3.31"E
		and other domestic works.	
Buffer zone			
NQ2	Bhadulia	Domestic, Background pollutants due to agricultural and other domestic works.	1.82 km in SE 23°48'16.24"N 87°13'30.61"E
NQ3	Kese	Domestic, Background pollutants due to agricultural and other domestic works.	2.82 km in NW 23°50'31.99"N 87°12'13.94"E
NQ4	Khayrasole	Domestic, Background pollutants due to agricultural and other domestic works.	5.77 km in S 23°47'16.25"N 87°15'51.28"E
NQ5	Denganja	Domestic, Background pollutants due to agricultural and other domestic works.	2.14 km in SE 23°48'51.29"N 87°14'22.19"E
NQ6	Lokepur	Domestic, Background pollutants due to agricultural and other domestic works.	8.54 km in NE 23°51'56.31"N 87°17'7.54"E

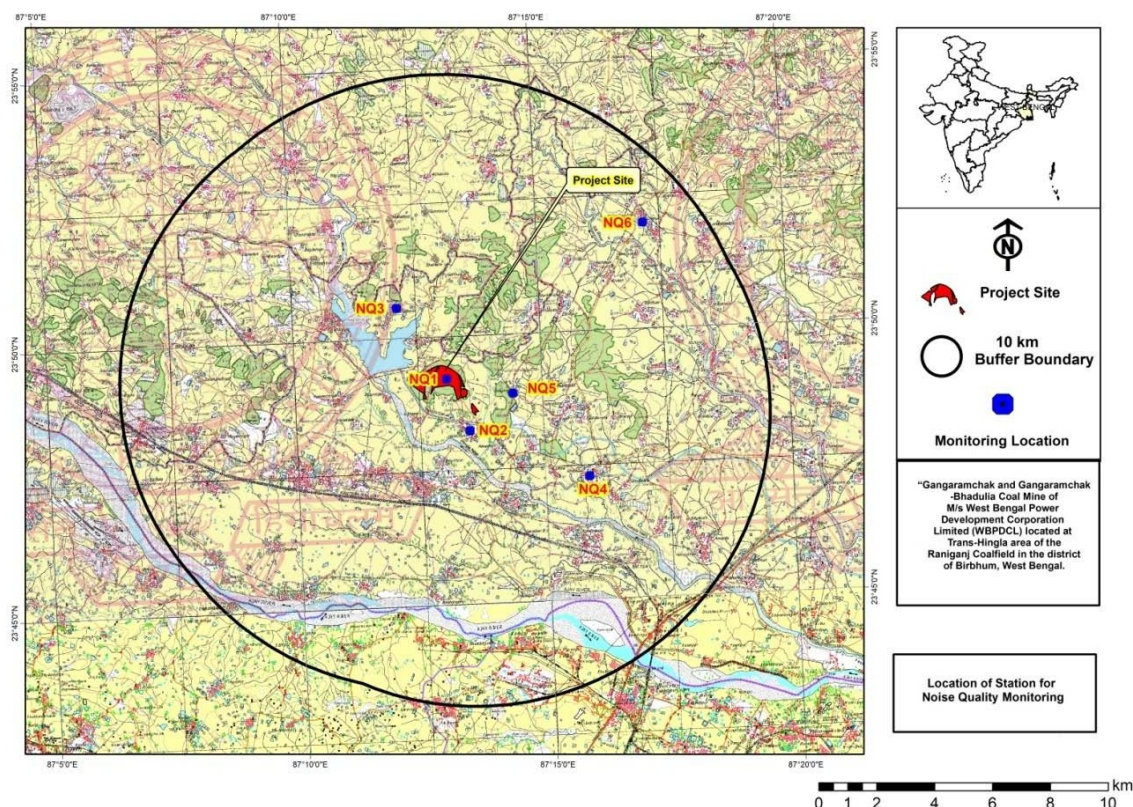


Fig. No. C3-9: Ambient Noise Monitoring Locations

Noise Standards:

Central Pollution Control Board has stipulated some specific standard for ambient noise-level in industrial, commercial, residential and silence zones for both day and night time. These are given in below Table:

TABLE NO. C3-16: INDIAN STANDARD FOR NOISE LIMIT

Land Category	Use	Noise Limit in dB(A) Leq	
		Day Time (6A.M. to 10P.M.)	Night Time (10P.M. to 6A.M.)
Industrial Area		75 dB(A)	70 dB(A)
Commercial Area		65 dB(A)	55 dB(A)
Residential Area		55 dB(A)	45 dB(A)
Silence Zone		50 dB(A)	40 dB(A)

(Source: Environmental Standards for Ambient Air, Automobiles, Fuel, Industries, & Noise; Pollution Control Law Series – CPCB)

Note: Silence zone: Hospital, Educational Institution, Wild Life Sanctuary, Courts & Sanitarium (within 100 meter around these locations).

Measured noise levels, displayed as a function of time, is useful for describing the acoustical climate of the community. Equivalent noise level is a single number descriptor for describing time varying noise levels.

Results& Discussions

The results of noise level monitoring occurred in March-May, 2022 is summarized in below table:

Table No. C3-17: Noise Level Monitoring Data of the Study Region (in dBA)

S. No.	Locations	Date of Monitoring	Results		Units
			Day	Night	
1.	Project site 1	08.03.2022	60.2	52.8	dB(A)
2.	Bhadulia	22.03.2022	53.6	41.2	dB(A)
3.	Kese	01.04.2022	57.5	43.6	dB(A)
4.	Khayrasole	16.04.2022	58.4	42.8	dB(A)
5.	Denganja	04.05.2022	51.1	38.5	dB(A)
6.	Lokepur	10.05.2022	52.8	40.6	dB(A)

Baseline Scenario

The values of noise observed in some of the areas are primarily owing to vehicular traffic. Assessment of hourly night time Leq (Ln) varies from 38.5 to 52.8 dB (A) and the hourly daytime Leq (Ld) varies from 51.1 to 60.02 dB (A) within the study area.

The status of noise quality within the 10 km zone of the study area is, therefore, within the MoEF& CC standards.

3.11 WATER ENVIRONMENT

Information on water resources in the study area was collected. The water resources in the study area are mainly streams and groundwater. The Hingla nalla flows in the area. The parameter of prime importance for water quality study was selected under physical, chemical inorganic, chemical organic, nutrient and heavy metal groups.

For establishing baseline status of water quality within the study area, surface water samples three sources and three ground water sources were collected as given below in Table C3-18. The surface water sample included the U/S and D/S samples of Hingla nalla.

The common sources used for domestic and irrigation in the core zone villages include wells, shallow dug well, river and ponds. The other system is tapping deep aquifers in some of the villages by deep tube wells i.e. hand pumps.

Methods and Location of Sampling:

To assess the impact of mining on water quality, six water samples have been collected from different locations. This comprises of three surface water and three ground water samples. All the water samples have been collected in the month of March-May, 2022 and analysed as per standards method prescribed in APHA (1992).

Table No. C3-18: Details of Water Quality Monitoring Stations

SI No	Location	Remarks	Distance/Direction/Coordinates
Ground Water			
GW1	Well in Gangpur Village	Drinking water	1.68 km, S 23°48'18.63"N 87°12'56.74"E
GW2	Well water in Sagarbanga Village	Drinking water	NW direction, adjacent(nearby) to site 23°49'28.24"N 87°12'52.87"E
GW3	Tube well water of Bhadulia Village	Drinking water	1.81 km, SE 23°48'16.24"N 87°13'30.61"E
Surface Water			
SW4	Canal	Baseline data to evaluate the impact of mining	1.39 km in S 23°48'27.28"N 87°13'16.65"E

SW5	Hinglo Dam	Baseline data to evaluate the impact of mining	1.70 km in NW 23°49'33.90"N 87°12'13.07"E
SW6	Pond water of Gangpur village	Baseline data to evaluate the impact of mining	1.62 km, S 23°48'16.69"N 87°12'57.12"E

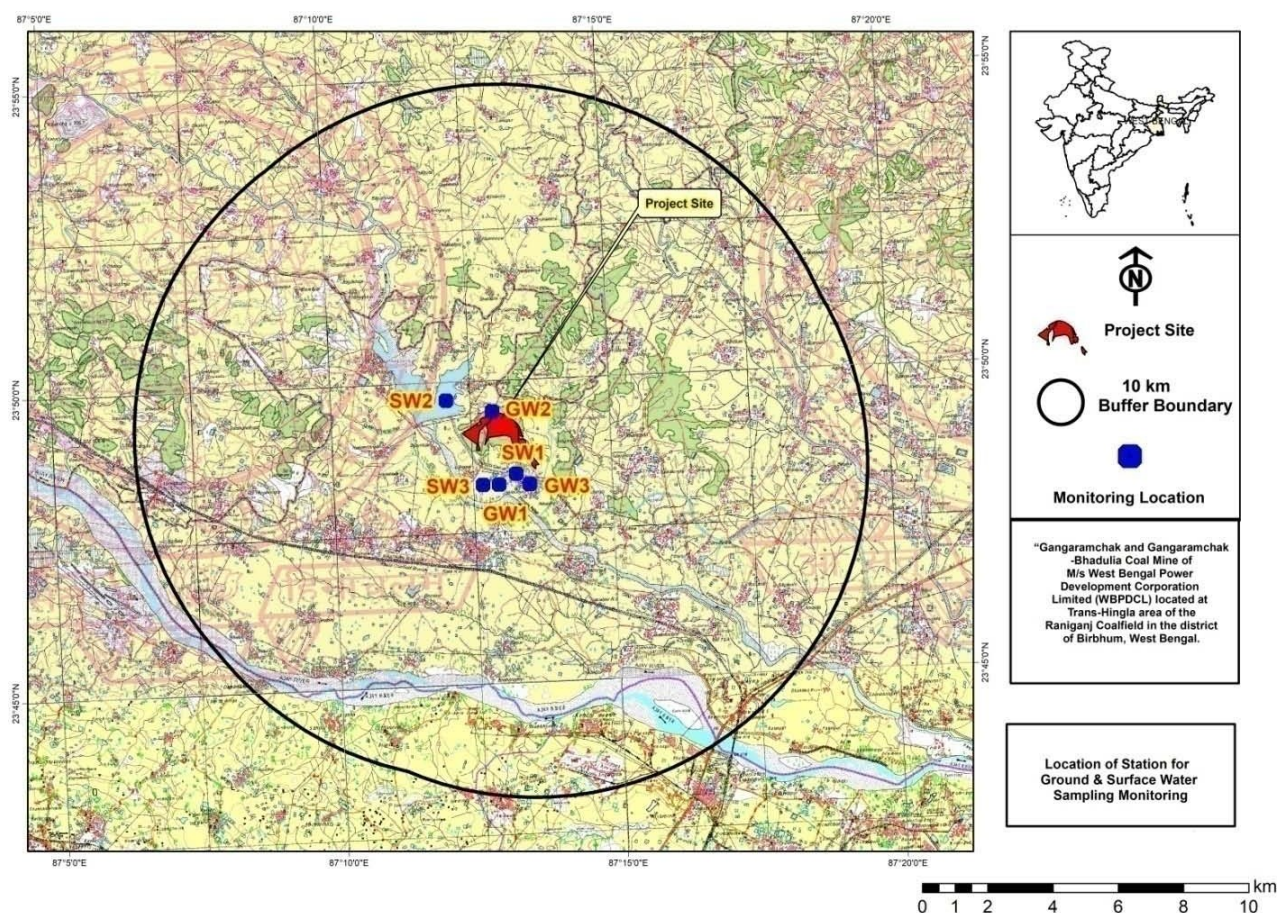


Fig. No. C3-10: Water Monitoring Locations

Results & Discussion:

The results of water quality monitoring occurred in March-May, 2022 is summarized in below table:

TABLE NO. C3-19: ANALYSIS RESULTS OF SURFACE WATER QUALITY OF THE STUDY AREA

TEST RESULTS						
S. No	Parameter	Test Method	Units	Canal	Pond water of Gangpur village	Hinglo Dam
1.	pH (at 25°C)	IS:3025(Part-11)	---	7.36	7.24	7.80
2.	Sulphate (SO ₄)	IS:3025(Part-24)	mg/l	12.0	8.5	16.2
3.	Nitrate (NO ₃)	IS:3025(Part-34)	mg/l	23.0	16.0	25.4
4.	Total Hardness (as CaCO ₃)	IS:3025(Part-21)	mg/l	148.0	110.0	172.0
5.	Chloride (as Cl)	IS:3025(Part-32)	mg/l	32.0	26.0	48.0
6.	Fluoride (as F)	APHA 4500F	mg/l	0.16	0.14	0.25
7.	COD (as O ₂)	APHA-5220 B	mg/l	24.0	18.0	46.0
8.	Iron (as Fe)	IS:3025(Part-53)	mg/l	0.186	0.154	0.224
9.	Dissolve Oxygen	IS-3025(Part-38)	mg/l	6.80	7.20	6.40
10.	Total Dissolved Solid	IS:3025(Part-16)	mg/l	360	280	402
11.	BOD (3 days at 27°C)	IS:3025 (P-44)	mg/l	4.12	2.10	7.20
12.	Calcium (as Ca)	IS:3025(Part-40)	mg/l	32.0	28.5	52.0
13.	Magnesium (as Mg)	IS:3025(Part-46)	mg/l	11.5	9.80	18.2
14.	Total Arsenic (as As)	IS:3025(Part-37)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
15.	Lead (as Pb)	IS:3025(Part-47)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)

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Gangaramchak and Gangaramchak -Bhadulia Coal Mine*

16.	Copper (as Cu)	IS:3025(Part-42)	mg/l	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)
17.	Zinc (as Zn)	IS:3025(Part-49)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
18.	Manganese (as Mn)	IS:3025(Part-59)	mg/l	BDL (<0.10)	BDL (<0.10)	BDL (<0.10)
19.	Total Chromium (as Cr)	IS:3025(Part-52)	mg/l	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)
20.	Cyanide (CN)	IS-3025(P-27)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
21.	Phenolic Compound as (C ₆ H ₅ OH)	IS: 3025 (P- 43)	mg/l	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)
22.	Boron (B)	IS: 3025 (P- 57)	mg/l	BDL (<0.10)	BDL (<0.10)	BDL (<0.10)
23.	Cadmium (Cd)	IS-3025(P-41)	mg/l	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)
24.	Mercury (Hg)	IS-3025(P-48)	mg/l	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)
25.	Nickel (Ni)	IS-3025(P-54)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
26.	Total Suspended Solid	IS:3025(Part-17)	mg/l	12.0	8.40	26.0
27.	Total Solid	IS:3025(Part-17)	mg/l	372.0	288.4	428.0
28.	Oil & Grease	IS: 3025 (P-39)	mg/l	BDL (<0.10)	BDL (<0.10)	BDL (<0.10)
29.	Faecal Coliform	IS-1622	MPN/10 0 ml	1.1×10 ³	1.4×10 ³	0.88×10 ³
30.	Total Coliform	IS-1622	MPN/10 0 ml	1.5×10 ³	2.6×10 ³	1.2×10 ³

TABLE NO. C3-20: ANALYSIS RESULTS OF GROUND WATER QUALITY OF THE STUDY AREA(AS PER IS: 10500, 2012)

TEST RESULTS								
S.No.	Parameter	Test method	Result			Unit	Acceptabl e Limit	Permissible Limit
			GW1 Well in Gangpur Village	GW2 Well water in Sagarban ga Village	GW3 (Tube well water) Bhadulia Village			
	Organoleptic & Physical Parameters							
1.	Colour	IS-3025(P-04)	<1.00	<1.00	<1.00	Hazen	5	15
2.	Odour	IS-3025(P-05)	Agreeable	Agreeable	Agreeable	-	Agreeable	Agreeable
3.	Taste	IS-3025(P-07 & 08)	Agreeable	Agreeable	Agreeable	-	Agreeable	-
4.	Turbidity	IS-3025(P-10)	<1.00	<1.00	<1.00	NTU	1	5
5.	pH value	IS-3025(P-04)	7.85	7.65	7.88	-	6.5-8.5	-
6.	Total Dissolve Solid (TDS)	IS-3025(P-16)	650	528	642	mg/l	500	2000
	General Properties							
7.	Aluminum (as Al)	IS:3025 (P- 55)	<0.01	<0.01	<0.01	mg/l	0.03	0.2
8.	Total Ammonia	IS:3025 (P- 34)	<0.10	<0.10	<0.10	mg/l	0.5	No Relaxation
9.	Anionic surface Detergents(as MBAS)	Annex K of IS- 13428	<0.10	<0.10	<0.10	mg/l	0.2	1.0

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10.	Barium (as Ba)	IS: 15302	<0.10	<0.10	<0.10	mg/l	0.7	No Relaxation
11.	Boron (as B)	IS:3025 (P- 57)	<0.01	<0.10	<0.10	mg/l	0.5	1.0
12.	Calcium(as Ca)	IS:3025 (P- 40)	49.2	48.0	45.3	mg/l	75	200
13.	Chloramines (as Cl ₂)	IS:3025 (P- 26)	<1.00	<1.00	<1.00	mg/l	4.0	No Relaxation
14.	Chloride (as Cl)	IS:3025 (P- 32)	85.6	74.2	94.5	mg/l	250	1000
15.	Copper (as Cu)	IS :3025 (P-42)	<0.05	<0.05	<0.05	mg/l	0.05	1.5
16.	Fluoride(as F)	IS: 3025 (P-60)	0.42	0.35	0.55	mg/l	1.0	1.5
17.	Free Residual Chlorine	IS: 3025 (P-26)	<0.1	<0.1	<0.1	mg/l	0.2	1.0
18.	Iron (as Fe)	IS: 3025(P-53)	0.132	0.146	0.138	mg/l	0.3	No Relaxation
19.	Magnesium (as mg)	IS: 3025 (P-46)	21.80	32.50	32.60	mg/l	30	100
20.	Manganese (as Mn)	Clause 35 of IS 3025	<0.10	<0.10	<0.10	mg/l	0.1	0.3
21.	Mineral Oil	Clause 6 of IS 3025	<0.50	<0.50	<0.50	mg/l	0.5	No Relaxation
22.	Nitrate (as NO ₃)	IS: 3025 (P- 34)	6.20	5.80	6.12	mg/l	45	No Relaxation
23.	Selenium (as Se)	IS:3025 (P- 56)	<0.01	<0.01	<0.01	mg/l	0.01	No Relaxation
24.	Silver (as Ag)	AnnexIS: 13428	<0.05	<0.05	<0.05	mg/l	0.1	No Relaxation
25.	Sulphate (as SO ₄)	IS:3025 (P- 24)	72.6	68.2	75.3	mg/l	200	400
26.	Sulphide(as H ₂ S)	IS-3025 (P-29)	<0.05	<0.05	<0.05	mg/l	0.05	No Relaxation
27.	Alkalinity(as Ca CO ₃)	IS:3025 (P- 23)	252	288	210	mg/l	200	600
28.	Total Hardness (as	IS:3025 (P- 23)	218	260	205	mg/l	200	600

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	CaCO ₃)							
29.	Zinc (as Zn)	IS:3025 (P- 49)	0.142	0.135	0.152	mg/l	5	15
	Parameters Concerning Toxic Substances							
30.	Cadmium (as Cd)	IS-3025(P-41)	<0.001	<0.001	<0.001	mg/l	0.003	No Relaxation
31.	Cyanide (as CN)	IS-3025(P-27)	<0.01	<0.01	<0.01	mg/l	0.05	No Relaxation
32.	Lead (as Pb)	IS-3025(P-47)	<0.01	<0.01	<0.01	mg/l	0.01	No Relaxation
33.	Mercury (as Hg)	IS-3025(P-48)	<0.001	<0.001	<0.001	mg/l	0.001	No Relaxation
34.	Molybdenum (Mo)	IS-3025(P-2)	<0.05	<0.05	<0.05	mg/l	0.07	No Relaxation
35.	Nickel (as Ni)	Annex L of IS-13428	<0.01	<0.01	<0.01	mg/l	0.02	No Relaxation
36.	Total Arsenic (as As)	IS-3025(P-37)	<0.01	<0.01	<0.01	mg/l	0.01	No Relaxation
37.	Total Chromium (as Cr)	Annex J of IS-13428	<0.05	<0.05	<0.05	mg/l	0.05	No Relaxation
38.	Poly nuclear Aromatic Hydro Carbons	APHA 6440	<0.0001	<0.0001	<0.0001	mg/l	0.0001	No Relaxation
39.	Poly chlorinated biphenyl	APHA 6630	<0.0001	<0.0001	<0.0001	mg/l	0.0005	No Relaxation
	MICROBIOLOGICAL PARAMETERS							
40.	<i>Escherichia coli</i>	IS-15185	Absent	Absent	Absent	/100ml	Absent	
41.	<i>Coliform Bacteria</i>	IS-15185	Absent	Absent	Absent	/100ml	Absent	

Interpretation

- The pH limit fixed for drinking water samples as per IS-10500 Standards is 6.5 to 8.5 beyond this range the water will affect the mucus membrane or water supply system. During the study period, the pH was varying for ground waters from 7.65 to 7.88 & in Surface water from 7.24 to 7.80. The pH values for all the samples collected in the study area during study period were found to be within the limits.
- The desirable limit for total dissolved solids as per IS-10500 Standards is 500 mg/l whereas the permissible limit in absence of alternate source is 2000mg/l. In ground water samples collected from the study area, the total dissolved solids are varying from 528 mg/l to 650 mg/l.
- Hardness of ground water varies from 218 mg/l to 260 mg/l. The desirable limit for Hardness is 200 mg/l whereas the permissible limit is 600mg/l.
- Concentration of Fluorides varied from 0.35 mg/l to 0.55 mg/l.

Ground Water Resources:

Annual ground water resource of the area is given in below:

a) Range of water table (m bgl)	
Pro-Monsoon (April-May)	
Core Zone	17.75 m
Buffer Zone	4.10 m
Post-Monsoon (Nov-Dec)	
Core Zone	15.50 m
Buffer Zone	2.90 m
b)Total annual replenishable recharge (million m³/year)	
By ground water table fluctuation method (million m ³ /year)	12.84
By rainfall infiltration factor method (million m ³ /year)	9.76
Average TARR (million m ³ /year)	11.3
c)Annual draft excluding estimated draft through mine discharge (million m³/year)	1.12
d)Estimated draft through mine discharge (million m³/year)	1.017
e) Net annual ground water availability (million m³/year)	9.163
f) Stage of ground water development in %	18.9

3.12 SOIL QUALITY:

Introduction

Soil is one of the most important natural resources of an area and knowledge about its physicochemical characteristics is essential to determine the soil quality/soil health. The soil health and quality has consistently evolved with an increase in the understanding of soil quality attributes. In this context the present study of the soil profile establishes the baseline characteristics and this will help in future in identifying the incremental changes if any, due to the operation of the proposed project.

To assess the mining impact on soil in and around Gangaramchak Block, the effect on agricultural field, baseline soil quality of the area has been evaluated with respect to physical and chemical parameters. The physical properties of soil, which is important for plant growth and agricultural productivity. The soils would be classified as red, brownish sandy and black cotton soils, black cotton soil supports agriculture, which is the main source of livelihood of the people in the area.

Methodology

Soil sampling has been carried out in the month of March-May, 2022. The standard IS procedure as mentioned below has been followed for sampling and all the sampling have been taken from the depth of 0-30 cm. and 30-60 cm. from all the sites.

Table No. C3-21: Details of Soil Sampling Locations

Stn. Code	Location	Source of Air Pollution	Distance/Direction & Coordinates
Core zone			
SQ1	Project Site 1	Domestic, Background pollutants due to agricultural and other domestic works.	23°49'12.76"N 87°13'3.31"E
Buffer zone			
SQ2	Kese	Domestic, Background pollutants due to agricultural and other domestic works.	2.82 km in NW 23°50'31.99"N 87°12'13.94"E
SQ3	Khayrasole	Domestic, Background pollutants due to agricultural and other domestic works.	5.77 km in SE 23°47'16.25"N 87°15'51.28"E
SQ4	Denganja	Domestic, Background pollutants due to agricultural and other domestic works.	2.14 km in SE 23°48'51.29"N

			87°14'22.19"E
SQ5	Lokepur	Domestic, Background pollutants due to agricultural and other domestic works.	8.54 km in NE 23°51'56.31"N 87°17'7.54"E

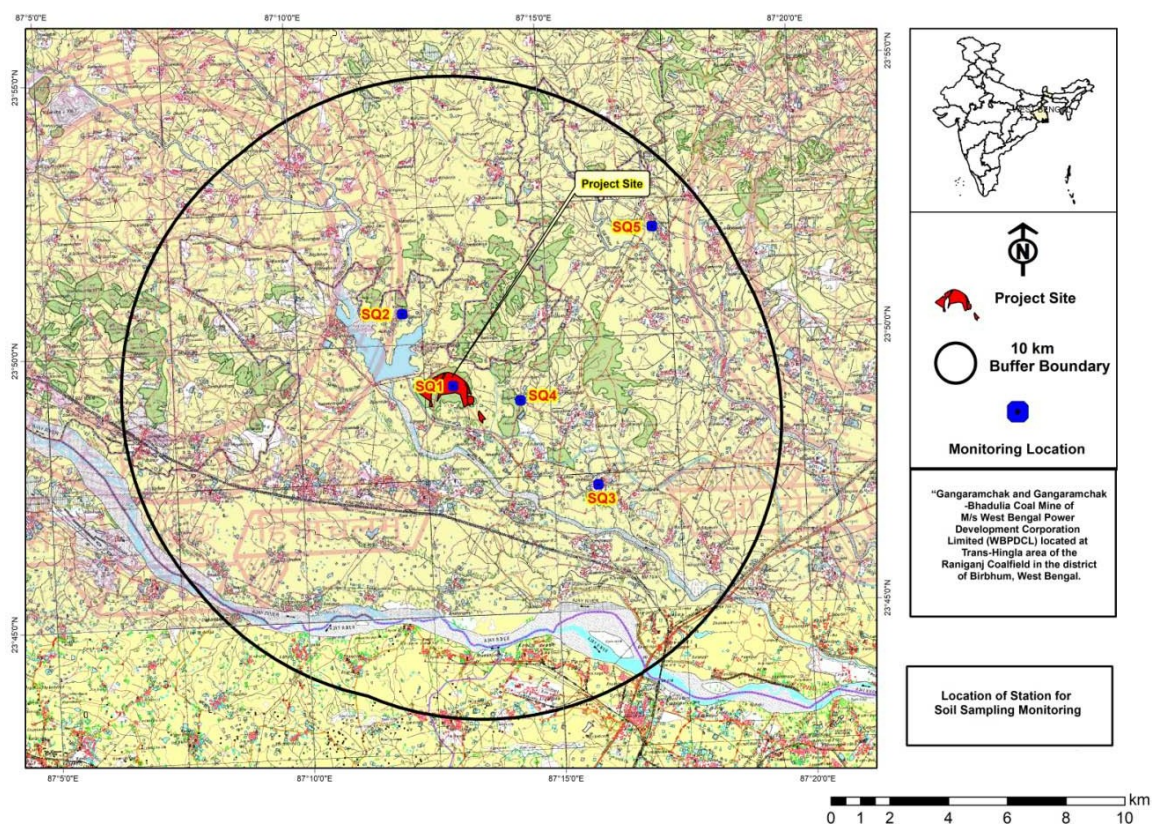


Figure No. C3-11: Soil Monitoring Locations

Monitoring Results

Monitoring results of soil samples are given below:

TABLE NO. C3-22: SOIL ANALYSIS RESULTS

		Location	Project Site 1	Kese	Khayrasole	Denganja	Lokepur
Sr. No.	Parameters	Units	Results	Results	Results	Results	Results
1	pH	-	8.05	7.60	7.55	7.40	7.32
2	Conductivity	µmhos/cm	536.0	480.0	416.0	312.00	451.0
3	Sodium (as Na)	mg/kg	128.30	56.15	76.20	55.10	64.21
4	Water holding capacity	%	32.50	29.05	28.94	34.50	34.93
5	Potassium (as K)	mg/kg	84.60	249.23	250.16	237.40	253.26
6	Sand	%	66.00	56.00	64.00	62.00	65.00
7	Clay	%	15.00	26.00	22.0	18.00	17.00
8	Silt	%	19.00	18.00	14.0	20.00	18.00
9	Calcium (as Ca)	mg/kg	454.00	441.00	445.00	156.00	514.98
10	Magnesium (as Mg)	mg/kg	168.10	173.09	153.56	68.50	158.26
11	SAR	-	0.95	1.49	1.55	0.98	0.69
12	CEC	meq/100gm	2.12	2.12	2.34	2.20	2.72
13	Phosphorus (as P)	mg/kg	10.80	12.50	12.76	12.40	11.81
14	Organic carbon	%	0.43	0.41	0.35	0.46	0.54

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15	Porosity	%	38.00	36.89	45.6	40.10	41.26
16	Permeability	cm/hr	1.82	1.60	1.88	1.84	1.67
17	Bulk Density	kg/cm3	1.41	1.44	1.38	1.18	1.43
18	Total Kjeldahl Nitrogen (TKN)	%	0.025	0.023	0.030	0.034	0.027

Data Analysis:

- **pH:** pH of soil mainly depends on the soil water ratio. The value of PH in study area is ranging between 7.32 to 8.05. The pH of soil samples in the study area indicated that in agriculture land, the soil pH was slightly alkaline.
- **Electrical Conductivity:** Electrical conductivity, as the measure of current carrying capacity, gives a clear picture of the amount of soluble salts present in the soil. It plays a major role in the salinity of soils. There is a relation between electrical conductivity and salinity, i.e. lesser the EC value low will be the salinity value of soil and vice-versa. Electrical conductivity values within 800 $\mu\text{mho/cm}$ are considered as normal nature of soil. EC values between 800 and 1600 $\mu\text{mho/cm}$ are considered critical for tolerant crops, while EC values ranging between 1600 and 2500 $\mu\text{mho/cm}$ are considered critical for salt tolerant crops, and EC values more than 2500 $\mu\text{mho/cm}$ are not considered safe for most of the crops. In the present study no samples have crossed EC values 800 $\mu\text{mho/cm}$, and thus almost all the soil samples are found to be suitable for agriculture. The value of Electrical conductivity in study area is ranging between 312.00 to 536 $\mu\text{mhos/cm}$.
- **Organic Carbon:** The organic substances are a major determinant of soil structure, moisture content, pH and the soil nutrient status of the topsoil. This differentiates among the fertile and non-fertile soils. The organic carbon content of the soil in terms of percentage collected from different sampling locations indicating variable organic matter content and decomposition rates. The requirement of optimum level of organic matter required by the plants slightly varies between species, as it is not a single nutrient source required for all the plants and for all the soils. The variation is also dependent on soil type, climate and existing plant species. The value of Electrical conductivity in study area is ranging between 0.35 to 0.54%
- **Phosphorus:** Phosphorus is the second most important macronutrient available in the soil of the biological systems. It is a major component of nucleic acids, phospholipids & many phosphorylated compounds. Similarly, it is also a second most limiting factor often affecting plant growth. Chemically, phosphorus exists in the soil in the form of both organic and inorganic forms. Generally plants are dependent on inorganic phosphorus especially in the form of phosphate ions, whereas organic phosphates are also important sources of phosphorus in almost all types of soils. The value of Phosphorus in study area is ranging between 10.80 mg/kg to 12.76 mg/kg.
- **Potassium:** This element is important in grain formation and is absolutely necessary for tuber development. All crops generally respond to application of potassium. Potassium increases crop resistance to certain diseases. It helps to prevent the undesirable growth of plants that is sometimes caused by excessive nitrogen. In general way, potassium exerts a balancing effect on the effects of both nitrogen and phosphorous; consequently, it is important as a multi-nutrient fertilizer. Soils with high clay content have a greater amount of mineral potassium than sandy soil. The value of Potassium in study area is ranging

between 84.60 to 253.26 mg/kg.

➤ **Nitrogen:** Nitrogen is having a major role in maintaining the fertility status of the soil. Nitrogen content in almost all the soils is observed to be very low. Plants are more dependent upon nitrate nitrogen during aerobic conditions and ammonical nitrogen during anaerobic conditions. Nitrogen content is favourable for the luxuriant growth of nitrogen fixing bacteria and blue-green algae in soil which are ultimately responsible for increased nitrogen content. The value of Nitrogen in study area is ranging between 0.023 to 0.034 %.

3.13 ECOLOGICAL ENVIRONMENT:

The ecological study reflects the potential of a regional ecosystem and its biological components. In India, the biological diversity of plants and animals varies from region to region on account of their diversity and density. Producers (plants), consumers (animals), and decomposers (microbes) govern the whole cycle of ecology. Plant and animals both are interdependent on each other.

The biological study is essential to understand the impact of any mining project on the existing flora and fauna of the study area. Studies on various aspects of the ecosystem play an important role in identifying sensitive issues for undertaking appropriate action to mitigate the impact, if required.

The environment baseline data generation report in respect to the flora-fauna has been prepared to assess the current ecology & biodiversity scenario of the study area and then based on the proposed project activities, to carry out Environmental Management Plan. The plan will identify and address the impacts, where these are adverse in nature, and thereafter Design mitigation measures to manage such impacts in a manner as to conserve the environment and ecology of the area. Conservation of biodiversity is essential for sustainable development. The main objective of the ecological survey is aimed to find out the baseline status of flora and fauna (terrestrial and aquatic ecosystem) before expansion of area to enhance the production and the start of Coal Mining activities at Gangaramchak-Bhadulia Coal Quarry of Bankura district, West Bengal.

Description of Study Area:

The present Gangaramchak-Bhadulia Coal quarry (186.42 ha) is existing mine, however, for the enhancement of the production (from 1.50 MTPA to 3.00 MTPA), expansion of lease is required. The present coal mine is Gangaramchak, Gangaramchak-Bhadulia, and Bastabpur villages of Birbhum district of West Bengal (Fig. C3-12).

The proposed Coal quarry of Birbhum district falls under seismic zone III which is categorized as a moderate damage risk zone (As per 1893:2002). The district is mainly covered by riverine alluvial soil and the remaining part of the district is covered by sandy red soil. The geographical coordinates of the Gangaramchak-Bhadulia Coal mine is 23°49'12.18"N and 87°13'8.22"E. The location of the Gangaramchak-Bhadulia Coal mine is shown in (Fig. C3-12).

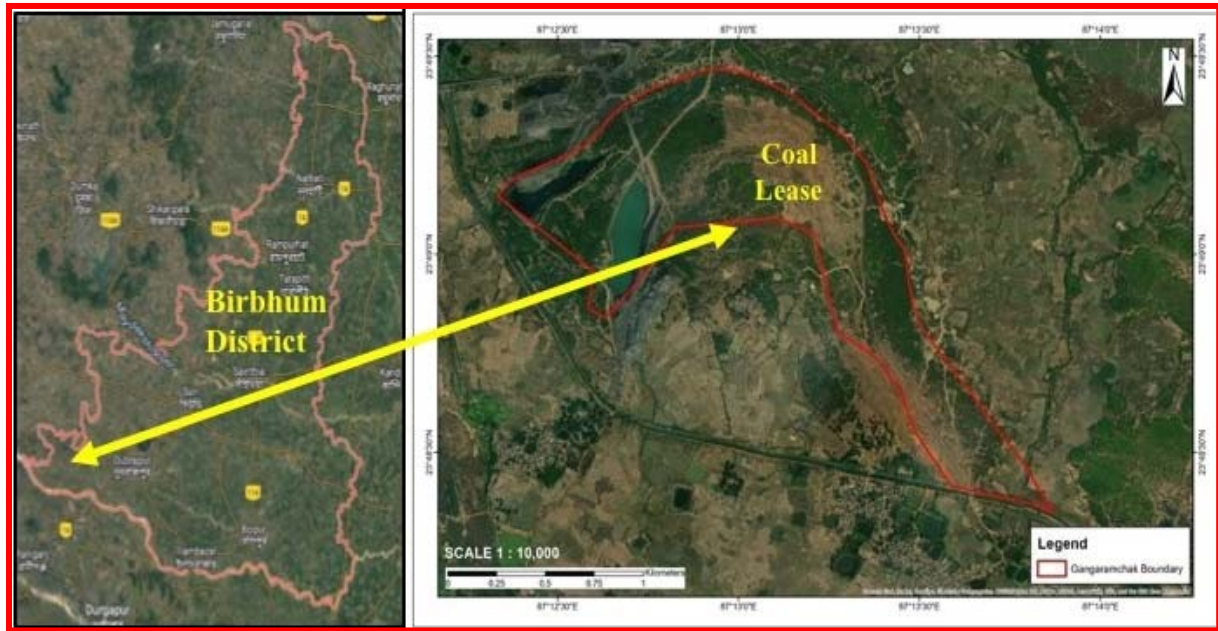


Fig. No. C3-12: Location of Gangaramchak-Bhadulia Coal mine in the Birbhum district

Forest and Vegetation:

There is no human settlement within the core zone (Fig. C3-12). The core zone of the project area is the Sal forest which also has some mixed natural vegetation. The maximum area required for the expansion of the project is covered by Sal forest. However, stage-II forestry Clearances for the diversion of 101.77 ha of forest have been obtained from the Department of Forest, West Bengal as per Forest Conservation Act under section 2, 1980. Major and dominant species in the forest is Sal (*Shorea robusta*), Asan (*Terminalia tomentosa*), Siris (*Albizia lebbeck*), Palas (*Butea monosperma*), Bamboo (*Dendrocalamus strictus*), Nilgiri (*Eucalyptus tereticornis*), Mahua (*Madhuca indica*), Karanj (*Pongamia pinnata*), Jamun (*Syzgygium cumini*), and Sagwan (*Tectona grandis*). The maximum tree cutting has been done by the forest department and the remaining is also being done by them. Compensatory afforestation shall be raised over 106.795 ha of identified non-forest land, and saplings of native species will be planted @1000/ha. On the other hand, the plantation will also be done along the road and approach road. For the roadside plantation, plant species will be selected based on the fruit-bearing and the species having dust arresting potential.

Eco-restoration / Planation on OB dumps:

During the field survey, it was observed that the Project proponent developed an eco- restoration site in the buffer zone. They have planted a huge number of tree saplings over an area of approx. 16 hectares (OB). They are also developing a Fruit Forest on their OB dumps and have planted several fruit-bearing trees such as Mango, Aamla, Amrud etc.



Fig. No. C3-13: Field Survey for Ecological data collection

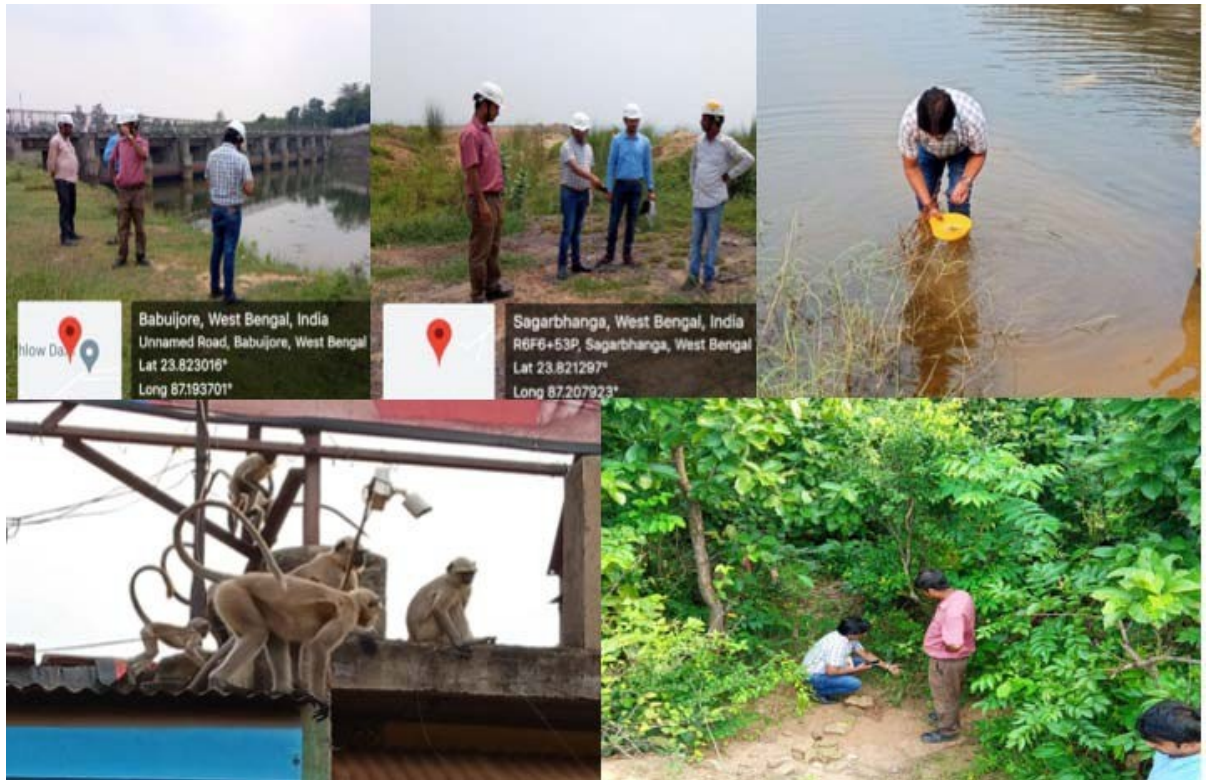


Fig. No. C3-14: Field Survey for Ecological data collection



Fig. No. C3-15: Plantation on OB dump and Fruit Forest Development on OB dump by the proponent

**Description of Eco-sensitive zones in the Study Area (Wildlife Sanctuary/
National Parks/ Animal or Elephant Corridors/ Protected Wetlands etc.):**

There are no National parks, Wildlife Sanctuary, Biosphere Reserves, Wildlife corridors, Tiger/Elephant reserves (existing as well as proposed) within 10 km area from the present coal mining project. Whereas, some reserved forests are present in different part of the study area. The Proposed expansion area was also a part of Sal forest; however, stage-II forestry clearance has been obtained from the State Forest Department for the mining the coal and the landuse details of the study area are given in Fig. C3-16 and Table C3-23.

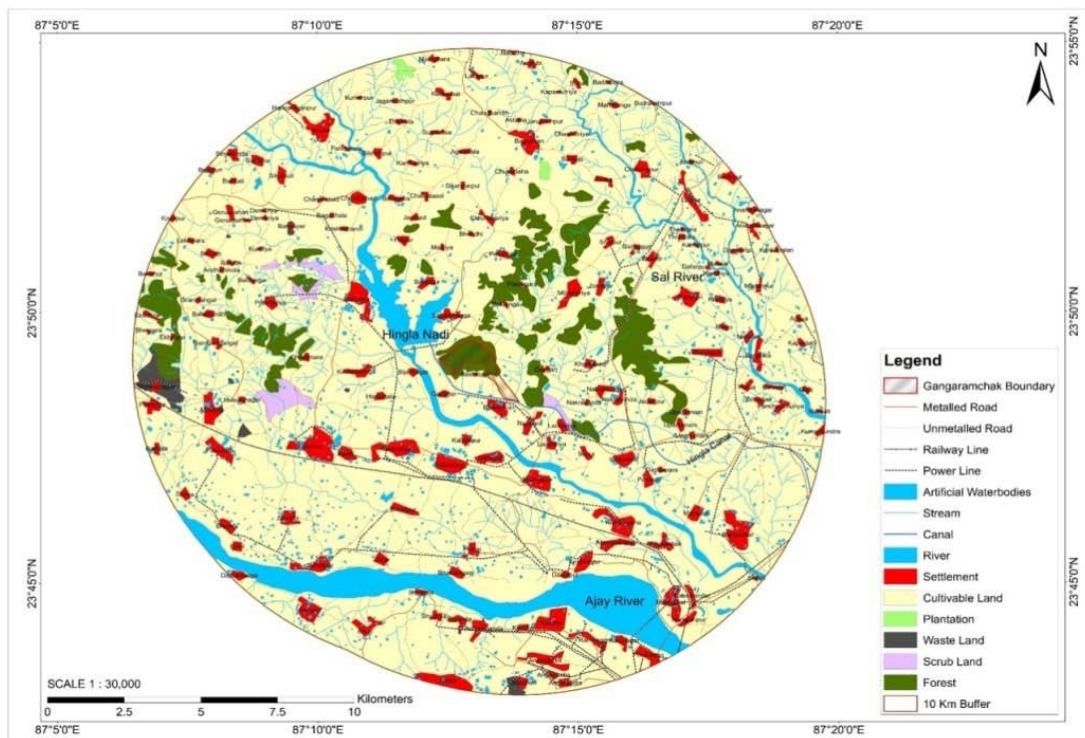


Fig. No. C3-16: Landuse Map of the Study Area (10 KM)

TABLE NO. C3-23: DETAILS OF LAND USE AND LAND COVER OF 10 KM BUFFER AREA OF THE PRESENT PROJECT

S. No	Land Use & Land Cover	10 KM Buffer (Area Ha)
1	Artificial Waterbody	868.84
2	Canal	23
3	Cultivable Land	29106.24
4	Dump	17.43
5	Forest	2114.37
6	Metalled Road	177.08
7	Plantation	49.84
8	Railway Line	61.47
9	River	2369.09
10	Scrub Land	262.76
11	Settlement	2418.33
12	Stream	620.98
13	Unmetalled Road	322.09
14	Wasteland	179.88
15	Old Quarry	4.04
16	Old Working Area ECL	2.2
	Total Area	38597.64

Drainage /Water Bodies of the Study Area

The proposed coal quarry as a whole is located in the Ajay River. The buffer zone of the study area drains into the Ajay River through the Hinglo River, Sal River, and several seasonal streams. Ajay River and Hinglo River are perennial systems that flow throughout the year with huge water fluctuation. Between the months of January to June maximum reduction in water level and flow has been documented. Most of the riverine channels present in the study area are seasonal (monsoon-fed) or ephemeral in nature. A large number of ponds are present in the study area which is mainly used for fish farming and storage of water for Cattle feeding and gardening purpose by the villagers, etc. the drainage map of the study area is given in Fig C3-17.

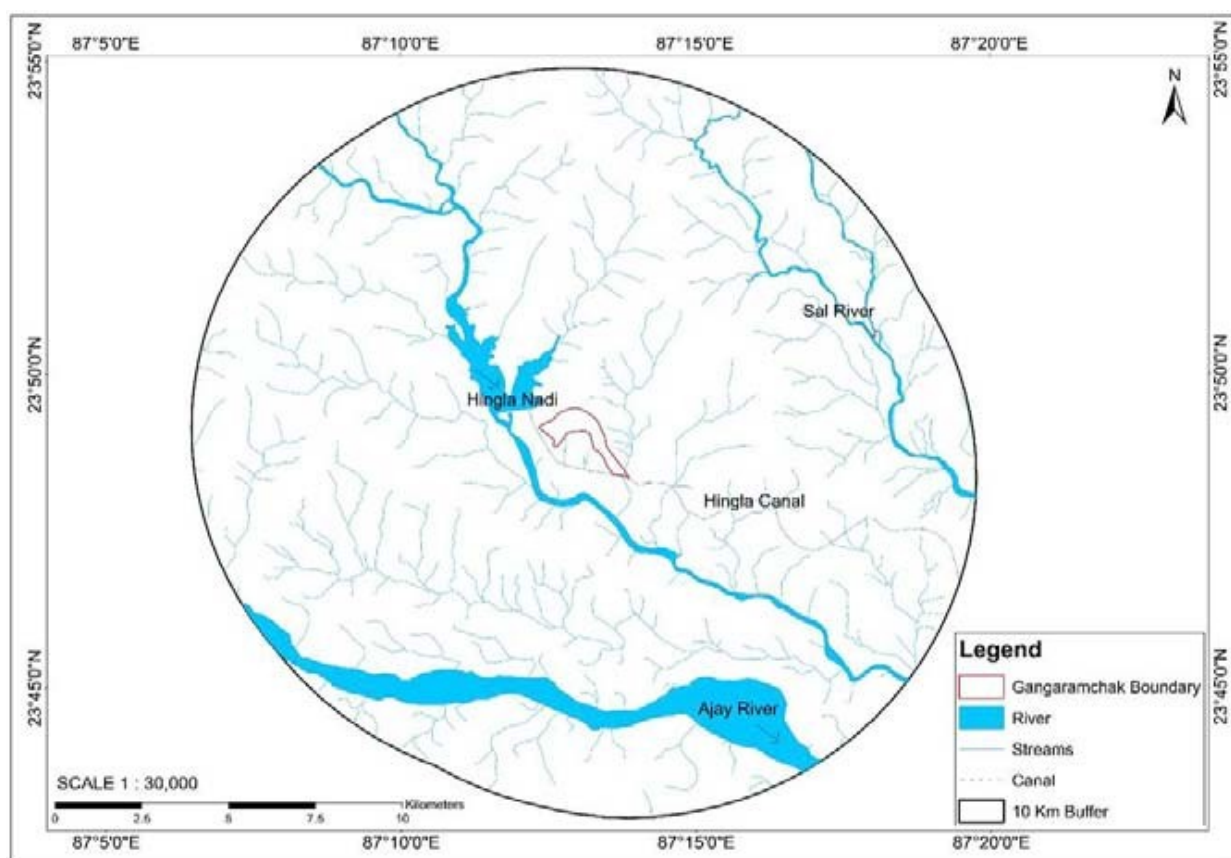


Fig. No. C3-17: Drainage Map of the Study Area (10 KM)

Scope and Objectives of the Study

The above study aims in identifying potential impacts on flora and fauna and to suggest relevant compensatory and mitigatory measures to protect/conservate biodiversity in the likely impacted area due to the project activity. Following points to be covered under the scope of work:

- Survey of terrestrial & aquatic flora & fauna for core & buffer zone separately.
- Details of endemic species found in the study area and their IUCN status,

Schedule status (as per WPA, 1972).

- Survey of the study area in terms of features like breeding & spawning grounds, habitats, flight paths, and the migratory path of the animals.
- Survey of flora covering types e.g. agriculture crop, commercial crop, plantation, natural vegetation/forest type, grass land. The endangered & endemic species of flora & fauna beside any other flora, if present are also to be identified.
- The survey has been covering a total listing of the faunal population. The survey has also covered endangered, endemic, migratory & detail of aquatic fauna.
- The assessment of potential damage to terrestrial & aquatic flora and fauna. The impact should be categorized as primary & secondary, temporary and long term, unavoidable & risk trans boundary impacts, possible irreversible change.

Methodology / Data Collection

A primary field survey was carried out within a 10 km radius from the lease area boundary of Gangaramchak-Bhadulia Coal mine. Survey was conducted during the summer period (March to May, 2022). Both terrestrial and aquatic ecosystems have been studied to understand the biological environment. Whereas, some secondary data were collected from authentic sources like the Forests Department, Fisheries Department, Agriculture Department of Birbhum District (WB), and available published literature.

Flora (Aquatic and Terrestrial)

For the collection of data for aquatic flora, the methodology prescribed in the standard book of Adoni (1985), NEERI (1998), and APHA (2015) has been adopted. A total of 06 sampling sites (AS-1 to AS-6) were selected for the collection of samples to analyze the aquatic flora (Table 2).

On the other hand, for the **terrestrial data**, community analysis was carried out during the summer season. For the collection of terrestrial data, a total of 07 sampling points (TS-1 to TS-7) were selected in the core and buffer area (Table C-24). At every sampling site, quadrates of 10m X 10m (100 sq.m.) size were randomly laid to study tree species. The circumference of all the adult individuals [≥ 30 cm circumference at breast height (CBH)] was measured with Freeman's tape. The study of communities was carried out by using qualitative characteristics, and quantitative characteristics. Qualitative characteristic mainly involved presence/absence of the species, genera and family. This showed the community structures, composition and other characteristic can be readily described by visual observation without actual measurements. The quantitative analysis involved the structure and composition of vegetation across vegetation types and compared in terms of frequency, density, abundance, and basal area of tree species.

Fauna (Aquatic and Terrestrial)

For the collection of data for **aquatic fauna**, the methodology prescribed in the standard book of Adoni (1985), NEERI (1998), and APHA (2015) has been adopted. A total of 06 sampling points (AS-1 to AS-7) were selected for the collection of samples to identify the the aquatic fauna (Table C3-24).

On the other hand, for the terrestrial fauna, the assessment of fauna was done by an extensive field survey in the core and buffer area at 7 different sites (TS-1 to TS-7) (Table C3-24). During the survey, the Line Transect method was used for the study of mammals and Transact & Patch sampling was used for Amphibians, visual encountered methods were used for reptiles and butterflies. The presence of wildlife was also confirmed from the animal calls, footmarks, excreta, and from the local inhabitants depending on the animal sightings and the frequency of their visits to the project area which was later confirmed from the different government offices like the forest department or wildlife department, etc. Observations pertaining to theavian fauna wascollected during a walk-through in the chosen transect for sighting birds. The diversity of birds was observed in each sampling location. Birds were noted and identified with the help of binocular and standard field identification guides.

Sampling Sites

A total of 7 sampling sites (TS-1 to TS-7) were selected for the terrestrial vegetation, avian fauna, and other terrestrial animals like insects, reptiles, mammals, etc. However, for the collection of samples and generation of data pertaining to the aquatic flora and fauna, 6 separate sampling sites (AS-6 to AS-6) were also selected at different locations in the study area (Table C3-24 and Fig. C3-18 & C3- 19).

TABLE NO. C3-24: LIST OF SAMPLING LOCATION SELECTED FOR STUDY OF BIOLOGICAL ENVIRONMENT

Sites for Terrestrial Sampling (TS) - Flora and Fauna				
S.No.	Location Name	Location Zone	Latitude	Longitude
1	Project Expansion Area	Core Zone	23°49'9.12"N	87°13'3.88"E
2	Bhadulia Village	Core Zone	23°48'35.37"N	87°13'37.76"E
3	Nakrakonda Forest	Buffer Zone	23°48'52.65"N	87°16'2.92"E
4	Palashbuni Village	Buffer Zone	23°51'6.83"N	87°13'59.32"E
5	Penchalia Village	Buffer Zone	23°49'53.05"N	87° 9'36.03"E
6	Kankartala Village	Buffer Zone	23°47'20.54"N	87°11'11.65"E
7	Laubere Village	Buffer Zone	23°47'12.18"N	87°14'15.15"E
Sites for Aquatic Sampling (AS) - Flora and Fauna				
S.No.	Location Name	Location Zone	Latitude	Longitude

1	Bastabpur Village	Core Zone (Seasonal Pond)	23°48'49.99"N	87°13'29.72"E
2	Bhadulia Village	Buffer Zone - Hinglo Canal	23°48'22.93"N	87°13'39.70"E
3	Hinglo Dam	Buffer Zone	23°49'26.53"N	87°11'53.51"E
4	Hinglo River	Buffer Zone- Hazratpur	23°47'8.40"N	87°14'6.76"E
5	Ajay River	Buffer Zone - Barajor	23°44'37.36"N	87°14'20.57"E
6	Rural Pond	Buffer Zone - Sahebpur	23°48'32.83"N	87°14'17.80"E

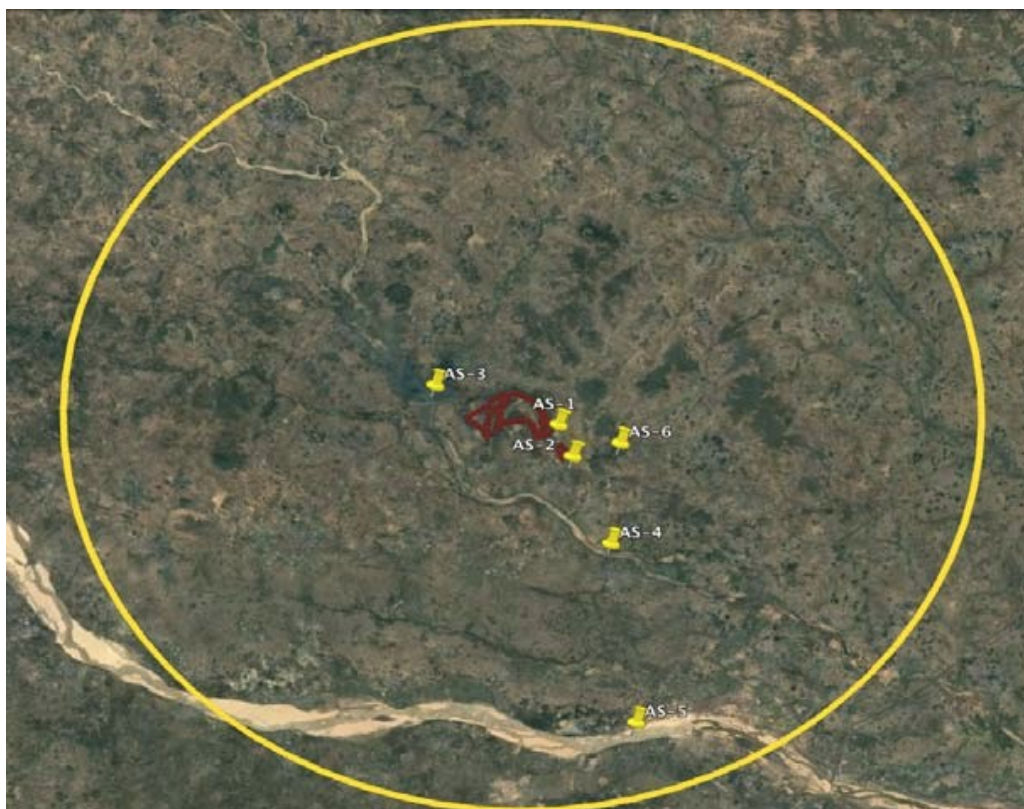


Fig No. C3-18: Location of Terrestrial Sampling (TS) sites for Flora-Fauna

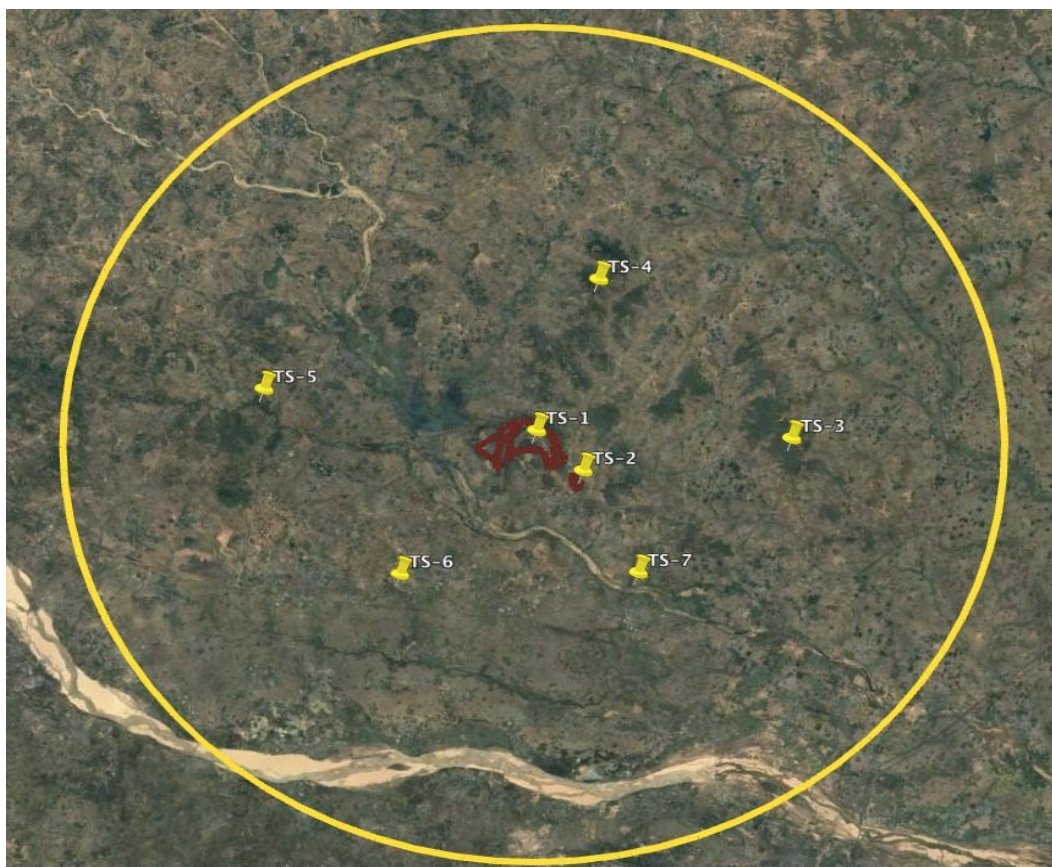


Fig. No. C3-19: Location of Aquatic Sampling (AS) sites of Flora-Fauna

Flora of the Study Area

West Bengal is enriched with forest and natural vegetation. Birbhum district has rich Sal forests in addition to mixed forests as well as pure bamboo crops. On the other hand, Birbhum district has a higher forest cover area in comparison to the other districts of West Bengal. However, within the district, the maximum forest is nearby the present coal mine area and is mainly Sal forests. The most dominant and common species in the study area, as well as a forest of the study area, is *Shorea robusta* (Sal), *Diospyros melanoxylon* (Kendu), *Terminalia tomentosa* (Asan), *Terminalia elliptica* (Sahaju), and *Tectona grandis* (Sagwan) etc.

A major part of the buffer zone of the project is agricultural land having a large number of major vegetation in the form of agroforestry. Vegetation patterns in villages and surrounding areas are slightly different from the forest. The common species grown near the villages are mostly edible, fruits bearing, or useful plants. Purposely planted tree patches (mostly fruit-bearing) are available nearby several villages in the study area. The most dominant tree species in the study area are *Aegle marmelos* (Bel), *Azadirachta indica* (Neem), *Buchanania latifolia* (Charu), *Embllica officinalis* (Amla), *Dalbergia sissoo* (Sisam), *Ficus bengalensis* (Bargad), *Musa paradisiacal* (Kela), *Syzygiumcumini* (Jamun),

Cassia siamea (Kasod/Siris), *Annona reticulate* (Sharifa) *Mangifera indica* (Aam) and *Tectona grandis* (Sagwan); and in case of shrubs *Antigonum leptopus*, *Ricinus communis*, *Lantana camara*, *Jatropha gossipifolia* and *Cassia auriculata* etc.

The evacuation route for the transportation of excavated coal materials from the mine lease is crossing some rural, agricultural areas and these areas have some shrubs, and medium & major trees. Most of the trees falling along the evacuation route are part of agroforestry. Also, the plantation will be done in the buffer zone by selecting the indigenous plant species (Species will be selected based on their fruits and natural propagation potential. Details of the forest area in the Birbhum district is given in Table C3-25.

Table No. C3-25: Details of Forest Area (sq.km) in Birbhum district, West Bengal

District	Geographical Area (Sq. km)	Very dense Forest	Mod. Dense forest	Open Forest	Total	% of GA	Change (2017)	Scrub
Birbhum	4,545	1.00	34.14	149.66	184.80	4.07	7.80	8.90

Source: India State of Forest Report-2019.

Flora of Core zone

Terrestrial

Flora of Core zone (Natural vegetation etc.).

Lease area is spread over the Sal forest land. So, there is large number of major vegetation present in the core zone (proposed for expansion). Some seasonal climbers, grasses and herbs are presenting the core zone. There is no any ecologically sensitive plant species (Rare, Endangered and Threatened) has been reported from the core zone. List of aquatic and terrestrial flora recorded from the core zone is given in **Table C3-26, C3-27 and C3-28.**

Agricultural Crops/ Commercial Crops of the Core zone

Lease area is covered with natural vegetation. Only few small agricultural plots situated in the south eastern corner of the lease area are part of the core zone. Local farmers grow some vegetables and other crops in the core zone are listed in the Table C3-28.

Aquatic Flora of Core zone (Phytoplankton/ Macrophytes).

The details of aquatic flora of the core zone were collected from sampling sites 1 (AS-1). During the present investigation *Polygonum glabrum* and *Cyperus* sp. *Ipomea* sp., *Cyperus* sp., *Hydrilla* sp., and *Nymphaeoides* sp. etc. were recorded among the aquatic vegetation due to presence of some seasonal ponds towards north eastern boundary of the lease. On the other hand, due to presence of these ponds, several phytoplankton species have been recorded. There is no any ecologically sensitive plant species have been collected from the core zone.

List of Phytoplankton and Macrophytic vegetation of the core zone are given in **Tables C3-29 to C3-31 and Figures C3-20 and C3-21.**

Flora of Buffer zone

Terrestrial Flora of Buffer zone (Natural vegetation / Commercial vegetation).

During the present survey, a total of 77 species of Trees; 19 species Shrubs/Palm; 11 species of Climbers/Creepers; and again 11 species of Grasses/Herbs have been documented from the different locations of the buffer zone. The most common fruit bearing trees observed in the study area planted by the locals in their respective premises were *Annona reticulata* (Ramphal), *Annona squamosa* (Seetaphal), *Mangifera indica* (Amba / Mango), *Phyllanthus emblica* (Amla), *Psidium guajava* (Guava), and *Syzigium cumini* (Jamun). All the details have been furnished based on the field survey at 7 different locations and data supported by the Department of Forest, Birbhum districts of West Bengal. The details of vegetation of the buffer zone is given in Tables C3-26 and C3-27

TABLE NO. C3-26: LIST OF TREES SPECIES OBSERVED IN THE STUDY AREA (10 KM) OF BIRBHUM DISTRICT INCLUDING FOREST AREAS OF BUFFER ZONE

S.No.	Botanical name	Local / common name	Family	Core	Buffer
1	<i>Acacia catechu</i>	Khair	Mimosaceae	-	+
2	<i>Acacia nilotica</i>	Babul / Babool	Mimosaceae	+	+
3	<i>Aegle marmelos</i>	Bel	Rutaceae	-	+
4	<i>Alangium salvifolium</i>	Ankula	Alangiaceae	-	+
5	<i>Albizia lebbek</i>	Siris / Kala siris	Mimosaceae	+	+
6	<i>Albizia procera</i>	Tentela(sirish-Dhala)	Mimosaceae	-	+
7	<i>Alstonia scholaris</i>	Chhatiana	Apocynaceae	-	+
8	<i>Anacardium occidentale</i>	Cashew tree	Anacardiaceae	+	
9	<i>Annona reticulata</i>	Ramphal	Annonaceae	-	+
10	<i>Annona squamosa</i>	Seetaphal	Annonaceae	+	+
11	<i>Anogeissus latifolia</i>	Dhau / Dhaka / Bakli	Combretaceae	-	+
12	<i>Artocarpus heterophyllus</i>	Panas	Moraceae	-	+
13	<i>Azadirachta indica</i>	Neem	Meliaceae	+	+
14	<i>Bauhinia purpurea</i>	Kanchan	Caesalpiniaceae	+	+
15	<i>Bauhinia racemosa</i>	Ambansia	Caesalpiniaceae	+	+
16	<i>Bombax ceiba</i>	Semul / Simili	Bombacaceae	-	+

17	<i>Bridelia retusa</i>	Kaji / Kaja	Euphorbiaceae	-	+
18	<i>Buchanania lanzan</i>	Char / Chironji	Anacardiaceae	+	+
19	<i>Butea monosperma</i>	Palash	Fabaceae	+	+
20	<i>Careya arborea</i>	Kumbhi	Myrtaceae	-	+
21	<i>Cassia fistula</i>	Amaltas	Caesalpiniaceae	+	+
22	<i>Cassia siamea</i>	Chakhunda	Caesalpiniaceae	+	+
23	<i>Cleistanthus collinus</i>	Karra	Euphorbiaceae	-	+
24	<i>Dalbergia paniculata</i>	Barabakulia	Caesalpiniaceae	-	+
25	<i>Dalbergia sissoo</i>	Sisoo	Caesalpiniaceae	+	+
26	<i>Delonix elata</i>	Radhachuda	Caesalpiniaceae	-	+
27	<i>Delonix regia</i>	Krisnachuda	Caesalpiniaceae	-	+
28	<i>Diospyros melanoxylon</i>	Tendu	Ebenaceae	+	+
29	<i>Erythrina indica</i>	Paldhua	Fabaceae	-	+
30	<i>Eucalyptus tereticornis</i>	Eucalyptus	Myrtaceae	+	+
31	<i>Ficus benghalensis</i>	Banyan / Bata / Bad	Moraceae	-	+
32	<i>Ficus microcrpa</i>	Kamrup	Moraceae	-	+
33	<i>Ficus racemosa</i>	Cluster Fig	Moraceae	+	+
34	<i>Ficus religiosa</i>	Peepal	Moraceae	-	+
35	<i>Gardenia latifolia</i>	Damkurudu	Rubiaceae	+	
36	<i>Gmelina arborea</i>	Gambhari	Verbenaceae	+	+
37	<i>Grewia hirsuta</i>	Kakarundah	Tiliaceae	-	+
38	<i>Haldinia cordifolia</i>	Haldu	Rubiaceae	-	+
39	<i>Lagerstroemia parviflora</i>	Sidha / Sudha	Lythraceae	-	+
40	<i>Leucaena leucocephala</i>	Subabul	Mimosaceae	-	+
41	<i>Madhuca longifolia</i>	Mahuva / Mahul	Sapotaceae	+	+
42	<i>Mangifera indica</i>	Amba / Mango	Anacardiaceae	-	+
43	<i>Manilkara zapota</i>	Chikoo	Sapotaceae	-	+
44	<i>Melia azadirachata</i>	Buckain	Meliaceae	-	+
45	<i>Moringa oleifera</i>	Sajana (muniga)	Moringaceae	+	+
46	<i>Moringa tinctoria</i>	Achhu	Moringaceae	+	+
47	<i>Morus alba</i>	Mulberry	Moraceae	-	+
48	<i>Neolamarckia cadamba</i>	Kadamb	Rubiaceae	-	+

49	<i>Nyctanthes arbor-tristis</i>	Gangasiuli	Oleaceae	-	+
50	<i>Oroxylum indicum</i>	Indian Trumpet	Bignoniaceae	-	+
51	<i>Phyllanthus emblica</i>	Amla	Euphorbiaceae	+	+
52	<i>Pithecellobium dulce</i>	Jungle jalebi	Mimosaceae	+	+
53	<i>Polyalthia longifolia</i>	Debadaru / Ashok	Annonaceae	-	+
54	<i>Polyalthia pendula</i>	Ashok	Annonaceae	-	+
55	<i>Pongamia pinnata</i>	Karanja	Fabaceae	+	+
56	<i>Prosopis spicigera</i>	Kejdi	Mimosaceae	-	+
57	<i>Psidium guajava</i>	Guava	Myrtaceae	+	+
58	<i>Pterocarpus marsupium</i>	Saja	Pterocarpaceae	-	+
59	<i>Sapindus emarginatus</i>	Ritha	Sapindaceae	-	+
60	<i>Schleichera oleosa</i>	Kusum	Sapindaceae	-	+
61	<i>Shorea robusta</i>	Sal	Dipterocarpaceae	+	+
62	<i>Soymida febrifuga</i>	Rohini	Meliaceae	+	
63	<i>Spondias pinnata</i>	Ambara / ambari	Anacardiaceae	-	+
64	<i>Sterculia apetala</i>	Panama tree	Sterculiaceae	-	+
65	<i>Streblus asper</i>	Sahada	Moraceae	-	+
66	<i>Syzigium cumini</i>	Jamun	Myrtaceae	+	+
67	<i>Tamarindus indica</i>	Imli	Caesalpiniaceae	-	+
68	<i>Tectona grandis</i>	Saguan	Verbenaceae	+	+
69	<i>Terminalia alata</i>	Marda	Combretaceae	-	+
70	<i>Terminalia arjuna</i>	Arjuna	Combretaceae	+	+
71	<i>Terminalia tomentosa</i>	Combretaceae	Asna	+	+
72	<i>Thespesia populnea</i>	Bankapas	Malvaceae	-	+
73	<i>Vitex negundo</i>	Begunia	Verbenaceae	+	+
74	<i>Vitex trifolia</i>	Nichinda	Verbenaceae	-	+
75	<i>Woodfordia fruticosa</i>	Dhaaya / Dawal	Lythraceae	+	+
76	<i>Ziziphus marutiana</i>	Borkuli	Rhamnaceae	+	+
77	<i>Ziziphus nummularia</i>	Kontikoli	Rhamnaceae	-	+
Source: Primary Survey data of P&M Solution, Noida, and the data supported by Department of Forest, Birbhum District (W.B.)					

**TABLE C3-27: LIST OF SHRUBS/GRASSES/ AND CLIMBERS& CREEPERS
FOUND IN THE STUDY AREA OF BIRBHUM DISTRICT, WEST BENGAL**

	Botanical name	Local / Common Name	Family	Core	Buffer
S.No.	Srubs and Palm				
1	<i>Abutilon indicum</i>	Kanghi	Malvaceae	+	+
2	<i>Agave americana</i>	Kamal Cactus	Agavaceae		+
3	<i>Barleria prionitis</i>	Porcupine flower	Acanthaceae	+	+
4	<i>Borassus flabellifer</i>	Tal	Arecaceae	+	+
5	<i>Calotropis gigantea</i>	Arakha	Asclepiadaceae	+	+
6	<i>Calotropis procera</i>	Arakha	Asclepiadaceae	+	+
7	<i>Carissa carandas</i>	Caranda	Apocynaceae		+
8	<i>Carissa spinarum</i>	Karonda	Apocynaceae	+	+
9	<i>Caryota urens</i>	Sarap(Calap)	Arecaceae		+
10	<i>Chromolaena odorata</i>	Siam weed	Asteraceae	+	+
11	<i>Clerodendrum serratum</i>	Babhanaiti	Verbenaceae		+
12	<i>Cocos nucifera</i>	Coconut	Arecaceae		+
13	<i>Colebrookea oppositifolia</i>	Indian Squirrel tail	Lamiaceae	+	+
14	<i>Grewia tilifolia</i>	Dhamani	Tiliaceae	+	+
15	<i>Ipomoea carnea</i>	Morning glory	Convolvulaceae	+	+
16	<i>Ixora parviflora</i>	Bhuin kuruma	Rubiaceae		+
17	<i>Lantana camara</i>	Raimuniya	Verbenaceae	+	+
18	<i>Phoenix sylvestris</i>	Bankhajuri	Arecaceae		+
19	<i>Withania somnifera</i>	Aswagandha	Solanaceae	+	+
	Climber and Creepers				
1	<i>Abrus precatorius</i>	Kaincha	Fabaceae	+	+
2	<i>Bauhinia vahlii</i>	Maloo creeper	Caesalpiniaceae	+	+
3	<i>Dendrophthoe falcata</i>	Banda	Loranthaceae		+
4	<i>Hemidesmus indicus</i>	Anantamul	Apocynaceae	+	+
5	<i>Jaminum arborescens</i>	Bana mali	Oleaceae		+
6	<i>Jasminum auriculatum</i>	Juhi	Oleaceae	+	+
7	<i>Leptadenia reticulata</i>	Jiwanti	Apocynaceae		+

8	<i>Mucuna pruriens</i>	Kaunch	Fabaceae	+	+
9	<i>Pyrostegia venusta</i>	Flame wine	Bignoniaceae	+	+
10	<i>Quisqualis indica</i>	Burma Creeper	Combretaceae		+
11	<i>Tylophora indica</i>	Antamul	Asclepiadaceae	+	+
Grasses/Herbs					
1	<i>Andrographis paniculata</i>	Kalmegh	Acanthaceae	+	+
2	<i>Apluda mutica</i>	Banjura grass	Poaceae	+	+
3	<i>Commelina benghalensis</i>	Bokna	Commelinaceae	+	+
4	<i>Cynodon dactylon</i>	Doob	Poaceae	+	+
5	<i>Cyperus rotundus</i>	Motha	cyperaceae	+	+
6	<i>Dactyl septemnerum</i>	Crow foot grass	Poaceae	+	+
7	<i>Dendrocalamus strictus</i>	Bamboo	Poaceae	+	+
8	<i>Digitaria ternate</i>	--	Graminae	+	+
9	<i>Kyllinga tenuifolia</i>	--	Cyperaceae	+	+
10	<i>Pennisetum purpureum</i>	Elephant grass	Poaceae	+	+
11	<i>Saccharum spontaneum</i>	Kans	Poaceae	+	+
Source: Primary Survey data of P&M Solution, Noida, and the data supported by Department of Forest, Birbhum District (W.B.)					

Agricultural vegetation/ Commercial vegetation of the Buffer zone.

The variety of crops growing by the local farmers in the buffer zone as well as in the Birbhum district. Vegetation details of the buffer zone was collected through the personal communication to the local people during field survey and from the 7 selected sites (TS-1 to TS-7), and the details are given in **Table C3-28**.

TABLE C3-28: LIST OF CROPS SEASONALLY PLANTED BY FARMERS IN THE STUDY AREA

Botanical/Eng. Name	Local/Trade Name	Family Name	Core Zone	Buffer Zone
<i>Abelmoschus esculentus</i>	Ladyfinger	Amaranthaceae	+	+
<i>Allium cepa</i>	Onion	Amaryllidaceae	+	+
<i>Arachis hypogaea</i>	Groundnut/Peanuts	Fabaceae	-	+
<i>Brassica nigra</i>	Mustard	Brassicaceae	+	+
<i>Brassica oleracea</i> var. botrytis	Cauliflower	Brassicaceae	-	+

<i>Brassica oleracea</i> var. capitata	Cabbage	Brassicaceae	-	+
<i>Cajanus cajan</i>	Pigeon pea/Toor Dal	Fabaceae	+	+
<i>Capsicum annuum</i>	Mirchi	Solanaceae	-	+
<i>Carica papaya</i>	Papaya	Caricaceae	-	+
<i>Cicer arietinum</i>	Channa/Gram	Fabaceae	-	+
<i>Coriander sativum</i>	Dhaniya	Apiaceae	+	+
<i>Hordeum vulgare</i>	Barley	Poaceae	-	+
<i>Lagenaria siceraria</i>	Bottle gourd/ Lauki	Cucurbitaceae	-	+
<i>Lycopersicon lycopersicum</i>	Tomato	Solanaceae	+	+
<i>Mamordica charanta</i>	Karela	Cucurbitaceae	-	+
<i>Oryza sativa</i>	Paddy	Poaceae	+	+
<i>Pennisetum glaucum</i>	Pearl millet/Bajra	Poaceae	-	+
<i>Solanum melongena</i>	Brinjal	Solanaceae	-	+
<i>Triticum aestivum</i>	Wheat	Poaceae	+	+
<i>Zea mays</i>	Makkha/Maize	Poaceae	+	+
Source: Primary Survey data of P&M Solution, Noida supported by the data of Department of Agriculture, Birbhum District (WB).				

Aquatic Flora of Buffer zone (Phytoplankton/ Aquatic Weeds)

Macrophytes: The diversity of aquatic Macrophytes was similar in both the core and buffer zone. Most of the aquatic vegetation was observed growing along the river bank. A total of 16 macrophytes species were recorded from the different water bodies in the study area. There is no any ecologically sensitive plant species (Rare, Endangered and Threatened) has been reported from the buffer zone. The details of macrophytic vegetation of the buffer zone are given in Table C3-29 and Figure C3-20.

TABLE C3-28: DETAILS OF MACROPHYTIC VEGETATION

S.No.	Name of the Taxa	Family Name	IUCN Status	AS- 1	AS- 2	AS- 3	AS- 4	AS- 5	AS- 6	Core Zone	Buffer Zone
1	<i>Alternanthera philoxeroides</i>	Amaranthaceae	LC		+	+	+	+	+		+
2	<i>Azolla pinnata</i>	Salviniaceae	LC		+	+	+	+			+
3	<i>Brachiaria mutica</i>	Poaceae	LC		+	+		+			+
4	<i>Chara hydrophytes</i>	Characeae	LC			+					+
5	<i>Commelina benghalensis</i>	Commelinaceae	LC					+	+		+
6	<i>Cyperus alopecuroides</i>	Cyperaceae	LC	+	+	+		+	+	+	+
7	<i>Cyperus difformis</i>	Cyperaceae	LC	+		+	+	+	+	+	+
8	<i>Eichhornia crassipes</i>	Pontederiaceae	LC		+	+	+	+	+		+
9	<i>Hydrilla verticillata</i>	Hydrocharitaceae	LC	+	+	+	+		+	+	+
10	<i>Ipomea aquatica</i>	Convolvulaceae	LC	+	+	+	+	+	+	+	+
11	<i>Ipomea carnea</i>	Convolvulaceae	LC	+	+	+	+		+	+	+
12	<i>Jussiaea repens</i>	Onagraceae	LC			+			+		+
13	<i>Lemna minor</i>	Araceae	LC	+	+	+	+	+	+	+	+
14	<i>Ludwigia parviflora</i>	Onagraceae	LC	+	+	+	+	+	+	+	+
15	<i>Marsilea quadrifolia</i>	Marsileaceae	LC			+	+				+
16	<i>Najas graminea</i>	Hydrocharitaceae	LC			+	+				+

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17	<i>Nymphoides aquatica</i>	Menyanthaceae	LC	+	+	+		+	+	+	+
18	<i>Nymphoides indica</i>	Menyanthaceae	LC		+	+	+				+
19	<i>Phragmites karka</i>	Poaceae	LC				+	+			+
20	<i>Polygonum glabrum</i>	Polygonaceae	LC	+	+	+	+	+	+	+	+
21	<i>Potamogeton nodosus</i>	Potamogetonaceae	LC		+	+					+
22	<i>Vallisneria spiralis</i>	Hydrocharitaceae	LC			+	+	+			+
23	<i>Sagittaria guayanensis</i>	Alismataceae	LC		+	+	+	+			+
24	<i>Typha latifolia</i>	Typhaceae	LC			+	+		+		+
			Total	9	15	22	17	15	14	9	24

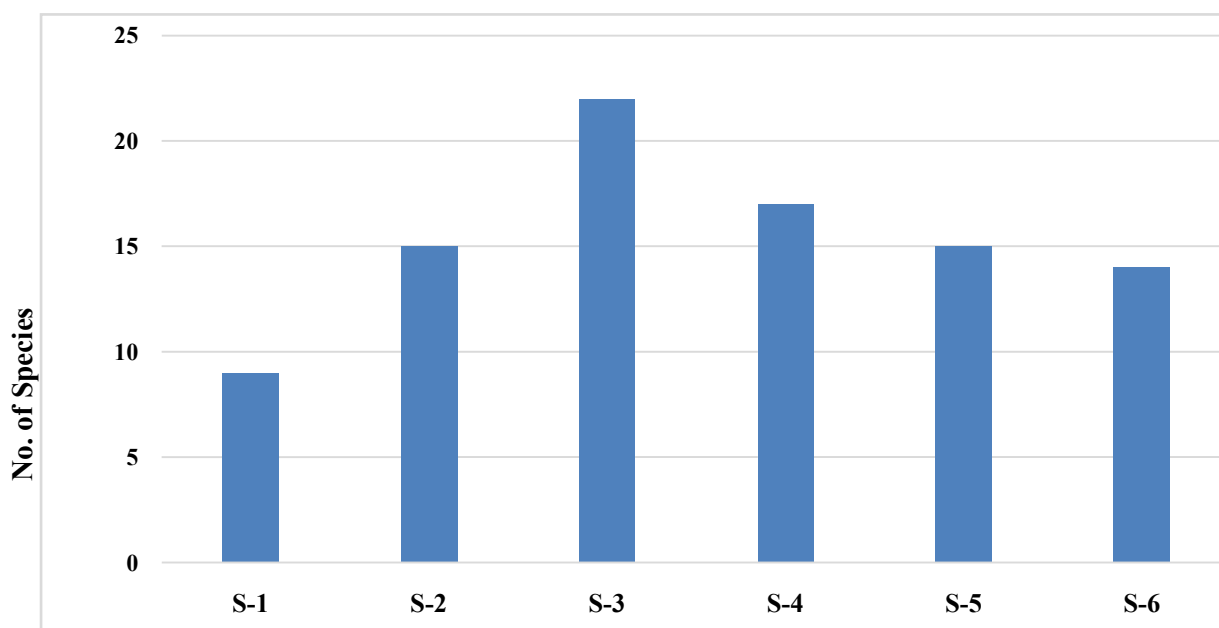


Figure C3-20: Qualitative variation of Macrophytes at different sampling sites

TABLE C3-30: LIST OF PHYTOPLANKTON RECORDED FROM THE DIFFERENT SAMPLING SITES OF THE STUDY AREA

S.N.	Taxonomic Details	AS-1	AS-2	AS-3	AS-4	AS-5	AS-6	IUCN Status
	Chlorophyceae							NA
1	<i>Ankistrodesmus</i> sp.	+	+	+		+	+	NA
2	<i>Ankistrodesmus falcatus</i>			+	+			NA
3	<i>Arthrodesmus</i> sp.		+	+		+		NA
4	<i>Chlorella</i> sp.	+		+		+	+	NA
5	<i>Chlorella vulgaris</i>		+			+	+	NA
6	<i>Chlorococcum</i> sp.	+	+	+	+			NA
7	<i>Closterium quadratum</i>			+	+			NA
8	<i>Coelastrum</i> sp.	+	+	+	+	+		NA
9	<i>Cosmarium formii</i>	+		+	+	+		NA
10	<i>Cosmarium margaritatum</i>		+			+		NA
11	<i>Gonium</i> sp.		+	+	+		+	NA
12	<i>Oocystis crassa</i>		+	+	+		+	NA

13	<i>Pediastrum duplex</i>			+	+	+	+	NA
14	<i>Pediastrum simplex</i>	+	+	+	+	+		NA
15	<i>Scenedesmus armatus</i>	+	+	+	+		+	NA
16	<i>Spirogyra</i> sp.	+	+	+	+		+	NA
17	<i>Tetraedron trigonum</i>		+			+	+	NA
18	<i>Ulothrix zonata</i>						+	NA
19	<i>Volvox</i> sp.		+	+	+		+	NA
20	<i>Zygnema</i> sp.	+	+			+		NA
	Total	9	14	15	12	11	11	
	Cyanophyceae							NA
1	<i>Anabaena</i> sp.	+		+	+	+	+	NA
2	<i>Anabaena circinalis</i>					+	+	NA
3	<i>Anabaena flosaque</i>	+	+	+	+	+	+	NA
4	<i>Anacystis</i> sp.		+					NA
5	<i>Aphanocapsa</i> sp.		+	+	+	+	+	NA
6	<i>Aphanothece</i> sp.			+		+	+	NA
7	<i>Chroococcus</i> sp.	+		+		+		NA
8	<i>Gloeocapsa</i> sp.		+	+	+			NA
9	<i>Lyngbya</i> sp.		+	+	+		+	NA
10	<i>Merismopedia</i> sp.	+		+		+		NA
11	<i>Merismopedia tenuissima</i>					+		NA
12	<i>Microcystis</i> sp.	+		+	+		+	NA
13	<i>Microcystis aeruginosa</i>		+			+	+	NA
14	<i>Nostoc</i> sp.	+		+	+			NA
15	<i>Oscillatoria subbrevis</i>			+	+	+	+	NA
16	<i>Spirulina</i> sp.		+					NA
17	<i>Spirulina laxissima</i>	+	+	+	+		+	NA
	Total	7	8	12	9	10	10	
	Bacillariophyceae							NA
1	<i>Achnanthes</i> sp.	+	+	+		+		NA
2	<i>Amphora ovalis</i>			+	+		+	NA
3	<i>Amphora</i> sp.	+	+	+	+	+		NA

4	<i>Cocooneis sp.</i>		+	+			+	NA
5	<i>Cyclotella sp.</i>			+		+		NA
6	<i>Cymbella affinis</i>	+	+	+	+	+	+	NA
7	<i>Eunotia major</i>				+	+		NA
8	<i>Fragillaria pinnata</i>		+		+			NA
9	<i>Gomphonema sp.</i>	+		+			+	NA
10	<i>Gomphonema lanceolatum</i>		+	+	+	+	+	NA
11	<i>Melosira sp.</i>	+	+				+	NA
12	<i>Melosira granulata</i>			+	+	+		NA
13	<i>Navicula similis</i>	+	+	+		+		NA
14	<i>Navicula subrhyncocephala</i>		+	+	+		+	NA
15	<i>Nitzschia palea</i>	+	+	+	+		+	NA
16	<i>Pinnularia sp.</i>			+		+		NA
17	<i>Synedra acus</i>				+	+	+	NA
18	<i>Synedra ulna</i>	+	+	+	+	+		NA
19	<i>Tabellaria sp.</i>		+	+		+		NA
	<i>Total</i>	8	12	15	11	12	9	
	<i>Euglenophyceae</i>							NA
1	<i>Euglena acus</i>		+	+	+	+	+	NA
2	<i>Euglena sp.</i>						+	NA
3	<i>Euglepha sp.</i>	+	+	+		+		NA
4	<i>Phacus sp.</i>		+	+			+	NA
5	<i>Phacus caudatus</i>	+			+	+		NA
6	<i>Trachelomonas sp.</i>			+	+	+	+	NA
	<i>Total</i>	2	3	4	3	4	4	
	Source: Primary Survey data of P&M Solution, Noida supported by the data of Department of Agriculture, Birbhum District (WB).							

TABLE C3-31: SITE WISE QUALITATIVE LIST OF PHYTOPLANKTON SPECIES RECORDED FROM THE CORE AND BUFFER ZONE

Class	S-1	S-2	S-3	S-4	S-5	S-6
Chlorophyceae	9	14	15	12	11	11
Cyanophyceae	7	8	12	9	10	10
Bacillariophyceae	8	12	15	11	12	9
Euglenophyceae	2	3	4	3	4	4
	26	37	46	35	37	34

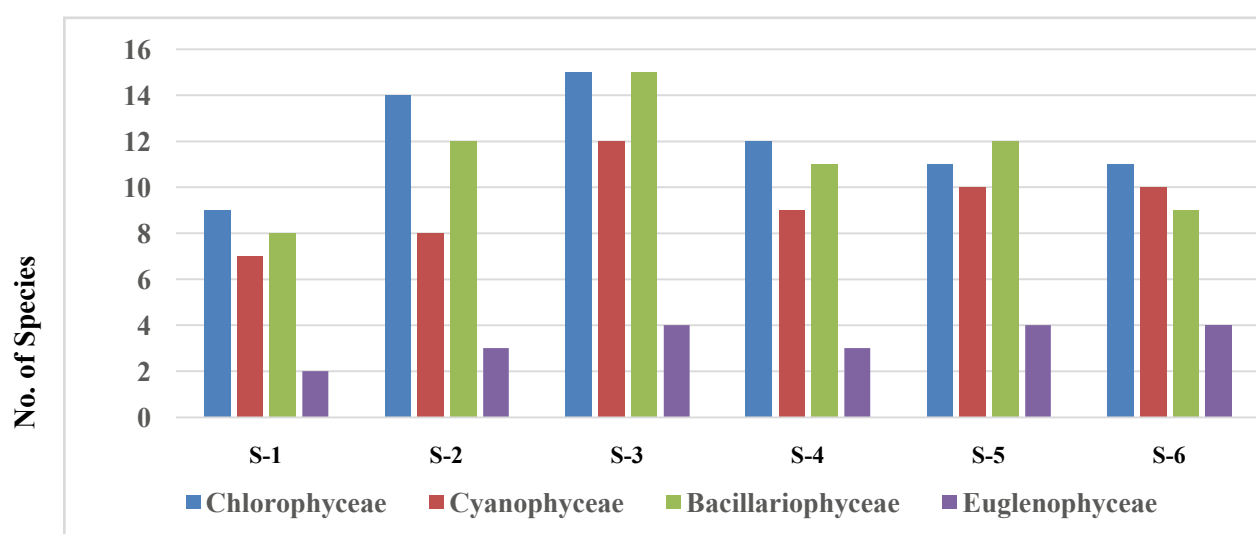


Figure C3-21: Qualitative variation of Phytoplankton at different sampling sites

Fauna of the Study Area

Proposed expansion of Gangaramchak-Bhadulia Coal Quarry is located in the Raniganj Coalfield Area of West Bengal. There is no habitat of major wild animals, nest of avian fauna, breeding grounds of fishes, and amphibian in the lease area. Only some moving birds were observed from the core zone. The maximum vegetation of core zone has been demolished by the forest department after FC clearance for the diversion of land for mining purposes.

On the other hand, buffer zone of the study area is enriched with forest and major vegetation. Forest fauna were different from the rest of the area of buffer zone. In the buffer zone, domesticated animals mainly constitute the faunal population.

The assessment of fauna was done on the bases of primary survey and secondary data was collected from different government offices like the forest department, wildlife department, etc. The presence of wildlife was also confirmed by the local inhabitants depending on the animal sightings and the frequency of their visits in to project area.

During the present study period, a large number of birds are noticed in the buffer zone of the study area. But, there are no bird habitats like nesting, breeding, and foraging patterns are noticed in the core zone.

Fauna of the Core Zone

Terrestrial fauna of core zone (Mammals/Reptiles/amphibians/birds/insects etc.).

There is no any permanent habitat of any faunal species was recorded from the core zone. However, some moving birds and butterflies were observed in the core zone. The details of animals found in the core zone is given in **Tables C3-32, C3-33, and C3-34.**

Aquatic Fauna of Core zone (Zooplankton/ Macro-invertebrates/ Fishes/ Amphibians/ Turtles etc.)

Site 1 was located in the core zone and all the aquatic faunal composition recorded from the core zone is given in **Tables C3-35, C3-36 and C3-37.**

Fauna of the Buffer Zone

To prepare a detailed report on the status of faunal biodiversity of the present study area (Core zone and 10 km buffer area) of Birbhum district; and to assess the impacts due to mining, transpiration, and operational activity which evolves suitable mitigation measures to protect & conserve biodiversity following components were studied: terrestrial biodiversity, wildlife survey (diversity), habitat study (feeding, breeding, roosting areas), distribution of birds, rare & endangered species of the study area. The fauna of the study area (Core and Buffer zone) vary on the local topography and different types of habitats. Based on the faunal habitat, the fauna of the study area has been categorized into two categories, i.e. **(i) Aquatic fauna, and (ii) Terrestrial fauna.**

Terrestrial Fauna of Buffer zone (Mammals/Reptiles/Amphibians/Birds/Insects etc.)

The major part of the study area lies under forest which also supports animals. Whereas, rural agricultural fields and barren land which restricts the wildlife habitat significantly. There is neither any wildlife sensitive area nor any corridor for the movement of wildlife in the study area. A list of the animals in the study area has been prepared on the basis of the primary survey and also inquired from the local people. The animals, thus recorded were cross-checked with Wildlife (Protection) Act, 1972 for their schedule status. Faunal details of the study area are given in **Tables C3-32 to C3-34**.

i. Mammals and Reptiles/ Amphibians

The domesticated animals like Goat (*Capra aegagrus*); Buffalo (*Bubalus bubalis*); Cow (*Bos primigenius*); Horse (*Equus caballus*); Ass (*Equus hemionus*) and Dog (*Canis lupus familiaris*) were observed moving in different parts of the study area, especially nearby town and villages. **There is no Schedule-I species** identified as per the Wildlife Protection Act, 1972. Mammals and Reptiles found in the study area are listed in **Table C3-32**.

TABLE C3-32: LIST MAMMALS, REPTILES AND AMPHIBIANS RECORDED FROM THE STUDY AREA

S.No.	Scientific Name	Common Name	Core Zone	Buffer Zone	Schedule status (as per WPA-1972)	IUCN status
Mammals						
1	<i>Bandicota bengalensis</i>	Bandicoot Rat	-	+	IV	LC
2	<i>Boselaphus tragocamelus</i>	Blue Bull	-	+	III	LC
3	<i>Canis aureus</i>	Jackal	-	+	II	LC
4	<i>Cervus unicolor</i>	Sambhar	-	+	III	VU
5	<i>Cuon alpinus</i>	Wild Dog	-	+	II	LC
6	<i>Felis chaus</i>	Jungle cat	+	+	IV	LC
7	<i>Funambulus palmarum</i>	Three-striped Squirrel	-	+	III	LC
8	<i>Funambulus pennanti</i>	Five striped palm squirrel	-	+	III	LC
9	<i>Herpestes edwardsi edwardsi</i>	Indian Grey Mongoose	-	+	II	LC
10	<i>Hyaena hyaena</i>	Stripped hyena	-	+	V	LC
11	<i>Lepus nigricollis</i>	Indian Hare	+	+	IV	LC
12	<i>Macaca mulatta</i>	Rhesus macaque	-	+	II	LC
13	<i>Mus booduga</i>	Indian Field Mouse	-	+	IV	LC
14	<i>Presbytis entellus</i>	Common langur	-	+	II	LC
15	<i>Pteropus giganteus</i>	Indian Flying Fox	-	+	IV	LC

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16	<i>Rattus rattus</i>	Common House Rat	-	+	IV	LC
17	<i>Rousettus leschenaultia</i>	Indian Fulvous Fruit- Bat	-	+	IV	LC
18	<i>Suncus murinus</i>	Grey musk Shrew	-	+	V	LC
19	<i>Sus scrofa</i>	Indian Wild Boar	-	+	III	LC
20	<i>Vulpes bengalensis</i>	Indian fox	+	+	II	LC
Reptiles and Amphibians						
1	<i>Bufo melanostictus</i>	Common toad	+	+	IV	LC
2	<i>Bungarus caeruleus</i>	Krait	+	+	IV	NE
3	<i>Calotes versicolor</i>	Garden lizard	+	+	IV	NE
4	<i>Chameleo zeylanicus</i>	Chameleon	-	+	II	LC
5	Chameleon	<i>Chamelion calcarata</i>	+	+	II	NE
6	<i>Chrysopelea taprobanica</i>	Tree Snake	-	+	II	LC
7	<i>Crotolus sp.</i>	Pit viper	-	+	II	LC
8	<i>Dryphis nasutus</i>	Whip Snake	-	+	II	LC
9	<i>Echis carinatus</i>	Saw scaled viper	-	+	II	LC
10	<i>Geochelone elegans</i>	Indian star tortoise	-	+	II	LC
11	<i>Hemidactylus flaviviridis</i>	House Gecko	-	+	IV	NE
12	<i>Naja naja</i>	Indian Cobra	+	+	II	LC
13	<i>Ophiophagus hannah</i>	King cobra	-	+	II	LC
14	<i>Ptyas mucosa</i>	Rat Snake	-	+	II	NE

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15	<i>Rock Lizard</i>	Agama buber culatus	+	+	-	NE
16	<i>Typhlops diardii</i>	Giant Blind Snake	-	+	II	LC
17	<i>Typhlops porrectus</i>	Slender Blind Snake	-	+	II	LC
20	<i>Xenochrophis piscator</i>	Dhondwa	-	+	II	LC
IUCN Status =LC: Least Concern, VU: Vulnerable, NE: Not Evaluated,						
Source: Primary Survey data of P&M Solution, Noida supported by the data of Department of Agriculture, Birbhum District (WB).						

ii. Avian Fauna

During the present study period, a total of 48 species of avian fauna was observed from the core and buffer zone of the study area. All the recorded species from the core zone were also common in the buffer zone. Among avian fauna, **there is no Schedule-I species** identified as per the Wildlife Protection Act, 1972. All the recorded avian fauna is listed under the Least Concern category of IUCN, except *Ciconia episcopus* (White-necked stork) which was under the vulnerable category. The details of the avian fauna are given in **Table C3-33**.

TABLE C3-33: AVIAN FAUNA OBSERVED FROM THE CORE ZONE AND 01 KM BUFFER ZONE

S.No	Scientific Name	Common Name	Core Zone	Buffer Zone	Schedule Status (WPA-1972)	IUCN Status
1	<i>Acridotheres tristis</i>	Myna	+	+	IV	LC
2	<i>Acridotheres tristis</i>	Common myna	+	+	IV	LC
3	<i>Alcedo atthis</i>	Small blue kingfisher		+	IV	LC
4	<i>Amandava amandava</i>	Red munia		+	IV	LC
5	<i>Amaurornis phoenicurus</i>	White-breasted waterhen		+	IV	LC
6	<i>Ardea cinerea</i>	Grey heron		+	IV	LC
7	<i>Ardea purpurea</i>	Purple heron	+	+	IV	LC
8	<i>Ardeola grayii</i>	Indian pond heron	+	+	IV	LC
9	<i>Athene brama</i>	Spotted Owlet		+	IV	LC
10	<i>Bubulcus ibis</i>	Cattle egret		+	IV	LC
11	<i>Butorides striatus</i>	Striated heron		+	IV	LC
12	<i>Casmerodius albus</i>	Great egret		+	IV	LC
13	<i>Centropus sinensis</i>	Crow pheasant		+	IV	LC
14	<i>Ceryle rudis</i>	Pied kingfisher		+	IV	LC
15	<i>Charadrius dubius</i>	Little ringed plover		+	IV	LC
16	<i>Ciconia episcopus</i>	White-necked stork		+	IV	VU
17	<i>Cinnyris asiaticus</i>	Purple Sunbird	+	+	IV	LC
18	<i>Columba livia</i>	Pigeon	+	+	IV	LC
19	<i>Corvus macrorhynchos</i>	Jungle crow	+	+	IV	LC
20	<i>Corvus splendens</i>	Crow	+	+	V	LC
21	<i>Dendrocygna icolour</i>	Fulvous whistling duck		+	IV	LC
22	<i>Dicrurus adsimilis</i>	Black drongo	+	+	IV	LC
23	<i>Egretta alba</i>	Larger egret		+	IV	LC

24	<i>Egretta garzetta</i>	Little egret		+	IV	LC
25	<i>Francolinus pondicerianus</i>	Titar	+	+	IV	LC
26	<i>Gallinule chloropus</i>	Common moorhen		+	IV	LC
27	<i>Gallus gallus</i>	Jungle hen		+	IV	LC
28	<i>Halcyon smymensis</i>	White-throated kingfisher		+	IV	LC
29	<i>Milvus migrans</i>	Black Kite		+	IV	LC
30	<i>Nycticorax nycticorax</i>	Black-crowned night heron		+	IV	LC
31	<i>Passer domesticus</i>	House sparrow	+	+	IV	LC
32	<i>Pelecanus onocrotalus</i>	Great white pelican		+	IV	LC
33	<i>Phalacrocorax carbo</i>	Great cormorant		+	IV	LC
34	<i>Phalacrocorax niger</i>	Little cormorant		+	IV	LC
35	<i>Pluvialis fulva</i>	Pacific golden plover		+	IV	LC
36	<i>Pseudibis papillosa</i>	Red-naped ibis		+	IV	LC
37	<i>Psittacula krameri</i>	Rose ringed Parakeet		+	IV	LC
38	<i>Pycnonotus cafer</i>	Red-vented bulbul		+	IV	LC
39	<i>Sarkidiornis melanotos</i>	Knob-billed duck		+	IV	LC
40	<i>Saxicoloides fulicatus</i>	Indian robin	+	+	IV	LC
41	<i>Spilopelia senegalensis</i>	Little brown dove	+	+	IV	LC
42	<i>Sturnia pagodarum</i>	Brahminy Starling		+	IV	LC
43	<i>Sturnus contra</i>	Asian pied starling		+	IV	LC
44	<i>Tachybaptus ruficollis</i>	Little grebe		+	IV	LC
45	<i>Tadorna ferruginea</i>	Ruddy shelduck		+	IV	LC
46	<i>Tringa tetanus</i>	Common redshank		+	IV	LC
47	<i>Turdoides caudate</i>	Common babbler	+	+	IV	LC
48	<i>Upupa epops</i>	Common hoopoe	+	+	IV	LC
49	<i>Vanellus indicus</i>	Red-wattled lapwing		+	IV	LC
IUCN Status =LC: Least Concern, VU: Vulnerable.						
Source: Primary Survey data of P&M Solution and the data supported by Department of Forest, Birbhum district, West Bengal.						

iii. Butter Flies

During the present study period, a total of 8 butterflies was observed from the core and buffer zone of the study area. All the recorded species were the least concerned category of IUCN and were also common in core and buffer zone. The details of the butterflies are given in **Table C3-34**.

TABLE C3-34: BUTTERFLIES OBSERVED FROM THE BUFFER ZONE OF THE STUDY AREA

S.No.	Common Name	Scientific Name	Core Zone	Buffer Zone	IUCN Status
1.	Plain Tiger	<i>Danaus chrysippus</i>	+	+	LC
2.	Common emigrant	<i>Catopsilia pomona</i>	+	+	LC
3.	Scarlet dragonfly	<i>Crocothemis erythraea</i>		+	LC
4.	Sunflower/Bordered Patch	<i>Chlosyne lacinia</i>		+	LC
5.	Stripped Tiger	<i>Danaus genutia</i>	+	+	LC
6.	Common crow	<i>Euploea core</i>	+	+	LC
7.	Blue tiger	<i>Tirumala limniace</i>		+	LC
8.	Small grass yellow	<i>Eurema brigitta</i>	+	+	LC
IUCN Status =LC: Least Concern, Source: Primary Survey data of P&M Solution, Noida and the data supported by Department of Forest, Birbhum District, West Bengal.					

Aquatic Fauna of the Buffer Zone (Zooplankton/ Macro-invertebrates /Fishes /Amphibians / Turtles etc.)

Aquatic fauna is referred to as any form of an animal that has adapted to living in aquatic environments such as rivers, lakes, ponds, dams, streams, etc.). Ajay, Hinglo and Sal Rivers are the major riverine system in the study area. Due to the perennial nature, the Hinglo Dam and Hinglo river support large number faunal species. On the other hand, a large number of fish ponds are available in the study area.

In general, faunal account of any water bodies can be divided into following categories, i.e., (i) zooplankton, (ii) Macro-invertebrates/Insects/Benthos (iii) Fishes (iv) Amphibians/ Reptiles/ etc. Details of Zooplankton; Macro-invertebrates/insects/benthos; Amphibians/Reptiles and Fishes recorded from the different water bodies of the study area (Birbhum District, West Bengal) are given in **Tables C3-35, C3-36, and C3-37.**

i. Zooplankton

Zooplankton is commonly found in all types of aquatic habitats. These are recognized as secondary producers and considered one of the best tools for the environmental monitoring program. During the present study period, a total of 53 zooplankton species were recorded and identified comprising of class Rotifera (18 species), Protozoa (9 species), Cladocera (12 species), Copepoda (10 species), and Ostracoda (4 species). The details of the zooplankton diversity recorded from different sampling location are given in **Table C3-35 and Fig C3-22.**

TABLE C3-35: ZOOPLANKTON SPECIES FOUND IN THE DIFFERENT WATER BODIES SITUATED IN THE BUFFER ZONE

S.No.	Name of the Taxa	AS-1	AS-2	AS-3	AS-4	AS-5	AS-6	Schedule Status in WPA (1972)	IUCN Status
Protozoa									
1	<i>Arcella</i> sp.	+	+	+			+	NA	NA
2	<i>Arcella discoides</i>			+	+	+		NA	NA
3	<i>Arcella vulgaris</i>		+		+		+	NA	NA
4	<i>Centropyxis</i> sp.		+	+	+	+	+	NA	NA
5	<i>Centropyxis ecornis</i>		+	+	+			NA	NA
6	<i>Diffugia</i> sp.	+		+		+	+	NA	NA
7	<i>Diffugia cuminata</i>		+	+	+	+	+	NA	NA
8	<i>Euglypha</i> sp.		+			+		NA	NA
9	<i>Metopus</i> sp.	+		+	+			NA	NA
	Total	3	6	7	6	5	5		
Rotifera									
1	<i>Anuraeopsis fissa</i>		+	+	+	+	+	NA	NA
2	<i>Asplanchna brightwelli</i>			+		+		NA	NA
3	<i>Brachionus</i> sp.	+	+	+				NA	NA
4	<i>Brachionus angularis</i>	+		+	+	+	+	NA	NA
5	<i>Brachionus calyciflorus</i>				+	+	+	NA	NA
6	<i>Brachionus falcatus</i>		+	+			+	NA	NA
7	<i>Cephalodella gibba</i>		+	+	+	+	+	NA	NA

8	<i>Filinia</i> sp.	+		+				NA	NA
9	<i>Filinia longiseta</i>			+	+	+		NA	NA
10	<i>Keratella</i> sp.		+					NA	NA
11	<i>Keratella Cochlearis</i>	+	+	+		+	+	NA	NA
12	<i>Keratella Tropica</i>	+	+		+	+		NA	NA
13	<i>Lecane</i> sp.			+	+	+	+	NA	NA
14	<i>Lecane luna</i>	+	+	+	+			NA	NA
15	<i>Monostyla quadridentatus</i>	+					+	NA	NA
16	<i>Mytilina</i> sp.		+		+	+		NA	NA
17	<i>Polyarthra vulgaris</i>			+				NA	NA
18	<i>Testudinella patina</i>		+	+	+			NA	NA
	Total	7	10	13	10	10	8		
	Cladocera								
1	<i>Alona</i> sp.	+				+		NA	NA
2	<i>Alona intermediate</i>		+	+			+	NA	NA
3	<i>Bosmina</i> sp.	+		+				NA	NA
4	<i>Bosmina longirostris</i>		+	+	+	+	+	NA	NA
5	<i>Ceriodaphnia</i> sp.		+				+	NA	NA
6	<i>Chydorus sphaericus</i>			+		+		NA	NA
7	<i>Daphnia</i> sp.	+	+		+			NA	NA
8	<i>Daphnia pulex</i>		+	+		+	+	NA	NA
9	<i>Diaphnosoma excisum</i>			+	+	+	+	NA	NA
10	<i>Leydigia</i> sp.		+		+		+	NA	NA
11	<i>Moina daphnia</i>			+	+	+	+	NA	NA
12	<i>Simocephalus</i> sp.	+	+	+				NA	NA
	Total	4	7	8	5	6	7		
	Copepoda								
1	<i>Cyclops</i> sp.	+	+	+	+		+	NA	NA
2	<i>Diaptomus</i> sp.		+	+	+	+	+	NA	NA
3	<i>Eucyclops</i> sp.	+		+		+		NA	NA
4	<i>Heleodiptomus viduus</i>		+			+		NA	NA

5	<i>Mesocyclops sp.</i>			+	+	+	+	NA	NA
6	<i>Nauplius larvae</i>	+	+	+	+	+	+	NA	NA
7	<i>Neodiaptomus sp.</i>			+				NA	NA
8	<i>Paradiaptomus sp.</i>	+			+	+	+	NA	NA
9	<i>Thermocyclops sp.</i>			+	+		+	NA	NA
10	<i>Thermocyclops crassus</i>		+	+	+	+		NA	NA
	Total	4	5	8	7	8	6		
Ostracoda									
1	<i>Cyprinotus sp.</i>		+			+		NA	NA
2	<i>Cypris sp.</i>	+		+	+		+	NA	NA
3	<i>Stenocypris sp.</i>	+	+	+		+		NA	NA
4	<i>Stenocypris malcolmsoni</i>		+	+	+	+	+	NA	NA
	Total	2	3	3	2	3	2		
Source: Primary Survey Data of P&M Solution Pvt. Ltd., Noida.									

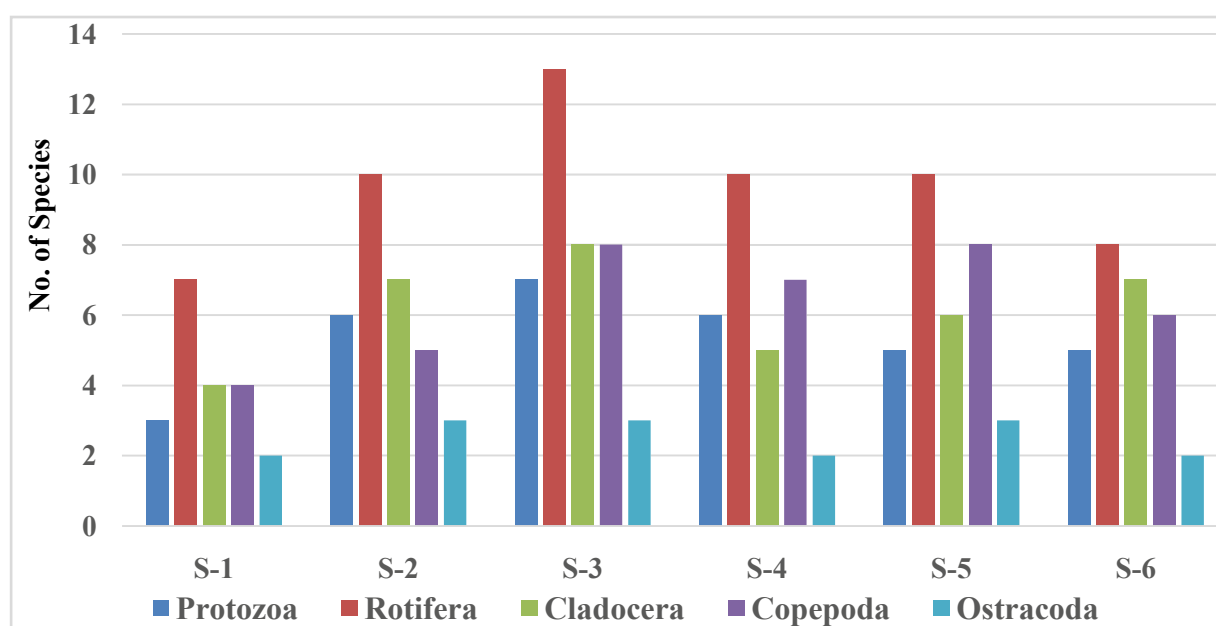


Figure C3-22: Site wise qualitative variation in Zooplankton species in the study area

ii. Macro-invertebrates (Insects/Benthos)

Macro-invertebrates are commonly found in all types of aquatic habitats such as streams, rivers, wetlands, lakes, and ponds. The term macro-invertebrate is used for those animals that have no backbone and can be seen with the naked eye. These animals generally include insects, crustaceans, mollusks, and

annelids. They are significant within the food chain as larger animals such as fish and birds rely on them as a food source. Various macro-invertebrate species were collected and identified from the present study area and listed in **Table C3-36**.

TABLE C3-36: MACRO-INVERTEBRATES RECORDED FROM THE CORE AND BUFFER ZONE

Sl. No.	Taxonomic details	S-1	S-2	S-3	S-4	S-5	S-6	Schedule Status in WPA (1972)	IUCN Status
	Insecta								
1									
2	<i>Baetis nymph</i>		+	+	+	+		NA	NE
3	<i>Caenid mayfly</i>	+	+	+	+		+	NA	NE
4	<i>Chironomus plumosus</i>					+		NA	NE
5	<i>Chironomus sp.</i>	+	+	+	+		+	NA	NE
6	<i>Damsel flies nymphs</i>		+	+	+	+		NA	NE
7	<i>Dragon flies nymphs</i>		+	+		+		NA	NE
8	<i>Ephydra larvae</i>	+	+	+	+	+	+	NA	NE
9	<i>Hirudineria glossophonia</i>		+	+				NA	NE
10	<i>Hirudineria sp.</i>			+	+			NA	NE
11	<i>Limnodrillus hoffmeisteri</i>					+		NA	NE
12	<i>Mayflies nymphs</i>	+		+	+	+	+	NA	NE
13	<i>Mosquitos larvae</i>	+	+	+	+	+		NA	NE
14	<i>Ranatra elongata</i>	+	+	+	+	+	+	NA	NE
15	<i>Ranatra filliformis</i>	+		+		+		NA	NE
16	<i>Stone flies nymphs</i>		+	+	+		+	NA	NE
17	<i>Tubifex tubifex</i>	+		+	+	+		NA	NE
	<i>Total</i>	8	10	14	11	11	6		
	Mollusca								
1	<i>Bellamya bengalensis</i>			+	+	+		NA	NE
2	<i>Bellamya dissimilis</i>		+				+	NA	NE
3	<i>Corbicula fluminalis</i>		+	+	+			NA	NE

4	<i>Corbicula sp.</i>	+		+	+	+	+	NA	NE
5	<i>Gyraulus convexus</i>		+	+		+		NA	NE
6	<i>Gyraulus sp.</i>	+			+			NA	NE
7	<i>Indoplanorbis exustus</i>			+	+			NA	NE
8	<i>Lymnaea acuminata</i>	+	+			+		NA	NE
9	<i>Lymnaea sp.</i>			+	+	+	+	NA	NE
10	<i>Melanoides lineatus</i>				+			NA	NE
11	<i>Melanoides tuberculatus</i>			+		+		NA	NE
12	<i>Pila globosa</i> (apple snail)		+	+	+		+	NA	NE
14	<i>Pisidium clarkeanum</i>			+	+			NA	NE
15	<i>Thira sp.</i>	+	+	+	+			NA	NE
16	<i>Thira tuberculata</i>			+		+		NA	NE
17	<i>Unio tigris</i>		+	+	+	+	+	NA	NE
18	<i>Vivipara bengalensis</i>		+		+			NA	NE
	Total	4	7	12	12	8	5		
Source: Primary Survey Data of P&M Solution Pvt. Ltd., Noida.									

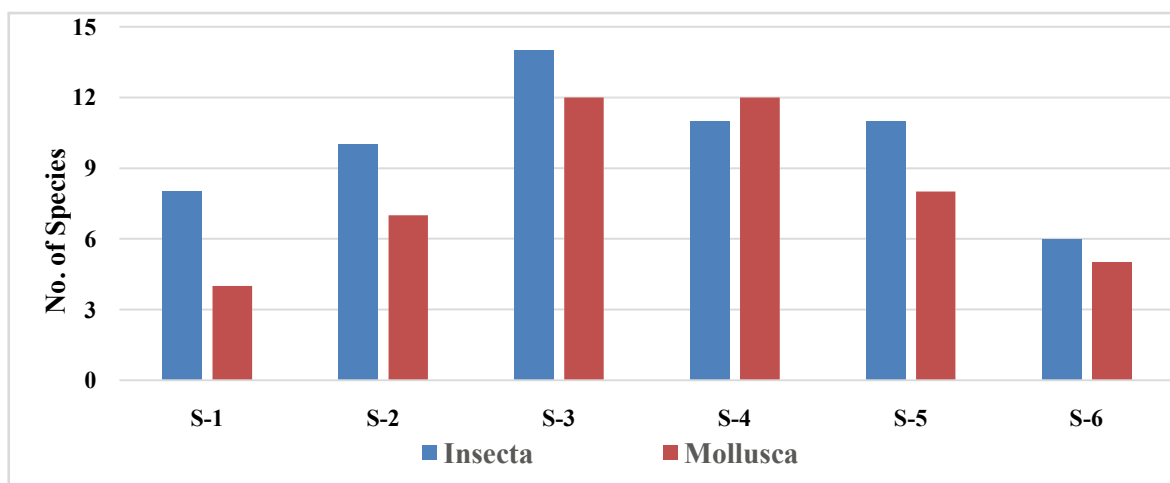


Figure C3-23: Site wise variation in macro-invertebrates in the study area (Core & Buffer zone)

i. Amphibians

Amphibians and reptiles are commonly found at places along the margin of aquatic and terrestrial systems. The presence of water bodies like rivers, streams, etc. in the study area are providing shelter to many amphibian species. Some of the commonly reported amphibian species in the present study areas are *Bufo melanostictus* (common Indian toad), *Euphlyctis cyanophlyctis* (Indian

skipper frog), and *Hoplobatrachus tigerinus* (Indian bullfrog). None of the Amphibians and reptiles have been observed under the Schedule-1 category (as per Wildlife Protection Act, 1972) and under the Rare, Endangered, and threatened category of IUCN.

ii. Fishes

The study area of the present coal mining project has some seasonal and perennial lentic and lotic water bodies which support variety of fishes. During the summer months, reduction in water level in all the water body has been recorded. Fishes found in the study area are listed in **Table C3-37** and their site-wise species variation is shown in **Figure C3-24**.

TABLE C3-37: FISH FAUNA FOUND IN THE DIFFERENT WATER BODIES OF THE STUD AREA

Name of the Taxa	Family Name	AS-1	AS-2	AS-3	AS-4	AS-5	AS-6	IUCN Status	Schedule Status in WPA (1972)
<i>Barilius barila</i>	Cyprinidae			+	+			LC	NA
<i>Barilius barna</i>	Cyprinidae					+		LC	NA
<i>Catla catla</i>	Cyprinidae		+	+	+	+	+	VU	NA
<i>Chanda nama</i>	Ambassidae	+		+	+	+		LC	NA
<i>Channa stiiatus</i>	Chandadae			+	+	+	+	LC	NA
<i>Cirrhinus carpio</i>	Cyprinidae			+	+	+		LC	NA
<i>Cirrhinus reba</i>	Cyprinidae		+	+	+	+	+	LC	NA
<i>Cirrhinus mrigala</i>	Cyprinidae		+	+	+	+	+	LC	NA
<i>Gudusia chapra</i>	Clupeidae			+		+		LC	NA
<i>Labeo bata</i>	Cyprinidae		+	+	+			LC	NA
<i>Labeo rohita</i>	Cyprinidae		+	+	+	+	+	LC	NA
<i>Macrobrachium malcomsoni</i>	Palaemonidae	+	+	+	+	+	+	LC	NA
<i>Mastacembelus armatus</i>	Mastacembelidae		+	+	+			LC	NA
<i>Mystus cavasius</i>	Cyprinidae			+				LC	NA
<i>Mystus tengara</i>	Bagridae	+	+	+	+	+	+	LC	NA
<i>Notopterus notopterus</i>	Notopteridae			+	+	+		LC	NA

<i>Pangasius buechanani</i>	Pangasiidae		+	+	+	+		LC	NA
<i>Puntius sarana</i>	Cyprinidae	+	+	+	+		+	LC	NA
<i>Puntius sophore</i>	Cyprinidae			+		+		LC	NA
<i>Puntius stigma</i>	Cyprinidae	+		+	+	+		LC	NA
<i>Puntius ticto</i>	Cyprinidae		+	+		+	+	LC	NA
<i>Xenentodon cancila</i>	Belonidae			+	+	+		LC	NA
	Total Species	6	11	21	17	17	10		

Note: VU= Vulnerable, LC= Least Concern and NA= Not Application. Source: Primary Survey data of

P&M Solution and data supported by Department of Fisheries, Birbhum District, WB.

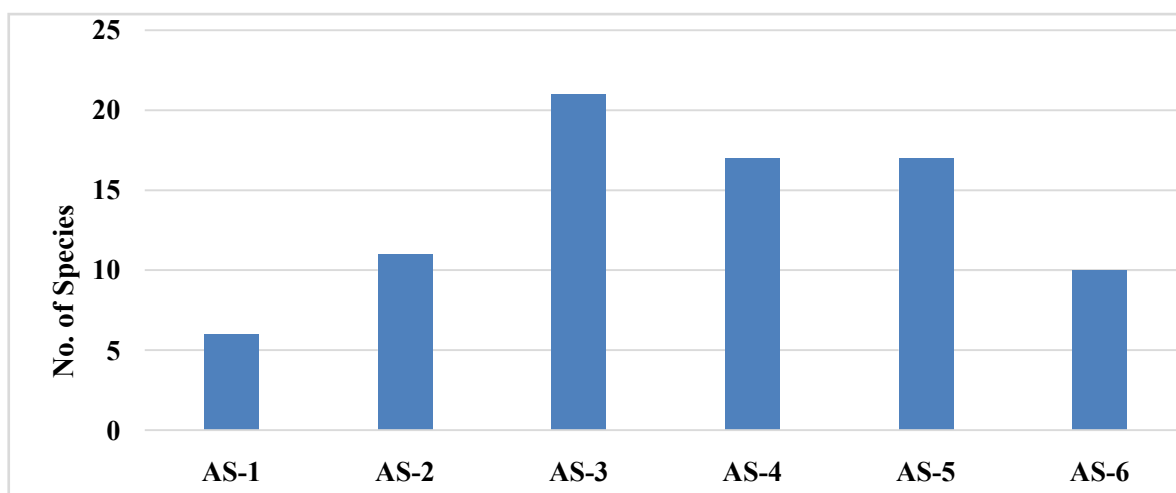


Figure C3-24: Site wise diversity variation of fishes in the study area (Core & Buffer zone)

Observations of Present Study (Flora & Fauna)Flora

Most of the parts of the present study area (Birbhumdistrict, West Bengal) are forest, Coal mining, agricultural fields, and villageland. The forest ofthe district comprises tropical dry and moistdeciduous vegetation due to high temperature and humidity. **Norare, endangered and threatened floral species have been observed from the core and buffer zone of the present study.** However, during the project period care will be taken to protect every flora species found in the study area especially found nearby the lease area and evacuation route.

Fauna

There are no National parks, Biosphere Reserves, Wildlife corridors, Tiger/Elephant reserves (existing as well as proposed), within 10 km of the project area.However,some reserved forest especially Sal forests are present in

different parts of the buffer zone. Some of these forests are located within 3 to 5 km away from the lease area as well as the evacuation route.

Any species belonging to themammals, amphibians, reptiles, and avian fauna of the study area are doesn't come under the **Schedule-I category** as per Wildlife Protection Act, 1972. To avoid the risk and threats due to the mining activities on the other faunal species found in the study area proper care will be taken. However, if any wildlife species are found nearby the lease area, that will be saved with the help of local forest department.

3.14 SOCIO-ECONOMIC STUDY:

Demography & Socio-economic Features Introduction

Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project of M/s The West Bengal Power Development Corporation Limited has obtained Environmental clearance from MoEF in the year of 2007 for the capacity of 1.00 MTPA of coal production. In order to evaluate various environmental impacts likely to be caused due to opencast mining activities for excavation of Coal over an ML area of 150.00 ha in Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project, an attempt has been made to assess the existing environmental scenario through generation of different baseline data on various environmental attributes. Hence, this Chapter outlines the present environmental setting of the project site & its surroundings and prediction of impact due to 50 & expansion of production i.e. from 1.00 MTPA to 1.50 MTPA.

Environmental Clearance is the permission from the Govt. for setting of certain projects like mining, which may impact environment considerably. Any new mining projects or existing mining projects going for enhancement in capacity require environmental clearance either from Ministry of Environment, Forest & Climate Change (MoEF & CC), Govt. of India for the matters falling under Category 'A' (as the schedule of notification number S.O. 1533 (E), date 14th September 2006) or at state level in the State Environment Impact Assessment Authority (SEIAA) for the matters falling under Category B. Further, as per the Gazette notification S.O. 1886(E) dated 20th April 2022 of MoEF & CC, for the symbol, figures and letters > 150 ha, the symbol, figures and letters > 500 ha shall be substituted for coal.

Legal and Regulatory Framework

EIA Notification 2006 is the principal legislation governing EIA in India. Besides this, the Government of India under Environment (Protection) Act 1986 issued a number of notifications, which are related environmental impact assessment. The MoEF & CC is the nodal agency to set up policy and standards for the protection of environment, along with the Central Pollution Control Board (CPCB).

The proposed expansion project is designated to be developed under the Environmental Impact Assessment (EIA) Notification and amendments under Environment (Protection) Act (EPA), 1986. Proposed project falls under

"Category A" as per the notification issued on 14th September 2006 by MOEF as expansion of environmental clearance procedure and amended thereof. Though, according to the Office Memorandum File No.-IA3-22/10/2022-IA.III dated 11th April 2022 of MoEF & CC, Public hearing/Public consultation is exempted for the expansion project where no additional land acquisition or forest land diversion are involved.

Location of the Project

The Gangaramchak-Bhadulia Opencast Coal Mining Project represents an isolated narrow elongated strip of coal bearing sediments of about 9 km in length in Trans-Hingla area of the Raniganj Coalfield in the district of Birbhum, West Bengal. The block is defined by the latitudes 23°48'20.812"N to 23°49'28.016"N and longitudes 87°12'20.292"E to 87°13'52.172"E. It is included in the Survey of India Topo Sheet No. 73M/1. Administratively the Block falls under Khoyrasol Police Station of Birbhum district in West Bengal State.

The coal block is covered within six villages of Birbhum district namely Gangarampur, Bastabpur, Bhadulia, Sahepur, Sagarbhanga and Ahmedpur.

The area is approachable by road only. The Khayrasole-Panchra road connects the block with the Raniganj - Suri Road, (NH-14) at Panchra. Another unmetalled road connects both Gangaramchak and Bhadulia Collieries, at Khayrasole. Raswan Railway Station, on the Andal-Palasthali section of the Eastern Railway, is located about 4 km south west of the block. Kazi Nazrul Islam Airport is situated about 22 km (aerial distance) away from the project site. The district head quarter is at Suri which is located about 45 km away (aerial distance). There are no mines present adjacent to the Gangaramchak-Bhadulia Opencast Coal Mining Project.

Demography

Demography is one of the important indicators of environmental health of an area. It includes population, sex ratio, number of households, literacy, population density, etc. In order to assess the Demographic & Socio-economic features of the area, Census data 2011, for the concerned 3 districts namely Birbhum & Burdhaman of West Bengal and Jamtara of Jharkhand state respectively was compiled and placed in the form of tabulation and graphical representation.

Demography of the Birbhum District

As per the census records 2011, the total population of Birbhum district as per 2011 Census is 35, 02,404 out of which 30, 52,956 reside in rural areas and 4,49,448 are from urban areas.

Decadal growth rate was observed as 16.1% during the decade of 2001-11. Rural decadal growth rate has followed a similar trend and reached to 10.7% in 2001-11 from 34.8% of 1951-61 after few ups and downs. The density of total population of the district has increased from 320 per sq. km. in 1961 Census to 771 per sq. km. in 2011 Census. The sex ratio of district Birbhum in 2011

Census is 956 of which rural is 955 and urban is higher than that of total and rural with 963.

The total Work Participation Rate of the district has remained slightly higher than State average since independence with exceptions in Census 1961, 1971 and 2011 when district averages (31.2, 26.7 and

38.0 respectively) were lower than the State (33.2, 27.9 and 38.1 respectively). The rural areas also follow a similar trend with exception in 1961, 1971 and 2011. In Census 2011, the district Work Participation Rates for total, rural and urban areas were 38.0, 38.3 and 36.3 respectively.

The literacy rate for the State has increased from 25.0% in 1951 to 76.3% in 2011 whereas for the district it has increased 19.9% in 1951 to 70.9% in 2011 Census.

Religion

According to 2011 Indian census, Hindus formed around 62% of the total population and Muslims over 37%. Muslims are in majority in Murarai I (58.92%), Murarai II (75.00%) and Nalhati II (70.10%) CD blocks in the northeast of the district, and have a significant presence in Nalhati-I (46.64%), Rampurhat-II (48.20%), and Ilambazar (47.40%) CD blocks. Others, including religious groups and non-religion population fall below 1% of the population.[39] In the 2001 Indian census of the district, Hindus formed around 65% of the population while 33% were Muslims. There is a sprinkling of other religious groups in the population.

Mother Tongue

The population by mother tongue for *Birbhum district* since 1961. It is observed from the Table that as per Census 2001, Bengali is the mother tongue for 91.9% of the population of the district followed by Santali (at 5.9%). Only 1.2% of the population of the district have returned their mother tongue as Hindi. The percentage of population reported Bengali as a mother tongue has increased from 90.5% in 1961 Census to 91.9% in 2001 Census but the percentage of population reported Santali as mother tongue has decreased from 6.9% in 1961 Census to 5.9% in 2001.

Methodology

In order to assess the Demographic & Socio-economic features along with the 10km distance based on field surveys and public consultations undertaken during the baseline field study period and Census records 2011, for the concerned 3 districts named Birbhum & Burdhaman of West Bengal and Jamtara of Jharkhand state respectively was compiled and placed in the form of tabulation and graphical representation. Entire study area is observed predominantly rural.

Secondary data have been collected from Census Records, 2011. A field survey has also been conducted within the study area. The parameters selected under socio economic component were, demography structure of the study area,

provision of basic amenities, welfare facilities, health status and quality of life. Relevant information collected from selected villages has been critically analysed.

Purpose of the Study

Socio-economic study was conducted to establish the baseline demographic features and impacts due to this "Coal Mining Project", as operation phase of any project invariably leads to Socio-economic changes. The construction phase of any kind of project could lead to unplanned and haphazard development of slums of various size and description with little or rudimentary.

TABLE C3-38: RURAL & URBAN POPULATION DISTRIBUTION(10 KM)

Zone	No. of Households	Total Population			Scheduled Castes			Scheduled Tribes		
		Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
Rural	37730	168682	87071	81611	53697	27594	26103	8809	4411	4398
%age	94.0%	94.0%	94.0%	94.0%	92.5%	92.6%	92.4%	91.6%	91.6%	91.5%
Urban	2468	10750	5532	5218	4366	2204	2162	813	406	407
%age	6.0%	6.0%	6.0%	6.0%	7.5%	7.4%	7.6%	8.4%	8.4%	8.5%
Total (10km)	40198	179432	92603	86829	58063	29798	28265	9622	4817	4805
Source-Census of India, 2011										

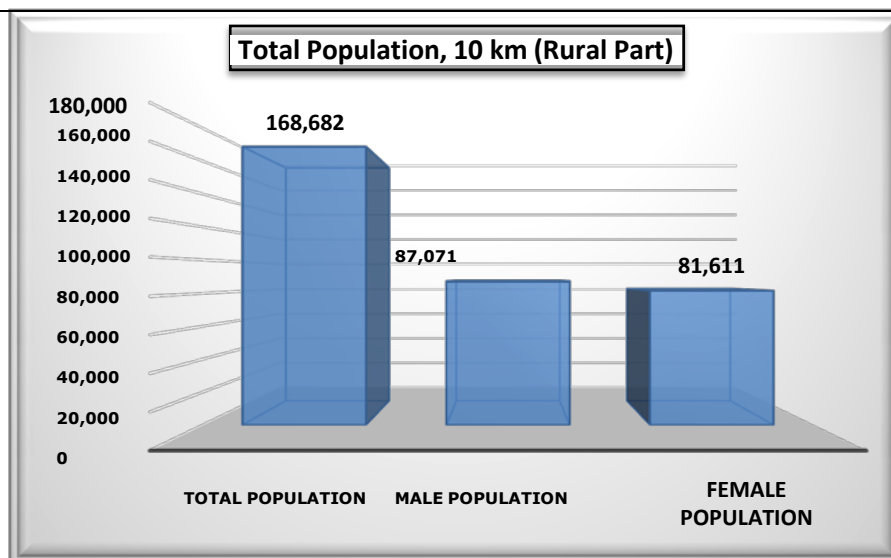


Figure C3-25: Male-Female wise Rural Population Distribution

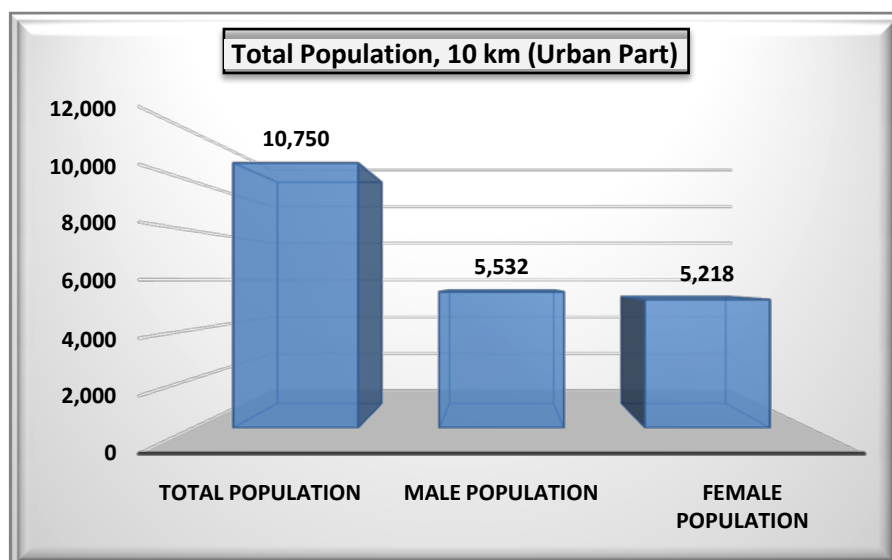


Figure C3-26: Male-Female wise Urban Population Distribution

Village wise details of population distribution are given as follows in **Table C3-39 & Table C3-40**

TABLE C3-39: VILLAGE-WISE POPULATION DISTRIBUTION (10KM STUDY ZONE)

Name of Village/Town	No of Households	Total Population			Child Population (0-6 Years)		
		Total	Male	Female	Total	Male	Female
Chandidaspur	41	207	117	90	47	21	26
Uttar Madanpur		Uninhabited Village					
Kapastari	200	958	462	496	140	59	81
Modipakri		Uninhabited Village					
Kailakuri	93	430	232	198	36	20	16
Belsara	251	1023	554	469	75	42	33
Panch Pukhuria		Uninhabited Village					
Katapalan	34	154	85	69	11	6	5
Saljor	70	317	168	149	42	24	18
Dhasunia	59	297	148	149	47	22	25
Putka	174	835	436	399	112	62	50
Ekuria	140	651	340	311	95	56	39
Gopalpur	197	885	464	421	96	51	45

Kunduakori	Uninhabited Village						
Aliat	364	1812	907	905	246	124	122
Amlakuri	157	773	402	371	128	58	70
Haripur	100	511	259	252	75	38	37
Budhpur	357	1968	973	995	336	167	169
Anandanagar	279	1022	525	497	119	52	67
Lokpur	911	4018	2022	1996	433	213	220
Mautara	Uninhabited Village						
Purbba Shibpur	263	1213	603	610	183	79	104
Bandagal	Uninhabited Village						
Dholasimul	Uninhabited Village						
Harinajol	53	281	137	144	30	16	14
Bhaddi	305	1298	672	626	164	80	84
Kamalpur	162	690	358	332	74	44	30
Karidha	150	552	287	265	61	28	33
Mankara	Uninhabited Village						
Demurtita	227	977	501	476	163	80	83
Demuria	285	1072	566	506	133	74	59
Kunda	Uninhabited Village						
Nichinta	135	604	318	286	65	41	24
Charigram	67	286	143	143	26	9	17
Chhora	216	925	471	454	78	35	43
Bara Ghata	158	620	309	311	95	42	53
Perua Gopalpur	342	1521	792	729	173	96	77
Katari	Uninhabited Village						
Chandidaspur	Uninhabited Village						
Mujrakonda	Uninhabited Village						
Perua	Uninhabited Village						
Rupaspur	319	1232	632	600	162	94	68
Kodalikana	Uninhabited Village						
Chuagar	207	727	379	348	85	46	39
Niga	77	330	170	160	35	20	15

Paratia	98	360	184	176	48	21	27
Maynabuni	52	243	117	126	35	17	18
Dejuri	Uninhabited Village						
Bara Ban	787	3845	1958	1887	526	261	265
Kondamasuri	27	124	60	64	30	15	15
Upar Banda	Uninhabited Village						
Raypur	79	379	181	198	73	34	39
Chalunebar	Uninhabited Village						
Kharikabad	278	1324	665	659	182	96	86
Kechkechia	Uninhabited Village						
Jhatibona	Uninhabited Village						
Jahidpur	174	684	349	335	95	48	47
Hatikata	88	356	182	174	46	25	21
Bhurjora	Uninhabited Village						
Uttar Hazaratpur	Uninhabited Village						
Ahmadpur	37	159	70	89	31	9	22
Sahebpur	Uninhabited Village						
Bhadulia	454	1979	1006	973	239	127	112
Bastabpur	172	749	384	365	114	51	63
Paschim Sibpur	Uninhabited Village						
Gangpur	172	799	437	362	123	67	56
Gangarampur	Uninhabited Village						
Sagarbhanga	245	1203	633	570	176	103	73
Madanpur	Uninhabited Village						
Bataspur	92	406	217	189	43	21	22
Hanulia	88	360	191	169	43	19	24
Palashbumi	261	1201	597	604	137	65	72
Tilshur	94	403	211	192	64	30	34
Kese	237	1079	562	517	165	94	71
Barajor	290	1295	671	624	142	73	69
Krishnapur	258	1188	617	571	119	63	56
Mahammadpur	84	349	179	170	39	23	16

Chak Gobinda	Uninhabited Village						
Domahatat	Uninhabited Village						
Purba Barkola	344	1412	725	687	198	99	99
Kendgara	435	2110	1124	986	245	136	109
Pansuri	265	1086	555	531	113	62	51
Sarsa	Uninhabited Village						
Laubere	360	1465	746	719	135	68	67
Naopara	579	2658	1389	1269	434	223	211
Shilabatpur	3	14	7	7	5	3	2
Naxrakanda	627	2683	1357	1326	345	178	167
Sermara	243	1019	530	489	115	70	45
Puratan Nagrakonda	152	635	322	313	62	28	34
Birjuri	27	111	56	55	4	3	1
Khayrashoal	788	3313	1709	1604	334	185	149
Shiarsol	15	55	28	27	4	4	0
Bhangaband	113	484	227	257	81	30	51
Bagashola	410	1718	855	863	198	101	97
Maynadal	308	1512	772	740	192	95	97
Jamrand	165	866	465	401	90	47	43
Churar	264	1194	630	564	139	72	67
Matiala	Uninhabited Village						
Jamalchak	Uninhabited Village						
Gaharakuri	41	157	87	70	11	6	5
Shrirampur	458	1727	887	840	214	119	95
Mahuribasa	Uninhabited Village						
Bansayer	195	876	451	425	126	74	52
Geruapahari	220	955	492	463	133	64	69
Penchalia	320	1327	684	643	178	92	86
Manjuria	Uninhabited Village						
Kanakpur	Uninhabited Village						
Babuirjor	771	3038	1596	1442	333	176	157
Ilamkuri	226	981	520	461	111	56	55

Hariektala	517	2362	1240	1122	321	170	151
Dhulkomra	44	241	121	120	56	22	34
Barra	2223	10798	5578	5220	1490	745	745
Arjjunshuli	53	243	125	118	36	22	14
Parsundi	601	2726	1442	1284	352	193	159
Paschim Barkola	242	1220	644	576	171	98	73
Tamra	290	1190	628	562	140	77	63
Maldiha	31	118	62	56	18	8	10
Bheleni	248	1041	563	478	126	68	58
Beinui	146	714	382	332	139	76	63
Barjadihi	Uninhabited Village						
Jamalpur	185	985	504	481	155	72	83
Meherpur	135	651	347	304	77	45	32
Gohalia	Uninhabited Village						
Simuldihi	97	474	248	226	90	55	35
Arazi Jamalpur	76	340	173	167	36	17	19
Nabasan	564	2498	1320	1178	297	162	135
Kathi	344	1791	910	881	303	155	148
Khajuria	3	25	13	12	3	0	3
Khalajuri	4	25	14	11	2	1	1
Ruppur	2	16	8	8	1	1	0
Kankartala	683	3390	1747	1643	453	245	208
Binodpur	137	605	308	297	73	39	34
Sira	254	1209	639	570	146	74	72
Nalgara	63	317	169	148	32	16	16
Palpai	717	2937	1549	1388	289	152	137
Rasa	931	4037	2097	1940	449	240	209
Panjeala	Uninhabited Village						
Sahapur	531	2597	1307	1290	469	231	238
Mundira	319	1439	731	708	171	81	90
Ichhabpur	Uninhabited Village						
Bhurachak	Uninhabited Village						

Dakshin Hazaratur	696	3420	1798	1622	373	191	182
Bagdiha	463	2000	1042	958	211	103	108
Bhuri	686	2965	1529	1436	334	162	172
Semalya	738	3395	1764	1631	404	220	184
Chhatrish Ganda	641	2894	1488	1406	369	185	184
Kendra Khottamdi (CT) (Part)-I	917	3875	1961	1914	439	222	217
Kendra Khottamdi (CT) (Part)-II	1551	6875	3571	3304	712	358	354
Piarsola	38	194	99	95	30	19	11
Kaliapathar	84	422	205	217	79	42	37
Eklabpur	145	664	347	317	89	56	33
Bahadurdi	130	558	281	277	95	52	43
Gramdanga	42	175	91	84	35	20	15
Kallathol	29	119	59	60	24	12	12
Beldanga	48	198	102	96	38	23	15
Nutandih	Uninhabited Village						
Andarsola	68	318	161	157	43	20	23
Kharna Chak	Uninhabited Village						
Piarsola	8	41	16	25	9	2	7
Jambad	55	240	124	116	38	19	19
Ghormara	89	446	230	216	74	36	38
Chak Katoria	Uninhabited Village						
Jamkanali	Uninhabited Village						
Lakhiabad	Uninhabited Village						
Bardhandangal	160	631	335	296	74	41	33
Paharpur	122	545	284	261	80	44	36
Afzalpur	380	1606	842	764	205	119	86
Kharikabad	30	129	70	59	21	14	7
Husunnagar	89	341	169	172	46	22	24
Lakhanpur	2	9	4	5	0	0	0
Saguna	20	92	45	47	18	9	9

Shyambathan	78	370	198	172	60	36	24
Mahijor	44	204	95	109	33	17	16
Simul Konda	167	588	291	297	86	42	44
Bankata	59	258	131	127	42	21	21
Saldaha	201	798	419	379	122	75	47
Siarsuli	183	757	400	357	92	44	48
Chandrabad	70	281	150	131	33	18	15
Baghasol	28	127	65	62	22	11	11
Krisnabandi	42	187	88	99	28	15	13
Satki	357	1665	873	792	252	137	115
Amba	609	2617	1370	1247	321	167	154
Kaliganj	40	161	85	76	27	13	14
Kalikasuli	37	155	79	76	26	12	14
Kunarpur	17	69	37	32	12	4	8
Bikrampur	475	2110	1107	1003	356	176	180
Kathijoria	138	649	337	312	100	55	45
Chakalthathal	32	142	58	84	14	7	7
Bara Akna	122	497	237	260	58	24	34
Jambad	8	29	17	12	2	2	0
Bhursa Kuri	Uninhabited Village						
Nij Mandhara	156	763	395	368	98	64	34
Charsola	Uninhabited Village						
Chandarpur	164	719	367	352	113	59	54
Marbhanga	63	269	144	125	31	18	13
Amdubi	179	746	401	345	106	58	48
Naikapur	200	923	491	432	108	63	45
Kali Pathar	174	844	447	397	116	75	41
Thalpota	55	272	126	146	44	18	26
Sagunibasa	132	644	334	310	99	54	45
Bagdahari	595	2451	1257	1194	296	138	158
Janardanpur	77	316	161	155	34	15	19
Janardanpur Chhit	Uninhabited Village						

Chuadaha	182	889	414	475	122	48	74
Sikandarpur	103	482	252	230	86	50	36
Patjor	82	381	191	190	47	22	25
Asatganj	Uninhabited Village						
Bheladi	96	439	224	215	60	28	32
Chhola Beria	293	1289	666	623	178	98	80
Chak Kamlasoli	Uninhabited Village						
Sikandarpur Chhit	1	1	1	0	0	0	0
Muraberia	479	2129	1092	1037	288	153	135
TOTAL (10km)	40198	179432	92603	86829	23082	11945	11137
Source-Census of India, 2011							

**TABLE C3-40: VILLAGE-WISE SC & ST POPULATION DISTRIBUTION
(10KM STUDY ZONE)**

Name of Village/Town	Total Population	Scheduled Castes			Scheduled Tribes		
		Persons	Males	Females	Persons	Males	Females
Chandidaspur	207	0	0	0	203	114	89
Uttar Madanpur	Uninhabited Village						
Kapastari	958	187	91	96	0	0	0
Modipakri	Uninhabited Village						
Kailakuri	430	60	34	26	0	0	0
Belsara	1023	756	415	341	0	0	0
Panch Pukhuria	Uninhabited Village						
Katapalan	154	77	46	31	0	0	0
Saljor	317	153	81	72	0	0	0
Dhasunia	297	173	83	90	0	0	0
Putka	835	310	164	146	0	0	0
Ekuria	651	310	164	146	189	90	99
Gopalpur	885	369	197	172	0	0	0
Kunduakori	Uninhabited Village						
Aliat	1812	472	241	231	0	0	0

Amlakuri	773	289	150	139	0	0	0
Haripur	511	23	14	9	0	0	0
Budhpur	1968	181	97	84	0	0	0
Anandanagar	1022	370	198	172	0	0	0
Lokpur	4018	1700	846	854	3	2	1
Mautara	Uninhabited Village						
Purbba Shibpur	1213	254	118	136	211	116	95
Bandagal	Uninhabited Village						
Dholasimul	Uninhabited Village						
Harinajol	281	14	7	7	0	0	0
Bhaddi	1298	547	263	284	0	0	0
Kamalpur	690	175	92	83	0	0	0
Karidha	552	285	137	148	0	0	0
Mankara	Uninhabited Village						
Demurtita	977	316	160	156	0	0	0
Demuria	1072	568	302	266	0	0	0
Kunda	Uninhabited Village						
Nichinta	604	298	158	140	0	0	0
Charigram	286	213	108	105	2	0	2
Chhora	925	208	101	107	0	0	0
Bara Ghata	620	555	279	276	0	0	0
Perua Gopalpur	1521	841	434	407	0	0	0
Katari	Uninhabited Village						
Chandidaspur	Uninhabited Village						
Mujrakonda	Uninhabited Village						
Perua	Uninhabited Village						
Rupaspur	1232	942	489	453	0	0	0
Kodalikana	Uninhabited Village						
Chuagar	727	384	199	185	0	0	0
Niga	330	273	137	136	9	7	2
Paratia	360	229	111	118	0	0	0
Maynabuni	243	115	55	60	0	0	0

Dejuri	Uninhabited Village						
Bara Ban	3845	156	81	75	0	0	0
Kondamasuri	124	9	3	6	0	0	0
Upar Banda	Uninhabited Village						
Raypur	379	245	120	125	0	0	0
Chalunebar	Uninhabited Village						
Kharikabad	1324	269	130	139	0	0	0
Kechkechia	Uninhabited Village						
Jhatibona	Uninhabited Village						
Jahidpur	684	480	241	239	0	0	0
Hatikata	356	356	182	174	0	0	0
Bhurjora	Uninhabited Village						
Uttar Hazaratpur	Uninhabited Village						
Ahmadpur	159	0	0	0	158	69	89
Sahebpur	Uninhabited Village						
Bhadulia	1979	847	435	412	0	0	0
Bastabpur	749	404	211	193	124	63	61
Paschim Sibpur	Uninhabited Village						
Gangpur	799	367	203	164	0	0	0
Gangarampur	Uninhabited Village						
Sagarbhanga	1203	935	498	437	5	3	2
Madanpur	Uninhabited Village						
Bataspur	406	107	55	52	0	0	0
Hanulia	360	213	109	104	0	0	0
Palashbuni	1201	529	262	267	0	0	0
Tilshur	403	53	27	26	185	93	92
Kese	1079	213	108	105	0	0	0
Barajor	1295	789	410	379	0	0	0
Krishnapur	1188	282	140	142	145	74	71
Mahammadpur	349	220	111	109	0	0	0
Chak Gobinda	Uninhabited Village						
Domahatat	Uninhabited Village						

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Purba Barkola	1412	1109	572	537	0	0	0
Kendgara	2110	606	326	280	0	0	0
Pansuri	1086	559	288	271	0	0	0
Sarsa	Uninhabited Village						
Laubere	1465	214	111	103	0	0	0
Naopara	2658	589	304	285	0	0	0
Shilabatpur	14	14	7	7	0	0	0
Naxrakanda	2683	1476	738	738	56	33	23
Sermara	1019	837	439	398	0	0	0
Puratan Nagrakonda	635	315	158	157	0	0	0
Birjuri	111	5	3	2	6	2	4
Khayrashoal	3313	1408	726	682	0	0	0
Shiarsol	55	0	0	0	0	0	0
Bhangaband	484	53	27	26	389	179	210
Bagashola	1718	310	149	161	305	155	150
Maynadal	1512	738	376	362	11	4	7
Jamrand	866	354	185	169	0	0	0
Churar	1194	389	191	198	0	0	0
Matiala	Uninhabited Village						
Jamalchak	Uninhabited Village						
Gaharakuri	157	12	6	6	0	0	0
Shrirampur	1727	500	257	243	6	4	2
Mahuribasa	Uninhabited Village						
Bansayer	876	124	64	60	222	112	110
Geruapahari	955	114	57	57	429	212	217
Penchalia	1327	197	101	96	2	2	0
Manjuria	Uninhabited Village						
Kanakpur	Uninhabited Village						
Babuirjor	3038	1008	522	486	0	0	0
Ilamkuri	981	524	278	246	0	0	0
Hariektala	2362	277	136	141	0	0	0
Dhulkomra	241	0	0	0	0	0	0

Barra	10798	1956	1006	950	2	2	0
Arjjunshuli	243	163	87	76	0	0	0
Parsundi	2726	1934	1011	923	1	1	0
Paschim Barkola	1220	499	263	236	0	0	0
Tamra	1190	253	136	117	0	0	0
Maldiha	118	113	60	53	0	0	0
Bheleni	1041	686	359	327	0	0	0
Beinui	714	354	184	170	4	2	2
Barjadihi	Uninhabited Village						
Jamalpur	985	0	0	0	0	0	0
Meherpur	651	209	110	99	0	0	0
Gohalia	Uninhabited Village						
Simuldihi	474	468	243	225	1	1	0
Arazi Jamalpur	340	135	67	68	0	0	0
Nabasan	2498	1135	591	544	0	0	0
Kathi	1791	139	60	79	0	0	0
Khajuria	25	0	0	0	0	0	0
Khalajuri	25	0	0	0	0	0	0
Ruppur	16	0	0	0	0	0	0
Kankartala	3390	561	271	290	98	46	52
Binodpur	605	258	130	128	0	0	0
Sira	1209	426	228	198	0	0	0
Nalgara	317	128	74	54	0	0	0
Palpai	2937	1015	533	482	6	4	2
Rasa	4037	1997	1051	946	113	60	53
Panjeala	Uninhabited Village						
Sahapur	2597	240	108	132	2	1	1
Mundira	1439	674	346	328	8	6	2
Ichhabpur	Uninhabited Village						
Bhurachak	Uninhabited Village						
Dakshin Hazaratur	3420	389	199	190	0	0	0
Bagdiha	2000	638	343	295	0	0	0

Bhuri	2965	876	444	432	175	90	85
Semalya	3395	1297	668	629	350	178	172
Chhatrish Ganda	2894	1521	762	759	309	154	155
Kendra Khottamdi (CT) (Part)-I	3875	1103	528	575	362	177	185
Kendra Khottamdi (CT) (Part)-II	6875	3263	1676	1587	451	229	222
Piarsola	194	0	0	0	21	12	9
Kaliapathar	422	0	0	0	414	199	215
Eklabpur	664	11	6	5	398	204	194
Bahadurdi	558	0	0	0	0	0	0
Gramdanga	175	0	0	0	175	91	84
Kallathol	119	0	0	0	103	51	52
Beldanga	198	0	0	0	198	102	96
Nutandih	Uninhabited Village						
Andarsola	318	0	0	0	0	0	0
Kharna Chak	Uninhabited Village						
Piarsola	41	0	0	0	5	1	4
Jambad	240	0	0	0	240	124	116
Ghormara	446	15	7	8	20	12	8
Chak Katoria	Uninhabited Village						
Jamkanali	Uninhabited Village						
Lakhiabad	Uninhabited Village						
Bardhandangal	631	195	93	102	0	0	0
Paharpur	545	288	150	138	11	3	8
Afzalpur	1606	553	276	277	8	2	6
Kharikabad	129	127	69	58	0	0	0
Husunnagar	341	94	46	48	1	1	0
Lakhanpur	9	0	0	0	0	0	0
Saguna	92	1	1	0	91	44	47
Shyambathan	370	0	0	0	98	55	43
Mahijor	204	0	0	0	0	0	0

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Simul Konda	588	44	20	24	144	75	69
Bankata	258	0	0	0	233	119	114
Saldaha	798	305	153	152	1	1	0
Siarsuli	757	92	48	44	0	0	0
Chandrabad	281	120	65	55	0	0	0
Baghasol	127	0	0	0	0	0	0
Krisnabandi	187	0	0	0	158	74	84
Satki	1665	349	179	170	0	0	0
Amba	2617	727	382	345	26	9	17
Kaliganj	161	6	2	4	0	0	0
Kalikasuli	155	70	39	31	0	0	0
Kunarpur	69	0	0	0	0	0	0
Bikrampur	2110	131	63	68	0	0	0
Kathijoria	649	176	93	83	0	0	0
Chakalthathal	142	0	0	0	142	58	84
Bara Akna	497	25	11	14	2	0	2
Jambad	29	0	0	0	29	17	12
Bhursa Kuri	Uninhabited Village						
Nij Mandhara	763	165	83	82	21	10	11
Charsola	Uninhabited Village						
Chandarpur	719	162	85	77	0	0	0
Marbhanga	269	60	29	31	0	0	0
Amdubi	746	288	156	132	0	0	0
Naikapur	923	22	9	13	278	155	123
Kali Pathar	844	0	0	0	167	87	80
Thalpota	272	0	0	0	260	122	138
Sagunibasa	644	0	0	0	495	257	238
Bagdahari	2451	528	268	260	255	121	134
Janardanpur	316	36	18	18	94	44	50
Janardanpur Chhit	Uninhabited Village						
Chuadaha	889	143	61	82	189	77	112
Sikandarpur	482	225	121	104	245	125	120

Patjor	381	28	16	12	351	175	176
Asatganj	Uninhabited Village						
Bheladi	439	50	24	26	0	0	0
Chhola Beria	1289	393	207	186	2	2	0
Chak Kamlasoli	Uninhabited Village						
Sikandarpur Chhit	1	0	0	0	0	0	0
Muraberia	2129	351	162	189	205	103	102
TOTAL (10km)	179432	58063	29798	28265	9622	4817	4805
<i>Source-Census of India, 2011</i>							

Sex Ratio

The 'Sex Ratio' of the study area is a numeric relationship between females and males of an area and bears paramount importance in the present day scenario where the un-ethnic pre-determination of sex and killing of female foetus during pregnancy is practiced by unscrupulous medical practitioners against the rule of the law of the country.

The 'Sex Ratio' was seen as 956 females per 1000 males in the Birbhum District. The same was recorded as 938 females for every 1000 males in the area. The child (0-6 year age) sex ratio of the study area was observed as 932 female children per 1000 male children.

The village wise male-female population distribution for the study area is depicted and shown by graphical representation in **Figure C3-27**.

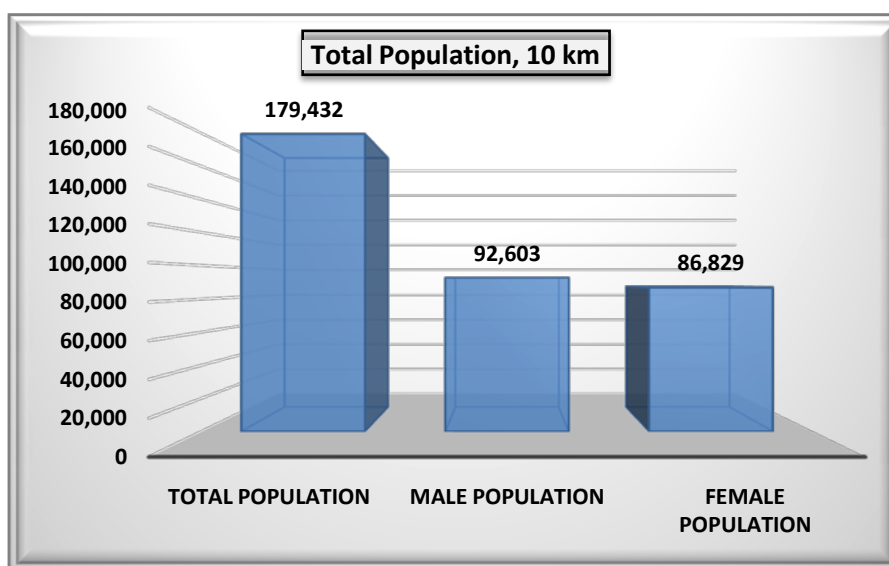


Figure C3-27: Male-Female wise Population Distribution Scheduled Caste & Scheduled Tribe Population

On the basis of the village wise SC & ST population distribution of the study area during 2011, the 'Scheduled Castes' population was observed as 58063 persons consisting of 29798 males and 28265 females respectively in the study area which accounts as 32.4% to the total population (179432 persons) of the study area. Scheduled Tribes ('ST') population was observed as 9622 persons, accounts as 5.4% to the total population of the study zone consisting of 4817 males and 4805 females in the 10 km radius study zone. It implies that the rest 62.2% of the total population belongs to the general category.

Male-female wise distribution of 'SC' & 'ST' population in the study area is graphically shown in **Figure C3-28 & Figure C3-29** as follows.

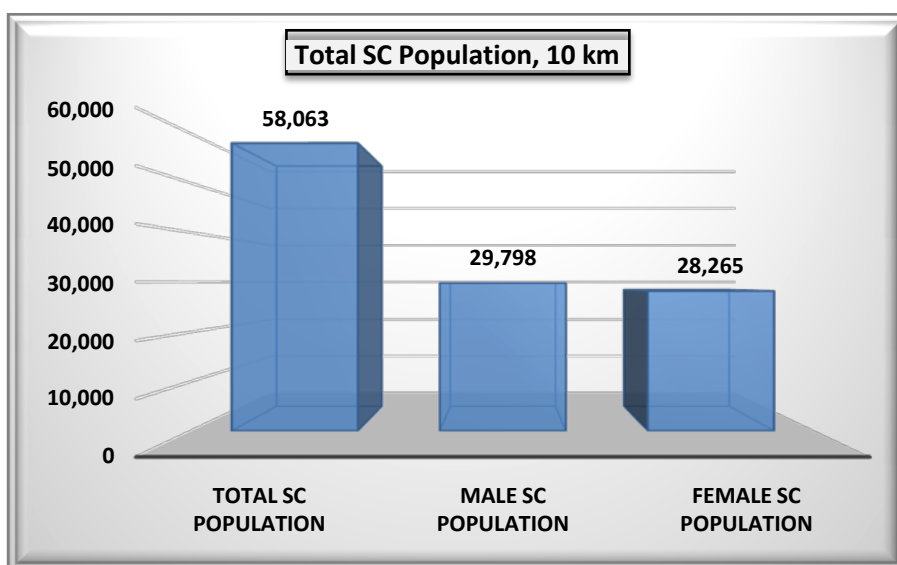


Figure C3-28: Scheduled Caste Population in the Study Area

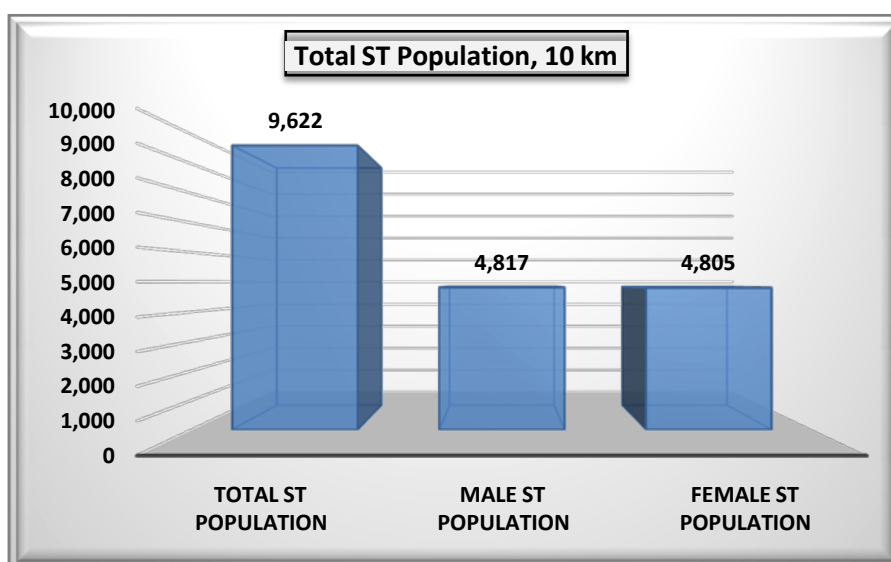


Figure C3-29: Scheduled Tribes Population in the Study Area

Literacy Rate

Literacy level is quantifiable indicator to assess the development status of an area or region. Male- Female wise literates and illiterates population is represented in **Table C3-41**. Total literates population was recorded as 107656 persons (60.0%) in the study area. **Table C3-41**. reveals that Male- Female wise literates are observed as 62977 & 44679 persons respectively, implies that the 'Literacy Rate' is recorded as 38.8% with male-female wise percentages being 35.0% & 25.0% respectively.

The Male-Female wise graphical representation of literates & illiterates population in study area villages/town is shown in **Figure C3-30**.

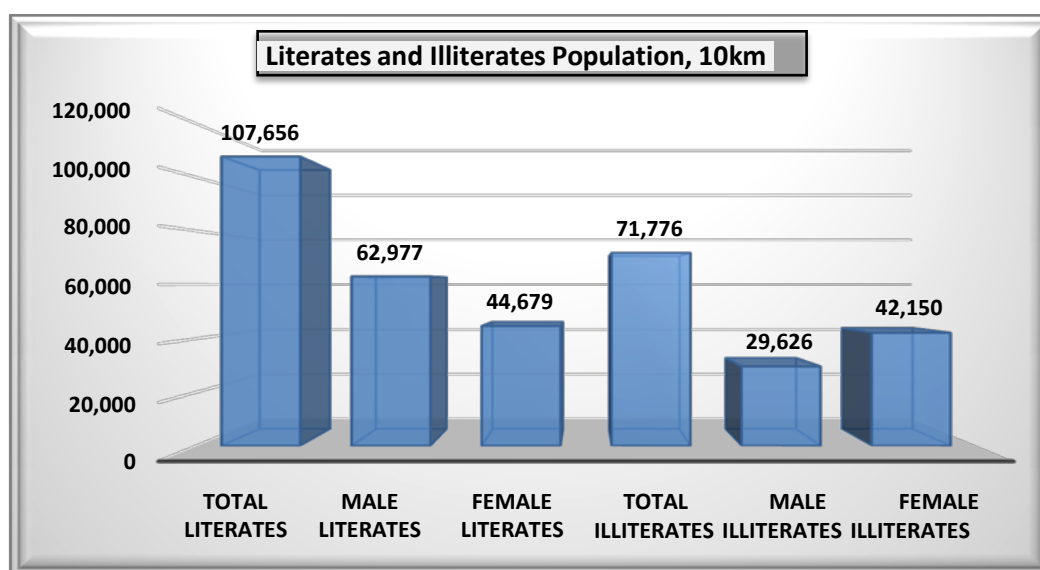


Figure C3-30: Male-Female wise Distribution of Literates & Illiterates

TABLE C3-41: MALE-FEMALE WISE LITERATES AND ILLITERATES (10KM)

Name of Village/Town	Total Population	Literates			Illiterates		
		Person	Male	Female	Person	Male	Female
Chandidaspur	207	49	39	10	158	78	80
Uttar Madanpur	Uninhabited Village						
Kapastari	958	557	300	257	401	162	239
Modipakri	Uninhabited Village						
Kailakuri	430	287	177	110	143	55	88
Belsara	1023	743	463	280	280	91	189
Panch Pukhuria	Uninhabited Village						
Katapalan	154	115	75	40	39	10	29
Saljor	317	237	141	96	80	27	53

Dhasunia	297	214	115	99	83	33	50
Putka	835	534	316	218	301	120	181
Ekuria	651	389	226	163	262	114	148
Gopalpur	885	599	343	256	286	121	165
Kunduakori	Uninhabited Village						
Aliat	1812	782	443	339	1030	464	566
Amlakuri	773	354	249	105	419	153	266
Haripur	511	286	168	118	225	91	134
Budhpur	1968	962	556	406	1006	417	589
Anandanagar	1022	645	381	264	377	144	233
Lokpur	4018	2614	1463	1151	1404	559	845
Mautara	Uninhabited Village						
Purbba Shibpur	1213	532	346	186	681	257	424
Bandagal	Uninhabited Village						
Dholasimul	Uninhabited Village						
Harinajol	281	207	108	99	74	29	45
Bhaddi	1298	774	465	309	524	207	317
Kamalpur	690	429	242	187	261	116	145
Karidha	552	302	192	110	250	95	155
Mankara							
Demurtita	977	415	239	176	562	262	300
Demuria	1072	497	308	189	575	258	317
Kunda	Uninhabited Village						
Nichinta	604	381	214	167	223	104	119
Charigram	286	162	91	71	124	52	72
Chhora	925	684	387	297	241	84	157
Bara Ghata	620	267	170	97	353	139	214
Perua Gopalpur	1521	1007	573	434	514	219	295
Katari	Uninhabited Village						
Chandidaspur	Uninhabited Village						
Mujrakonda	Uninhabited Village						
Perua	Uninhabited Village						

Rupaspur	1232	669	408	261	563	224	339
Kodalikana	Uninhabited Village						
Chuagar	727	509	303	206	218	76	142
Niga	330	195	115	80	135	55	80
Paratia	360	255	143	112	105	41	64
Maynabuni	243	118	67	51	125	50	75
Dejuri	Uninhabited Village						
Bara Ban	3845	2113	1179	934	1732	779	953
Kondamasuri	124	38	20	18	86	40	46
Upar Banda	Uninhabited Village						
Raypur	379	173	102	71	206	79	127
Chalunebar	Uninhabited Village						
Kharikabad	1324	660	372	288	664	293	371
Kechkechia	Uninhabited Village						
Jhatibona	Uninhabited Village						
Jahidpur	684	433	250	183	251	99	152
Hatikata	356	194	121	73	162	61	101
Bhurjora	Uninhabited Village						
Uttar Hazaratpur	Uninhabited Village						
Ahmadpur	159	41	22	19	118	48	70
Sahebpur	Uninhabited Village						
Bhadulia	1979	1278	737	541	701	269	432
Bastabpur	749	367	245	122	382	139	243
Paschim Sibpur	Uninhabited Village						
Gangpur	799	457	300	157	342	137	205
Gangarampur	Uninhabited Village						
Sagarbhangra	1203	640	393	247	563	240	323
Madanpur	Uninhabited Village						
Bataspur	406	275	155	120	131	62	69
Hanulia	360	247	151	96	113	40	73
Palashbuni	1201	775	446	329	426	151	275
Tilshur	403	238	140	98	165	71	94

Kese	1079	588	332	256	491	230	261
Barajor	1295	794	481	313	501	190	311
Krishnapur	1188	783	465	318	405	152	253
Mahammadpur	349	226	137	89	123	42	81
Chak Gobinda	Uninhabited Village						
Domahatat	Uninhabited Village						
Purba Barkola	1412	651	395	256	761	330	431
Kendgara	2110	1365	799	566	745	325	420
Pansuri	1086	678	403	275	408	152	256
Sarsa	Uninhabited Village						
Laubere	1465	1201	651	550	264	95	169
Naopara	2658	1517	884	633	1141	505	636
Shilabatpur	14	4	2	2	10	5	5
Naxrakanda	2683	1723	1003	720	960	354	606
Sermara	1019	627	372	255	392	158	234
Puratan Nagrakonda	635	395	234	161	240	88	152
Birjuri	111	98	51	47	13	5	8
Khayrashoal	3313	2214	1258	956	1099	451	648
Shiarsol	55	47	23	24	8	5	3
Bhangaband	484	203	119	84	281	108	173
Bagashola	1718	1147	618	529	571	237	334
Maynadal	1512	882	520	362	630	252	378
Jamrand	866	512	315	197	354	150	204
Churar	1194	750	439	311	444	191	253
Matiala	Uninhabited Village						
Jamalchak	Uninhabited Village						
Gaharakuri	157	114	74	40	43	13	30
Shrirampur	1727	963	571	392	764	316	448
Mahuribasa	Uninhabited Village						
Bansayer	876	494	308	186	382	143	239
Geruapahari	955	555	325	230	400	167	233
Penchalia	1327	766	478	288	561	206	355

Manjuria	Uninhabited Village						
Kanakpur	Uninhabited Village						
Babuirjor	3038	1908	1135	773	1130	461	669
Ilamkuri	981	568	347	221	413	173	240
Hariektala	2362	1544	913	631	818	327	491
Dhulkomra	241	120	69	51	121	52	69
Barra	10798	6568	3794	2774	4230	1784	2446
Arjjunshuli	243	156	88	68	87	37	50
Parsundi	2726	1605	970	635	1121	472	649
Paschim Barkola	1220	736	410	326	484	234	250
Tamra	1190	774	464	310	416	164	252
Maldiha	118	34	21	13	84	41	43
Bheleni	1041	487	321	166	554	242	312
Beinui	714	352	206	146	362	176	186
Barjadihi	Uninhabited Village						
Jamalpur	985	632	351	281	353	153	200
Meherpur	651	324	214	110	327	133	194
Gohalia	Uninhabited Village						
Simuldihi	474	159	96	63	315	152	163
Arazi Jamalpur	340	261	146	115	79	27	52
Nabasan	2498	1540	914	626	958	406	552
Kathi	1791	1133	623	510	658	287	371
Khajuria	25	9	6	3	16	7	9
Khalajuri	25	16	10	6	9	4	5
Ruppur	16	13	7	6	3	1	2
Kankartala	3390	2068	1163	905	1322	584	738
Binodpur	605	376	209	167	229	99	130
Sira	1209	732	452	280	477	187	290
Nalgara	317	205	119	86	112	50	62
Palpai	2937	1944	1142	802	993	407	586
Rasa	4037	2394	1392	1002	1643	705	938
Panjeala	Uninhabited Village						

Sahapur	2597	1381	781	600	1216	526	690
Mundira	1439	877	505	372	562	226	336
Ichhabpur	Uninhabited Village						
Bhurachak	Uninhabited Village						
Dakshin Hazaratur	3420	2398	1357	1041	1022	441	581
Bagdiha	2000	1371	824	547	629	218	411
Bhuri	2965	1614	976	638	1351	553	798
Semalya	3395	2088	1245	843	1307	519	788
Chhatrish Ganda	2894	1691	1010	681	1203	478	725
Kendra Khottamdi (CT) (Part)-I	3875	2191	1248	943	1684	713	971
Kendra Khottamdi (CT) (Part)-II	6875	4278	2564	1714	2597	1007	1590
Piarsola	194	95	64	31	99	35	64
Kaliapathar	422	166	93	73	256	112	144
Eklabpur	664	409	239	170	255	108	147
Bahadurdi	558	328	190	138	230	91	139
Gramdanga	175	100	58	42	75	33	42
Kallathol	119	54	33	21	65	26	39
Beldanga	198	71	43	28	127	59	68
Nutandih	Uninhabited Village						
Andarsola	318	213	124	89	105	37	68
Kharna Chak	Uninhabited Village						
Piarsola	41	23	10	13	18	6	12
Jambad	240	107	62	45	133	62	71
Ghormara	446	298	165	133	148	65	83
Chak Katoria	Uninhabited Village						
Jamkanali	Uninhabited Village						
Lakhiabad	Uninhabited Village						
Bardhandangal	631	405	246	159	226	89	137
Paharpur	545	298	173	125	247	111	136
Afzalpur	1606	930	558	372	676	284	392

Kharikabad	129	67	44	23	62	26	36
Husunnagar	341	222	120	102	119	49	70
Lakhanpur	9	6	3	3	3	1	2
Saguna	92	34	20	14	58	25	33
Shyambathan	370	187	117	70	183	81	102
Mahijor	204	102	60	42	102	35	67
Simul Konda	588	391	224	167	197	67	130
Bankata	258	139	74	65	119	57	62
Saldaha	798	443	280	163	355	139	216
Siarsuli	757	492	322	170	265	78	187
Chandrabad	281	191	115	76	90	35	55
Baghasol	127	69	48	21	58	17	41
Krisnabandi	187	96	54	42	91	34	57
Satki	1665	1101	629	472	564	244	320
Amba	2617	1762	1025	737	855	345	510
Kaliganj	161	63	40	23	98	45	53
Kalikasuli	155	83	48	35	72	31	41
Kunarpur	69	49	30	19	20	7	13
Bikrampur	2110	1162	699	463	948	408	540
Kathijoria	649	422	240	182	227	97	130
Chakalthathal	142	55	29	26	87	29	58
Bara Akna	497	336	175	161	161	62	99
Jambad	29	22	15	7	7	2	5
Bhursa Kuri	Uninhabited Village						
Nij Mandhara	763	495	283	212	268	112	156
Charsola	Uninhabited Village						
Chandarpur	719	432	247	185	287	120	167
Marbhanga	269	203	111	92	66	33	33
Amdubi	746	418	246	172	328	155	173
Naikapur	923	593	340	253	330	151	179
Kali Pathar	844	522	300	222	322	147	175
Thalpota	272	73	46	27	199	80	119

Sagunibasa	644	374	227	147	270	107	163
Bagdahari	2451	1580	887	693	871	370	501
Janardanpur	316	209	121	88	107	40	67
Janardanpur Chhit	Uninhabited Village						
Chuadaha	889	508	286	222	381	128	253
Sikandarpur	482	228	125	103	254	127	127
Patjor	381	203	124	79	178	67	111
Asatganj	Uninhabited Village						
Bheladi	439	308	185	123	131	39	92
Chhola Beria	1289	731	428	303	558	238	320
Chak Kamlasoli	Uninhabited Village						
Sikandarpur Chhit	1	1	1	0	0	0	0
Muraberia	2129	1244	743	501	885	349	536
TOTAL (10km)	179432	107657	6297	44679	71776	29626	42150
<i>Source-Census of India, 2011</i>							

Economic Profile of the District:

Birbhum district is primarily an agricultural district with around 75% of the people dependent on agriculture. While 159.3 Sq. km (61.5 sq. mi) of land is occupied by forests, 3,329.05 km² (1,285.35 sq. mi) of land is used for agricultural purposes. 91.02% of the population live in villages. Out of total 4,50,313 farmers (holding 3,20,610ha of land), 3,59,404 are marginal farmers (holding 1,41,813ha altogether), 63,374 are small farmers(holding 95,144ha altogether), 26,236 are semi-medium farmers (holding 76,998ha altogether), 1,290 are medium farmers (holding 6,215ha altogether), and 9 are large farmers (holding 440ha of land). The average size of land holding per farmer is 0.71ha. 6,07,172 persons work as agricultural laborers in Birbhum. Major crops produced in the district include rice, legumes, wheat, corn (maize), potatoes and sugar cane. The district has thirteen cold storages. Land with irrigation facilities in 2001-02 totaled 2,763.9 km² (1,067.1 sq. mi). There are five barrages, providing irrigation support. Canada Dam on the Mayurakshi River at Massanjore lies close to the border of Birbhum and the Dumka district in Jharkhand. Further down the Mayurakshi is the Tilpara Barrage at Suri.

Birbhum is a major centre of cottage industries. Perhaps the most notable cottage industry is a non- profit rural organisation named Amar Kutir. Other main industries in Birbhum are agriculture-based industries, textiles, forestry, arts and crafts. Sriniketan is noted for its dairy industry and as a forestry centre. Some of the notable forms of cottage industries of Birbhum include textile especially cotton and locally harvested tussar silk, jute works, batik, kantha stitch, macramé (weaving by knotting threads), leather, pottery and terracotta, solapith, woodcarving, bamboo and cane craft, metal works and tribal crafts. There are 8,883 small and medium scale industries. Principal industries of the district include cotton and silk harvesting and weaving, rice and oilseed milling, lac harvesting, and metalware and pottery manufacture. Bakreshwar Thermal Power Station is the only heavy industry in the district.

Sainthia is known as business capital of Birbhum and an economically important city. Sainthia is the major centre for export and import of cottage industries. Huge numbers of businesses run in this city and its economy stands tall due to sales of agricultural based products.

In 2006 the Ministry of Panchayati Raj named Birbhum one of the country's 250 most backward districts (out of a total of 640). It is one of the eleven districts in West Bengal currently receiving funds from the Backward Regions Grant Fund Programme (BRGF).

Workers Scenario:

Occupational Pattern was studied to assess the skills of people in the study area. Occupational pattern helps in identifying major economic activities of the area. In the study area the Main and Marginal Workers population was observed as 34795 (19.4%) and 30520(17.0%) to the total population (179432) while the remaining 114117(63.6%) persons were recorded as non-workers. Thus it implies that the

semi-skilled and non-skilled work-force required in study area for the project is available in aplenty.

The village-wise main and marginal workers population with further classification as casual, agricultural, households and other workers is shown as follows in **Table C3-42**.

TABLE C3-42: VILLAGE-WISE OCCUPATIONAL PATTERN IN THE STUDY AREA (10KM)

Name of the Village/Town	MAINWO RK_P	MAIN_C L_P	MAIN_AL _P	MAIN_H H_P	MAIN_O T_P	MARGWO RK_P	MARG_C L_P	MARG_A L_P	MARG_H H_P	MARG_O T_P
Chandidaspur	53	13	23	8	9	37	5	28	2	2
Uttar Madanpur	Uninhabited Village									
Kapastari	93	38	4	0	51	206	7	186	4	9
Modipakri	Uninhabited Village									
Kailakuri	141	105	3	3	30	19	0	13	1	5
Belsara	293	199	44	2	48	145	8	132	0	5
Panch Pukhuria	Uninhabited Village									
Katapalan	5	0	3	0	2	39	5	25	1	8
Saljor	67	29	26	0	12	37	19	13	0	5
Dhasunia	58	26	27	0	5	79	16	59	0	4
Putka	283	133	140	0	10	54	4	46	1	3
Ekuria	149	16	123	1	9	199	0	198	1	0
Gopalpur	274	109	122	8	35	8	0	6	0	2
Kunduakori	Uninhabited Village									
Aliat	199	22	88	32	57	345	3	272	12	58
Amlakuri	130	114	8	0	8	127	2	122	0	3
Haripur	21	11	1	3	6	91	5	1	8	77

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Budhpur	498	107	223	6	162	88	6	43	5	34
Anandanagar	86	61	5	1	19	208	36	78	36	58
Lokpur	826	79	79	149	519	451	30	137	60	224
Mautara	Uninhabited Village									
Purbba Shibpur	243	160	50	1	32	180	8	99	3	70
Bandagal	Uninhabited Village									
Dholasimul	Uninhabited Village									
Harinajol	31	2	2	0	27	30	12	7	0	11
Bhaddi	155	72	30	1	52	412	29	317	1	65
Kamalpur	137	21	82	2	32	77	1	57	1	18
Karidha	29	13	6	2	8	304	2	285	1	16
Mankara	Uninhabited Village									
Demurtita	48	14	11	1	22	313	57	204	2	50
Demuria	371	107	223	18	23	73	13	51	1	8
Kunda	Uninhabited Village									
Nichinta	208	74	100	18	16	69	3	62	2	2
Charigram	79	14	49	1	15	12	1	8	1	2
Chhora	275	54	151	0	70	48	23	5	2	18
Bara Ghata	45	39	4	0	2	169	0	162	1	6
Perua Gopalpur	343	62	83	12	186	98	1	5	0	92

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Katari	Uninhabited Village									
Chandidaspur	Uninhabited Village									
Mujrakonda	Uninhabited Village									
Perua	Uninhabited Village									
Rupaspur	270	22	98	0	150	133	8	67	4	54
Kodalikana	Uninhabited Village									
Chuagar	120	38	53	3	26	172	17	146	4	5
Niga	106	26	4	0	76	0	0	0	0	0
Paratia	14	0	0	0	14	93	0	5	0	88
Maynabuni	66	21	28	0	17	0	0	0	0	0
Dejuri	Uninhabited Village									
Bara Ban	608	202	279	11	116	649	32	586	1	30
Kondamasuri	29	7	21	0	1	4	0	3	0	1
Upar Banda	Uninhabited Village									
Raypur	104	4	98	0	2	9	0	8	0	1
Chalunebar	Uninhabited Village									
Kharikabad	272	26	217	0	29	97	64	1	0	32
Kechkechia	Uninhabited Village									
Jhatibona	Uninhabited Village									
Jahidpur	58	29	5	1	23	252	3	248	0	1

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Hatikata	99	3	88	0	8	20	0	20	0	0
Bhurjora	Uninhabited Village									
Uttar Hazaratpur	Uninhabited Village									
Ahmadpur	45	0	44	0	1	14	0	9	0	5
Sahebpur	Uninhabited Village									
Bhadulia	202	69	58	11	64	479	204	253	5	17
Bastabpur	74	29	26	0	19	197	13	172	0	12
Paschim Sibpur	Uninhabited Village									
Gangpur	100	56	25	0	19	146	39	105	0	2
Gangarampur	Uninhabited Village									
Sagarbhangra	240	53	148	4	35	199	20	155	5	19
Madanpur	Uninhabited Village									
Bataspur	17	6	1	0	10	219	3	213	0	3
Hanulia	82	5	66	0	11	35	6	27	0	2
Palashbumi	222	69	131	0	22	155	63	86	2	4
Tilshur	6	4	0	0	2	214	0	214	0	0
Kese	56	21	17	0	18	401	11	377	1	12
Barajor	353	76	138	14	125	46	8	25	1	12
Krishnapur	372	80	111	6	175	43	1	4	2	36
Mahammadpur	11	2	0	0	9	101	35	64	0	2

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Chak Gobinda	Uninhabited Village									
Domahatat	Uninhabited Village									
Purba Barkola	268	22	174	0	72	186	38	141	0	7
Kendgara	413	93	63	8	249	233	12	182	7	32
Pansuri	280	35	204	0	41	95	2	82	0	11
Sarsa	Uninhabited Village									
Laubere	477	119	31	7	320	30	0	2	0	28
Naopara	657	118	296	10	233	108	11	70	11	16
Shilabatpur	3	0	0	0	3	0	0	0	0	0
Naxrakanda	388	58	183	1	146	540	111	371	0	58
Sermara	101	6	42	6	47	377	2	314	9	52
Puratan Nagrakonda	169	75	68	0	26	84	30	2	0	52
Birjuri	32	2	2	0	28	1	0	0	0	1
Khayrashoal	972	164	86	47	675	146	10	25	7	104
Shiarsol	9	0	0	0	9	10	1	0	0	9
Bhangaband	21	0	1	0	20	257	2	64	6	185
Bagashola	353	81	125	10	137	237	95	137	0	5
Maynadal	477	67	174	13	223	17	0	10	1	6
Jamrand	234	119	53	0	62	154	43	85	0	26
Churar	586	233	107	194	52	58	1	15	9	33

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Matiala	Uninhabited Village									
Jamalchak	Uninhabited Village									
Gaharakuri	0	0	0	0	0	53	17	22	0	14
Shrirampur	295	32	214	2	47	325	31	143	50	101
Mahuribasa	Uninhabited Village									
Bansayer	208	55	130	0	23	240	11	206	0	23
Geruapahari	337	67	218	12	40	54	6	38	6	4
Penchalia	347	230	52	7	58	382	94	203	15	70
Manjuria	Uninhabited Village									
Kanakpur	Uninhabited Village									
Babuirjor	200	40	19	6	135	1008	175	675	34	124
Ilamkuri	230	94	86	1	49	134	2	116	3	13
Hariektala	590	254	238	4	94	221	6	156	34	25
Dhulkomra	53	4	1	1	47	52	2	9	23	18
Barra	2014	286	513	17	1198	1030	32	162	15	821
Arjjunshuli	1	0	0	0	1	77	18	54	2	3
Parsundi	569	265	218	0	86	418	62	292	0	64
Paschim Barkola	19	3	1	2	13	387	30	181	5	171
Tamra	158	70	4	2	82	356	28	30	6	292
Maldiha	1	0	1	0	0	41	4	0	0	37

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Bheleni	57	10	18	0	29	276	37	87	1	151
Beinui	164	63	73	15	13	91	11	64	12	4
Barjadihi	Uninhabited Village									
Jamalpur	132	80	41	2	9	165	6	156	0	3
Meherpur	179	172	1	2	4	31	1	1	0	29
Gohalia	Uninhabited Village									
Simuldihi	117	31	82	3	1	131	20	103	6	2
Arazi Jamalpur	90	47	11	14	18	32	11	16	3	2
Nabasan	697	305	177	40	175	282	97	52	24	109
Kathi	515	44	294	11	166	6	0	2	2	2
Khajuria	8	0	6	2	0	0	0	0	0	0
Khalajuri	8	0	7	0	1	0	0	0	0	0
Ruppur	3	0	3	0	0	1	0	0	0	1
Kankartala	406	57	151	6	192	534	56	320	4	154
Binodpur	180	109	64	0	7	36	13	22	0	1
Sira	378	251	23	0	104	20	4	15	0	1
Nalgara	48	16	20	1	11	83	4	45	18	16
Palpai	572	401	76	3	92	417	20	338	7	52
Rasa	738	160	414	8	156	472	48	234	16	174
Panjeala	Uninhabited Village									

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Sahapur	357	193	124	7	33	386	49	198	14	125
Mundira	66	3	21	4	38	768	12	113	93	550
Ichhabpur	Uninhabited Village									
Bhurachak	Uninhabited Village									
Dakshin Hazaratur	1002	160	163	62	617	345	9	103	28	205
Bagdiha	437	289	74	7	67	435	6	335	10	84
Bhuri	532	172	166	28	166	576	86	355	11	124
Semalya	638	62	264	4	308	514	9	361	9	135
Chhatrish Ganda	388	30	11	15	332	927	8	203	8	708
Kendra Khottamdi (CT)-I (Part)	1161	114	320	2	725	182	18	36	3	125
Kendra Khottamdi (CT)-II (Part)	1008	23	10	12	963	1289	28	437	93	731
Piarsola	46	40	1	0	5	29	19	8	0	2
Kaliapathar	46	30	9	1	6	204	193	11	0	0
Eklabpur	16	2	0	0	14	238	81	151	2	4
Bahadurdi	22	0	1	0	21	294	3	285	2	4
Gramdanga	3	0	0	0	3	97	1	88	1	7
Kallathol	6	2	1	0	3	59	39	19	0	1
Beldanga	2	0	1	0	1	107	72	35	0	0

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Nutandih	Uninhabited Village									
Andarsola	1	0	1	0	0	96	2	86	0	8
Kharna Chak	0	0	0	0	0	0	0	0	0	0
Piarsola	0	0	0	0	0	10	1	7	0	2
Jambad	3	0	0	0	3	101	0	92	2	7
Ghormara	4	0	1	1	2	132	7	125	0	0
Chak Katoria	Uninhabited Village									
Jamkanali	Uninhabited Village									
Lakhiabad	Uninhabited Village									
Bardhandangal	32	1	3	0	28	231	59	170	0	2
Paharpur	30	0	3	0	27	291	12	265	0	14
Afzalpur	260	11	23	4	222	239	18	177	3	41
Kharikabad	9	0	1	4	4	39	0	28	0	11
Husunnagar	3	0	0	0	3	107	3	103	0	1
Lakhanpur	0	0	0	0	0	2	0	2	0	0
Saguna	30	29	0	0	1	17	2	14	0	1
Shyambathan	88	70	4	0	14	42	4	30	0	8
Mahijor	38	29	4	0	5	43	2	40	0	1
Simul Konda	162	103	28	12	19	137	65	57	11	4
Bankata	77	47	25	0	5	43	6	32	0	5

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Saldaha	241	35	167	20	19	187	16	169	0	2
Siarsuli	236	172	35	10	19	55	7	44	0	4
Chandrabad	130	61	64	0	5	0	0	0	0	0
Baghasol	54	16	37	0	1	2	1	1	0	0
Krisnabandi	84	36	42	0	6	0	0	0	0	0
Satki	496	51	293	29	123	25	11	12	0	2
Amba	676	117	133	177	249	259	58	111	4	86
Kaliganj	67	12	36	8	11	34	9	24	1	0
Kalikasuli	63	19	10	30	4	28	16	10	2	0
Kunarpur	27	9	1	0	17	6	6	0	0	0
Bikrampur	96	56	13	1	26	574	75	475	1	23
Kathijoria	49	18	3	2	26	224	38	179	2	5
Chakalthathal	39	10	27	0	2	65	3	62	0	0
Bara Akna	103	51	42	2	8	208	98	107	1	2
Jambad	8	0	6	0	2	16	2	14	0	0
Bhursa Kuri	Uninhabited Village									
Nij Mandhara	170	83	5	7	75	229	127	60	3	39
Charsola	Uninhabited Village									
Chandarpur	62	23	6	6	27	245	11	223	4	7
Marbhanga	109	44	59	1	5	4	2	1	0	1

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Amdubi	228	105	108	0	15	1	0	1	0	0
Naikapur	153	78	25	9	41	230	142	69	0	19
Kali Pathar	216	39	132	13	32	235	20	205	3	7
Thalpota	6	0	4	0	2	128	29	91	0	8
Sagunibasa	11	1	0	0	10	268	43	224	1	0
Bagdahari	693	177	288	8	220	465	104	333	1	27
Janardanpur	117	72	30	3	12	44	22	19	0	3
Janardanpur Chhit	Uninhabited Village									
Chuadaha	267	22	22	8	215	238	22	205	0	11
Sikandarpur	33	8	21	0	4	216	34	162	3	17
Patjor	2	0	1	0	1	143	32	107	0	4
Asatganj	Uninhabited Village									
Bheladi	107	104	2	0	1	31	6	22	2	1
Chhola Beria	245	144	66	5	30	294	10	235	26	23
Chak Kamlasoli	Uninhabited Village									
Sikandarpur Chhit	0	0	0	0	0	1	0	0	0	1
Muraberia	120	75	18	1	26	601	46	483	29	43
TOTAL (10km)	34795	9928	11086	1279	12502	30520	3831	18265	880	7544
<i>Source-Census of India, 2011</i>										

ABBREVIATIONS:

MAIN WORKERS POPULATION: **MAIN_WORK_P** : Main workers total population, **MAIN_CL_P** : Main cultivated labour population, **MAIN_AL_P** :

Main agricultural labour population, **MAIN_HH_P** : Main workers

population involved in household industries, **MAIN_OT_P** : Main other workers population

MARGINAL WORKERS POPULATION:

MARG_WORK_P : Marginal workers total population, **MARG_CL_P** : Marginal cultivated laborers total population, **MARG_AL_P** : Marginal agricultural laborers population, **MARG_HH_P** : Marginal workers involved in

household industries, **MARG_OT_P** : Marginal other workers Population

Distribution of work participation rate of the study area population is shown in **Table C3-43.** as follows;

TABLE C3-43: DISTRIBUTION OF WORK PARTICIPATION RATE (10KM)

Occupation Class	Year, 2011
Main Workers	34795 (19.4%)
Male	31048(89.2%)
Female	3747(10.8%)
Marginal Workers	30520(17.0%)
Male	20869(68.4%)
Female	9651(31.6%)
Non-Workers	114117(63.6%)
Male	40686 (35.6%)
Female	73431(64.4%)
Total Population (10km)	179432
<i>Source: Census of India Records, 2011</i>	

Graphical representation of Workers Scenario is given below as **Figure C3-31.**

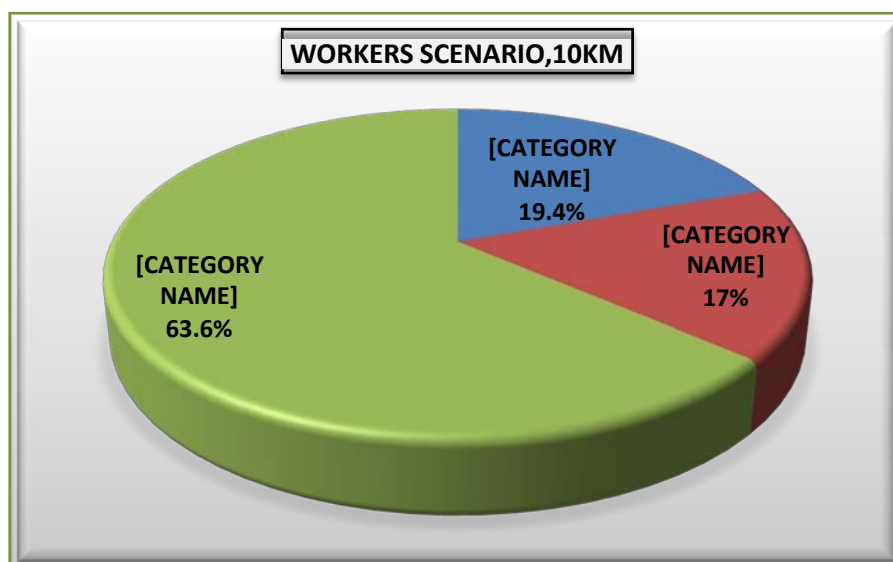


Figure C3-31: Workers Scenario of Study Area Composition of Main Workers:

The 'Main Workers' were observed as 34795 persons (19.4%) to the total population (179432) of the study area and its composition is made-up of Casual laborers as 9928 (28.5%), Agricultural laborers

as 11086 (32.0%), Household workers 1279 (3.5%) and other workers as 12502 (36.0%) respectively. Composition of Main workers is shown below as **Figure C3-32.**

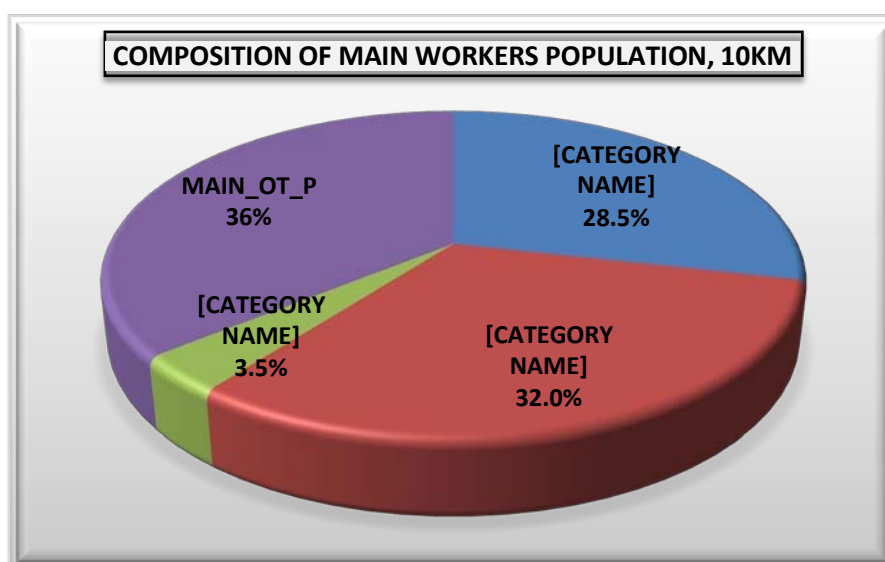


Figure C3-32: Composition of Main Workers

Population Composition of Marginal Workers:

The total marginal workers are observed as 30520 which constitute 17.0% to the total population (179432) comprise of Marginal Casual Laborers as 3831 (12.0%), Marginal Agricultural Laborers as 18265(60.0%), Marginal Household laborers as 880 (3.0%) and marginal other workers were also observed as 7544 (25.0%) of the total marginal workers respectively. Details about marginal workers in the study area are tabulated in **Table C3-43**. Composition of Marginal workers is shown in **Figure C3-33** as follows.

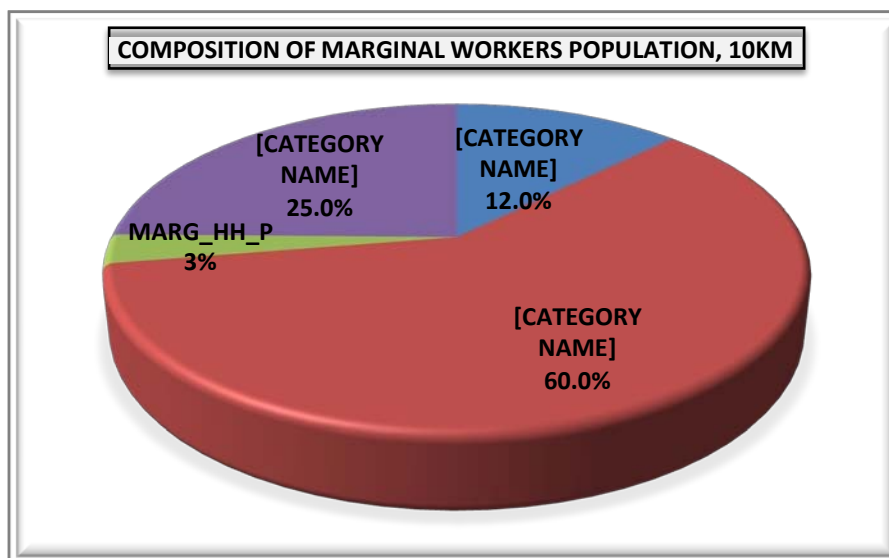


Figure C3-33: Composition of Marginal Workers

Composition of Non-Workers:

The total Non-workers population was observed as 114117 which accounts 63.6% to the total population (179432) of the study area. Male-female wise Non-workers population was recorded as 40686 Males (35.6%) and 73431 Females (64.4%) respectively. Details about Total Non-workers in the study area are compiled in **Table C3-44**. Graphical representation of Non-workers population is shown as follows in **Figure C3-34**

TABLE C3-44: COMPOSITION OF NON-WORKERS

Non-Workers Population		
Persons	Males	Females
114117	40686 (35.6%)	73431(64.4%)

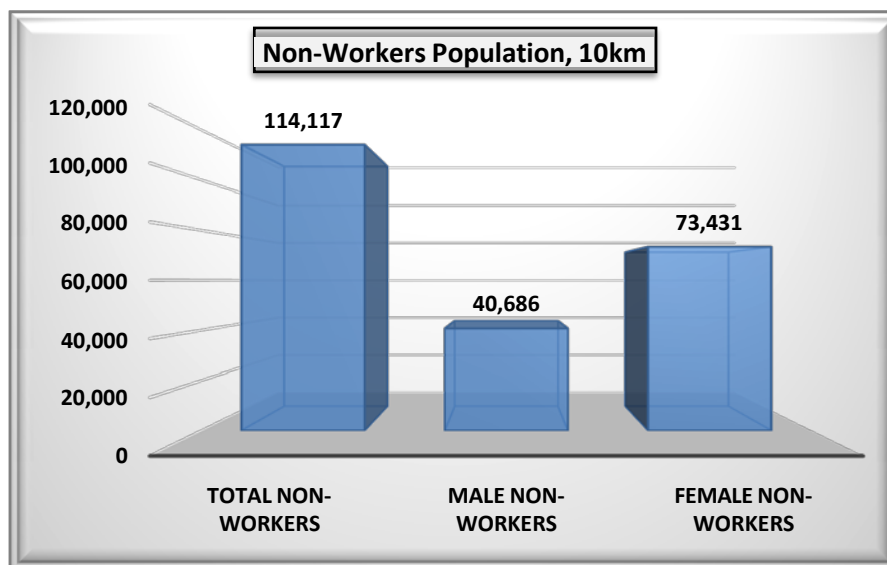


Figure C3-34: Composition of Non-Workers Basic Infrastructure Facilities Availability(as per the census records of 2011)

A review of basic infrastructure facilities (*Amenities*) available in the study area has been done on the basis of the field survey and Census records, 2011 for the study area inhabited revenue villages of Birbhum, Burddhaman and Jamtara District in West Bengal and Jharkhand state respectively. The study area has moderate level of basic infrastructure facilities like educational, medical, potable water and power supply and transport & communication network.

As per the Census Records 2011, the study area has a total of 212 villages/towns of mainly Birbhum & Burddhaman of West Bengal and Jamtara of Jharkhand state respectively. Overall study area villages/towns are falling mainly under 6 tehsils named Dubrajpur, Khoyrasol, Jamuria, Pandabeswar, Nala, Kundhit of Birbhum & Burddhaman districts of West Bengal and Jamtara district of Jharkhand state respectively.

There are forty nine (49) villages under Birbhum, Burddhaman and Jamtara districts of West Bengal and Jharkhand state respectively found as uninhabited villages in the study area. There is only one town namely Kendra Khottamdi (CT) under Burddhaman district of West Bengal.

Educational Facilities

There is a total no. of 203 Primary schools existing in the 10km radius study area. About fifty nine (59) no's of Middle schools are found in the study area. Only twenty four (24) Higher Secondary School (SS) and fourteen (14) Senior Secondary School (SSS) facility is available in the study area. The educational facilities have been further strengthening now and a number of private public schools and colleges are also functioning in the surroundings of the study area. Besides, there are Engineering and Medical colleges available in Towns and District headquarters only. Higher education facilities are available in Towns of the district. There is a considerable improvement in educational facility. The villages of the study area have no such facilities can reach within 5 to 10km range. Entire study area is predominantly rural as no town was observed in the study area.

Availability of University Education in Birbhum District

Birbhum district has one famous university viz. Visva Bharati Viswavidyalaya. The university was established by first non-European Nobel laureate Rabindranath Tagore in 1921 and later it was declared as Central University and an institution of national importance by an act of Parliament in 1951. The territorial jurisdiction of this university spread over Bolpur Sriniketan.

Medical Facilities

The medical facilities are provided by different agencies like Govt. & Private individuals and voluntary organizations in the study area. As per the census 2011, only one primary health center exists in Barra village under Khoyrasol tehsil of Birbhum district in West Bengal state lying in the study area; most of the study area villages depend upon the towns & district HQ concerned with the study area having such facility. About twenty nine (29) Primary Health Sub-Center exists in the villages of the study area. Only one Mother & Child Welfare Center was found in Babuirjor village of Khoyrasol tehsil in Birbhum district of West Bengal state lying in the study area. There was no allopathic Hospitals except three (03) medical dispensaries were found in the study area. No Family Welfare Center was found in the study area. Overall study area villages are served by average medical facilities. Specialized medical facilities are available only in towns and District Headquarter (HQ) only.

Potable Water Facilities

Potable water facility is available in most of the villages/towns of the study area. The entire study area has average level of potable water facilities. Hand Pump (HP) facility is commonly observed in the study area as potable water facility. Out of the total 212 villages, only 68 villages (32.1%) are served with River/Canal water in the study area. As per the census records of 2011, about 131 villages (61.8%) being served with Tank/Pond/Lake in the study area.

Communication, Road & Transport Facilities

Apart from Post & Telegraph (P & T) services, transport is the main communication linkage in the study area. Compiled census 2011, data shows that the study area has poor postal facilities in the 10km radius zone. About 20 villages (9.4%) were found serving with Post Office facilities in the study area, remaining villages are depending upon towns of the study area. The study area has average rail and road network, passes from the area.

Only two villages named Rasa & Amba (*Madal Ehakkhechradi*) under Khoyrasol & Kundhit tehsil of Birbhum and Jamtara district in West Bengal and Jharkhand states respectively were found with railway station facility in the study area.

Nearest town Dubrajpur is situated at about 15.0 km in East-Southeast direction from the coal mine lease area. Nearest railway station is situated at Bhimgara/Bhimgarh, West Bengal which is about 10.5 km in Southeast direction from the mine lease area. Nearest airport is Kazi Nazrul Islam Airport Durgapur in West Bengal state is located at a distance of Approx. 22.0 km in South direction from the mine lease area site.

Project Site Area

The area is approachable by road only. The Khoyrasol-Panchra road connects the block with the Raniganj - Suri Road, (NH-14) at Panchra. Another unmetalled road connects both Gangaramchak and Bhadulia Collieries, at Khoyrasol. Raswan Railway Station, on the Andal-Palasthali section of the Eastern Railway, is located about 4 km south west of the block. Kazi Nazrul Islam Airport is situated about 22 km (aerial distance) away from the project site. The district head quarter is at Suri which is located about 45 km away (aerial distance).

Banking Facility

The study area has almost all the schedule commercial banks with ATM facility at urban areas and the district HQ.

Power Supply

It is revealed from the compiled information on amenities availability as per the census record of 2011; most of the villages and towns are observed not electrified for Domestic, Agriculture, and Commercial & for all purposes, as electrification is very poor in the study zone. About one hundred twenty-seven (127) villages (60.0%) and towns of the study area are electrified for domestic purpose, only 16 villages (7.6%) for agricultural and 31 villages (14.6%) for commercial purpose and only 12 villages (5.7%) were recorded electrified for all purposes in the study area. Out of 212 villages/towns in the study area, 83 villages (39.2%) including 49 uninhabited villages (23.1%) are not electrified for any purpose in the study area.

Bakreswar Thermal Power Project, under The West Bengal Power Development Corporation Limited, located in 'Birbhum' district is one of the most reliable and prestigious coal-fired power plants in West Bengal and in India as well. Total

capacity of electricity generation in its five units is 1050 MW. In the year 2010-11, 395491 units (in thousand K.W.H.) of electricity were consumed in the district.

The district Birbhum has 2,455 villages of which 2243 are inhabited and 6 municipal towns. Out of the total villages, 2091 villages are covered under RGGVY project of which 1750 (83.7%) villages have been electrified under the scheme.

Village/town wise Basic Infrastructure and Amenities availabilities data for the entire study area is compiled and presented in **Table C3-45** as follows;

TABLE C3-45: VILLAGE WISE BASIC AMENITIES AVAILABILITY

	P	M	S	SS	CH	PH	PH	M	C	H	D	F	T	W	H	T	R	T		P	PT	B	R	P	K	N	F	E	E	E	E
			S	S	C	C	SC	W				WC			P	W		k		O	O	S	S	R	R	W	P	D	A	C	A
Chandidaspur	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	2	1	2	2	1	1	2	2
Uttar Madanpur	Uninhabited Village																														
Kapastari	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	2	2	1	1	1	2	2	
Modipakri	Uninhabited Village																														
Kailakuri	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	1	2	1	1	1	2	2	
Belsara	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	1	1	2	1	1	1	2	2		
Panch Pukhuria	Uninhabited Village																														
Katapalan	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	1	2	2	2	2	1	2	2	1	2	2	2	
Saljor	1	0	0	0	0	0	0	0	0	0	0	2	1	1	2	1	1	2	2	2	2	2	2	1	1	1	1	2	2	2	
Name of the Village/Town	1	0	0	0	0	0	1	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	1	1	1	2	2	2	
Dhasunia																															
Putka	2	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	1	1	1	2	2	2	

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Ekuria	1	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	2	2	2		
Gopalpur	1	1	1	1	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	1	1	1	1	2	2	
Kunduakori	Uninhabited Village																														
Aliat	1	0	0	0	0	0	1	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2	2	
Amlakuri	1	0	0	0	0	0	1	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	1	1	1	2	2	2	
Haripur	1	0	0	0	0	0	1	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	1	1	1	2	2	2	
Budhpur	1	0	0	0	0	0	1	0	0	0	0	2	2	1	2	1	1	2	2	2	1	2	1	1	1	1	1	2	2	2	
Anandanagar	2	0	0	0	0	0	0	0	0	0	0	2	1	1	2	2	1	2	2	2	2	2	2	1	2	1	1	2	1	2	
Chak Modpur	Uninhabited Village																														
Lokpur	6	1	1	1	0	0	1	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	1	2	2	2	
Mautara	Uninhabited Village																														
Purbba Shibpur	1	0	0	0	0	0	1	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	1	1	1	2	2	2	
Bandagal	Uninhabited Village																														
Dholasimul	Uninhabited Village																														
Harinajol	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	1	2	1	1	2	2	2	
Bhaddi	2	1	0	0	0	0	0	0	0	0	0	2	2	1	1	2	1	2	2	2	2	2	2	1	2	1	1	2	2	2	
Kamalpur	1	0	0	0	0	0	0	0	0	0	0	2	1	1	2	1	1	2	2	2	2	2	2	1	1	1	1	2	2	2	
Karidha	1	0	0	1	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	2	2	2	2	1	2	2	2
Mankara	Uninhabited Village																														
Demurtita	2	0	0	0	0	0	0	0	0	0	0	2	1	1	2	2	1	2	2	2	2	2	2	1	2	1	1	2	1	2	

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Demuria	2	1	0	0	0	0	0	0	0	0	0	2	1	2	1	1	1	2	2	2	2	2	2	2	2	1	1	2	1	2
Kunda	Uninhabited Village																													
Nichinta	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1
Charigram	1	0	0	0	0	0	0	0	0	0	0	2	1	2	1	1	1	2	2	2	2	2	2	1	1	2	1	2	1	2
Chhora	1	0	0	0	0	0	0	0	0	0	0	2	1	2	1	1	1	2	2	2	2	2	2	2	2	2	1	2	1	2
Bara Ghata	1	0	0	0	0	0	0	0	0	0	0	2	1	2	1	1	1	2	2	2	2	2	2	2	2	2	1	2	1	2
Perua Gopalpur	2	1	1	1	0	0	1	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	1	2	1	1	2	2	2
Katari	Uninhabited Village																													
Chandidaspur	Uninhabited Village																													
Mujrakonda	Uninhabited Village																													
Perua	Uninhabited Village																													
Rupaspur	2	1	1	0	0	0	1	0	0	0	0	2	2	1	2	2	1	2	1	2	2	2	2	2	2	1	1	2	2	2
Kodalikana	Uninhabited Village																													
Chuagar	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	2	1	2	2	2	2	2	2	1	2	2	1	2	2	2
Niga	1	0	0	0	0	0	0	0	0	0	0	2	2	2	1	2	1	2	2	2	2	2	2	2	2	2	1	2	2	2
Paratia	1	0	0	1	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	2	2	2	1	2	2	2
Maynabuni	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	1	2	2	1	2	2	2
Dejuri	Uninhabited Village																													
Bara Ban	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	2	2	1	1	2	2	2
Kondamasuri	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	2	2	2	1	2	2	2

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Upar Banda	Uninhabited Village																														
Raypur	1	1	0	0	0	0	1	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	2	2	2	1	2	2	2	
Chalunebar	Uninhabited Village																														
Kharikabad	2	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2	2	
Kechkechia	Uninhabited Village																														
Jhatibona	Uninhabited Village																														
Jahidpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	2	2	2	1	2	2	2	
Hatikata	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	2	2	2	2	1	2	2	2
Bhurjora	Uninhabited Village																														
Uttar Hazaratpur	Uninhabited Village																														
Sahebpur	Uninhabited Village																														
Bhadulia	1	0	0	0	0	0	1	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2	2	
Bastabpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	2	2	2	1	2	2	2	
Paschim Sibpur	Uninhabited Village																														
Gangpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	2	1	2	1	2	2	2	1	1	2	2	1	2	2	2	
Gangarampur	Uninhabited Village																														
Sagarbhanga	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	2	2	2	2	2	1	1	2	1	1	2	2	2	
Madanpur	Uninhabited Village																														
Bataspur	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	2	2	1	2	2	2	
Hanulia	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	2	2	1	2	2	2	

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Palashbumi	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	1	2	2	2
Tilshur	2	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	2	2	1	2	2	2
Kese	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	2	1	1	2	2	2
Barajor	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	2	2	2	2	2	1	1	2	1	1	2	1	2
Krishnapur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	2	2	2	2	2	1	1	2	1	1	2	1	2
Mahammadpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	2	2	2	2	2	2	1	1	2	1	2	1	2
Chak Gobinda	Uninhabited Village																													
Domahatat	Uninhabited Village																													
Purba Barkola	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	2	2	2	2	2	2	1	1	1	1	2	1	2
Kendgara	2	1	1	0	0	0	1	0	0	1	0	2	2	1	1	1	1	2	1	2	2	2	2	1	1	1	1	2	1	2
Pansuri	2	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	1	2	1	1	2	2	2
Sarsa	Uninhabited Village																													
Laubere	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2	2
Naopara	1	1	1	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2	2
Shilabatpur	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2
Naxrakanda	3	1	1	1	0	0	1	0	0	0	0	2	2	1	1	2	1	2	1	2	1	2	1	1	2	1	1	2	2	2
Sermara	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	2	1	2	1	2	2	2	1	1	2	1	1	2	2	2
Puratan Nagrakonda	2	0	1	1	0	0	0	0	0	0	0	2	2	1	1	2	1	2	1	2	2	2	1	1	2	2	1	2	2	2
Birjuri	1	1	1	1	0	0	0	0	0	0	0	2	2	1	1	2	1	2	1	2	2	2	1	1	2	2	1	2	2	2
Khayrashoal	5	2	1	0	0	0	1	0	0	2	0	2	2	1	2	2	1	2	1	1	2	2	1	1	2	1	1	2	2	2

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Shiarsol	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	0	2	1	2	2	2
Bhangaband	2	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	2	1	1	2	2	2
Bagashola	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	2	1	1	2	1	2
Maynadal	1	1	1	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2
Jamrand	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	2	2	2	2	2	2	1	1	2	1	2	1
Churar	1	0	0	0	0	0	1	0	0	0	0	2	2	1	1	1	1	2	1	2	2	2	2	1	1	1	1	2	1
Matiala	Uninhabited Village																												
Jamalchak	Uninhabited Village																												
Gaharakuri	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	2	2	1	2	2
Shrirampur	2	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	2	2	2	2	2	1	1	2	1	1	2	2
Mahuribasa	Uninhabited Village																												
Bansayer	3	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	2	2	1	2	2
Geruapahari	2	1	1	0	1	0	1	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	2	1	2	2
Penchalia	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	2	1	1	2	2
Manjuria	Uninhabited Village																												
Kanakpur	Uninhabited Village																												
Babuirjor	1	2	1	1	0	0	1	1	0	0	0	2	2	1	1	2	1	2	2	2	2	2	1	1	2	1	1	1	2
Ilamkuri	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	2	1	1	1	2
Hariektala	2	0	0	0	0	0	1	0	0	0	0	2	2	1	2	1	1	2	2	1	2	2	1	1	1	1	1	2	2

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Gangaramchak and Gangaramchak -Bhadulia Coal Mine*

Dhulkomra	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	2	1	2	2	2
Barra	3	1	1	1	0	1	0	0	0	0	0	2	2	2	1	2	1	2	2	2	2	2	2	1	2	1	1	1	1	1
Arjjunshuli	1	0	0	0	0	0	0	0	0	0	0	2	2	2	1	2	1	2	2	2	2	2	1	1	2	1	1	2	2	2
Parsundi	4	1	1	0	0	0	1	0	0	0	0	2	2	2	1	2	1	2	1	2	2	2	1	1	2	1	1	2	1	2
Paschim Barkola	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	2	2	2	2	2	1	1	1	1	1	2	2	2
Tamra	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	1	2	2	2
Maldiha	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	1	2	2	2
Bheleni	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	2	1	1	2	2	2
Beinui	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	1	2	2	2
Barjadihi	Uninhabited Village																													
Jamalpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	2	1	2	1	1	2	2	2
Meherpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	1	2	1	1	2	2	2
Gohalia	Uninhabited Village																													
Simuldihi	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2	2
Arazi Jamalpur	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2
Nabasan	2	1	1	0	0	0	1	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	1	2	1	2
Kathi	1	0	0	0	0	0	0	0	0	0	0	1	2	1	1	2	1	2	2	2	2	2	2	1	2	1	1	1	1	1
Khajuria	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2
Khalajuri	0	0	0	0	0	0	0	0	0	0	0	2	2	2	1	2	1	2	2	2	1	2	2	1	2	2	1	2	2	2
Ruppur	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2

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Kankartala	2	1	0	0	0	0	1	0	0	0	0	2	2	1	1	2	1	2	2	2	2	2	2	1	2	1	1	1	1	1	1
Binodpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	2	2	2	2	2	2	1	2	2	1	1	1	1	1
Sira	1	0	0	0	0	0	1	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	1	1	1	1	1
Nalgara	1	1	1	0	0	0	0	0	0	0	0	2	2	2	1	1	1	2	2	2	2	2	1	1	2	2	1	2	1	2	2
Palpai	1	0	0	0	0	0	0	0	0	0	0	2	2	2	1	1	2	2	2	2	2	2	2	1	2	1	1	2	1	2	2
Rasa	3	1	1	1	0	0	1	0	0	0	0	2	2	2	1	1	1	2	1	2	2	1	2	1	2	1	1	1	1	1	1
Panjeala	Uninhabited Village																														
Sahapur	1	0	0	0	0	0	0	0	0	0	0	2	2	2	1	1	2	2	2	2	2	2	1	1	2	1	1	1	1	1	1
Mundira	1	1	1	1	0	0	1	0	0	0	0	2	2	2	1	1	1	2	1	2	2	2	1	1	2	1	1	1	1	1	1
Ichhabpur	Uninhabited Village																														
Bhurachak	Uninhabited Village																														
Dakshin Hazaratur	2	1	1	1	0	0	0	0	0	0	0	2	2	2	1	1	1	2	1	2	2	2	1	1	2	1	1	1	1	1	1
Bagdiha	2	1	1	0	0	0	1	0	0	0	0	2	2	2	1	1	1	2	2	2	2	2	1	2	1	1	2	2	2	2	2
Bhuri	2	1	0	0	0	0	1	0	0	0	0	1	2	2	1	2	1	2	1	2	2	2	1	1	2	1	1	1	1	1	1
Semalya	3	3	0	0	0	0	0	0	0	0	0	1	1	2	1	1	1	2	1	2	2	2	1	1	2	1	1	2	1	2	2
Chhatrish Ganda	1	0	0	0	0	0	1	0	0	0	0	1	2	2	1	2	1	2	2	2	2	2	1	1	2	1	1	1	1	1	1
Kendra Khottamdi (CT) (Part)-I	Urban Part																														
Kendra Khottamdi (CT) (Part)-II	Urban Part																														

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Piarsola	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	1	2	1	1	2	2	2
Kaliapathar	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	1	1	1	1	2	2	2
Eklabpur	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2	2
Bahadurdi	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	1	2	1	1	2	1	2	2	2	2
Gramdanga	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	1	2	1	1	2	1	2	2	2	2
Kallathol	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Beldanga	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Nutandih	Uninhabited Village																													
Andarsola	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Kharna Chak	Uninhabited Village																													
Piarsola	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Jambad	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Ghormara	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2	2
Chak Katoria	Uninhabited Village																													
Jamkanali	Uninhabited Village																													
Lakhiabad	Uninhabited Village																													
Bardhandangal	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	1	2	1	1	2	1	1	2	2	2
Paharpur	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	1	2	1	1	2	2	2
Afzalpur	1	1	1	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	1	2	2	2	1	1	2	1	1	2	2	2
Kharikabad	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	1	2	1	2	2	2	2

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Husunnagar	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	1	1	2	1	2	2	2	2
Lakhanpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	1	1	2	1	2	2	2	2
Saguna	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	1	1	2	1	2	2	2	2
Shyambathan	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2
Mahijor	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2
Simul Konda	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2
Bankata	2	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	1	2	1	1	2	2
Saldaha	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2
Siarsuli	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	2	2	2
Chandrabad	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	1	1	1	2	2
Baghasol	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	1	2	1	2	2	2
Krisnabandi	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	1	2	1	2	2	2
Satki	2	1	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	1	2	2
Amba	2	2	1	0	0	0	1	0	0	0	0	2	2	1	2	1	1	2	1	2	1	1	1	1	1	1	1	2	2
Kaliganj	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	1	2	1	2	2	2
Kalikasuli	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	1	2	1	1	2	2
Kunarpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	1	2	2
Bikrampur	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	2	2	2
Kathijoria	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	1	1	2	2	2
Chakalthathal	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2

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Bara Akna	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Jambad	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Bhursa Kuri	Uninhabited Village																													
Nij Mandhara	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	1	2	1	1	2	1	2	2	2	2
Charsola	Uninhabited Village																													
Chandarpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	1	2	1	1	2	1	2	2	2	2
Marbhanga	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Amdubi	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Naikapur	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	1	2	2	2	1	1	2	1	2	2	2	2
Kali Pathar	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	1	2	1	1	2	1	2	2	2	2
Thalpota	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	1	2	2	2	2	2	1	1	1	1	1	2	2	2
Sagunibasa	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	1	1	1	2	2	2
Bagdahari	1	1	1	1	0	0	1	0	0	0	0	2	2	1	2	2	2	2	1	2	2	2	1	1	2	1	1	2	2	2
Janardanpur	1	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	2	2	2	1	1	2	1	2	2	2	2
Janardanpur Chhit	Uninhabited Village																													
Chuadaha	3	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Sikandarpur	2	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Patjor	2	0	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2
Asatganj	Uninhabited Village																													
Bheladi	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2

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Chhola Beria	1	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2																										
Chak Kamlasoli	Uninhabited Village																																																							
Sikandarpur Chhit	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2																											
Muraberia	3	1	0	0	0	0	0	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	1	1	2	1	2	2	2	2																										
TOTAL (10km)	2	Status for Availability and Non-Availability is shown as A (1) & NA (2)respectively																																																						
	0																													5	2																									
	3																													9	4	14	1	1	29	1	0	3	0																	

Source-<http://www.censusindia.gov.in/2011census/dchb/DCHB.html>

Abbreviations:

Educational Facilities: P-Primary School, M-Middle School, SS-Higher Secondary Schools, SSS-Senior Secondary School

Medical Facilities: CHC-Community Health Centre, PHC-Primary Health Centre, PHSC-Primary Health Sub-Centre, MCWC-Maternity and Child Welfare Centre, H- Hospital, D-Dispensary, FWC-Family Welfare Centre

Drinking Water Facilities: T-Tap Water, W-Well Water, HP-Hand Pump, TW-Tube Well Water, R-River Water, Tk-Tank Water, O-Other Drinking Water Facility, CT-Community Toilet

Communication & Transport Facilities: PO-Post Office, SPO-Sub-Post Office, PTO-Post & Telegraph Office, Tel. -Telephone Connection, Mob.-Mobile Phone Coverage, BS-Bus Services, RS-Railways Services

Approach to Village: PR-Paved Roads, KR-Kuchha Road, FP-Foot Path

Power Supply: ED-Power Supply for Domestic use, E Ag.-Power Supply for Agricultural use, EC- Power supply for Commercial use, EA-Electricity for All Purposes
Nearest Town & Distance, km: a for < 5 km, b for 5-10 km and c for 10+ km of nearest place where facility is available is given.

Brief Description of Places of Religious, Historical or Archaeological Importance and Tourist interest in Villages and Towns of the District:*(District level information only)*

Brief description of place of religious, historical or archaeological and tourist interest are as follows;

Major Social and Cultural Activities of the District like Festivals and Fairs

Innumerable fairs, festivals and socio-cultural events are held throughout the year in the district having wide admixture of religion, community and culture. The followers of the main faiths and some tribal groups observe their own religious festivals whereas they intermingle in certain *Melas* (fairs) and ceremonies. Brief notes on the major festivals and *Melas* of the district are given below:

➤ *Festivals of District Birbhum*

Hinduism, as a result of this admixture, attained various eclectic forms in the district. On the one hand it is influenced by tantric Buddhism, on the other hand by the folk rituals. This influence is evident in all the forms Hinduism expresses itself -Vaishnavism, Saivism, Saktism etc.

➤ *Distinctive Festival of District Birbhum*

Festivals related to Brahmadatyai Worship: At a number of places in the district, the worship of Brahmadaitya or Brahmadatyai takes place every year. The worship takes place at the spot where a tree, as per popular belief, is haunted by a ghost of Brahmin and his worship ensures cure from disease, fulfilment of a desire etc. Such worship centres are to be found in Suri, Mohammad Bazar, Bolpur and Sainthia.

Jadupatuas: Jadupatuas are a class of people, a mixed one, as by religion they are having the faith in Allah but also worshipping Kali, Manasa and various other Hindu deities.

Places of Archaeological Importance:

From the Archaeological point of view, Birbhum district has got a very little amount of pre-historic artifacts. However, evidences of some post-historic sites deserve mention. Most important of them is Neolithic- Chalcolithic site of Mahisdal near Bolpur on the north bank of the river Kopai. There was settled agriculture in the chalcolithic period, rice was already a staple crop and there was enough surplus produce to need the construction of the pit-granary. This period dates back to 1380 & 855 B.C.

Place of Religious and Historical Importance:

In Birbhum district there are a number of famous temples having religious importance to the people of the district as well as to the people outside the district. Some of the places of religious and historical importance in the district are:

Bhadrapur: Bhadrapur is in Nalhati-I C.D. Block. Bhadrapur contains a dilapidated house of Maharaj Nandokumar with an imposing entrance and an old

Siva temple within.

Bhadiswar: Bhadiswar is in Murarai-I C.D. Block. Two brick built mounds (at Sasthitala), locally said to be the ruins of the palace and temple of one King named Bhadreswar (or Bhadrasen) is its main attraction.

Birchandrapur: This village is also known as Ekchakra or Ekchaka. It is in Mayureswar-IC.D. Block. It is said that this village is associated with Pandavas.

Dubrajpur: All temples in Dubrajpur town are Siva temples and built of brick. AkshayDasi's Siva temple has some nice carvings. Sivalaya, a group of five shrines in Mahatopara is also worth mentioning for fine craftsmanship.

Ghurisa: This village is in Illambazar C.D. Block and was once a famous centre of Sanskrit learning, especially in Nyaya. There are sixteen temples here of which two are worth mentioning.

Joljol (Jaljala): This village is also located in Bolpur-Sriniketan C.D. Block is now popularly known as Kankalitala (Knaakaalitala). It is considered to be one of the 52 pithasthans (sacred places) where the waist (Knaakaal) of Sati fell. Presently a number of temples and holy sink has been built here and daily worship is conducted and this place has become a centre for tourist attraction and pilgrimage.

Joydev-Kenduli: This village also known as Kendu-Bilwa is located in Illambazar C.D. Block. It is famous as the birth place of the great Sanskrit lyric poet Joydev of 12th century AD who was the court poet of Lakshmansen and composer of Gitagovindam in praise of Radha and Krishna. It was built by the mother of Maharaja Kirtichand Bahadur of Bardhaman in AD 1683.

Labhpur: Previously known as Attahas, Labhpur is a place which is considered to be another Sakta pithasthan where, it is said, Sati's lips fell and the temple of Goddess Phullora has been constructed on the spot.

Mallarpur: It is famous for the old shrine of the Malleswar Siva (anadi-lingam). There are 25 temples surrounded by the wall, the majority of which are small charchala (four domed) shrines each containing a lingam, all built of phulpathar.

Margram: The biggest village in Rampurhat-II C.D. Block situated on the bank of Dwaraka River. There is a big dilapidated uninhabited building in the village, said to be the residence of a dewan in the court of Sirajuddaula.

Nalhati: The village is considered to be one of the 52 Sakta pithasthans. There is a temple on the fort of hillock, known as Lalateswari temple, where the presiding deity is Goddess Lalateswari, a form of Sakti.

Nanoor: Nanoor is most famous as the birth place of Chandidas, the Vaishnav lyric poet of the 14th century AD and for this reason it is also a famous Vaishnav pilgrim centre. Chandidas was a Vaishnavite.

Rajnagar or Nagar: This place was an important seat of administration of the Muslim rulers (Jagirdars) of those days. It was once a prosperous area.

Sainthia: Today's Sainthia consists of two villages, Debiganj and Nandipur of

earliertimes. This Nandipur is also one of the 52 Sakta pithasthans, being the seat of Nandikeswari.

Supur: A village in Bolpur-Sriniketan C.D. Block. According to local belief it was the residence of mythical Raja Surath.

Places of Tourist Interest:

Bolpur-Santiniketan: Bolpur is a municipal town in the district which is important as a trade-centre of rice, but more important nowadays as a gateway to the Santiniketan (Visva-Bharati). But the legends and anecdotes apart, the history of Bolpur does not go much beyond. As per Captain Sherwill, it was a small hamlet with no more than 163 'Kutchas' or 'mud' builds houses during 1851-52.

Visva-Bharati: Visva-Bharati is situated in a rural setting in the district of Birbhum. The place is called Santiniketan. The university campus is about 3 km. from the Bolpur (Santiniketan) railway station. The university has two campuses, one at Santiniketan and the other at Sriniketan, which is further 3 km. from Santiniketan.

Rehabilitation & Resettlement (R & R)

Policy to be adopted (Central/State) in respect of the project affected persons including home or land oustees and landless labour. Hence, any planning with respect to Rehabilitation & Resettlement is applicable as per the rules of state government.

Project Benefits

Employment Generation

Around 300 numbers of persons are likely to be engaged directly in this mining project. There are floating population in the project site such as service providers, contractors etc. To meet the essential needs of the workers necessary welfare facilities as per the provisions of Factories Act, 1948 and amendment thereof will be provided by the company.

Enhancement in Economy of the Country

The national economy will gain to the extent of several crores by the way of wages payable to about 270 numbers of employees for another 4 years and it is expected that around 10 numbers of additional persons will get indirect employment for this expansion.

There is huge demand of coal in West Bengal for Power generation and other utility. Thus, winning of coal at the rate of 1.50 MTPA from this project is highly essential.

CHAPTER-4

ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.0 INTRODUCTION:

An essential step in Environmental Impact Assessment (EIA) is to identify all potential environmental impacts and then examine critically to find out the major impacts (both beneficial and adverse), which are then analyzed in detail. Based on description of present environment as described in Chapter-3, a scientific evaluation on various impacts that are likely to influence the present environment is furnished in this chapter. To overcome the various environmental problems, possible mitigation measures have been suggested in the Environmental Management Plan (EMP).

In the present study, likely impact and its extent on various environmental parameters viz. topography and drainage, land, water, noise, air, ecological and socio-economic conditions were studied by assessing the baseline environmental status of the area and estimations were made as how this will change with commencement of project activity. The mitigation measures have been worked out with a view to bring down the levels of impacts within limits. In each of the areas of impact, measures have to be taken to mitigate adverse impacts and where these are beneficial in nature such impacts are to be enhanced/augmented so that the overall adverse impacts are reduced to substantial extent.

4.1 ENVIRONMENTAL IMPACTS:

The identification of potential environmental impact is first step in the Environmental Impact Assessment (EIA). There are various techniques available for impact identification. These include checklists, matrix, networks cause effect diagrams etc. In the present study, matrix method has been used. Impact assessment of the proposed project would help in implementing the project in an eco-friendly manner. The environmental attributes that are influenced due to the mining activities can be identified by observing the Impact on:

- Air Quality
- Water quality (both Surface & Ground water quality)
- Noise level
- Soil quality
- Land use
- Forests & Vegetation
- Wildlife
- Public health & safety
- Socio-economics

MITIGATION MEASURES:

The mining activities may disturb environment in various ways such as degradation of land, dust generation, deterioration of water and soil quality, affecting the biological and socio-economic environment of the area. The impacts of mining on various environmental parameters were assessed and are given below.

4.2 IMPACT ON AIR QUALITY:

The major cause of air pollution in the open cast mining is mainly caused due to generation of dust arising from mining activities. In case of this opencast mine mining operations drilling & blasting, mining extraction, loading and unloading, movement of vehicles on haul roads, external dumping, etc. are expected to generate airborne fugitive dusts. Large quantities of dust get air borne and is carried away from coal stocks overburden dumps induced by wind blow.

Air Quality Modelling

Atmospheric dispersion modeling is the mathematical simulation of how air pollutants disperse in the ambient atmosphere. It is performed with computer programs that solve the mathematical equations and algorithms which simulate the pollutant dispersion. The dispersion models are used to estimate or to predict the concentration of air pollutants by using various inputs such as meteorological parameters viz. temperature, wind speed and direction, mixing depths, inversion level, etc. and source emissions. emitted from sources on the desired area. Such models are helpful to the government agencies for protecting and managing the ambient air quality. The models are typically employed to determine whether the ambient air quality level due to proposed project will comply with the National Ambient Air Quality Standards (NAAQS) or not. Over and above the prediction of the concentration of pollutant at a particular area / locations, it also assists in the designing of effective control measures / strategies to reduce emissions of harmful air pollutants during operation. It also guide on the required pollution control equipment.

For the proposed atmospheric dispersion modeling study, United States Environmental Protection Agency's (USEPA) approved and also recommended by the Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India, regulatory air quality model i.e. AERMOD is applied to predict ground level incremental concentrations (GLCs) of concerned critical pollutants. Prior to air quality modeling exercise, meteorological condition during one season over project site is extensively studied and were also compared with secondary data from the government sources. Concentrations are estimated for the critical pollutants assessed over appropriate averaging times (i.e. 8 hours and 24 hours) based on the applicability of the National Ambient Air Quality Standards (NAAQS).

The proposed Gangaramchak Block represents an isolated narrow elongated strip of coal bearing sediments of about 9 km in length in Trans-Hingla area of the Raniganj Coalfield in the district of Birbhum, West Bengal. The block is defined by the latitudes 23°48'20.812"N to 23°49'28.016"N and longitudes 87°12'20.292"E to 87°13'52.172"E. It is included in the Survey of India Toposheet No. 73M/1 and in the Sheet No. 16 of the geological map of the Raniganj Coalfield published by the Geological Survey of India.

Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project comprise both forest and non-forest lands. It is running opencast mechanized mining project and the present proposal is for enhancement of production capacity of coal from 1.00 MTPA to

3.0 MTPA. The project area of the block is 187 ha which includes Mine lease area of 150 Ha. The project is located in village Basantpur, Tehsil Khoyrasole, Dist-Birbhum Of West Bengal State.

The proposed project is open cast coal mining project hence modeling is done by considering area source and line source to predict impact on ambient air quality during mining operations(like loading and unloading of material, blasting, crushing, material handling) and traffic density due to transportation of coal. To assess the impact of air emissions from various continuous sources, air dispersion Modelling study has been conducted with the help of Aermid version 18.01.97 model of Aermid Cloud™ developed by Envitrans Infosolution Pvt. Ltd.

AERMOD atmospheric dispersion modeling system is an integrated system. It is a steady-state dispersion model designed for short-range (up to 50 kilometers) dispersion of air pollutant emissions from stationary industrial sources. It includes meteorological data preprocessor (AERMET) that accepts surface meteorological data, upper air soundings, and optionally, data from on-site instrument towers. It then calculates atmospheric parameters needed by the dispersion model, such as atmospheric turbulence characteristics, mixing heights, friction velocity, Monin-Obukov length and surface heat flux.

A terrain preprocessor (AERMAP) whose main purpose is to provide a physical relationship between terrain features and the behavior of air pollution plumes. It generates location and height data for each receptor location. It also provides information that allows the dispersion model to simulate the effects of air flowing over hills or splitting to flow around hills.

Model Setup

Detailed model set up is given in the following table:

Table C4-1: Parameters for Aermid

Parameter	Details
Model Name	Aermid
Software Name	AermidCloud™
Model Type	Steady state Gaussian plume air dispersion model
Topography	Plain terrain
Average Time	24 hours
Source Type	Area source
Boundary limit	10 km X 10 km
Surface Meteorological Data	Site specific data processed by AERMET

Meteorological Parameters

Surface meteorological data at project site was collected for post monsoon season, 2020. The hourly meteorological data considered during this period were:

- Wind speed;
- Wind direction;
- Ambient atmospheric temperature;
- Cloud cover;
- Relative Humidity

Meteorological data for the project area has been obtained for the period starting from March to May 2022. Wind rose diagram is shown as **Figure 1-1**.

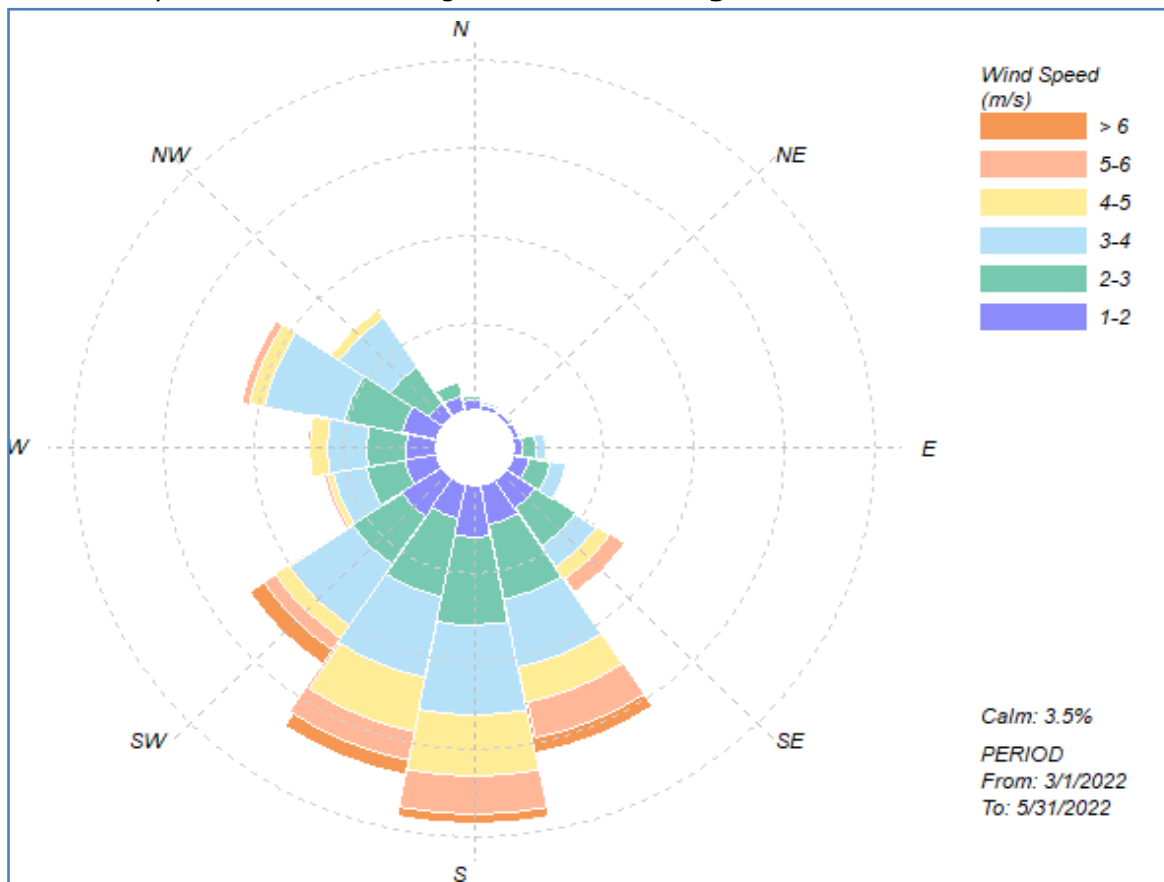


Figure C4-1: Windrose Diagram (at site)

Wind rose represents the wind patterns in the nearby area of project site. The first predominant wind direction is from S to N. whereas, second predominant wind direction is from SSE to NNW. The calm conditions are 3.5% during the study period.

Model Options Used For Computations

The options used for short-term computations are:

- The plume rise is estimated by Briggs formulae, but the final rise is always limited to that of the mixing layer;
- Stack tip down-wash is not considered;
- Buoyancy Induced Dispersion is used to describe the increase in plume dispersion

during the ascension phase;

- Calms processing routine is used by default;
- It is assumed that the pollutants do not undergo any physio-chemical transformation and that there is no pollutant removal by dry deposition;
- Washout by rain is not considered;
- Flat terrain is assumed / used for computations;
- Cartesian co-ordinate system has been used for computations; and
- The model computations have been done for 10 km with 100 m grid interval.

Model Setup Emission of PM10

The major sources of PM10 emission in case of mining project are the loading activity at mine site (loading of material over trucks / trucks by excavators), material handling, Blasting, crushing, overburden and the movement of vehicles on unpaved haul roads. The emission rates for these sources are given in latest USEPA's AP-42 guidelines.

Loading of Material

The material will be loaded on dumpers using excavators. JCB will be used for loading of material during the 3 working shift of 24 hours/day. Emission factor for PM 2.5 is 0.001 (Nevada Division of Environmental Protection Bureau of Air Pollution Control (BAPC) Permitting Branch) The PM10 emission rate due to loading activity is calculated using below equation.

$$E = k \times 0.0016 \times \left(\frac{U}{2.2} \right)^{1.3} \left(\frac{M}{2} \right)^{1.4} \quad (\text{USEPA's AP42, (Nov 2006)})$$

Where,

E = Emission Factor, kg/ton

k = Particle size multiplier, 0.35

for PM10 M = Moisture Content, %

u = Mean wind speed, m/s

Parameters	Block
Production(MTPA)	3.0
Working hour	21
working days	300
total working hour	6300
Moisture Content (%)	0.7
Emission rate PM 10 (g/sec/m2) due to load & unloading of material	0.0017
Emission rate PM 10 (g/sec/m2) due to overburden	0.00012
Emission rate PM 10 (g/sec/m2) due to Blasting	0.000134

Source: USEPA AP-42

Emission of PM10 due to Transportation

Vehicular movement was calculated for the transportation activities proposed from the river beds through the locals roads to the nearby villages. Transportation of coal from mining area to railway station by trucks/ tractor trolleys. The approach roads has been provided up to the siteto railway station.

The coal is carried by tipping trucks to the nearer Hazarathpur railway siding through the PWD road via Sarsa More and Nowpara Bridge. Hazarathpur railway siding is on Bhimgarh-Palasthali section of Asansoldivision of Eastern railway at a distance of 4.77 km from the mine. Sized and picked coal is loaded into railwagons by pay loader. Distances of different end use plants with respect to Bankura and Durgapur railway. Total around 200 trucks will be engaged per day on the basis of 25 tonne capacity of trucks, approx. The present road network is good enough to bear the projected traffic load. However, maintenance & strengthening of the roads will be done as and when required. The line source modeling was done by using Aermotd - line source model. Emission factors for different categories of vehicles for PM is 1.965 g/km as per report 'The Automotive Research Association of India, Pune' dt. August 17, 2007.

Total Pollution load (Et) of the vehicles was determined using equation below. The total

$$E_i = \sum_j (Veh_j D_j) e_{ijkm}$$

number of vehicles for each category was used to estimate emission as daily average.

where, Et is the total estimated emission of each pollutant (expressed as g/day or tons/day), Vehj is the number of vehicles of type j, Dj is the distance travelled by vehicle type j and ei is the emission factor of vehicle type i (expressed as g/km).

Incremental Increase

For the purpose of the impact assessment, the more relevant determination for anticipated pollutants is the incremental increase in the background concentration rather than the determination of maximum GLC values. In the present study, an attempt has been made to determine the increase in the concentration of PM for locations where ambient air quality stations were established. The resultant concentration thus obtained along with the background levels is present in **Table C4-3**.

Table C4-2: Air Monitoring Locations

Stn. Code	Receptor Name	Location	Latitude	Longitude
Core zone				
A1	Receptor 1	Project Site 1	23°49'19.95"N	87°12'43.93"E
A2	Receptor 2	Project Site 2	23°49'0.04"N	87°13'18.27"E

Buffer zone				
A3	Receptor 3	Bhadulia	23°48'16.24"N	87°13'30.61"E
A4	Receptor 4	Kese	23°50'31.99"N	87°12'13.94"E
A5	Receptor 5	Krishna Bandi	23°51'27.28"N	87°10'29.51"E
A6	Receptor 6	Islamkuri	23°48'53.37"N	87°11'51.81"E
A7	Receptor 7	Tilshur	23°50'53.29"N	87°12'51.74"E
A8	Receptor 8	Lokepur	23°51'56.31"N	87°17'7.54"E

Table C4-3: Resultant Concentration Value of PM 10

Location Code	Receptor	Background Maximum Concentration ($\mu\text{g}/\text{m}^3$)	Total* Incremental Concentration ($\mu\text{g}/\text{m}^3$) PM10	Resultant Concentration ($\mu\text{g}/\text{m}^3$)	Limit
Receptor 1	Project Site 1	87.69	546.02	633.71	2000
Receptor 2	Project Site 2	89.92	46.03	135.95	2000
Receptor 3	Bhadulia	70.38	5.85	76.23	100
Receptor 4	Kese	74.30	0.00	74.3	100
Receptor 5	Krishna Bandi	69.56	0.00	69.56	100
Receptor 6	Islamkuri	64.09	0.00	64.09	100
Receptor 7	Tilshur	70.10	0.00	70.10	100
Receptor 8	Lokepur	63.40	0.00	63.40	100

C. Green Belt: - Planting of trees all along main mine haul road and regular grading of haul roads will be practiced to prevent the generation of dust due to movement of dumpers/trucks.

Other Mitigation Measures

- Water sprinkling will be done on the roads regularly.
- Care will be taken to prevent spillage by covering the carrying vehicles with tarpaulin and sprinkling of water, if dry.
- Fortnightly scraping of road in order to keep the roads almost leveled. This will ensure smooth flow of vehicles and also prevent spillage.
- Proper tuning of vehicles to keep the gas emissions under check.
- Plantation of trees along the roads to help reduce the impact of dust in the nearby villages.

Drilling Operation:

Dust emanated during drilling operation could be reduced by

- Providing drills with dust arrester or collector.
- Proper maintenance of drill bits.
- Sprinkling of water before and after drilling in dry seasons.
- Dust generation would also be reduced by using sharp drill bits for drilling holes and drills with water flushing system.
- Drill operators will be provided with dust mask, if necessary, to minimize the impact of air pollution on the workers.

Blasting Operation:

Generation of dust during blasting would be minimized by taking the following measures;

- Proper burden and spacing of blast hole.
- Proper charge per delay.
- Water shall be sprayed at Quarry Faces before and after blasting.

Loading and Transportation:

To minimize the adverse impact on air quality due to loading/unloading and transportation the following measure are proposed:

- The un-metalled service roads are proposed to be metalled or adequately compacted before being put into use.
- Overloading of vehicles will be avoided as spillage generates dust.
- Trucks carrying coal will be covered with tarpaulin sheets to prevent fugitive dust generation.
- Continuous cleaning of haul roads & regularly filling of pot holes.

- Water sprinkling during loading, unloading and transportation in the haul roads.
- All the fossil fuel consuming vehicles & equipment shall be properly maintained as per the guideline of the manufacturer to keep the SO₂ & NO_x level within the limit.
- Vehicles having 'Pollution Under Control (PUC) Certificate' will be engaged in the mines.

Dumping Area:

Once the overburden dump has reached its designed size, Coir matting will be adopted. Jute mat/coir netting of about 25 mm X 25 mm mesh size shall be laid on slopes and anchored by pins on leveled surfaces to prevent displacement and to have intimate contact. The mat/net shall be covered with 80 mm thick good agricultural soil mixed with fertilizer, pesticides and saw dust/hay as base for vegetation along with seeds of Grass-Legume mixture.

Grasses like *Stilohamata* and *Cynodon* with *Baugenvillia* are quick growing to provide biomass, have the ability to survive on toxic waste material and tolerant to adverse pH, extremely low nutrient conditions and toxic metals. Extensive root system of these species holds loose soil particles and prevents soil erosion while enhancing productivity to a sustainable level. On the other hand, legumes are drought tolerant, perennial, fast growing and enrich nitrogen in derelict sites. Some common species like, *Stylosanthes humilis*, *Stylosanthes hamata*, *Sesbania sesban*, *Crotalaria sp.*, *Desmodium sp.* etc. are proven to be excellent nitrogen fixing legumes. At the end of growing season, grasses eventually dry to form mulches which conserve moisture. Moreover dry mulch decomposes to form humus & organic matter which initiate nutrient cycling on the derelict sites. Legumes, being perennial, also conserve moisture, accrete organic matter & create a nitrogen rich substrate for the soil by decomposition of their subterranean parts. This not only stops erosion of soil by wind or rain and help to maintain uniform moisture content of the soil underneath but also helps in growth of shrubs & trees species.

Haul Road:

Haul roads are major sources of fugitive dust in a mine. To reduce the problem of dust generation from haul roads, the following actions will be taken up:

- The prevailing practice of construction of haul roads with the layers of hard stones overlaid by laterite fines and subsequently compacted by road rollers in surrounding areas will be continued.
- The haul roads will be compacted and water spraying will be done in a number of runs using only a small quantity of water each time just sufficient to wet the surface.
- Ensuring transport equipment to be leak proof.
- Over loading of the transport vehicles will be prevented in order to avoid spillage.
- Regular water sprinkling especially before transportation.

Coal Stack Yard:

Water sprinkling will be adopted daily in coal stack yard. Peripheral plantation around the stack yard will also be taken up to arrest the air borne dust, if any.

Emissions during Material Handling:

In this block only dumpers have been used for material handling. Particulates may be emitted from any of the material handling operations. Most of the emissions occur at transfer points.

Traffic density

	Number of Trips/day	Capacity of tripper-T	Quantity per day-T	Working day in a year	Total qty in a year	MTPA
Existing	134	25	3350	300	1005000	1.01
Proposed	400	25	10000	300	3000000	3.0

4.3 IMPACT ON WATER QUALITY & DRAINAGE SYSTEM:

Drainage System:

A number of ephemeral nalas drain the core area to the Hingla River flowing to the south and west of the block boundary of Gangaramchak and Gangaramchak-Bhadulia Coal Block. Initially, Water has been drawn from the tube wells of nearby villages after taking the necessary permissions from the state Government afterwards the mine water generated will be used.

The storm water discharge coming out of quarries and dump through a network of garland drains is expected to contain solid particles. These solid particles shall be removed by settling in the settling pond before being used for dust suppression and plantation. Hence, there shall be no change in drainage system due to this mining project in buffer zone.

Ground Water Quality:

Major impact of opencast mining on groundwater regime is quality deterioration. Ion leaching from overburden material due to weathering causes increase of dissolved particles into the infiltrated water to aquifer. The proposed mining activities shall be carried out upto a depth of 73m from average groundlevel.

Groundwater occurrence and storage in study area are mainly controlled by the geological structure and formation of the area. The ability of geological formation to store and transmit water is dependent on its formation parameters, such as porosity and hydraulic conductivity. Based on these two parameters, the rock formation of the area may be classified as hard and soft rocks. Hard rocks, mainly crystalline and consolidated sedimentary is characterized by very little porosity. Ground water in such rocks circulated to a limited extent through the secondary openings represented by joints, cracks, fissures and such other planes of discontinuity. Soft rocks represented by sandstones, pebbles and loose sand, pass higher degree of primary porosity and are characterized by higher water storage capacity. The area is underlain by Precambrian metamorphic rock. The weathered residuum of the hard rocks as well as the fractures, joints, fissures, faults and other zones of discontinuity are the principal repositories of ground water in the area. The weathered zone is usually of limited thickness, fractures and joints generally close up with depth. The thickness of weathered mantle in the hard rock zone of area is about 15-25 meter in the topographic lows. Ground water in the weathered and fracture zones of hard rocks occur under unconfined condition. Ground water circulating through fracture

zone is sometimes held under pressure.

Groundwater in entire region is portable with pH ranging between 7 to 7.5 and total dissolved solids (TDS) between 240 to 300 mg/litter.

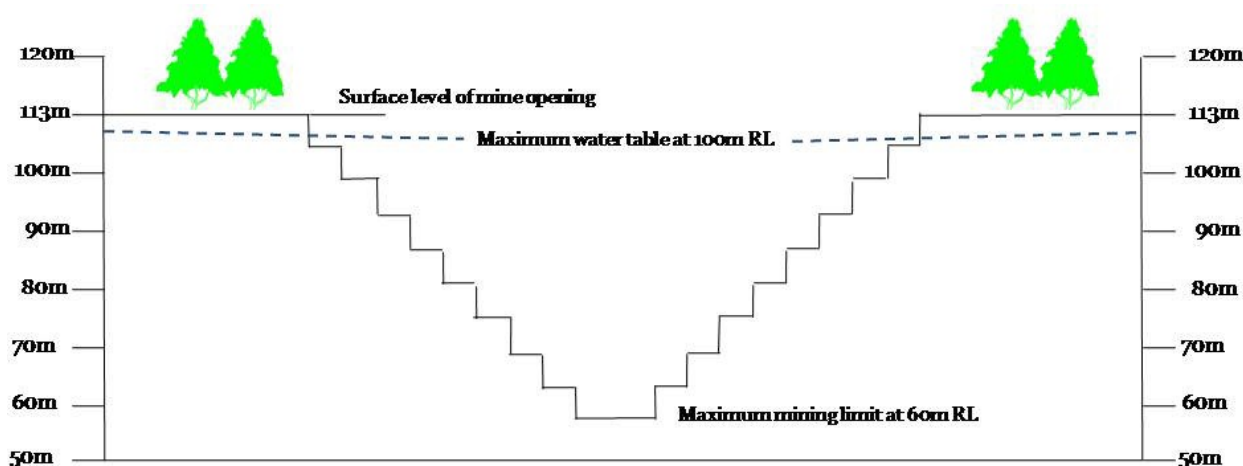


**Fig. No. C4-6: Schematic Diagram showing Ground Water Table
w.r.t. Pit Limit**

Ground Water Ingress:

Open cast mining activity leads to creation of depressions in the earth's surface which hinders smooth subsurface flow of groundwater. The detail hydrogeological investigations surrounding the buffer zone of lease area suggest water table exists at a depth ranging between 4.10 to 17.75 meters below ground level. Field investigation in the core zone indicates that the ground water zone is encountered between 10 to 15mbgl. Therefore, the seepage of groundwater shall occur as and when water table is intersected. The ingress of water during mining will be through the vertical cross section of the mining pit as well as through the floor and will be accumulated within pit.

The volume of water considered as seepage during mining through backfilled area, mine strata and surface is 20% of the water inflow due to direct rainfall. The study shows that the total catchment area is 0.8 sq.km and the water inflow due to direct rain on the day of maximum rainfall is 84000 cum/day. Therefore, the seepage quantity is 16800 cum/day.

The impacts exerted on groundwater regime due to mining may be for temporary period during mine life and would tend to regain the initial conditions as infiltration of rainwater would balance the mine dewatering over a period of time. Considering the present stage of groundwater development and availability of groundwater in the lease area it does not seem that the mining is going to make any adverse impact on the groundwater regime of the area.

Ground Water Recharge for Mine Lease Area:

For the Gangaramchak &Gangaramchak-Bhadulia block in particular, the total average rainfall is about 1405 mm of which 90 % precipitation is during rainy season. For rainwater estimates for pumping purpose, a high of 69 mm of rainfall in a day has been considered. The volume of rain water entering to the mine and accumulating in the quarry has been estimated on the basis of direct catchment area, maximum daily precipitation and the run-off coefficient. An additional 20% additional make of water has been considered to account for ground water seepage and aquifer water.

Volume of rain water entering to the mine and accumulating in the quarry (make of water) has been assessed on the basis of the following formula:

$$Q = A \times H \times \partial \text{ m}^3/\text{day}$$

Where,

A - Catchment area in m^2

H - Maximum daily precipitation in mm

∂ - Run-off co-efficient

The run-off co-efficient (∂) has been considered as below:

For mined out area : 0.60

The maximum broken area within this interim period is envisaged in the tenth year of operation and estimation for make of water done on the quarry parameters for tenth year only.

Following parameters were considered:

Maximum broken area: 49.60ha

Make of water within pit = $49.60 \times 10000 \times 0.105 \times 0.60 = 31248 \text{ m}^3$
Total accumulated water in pit = 31248 m^3

Additional 20% water for ground water and seepages = 6249.60 m^3 .
Total water estimated for pumping requirement = 37497.60 m^3

Surface Water:

Quality of surface water indicates (when compared with IS: 3025, Class C) all values are within the safety limit except the BOD value of canal and Hinglo Dam. Also quality of ground water indicates (when compared with Desirable limits as per IS: 3025) the water quality is very suitable to use as drinking water. Mining and allied activities shall have no impact or bearing on these. During mining substantial quantities of particulates are anticipated to be generated which may result in increase in silt content in adjoining water bodies if allowed to go outside. In order to prevent siltation, storm water will be collected through garland drains and reused after settling in settling pond. A garland drain of 5-7 meter width has been planned along the lease boundary to channelize the storm water from the catchment area.

Total Water requirement in the Gangaramchak & Gangaramchak Bhadulia Coal Mine is estimated to be 150KLD. For dust suppression peak water demand shall be 90 KLD, plantation will consume 45 KLD whereas drinking water need along with cleaning & washing at work place is 15 KLD. The total required water shall be collected from rain water harvesting pond whereas drinking water shall be from bore well from nearby villages. No objection certificate (NOC) has been obtained from CGWB for ground water abstraction vide NoC no-176/TW-12 dated 07.11.2006, a comprehensive Hydrogeological report is also prepared for this project. Water required for sprinkling & plantation purpose

shall be collected from the settling tank/water harvesting pit.

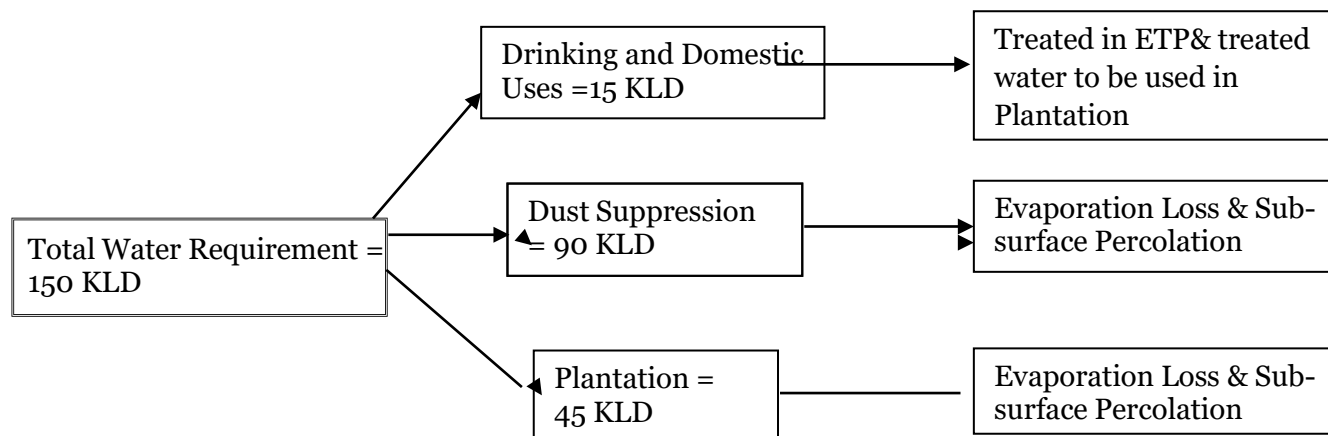


Fig. No. C4-7: Water Balance Chart of the Mine

4.4 WATER MANAGEMENT & WATER POLLUTION MITIGATION MEASURES:

Surface Water Pollution Control:

The objective is to regulate the surface water of the mining area in such a manner so as to cause minimum contamination and alteration of drainage system.

Water management (including storm water drainage) scheme (by a network of garland drains/diversion ditches and catch-pits) has been planned. Attempts shall be made to minimize the discharge of surface run off during monsoon. Domestic waste shall be treated in STP and shall be used for green belt development purpose. The salient features of the scheme are as follows:

- Retaining walls will be built all-around the external dumps which will have weep holes for passage of storm water to join garland drains.
- Garland drains shall be constructed as much as possible around quarries and external dumps (depending on contours). The garland drains shall be routed through settling pits and settling tanks to settle down suspended solids in the storm water.
- Settling pits and drains shall be cleaned periodically, especially before and after rainy season.
- Small grasses & bushes in garland drains will hold back solid particles from draining away.
- Small stone barriers across the drain will check water current & arrest solid particles.
- No overburden or loose sediments will be kept in the working benches particularly during monsoon months.
- No mine water will be discharged into the river which is flowing within the leasehold.

- Monitoring of river shall be done at regular intervals & records maintained.
- Effluents from the rest areas will be diverted through drains to the guard pond after proper treatment for use in vehicle wash system, workshop and green belt development.
- Sanitary sewage generated in office area
- Problems due to inundation and flood will not arise as the mine is in upland and at a higher altitude than the normal surface level. The clarified water from the settling pond will be used in dust suppression and plantation.

Ground Water Pollution Control:

The ground water table of the project area varies from 10m to 15mbgl whereas the pit limit by the end of the lease period will be at 73m below from the average surface level. Thus, the quarry depth during the lease period will intersect the ground water table.

During rainy season the accumulated rain water in the quarry pit shall be pumped out. The rain water will be passed through the garland drain into the settling tank to arrest suspended solids, if any. 1 Settling pond of 100m length, 100m width and 4m depth shall be constructed to collect rain water from pit. The tank will have High Density Polythene coating to hold the water throughout the year. 1 more settling pond to be constructed near the dump connecting to garland drains. The settled water shall be used in water sprinkling & Plantation.

Mining is a physical process where water is mainly used for dust suppression and washing of heavy earth moving machines. Since no chemical transformation takes place and the ore is naturally occurring, there is no possibility of any chemical contamination in this waste water except an increase in suspended solids comprising ore particles, clay, etc in surface run off during monsoon. During oil changes in equipment & other machinery, there are chances of spillage of oil and generation of waste water containing oil & grease. A sanitary sewerage treatment plant has been proposed as almost 270 manpower will be deployed in Gangaramchak & Gangaramchak Bhadulia Coal mining project.

The core zone, being at a higher elevation allows substantial quantity of precipitated water to flow down as run off to the streams/nalas in close vicinity. In operational period the runoff is expected to carry substantial amount of solids from mining zone.

Rain Water Harvesting:

For the operation of the mining units the extraction of natural resources is unavoidable but effective steps shall be taken towards replenishing the natural resource conservation. In order to keep pace with the dwindling availability of the natural resources & resource utilization it has been proposed to take steps for organizing resource conservation initiatives.

Water is a scarce natural resource in most regions of India. Water from perennial sources/ground water sources is piped to utilization centers. Collection, storage & efficient use of rainwater can reduce the cost of water collection & supply. To cater to the needs of daily water requirement now-a-days mines are coming up with implementing the techniques of Rain Water Harvesting (RWH) over the roofs of offices, rest sheds and by making percolation tanks.

Broadly there are two ways of harvesting rain water:

1. Surface runoff harvesting
2. Roof top rainwater harvesting

In mining area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods. In the present context of open cast mining, rainwater flows away as surface runoff and hence, Rain Water Harvesting from land surface (paved and unpaved areas) is proposed.

A) Rain Water Harvesting from Land Surface:

Rainwater harvesting using land surface is less complex way of collecting rainwater and can be done in the mining areas. It involves improving runoff capacity of the land surface through various techniques including collection of runoff with drain pipes and storage of collected water. Ground catchment techniques provide more opportunity for collecting water from a larger surface area. By retaining the flows of small creeks and streams in small storage reservoirs created by low cost earthen dams, this technology can meet water demands during dry periods. There is a possibility of high rates of water loss due to infiltration into the ground, and, because of the often marginal quality of the water collected, this technique is mainly suitable for storing water for plantation and other purpose.

B) Rain Water Harvesting through Contour Bund:

Contour Bunds are effective methods to conserve soil moisture in watershed for long duration. These are suitable in low rain fall areas where monsoon run off can be impounded by constructing bunds on the sloping ground all along the contour of equal elevation. Flowing water is intercepted before it attains the erosive velocity by keeping suitable spacing between bunds. Spacing between two contour bunds depends on the slope of the area as the permeability of the soil. Lesser the permeability of soil, the close should be spacing of bunds. Contour bunding is suitable on lands with moderate slopes without involving terracing.

The average annual rainfall of the project area is 1405 mm and the runoff coefficient factors have been taken as per guidelines of Manual on Norms and Standards for Environmental Clearances by MoEF& CC, Govt. of India.

So the total annual runoff can be calculated as:

Runoff = Rainfall × Catchment Area × Runoff Coefficient

Annual Rainfall = 1405mm = 1.405 m

Total Project Area = 1864200sq. m

Coefficient of Run off for Rooftop (Inclined) = 0.90

Coefficient of Run off for Rooftop (Flat) = 0.80

Coefficient of Run off for Road/Paved Area = 0.70

Coefficient of Run off for Open Area = 0.25

Coefficient of Run off for Greenbelt Area =
0.15 Rain water can effectively be collected from;

Maximum size of void in 10th year of mining = 49600 sq.

mTop soil dump area = 18000 sq.
m

Road & Infrastructure = 68000 sq. m

Runoff from Void pit area = 1.405 m X 49600 sq. m X 0.25 =

17422 m³ Runoff from Top soil dump area = 1.405 m X 18000 sq. m X

0.25 = 6322.5 m³ Runoff from Road & Infrastructure = 1.405 m X 68000 sq. m

X 0.7 = 66878 m³

Total Runoff from Project Area 90622.5 m³

The annual runoff generated in the project site is 90622.5 m³. By considering the loss of 20% due to evaporation, spillage and wastage, the effective runoff that can be harvested inside the project area is 72498 m³.

Daily water requirement (except drinking purpose) is 80 m³. So with 300 working days, the water requirement will be

= 80 m³ X 300 = 24,000 m³

The surface runoff being generated from the project area will be channelized to rain water harvesting ponds through network of drainage systems. The bottom of the ponds is naked and natural seepage from the bottom will recharge the ground water regime. Hence the storage ponds will act as recharging structure. Even though rain water will be sufficient to fulfill the daily requirement of water but in the initial years of mining, when the mining pit is smaller in size or in the year with deficit rainfall surface water will be collected with due permission.

Runoff Generation from Quarry pit, Dump, Ore storage, etc

- a) Maximum size of void will be in 10th year of mining = 49.60 ha

Considering 1" or 25 mm/hr rainfall in worst case scenario, mining quarry is expected to generate

= 49.60 ha X 2.47 X 4046 X 0.025 m/hr = 12392 m³/hr [1 ha. = 2.47 acres & 1 acre = 4046 m²] Considering Seepage loss to be 40% in the mining pit; 60% will be collected as pumped out water.

Rain water to be pumped from Mining Pit 36694.1 m³/hr X 0.6 = 7435 m³/hr Considering 2 hr. detention time, volume of settling tanks required = 14871 m³

So, Size of Settling Pond required for the maximum runoff water generated shall be with dimension of 75m length X 50m width X 4m depth.

Gangaramchak & Gangaramchak Bhadulia Coal Mining Project shall construct the settling tank of 75m X 50m X 4m size, which shall be connected to garland drains. This tank will be in use to collect the water through garland drains and allowed to settle the water.

- b) Total maximum area occupied by Dump and Top soil in the 10th year of mining = 14.58 ha

Considering 1" or 25 mm/hr rainfall, dumping area is expected to generate = 14.58 ha X 2.47 X 4046 X 0.025m/hr = 3642.67 m³/hr

Considering Seepage loss to be 30% in the Dumping area; 70% will be collected through garland drains as surface run off.

Rain water to be collected as Surface Run off = 3642.67 m³/hr X 0.7 = 2550 m³/hr
Considering 2 hr. detention time, volume of settling tanks required = 5100 m³

- c) Total area occupied by Infrastructures within the ML area = 6.80 ha

- d) Considering 1" or 25 mm/hr rainfall, infrastructure area is expected to generate = 6.8 ha X 2.47 X 4046 X 0.025m/hr = 1699 m³/hr

- e) Considering Seepage loss to be 20% in the infrastructure area; 80% will be collected through garland drains as surface run off.

Rain water to be collected as Surface Run off = 1699 m³/hr X 0.8 = 1359 m³/hr
Considering 2 hr. detention time, volume of settling tanks required = 2718 m³

So maximum water collected from dumping & infrastructure area shall be = 5100 m³ + 2718 m³ = 7818 m³

So, size of Settling Pond required for the maximum runoff water generated from dumping & infrastructure area shall accommodate in one Settling Pond with dimension of 40m length X 40m width X 5m depth.

The daily water requirement for the project for sprinkling and plantation purpose, etc is 80 KLD. Thus the settling tanks will play a vital role in supplying daily water requirement for sprinkling and plantation purpose for about a month.

4.5 IMPACT ON NOISE QUALITY:

In the mechanised open-cast mine, mining operations such as drilling, blasting, excavation, loading and unloading, movement of dumpers, etc are expected to generate noise. In this particular mine, the operation will be limited to three shift of eighteen hours duration in a day. The various sources of noise mentioned above shall only be periodical and are limited to a fixed period of operation only. In addition to this, the transportation of ores might cause a little effect on the noise level.

Noise levels in the work zone shall vary from about 65 to 90 dB (A), except during blasting, which shall carried out at a specific time of the day. Personal exposure shall be less than 80 dB (A) because operators only remain very close to the machines and they sit in closed cabins. Noise level in work zone is expected to increase marginally in the open-cast mining area due to excavation, drilling & blasting, handling and transportation of overburden and coal. Measures suggested in section 4.8 below, shall reduce the noise level. Impact of noise level on the nearby villages has been predicted not to increase significantly.

Blasting Effects:

Noise generated from blasting is neither continuous nor for longer duration but instantaneous. It takes less than five seconds to occur. Noise of blast is site specific and depends on type, quantity of explosives, dimension of drill holes, degree of compaction of explosive in the hole and rock. Hence the impact of noise will be limited and the blasting will be performed at a particular time during the day time only. It should be noted that there are no villages within the lease boundary and the proposed area is not the habitat of any wild animals.

Blasting incorporates detonation of small or large quantities of explosives in a blast holes. The burden, spacing, stemming, charge per delay and other parameters vary from place to place depending on the rock type, drill diameter & explosive type in use. A blast design is evolved depending on the preferences of the mine that determines the size of the fragments to be obtained, throw distance of the muck and shape of the muck pile and of course the economics of the sub-system operation. A perfect blast will generally create less noise, air over-pressure and ground vibration. However, due to changing rock mass conditions, it is difficult to predict these parameters.

4.6 NOISE POLLUTION MITIGATION MEASURES:

The sources of noise in this particular project are drilling, blasting, movement of vehicles, loading & unloading of materials. However, Noise level shall be maintained below 75 dB (A) in work zone (for 8 hours exposure). The mitigation measures for noise pollution are of following types:

- Prevention at source
- Attenuation in transmission path and
- Protective measures on work environment.

The following measures will be taken to reduce noise levels;

- Diesel powered machineries which are major source of noise in open cast environment will be properly maintained as per maintenance schedule to prevent undesirable noise.
- Attention shall be paid towards rigorous maintenance of silencers of diesel engines.
- Static diesel engines shall be housed as far as possible (not made of sheet metals or surrounded by baffles). If possible they will be placed on vibration isolators.
- Drill machine operators, blasters and dumper drivers will be issued earplugs and earmuffs. Duty hours of operators of noisy machinery will be regulated to keep their noise exposure levels within limits.
- Provision of sound proof cabins for the workers deployed on machines producing higher level of sound like dumpers, shovels etc.
- Blasting will be made during day time and if possible, at a particular time.
- Green belt will be developed around office building and mine to reduce noise level.

Control of Vibration, Noise and Fly Rock Generation due to Blasting:

For any possibility of objectionable ground vibration the broad blasting parameters may be implemented as per the field condition along with the use of delay detonator. The blasting parameters should be suitably set to minimize ground vibration with in safety limit. Measures to be taken while blasting in opencast mines are as follows:

- Blasting shall be carried out only during daytime, at a particular time as per schedule.
- Blasting will not be done in stormy condition or during morning & evening hours.
- Maximum permissible charge per delay would depend on the distance of structure to be protected from the blasting.
- Detonation cords, cord relays, mili-second delay detonators will continue to be used for connection and initiation of holes.
- Suggested number of rows in a blast should not be more than four to reduce fly rock and ground vibrations.
- Length of blast will depend on the total number of holes which can be blasted in a round while observing the above guidelines/restrictions. However, it should be as large as design would permit. Attempts should be made to have one large blast with less frequency than to have several small blasts.
- All the holes are proposed to be blasted by safety fuse firing system to control the throw and vibration.
- Provisions will be kept for conducting trial blast by any competent agency / organization and the suggestions will be made in use to reduce the ground vibration.

4.7 IMPACT ON TOPOGRAPHY & LAND USE:

The terrain in general, portrays a gently undulating topography with few isolated hillocks in the South central and South-western part. The main coal bearing area with subdued topography is skirted on the northern and southern sides by hills of basic volcanic rocks. The area exhibits gently undulating topography with elevation ranging from 94 m to 121 m above mean sea level. The general slope of the area is towards south-west. The ground slope is rather steep both towards east and west. The block has highest elevation of 121 m (contour value) around GRC-16 and GRC-41 in the northern part of the block. Mining has been started within the lease area. By the end of the life of the mine, i.e. after 3 years, an area of 141.9 ha. shall be excavated out of which 127.9 ha area will be backfilled and the remaining 14 ha area will remain void which will be used as water reservoir.

There will be two types of waste material generation in the coal mining process, viz. Top soil and OB. Top soil will be scrapped and stored in the designated place over an area of 5.80 ha. Top Soil will be utilized in plantation, however, will be spread over the reclaimed area in later phases during the progressive and final closure of the mine. The overburden generated in the initial years has been dumped outside the north western boundary of the Block. A box cut will be made near Borehole GRC-48 (Beyond In-crop Borehole) at the edge of the northern quarry boundary and progress towards south. Mining will be extended in both eastern and western flanks from the access trench. Coal and OB benches will be developed separately for continuous working. An area of 12.78 Ha of Land will be utilized for OB dumping externally.

A total of 172.17 ha of land will be broken for mining purposes out of which 127.9 ha will be backfilled. Overburden removal will reach to 29.94 Mcum and coal production will be in a tune of 5.725 million tons. Top soil of 0.84 Mcum will be generated out of which 0.70 Mcum of top soil will be spread over the backfilled and external dumping ground.

The extensive afforestation on abandoned mining benches, overburden dumps and other areas shall match well with the forests in the study area to the maximum possible extent, to provide a uniform land use befitting to the location. Afforestation has been planned in a manner, which will actually increase the bio-diversity of the local ecosystem. Positive impacts on land use due to creation of subsequent artificial forest land generation, which shall come in view from 2031-32 when initial green belt attains height. The planned tree density of 1600 trees per ha. is comparable to the forests in the study area.

C4-25

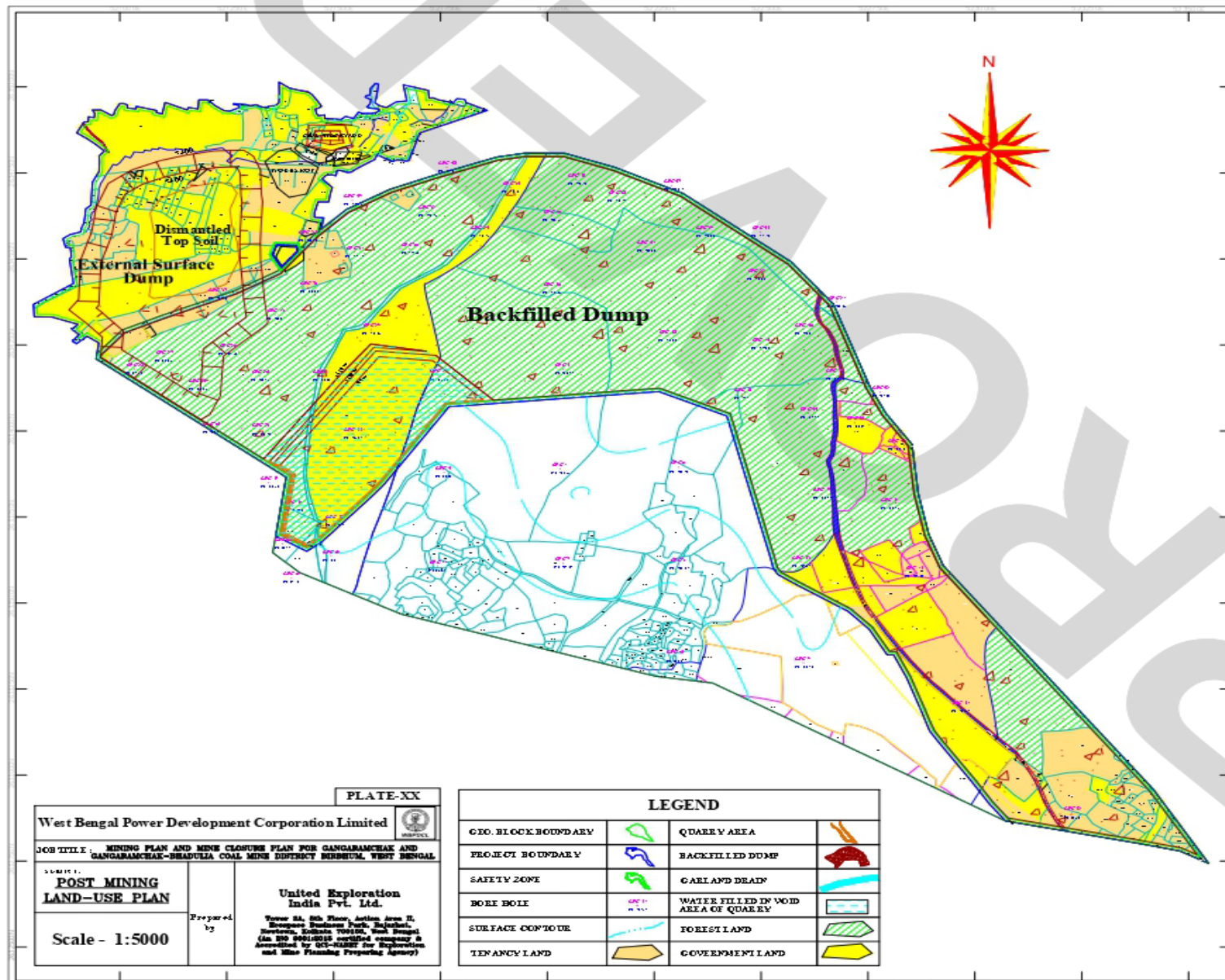


Fig. No. C4-10: Post Mine Closure Plan

Some of the civil construction shall remain after cessation of active mining. These infrastructure facilities shall benefit the site as the roads will form a much better communication link with the outside compared to the existing unpaved roads. The office buildings etc. may be used by the State government or Central government agencies or can be developed as a school /primary health centre in the region.

Impact on Soil:

Top soil will be scrapped and stored in the designated place over an area of 1.80 ha. as shown in the respective stage plans. Top Soil will be utilized in the plantation and will be spread over the reclaimed area in later phases during the progressive and final closure of the mine.

Although minimum storage time shall be attempted to avoid nutrient loss, but loss of some nutrients due to temporary storage and even after direct placement of soil to the reclaimed areas of the external waste dump, cannot be ruled out.

Management of Top Soil

Where possible, topdressing material will be re-spread directly from stripped areas onto areas being rehabilitated. Where this is not possible, topdressing material will be stored in stockpiles. Stock piles will be dumped at places where they would not be disturbed by future mining. Sediment fences or other barriers can be used where necessary to retain sediment. When stock piling of top soil is done, the mound should not be higher than 1.20m (without amendments) and 3.0m (with amendments). The overall topography for the graded surface should be designed to minimize the uncontrolled flow of runoff. Dispersed sheet flow should be broken up by terraces or benches along the slope that also follow topographic contours. On a fine scale the ground surface can be roughened by the tracks of a bulldozer perpendicular to the slope. Construction of stockpiles with a "rough" surface condition will reduce erosion hazard, improve drainage and promote re-vegetation.

Preservation of Top Soil

Stockpiling topsoil may result in disruption & loss of beneficial soil microorganisms and nutritional values, hence needs preservation. Re-vegetation of the stockpile should be done to protect the soil from erosion, discourage weeds and maintain active populations of beneficial soil microbes. Temporary Seeding shall be carried out as soon as possible within 30 days after the formation of the stockpile. If stockpiles will not be used within 12 months they will be stabilized with permanent vegetation to control erosion and weeds. Native grass species should be selected for re-vegetating top soil stock piles. Topsoil can be mixed with organic material or manufactured soil amendments to improve the growing capability. To the extent practicable, above ground vegetation, including tree litter should be mixed or otherwise incorporated into the topsoil. Stockpiled topsoil needs significant fertilizer application for the establishment and maintenance of vegetation. Soil amendments should be applied before seeding or planting. Common soil amendments used are biosolids, compost, manure, lime and coal combustion byproducts.

Impact on Agriculture:

This revised mining plan involves an area of 186.42 ha of area comprising both forest and non-forest land. Out of 186.42 ha, an area of 47.65 ha has already been transferred to WBPDCCL on 8th August, 2015. The remaining area involves 101.77 ha of forest land for which stage II clearance has already been obtained. An area of around 37 ha as suggested in the previously approved mining plan was utilized for Overburden dumping and infrastructure development by prior allottee. Mining Lease has been granted for an area of 149.42 ha including 37 ha of non forest land outside the block boundary.

4.8 PROPER LAND USE PLANNING AND MINE CLOSURE:

Pond shall be the post mining use of land in the ML area. The surrounding of the abandoned mine pits after complete exhaust shall be afforested. Justifications of deciding pond as the post mining land use are as follows:

- The artificial pond developed on abandoned quarry areas in the lease shall fulfill the water need of the area for agriculture. The pond boundary shall be fences to avoid any mishaps.
- The pond will also be used for pisciculture.

Some of the civil construction shall remain after cessation of active mining. These infrastructure facilities shall benefit the site as the roads will form a much better communication link with the outside compared to the existing unpaved roads and the office buildings etc. may be used by the State government or Central government agencies or can be developed as a school/primary health centre, etc. in the region. The areas of temporary use viz. stack yard, areas for site services, etc. shall be afforested during closure. Electrical installations shall be dismantled following proper procedure. Post mine land use plan shall be as follows.

Table No. C4-5: Land Utilization during Mining and Post Closure Period

Type	Land Use (Proposed)	Land Use (End of life)	Land Use (Post Closure)						Total
			Agriculture Land	Plantation	Water Body	Public Use	Forest Land	Undisturbed	
Excavation Area	141.90								
Backfilled Area	--	127.9		35.90			92		127.9
Excavated Void	--	14			10		4		14.0
Top Soil Dump	5.8	5.8		5.8					5.8
External Dump	12.78	12.78		12.78					12.78
Safety Zone	8.01	8.01		2.24			5.77		8.01
Road & Infrastructure	2.24	2.24				2.24			2.24
Garland Drain	1.44	1.44				1.44			1.44
Undisturbed	14.25	14.25						14.25	14.25
Total	186.42	186.42		56.72	10	3.66	101.77	14.25	186.42

4.9 Solid Waste Management:

There will be two types of waste material generation in the coal mining process, viz. Top soil and OB. Top soil will be scrapped and stored in the designated place over an area of 5.80 ha. Top Soil will be spread over the reclaimed area in later phases during the progressive and final closure of the mine. Concurrent backfilling is in progress and shall be continued to do so.

Waste material will be compacted and stabilized by dumping the various sized material in a mixture form. Following steps shall be taken for the management of waste dump;

- Waste dumps location in the mine will be chosen according to topography, future aspects of mining and economy in transportation. Waste dump ground should be stable, strong and away from water reservoir.
- Dump site have no interference with primary drainage condition of the mine.
- The disposal sites have not been located in an area where future population growth or developments are likely to affect the ability of the site to meet performance objectives.
- Ring bund and drain all around the dump, at the toe shall be formed so that the rain water falling over the slopes and bringing down small quantities of silt will be arrested at the toe itself and prevented from going far away to agriculture land & into the nearby nalas etc. Settling tank along drain shall be provided at some intervals.
- Formation of masonry chutes at suitable intervals to bring down the rain water from the top of the dump to the ground levels. By this method, carrying away large quantities of silts & eroding the slopes year after year by water will be prevented.
- Garland drains (diversion ditches) shall be built to avoid water from outside entering into or becoming pounded against overburden dump.
- There shall be settling tanks connected to garland drains so that fine sands & heavy particles coming with water shall settle down and clear water is reused.
- Contour trenches shall be made on overburden dumps to control surface runoff & subsequent erosion.
- Grasses shall be planted over the dump slope followed by shrubs & trees. Height of the external dump will be maximum 60 meter on average with 30 meter height in each tier. The dumps shall have the following protection measures:
- The external dumping will be followed with 30 meter tier with a maximum height of 60 meter in the northern side, with an overall slope of 32°. Internal dumping will follow the quarry floor and will maintain a height of maximum upto 60 meter from the average ground height. Overall slope along towards the mined out void will be 28°, while above the ground level it will be 32°. Each tier will be of 30 meter height both below and above ground levels.
- The external dumps will have stretches of retaining wall at suitable locations. The retaining walls will be made up of boulders. The walls will be of maximum 1m height and the top surface will be of 0.5m flat. Retaining walls will have weep holes to drain out water.
- The completed dumps and the back-filled areas shall be gradually afforested to

increase the stability. Internal dumps & backfilled areas shall match with adjoining ground profile.

The Other solid waste like Municipal Solid Waste and Hazardous solid waste are likely to be generated. The municipal Solid waste like organic waste from canteen and office shall be composted for horticulture use. STP Sludge shall be dried in sludge drying bed and shall be used for horticulture purpose. Hazardous Waste like Used oil, oil & grease skimming, chemical sludge from waste water treatment, other scrap material etc. shall be collected and disposed off as per Hazardous & other Waste (Management and Transboundary Movement) Rule, 2016 and amendments thereof. Necessary authorization shall be obtained from West Bengal State Pollution Control Board for collection and disposal of Hazardous Waste. Hazardous Waste shall be sold to authorized re-processor/recycler unit only.

4.10 IMPACT ON VEGETATION:

Out of 186.42 ha of the said mining project about 101.77 ha area is coming under forest land category. The remaining non-forest land has thin vegetation cover; mostly herbs & shrubs. The first and direct impact of mining operations in forested areas is the eviction of forests which alters the food availabilities and wildlife habitat.

The existing forests in the buffer zone will be subjected to human disturbances of various kinds like tree felling for fuel-wood requirement, expansion of agriculture into the forest area and diminished renewal of flora due to a polluted environment. Due to dusts from blasting and vehicle movements the surrounding are likely to be affected but water sprinkling and increase in vegetation cover are proposed to minimize the impact. The flora in the Buffer Zone is likely to be affected because of the mining activity and transportation of vehicles but this impact will be substantially reduced by plantation within and along the transportation road. Sal, Amla, Tal, Jamun are the most dominant species in the forest of this region.

No medicinal plants reported to be under Threatened or Near Threatened category are observed in the study area.

4.11 AFFORESTATION/PLANTATIONS PROGRAMME:

In order to mitigate and minimize the environmental impacts, arising due to mine project especially from air pollution, noise pollution, soil erosion etc. the Greenbelt Development around the project sites can provide the best mitigation option. The green canopy not only absorbs some of these pollutants but also improves the aesthetic environment. Therefore, a "Green Belt Development Plan" has been proposed around the mine lease area and along the conveyor corridor. The green belt shall serve the following purposes:

- Compensate the damage to vegetation due to setting up & operation of the mine.
- Prevent the spread of fugitive dust generated due to mining and allied activities.
- Attenuate noise generated by the mine.
- Reduce soil erosion.
- Help stabilize the slope of over-burden dumps.
- Increases green cover and improve aesthetics.
- Attract animals to re-colonise the area when the mine is abandoned.

Safety zone all along the mining lease boundary and project boundary is considered as 7.5 meter. The green belt is proposed to be developed in safety zone covering 8.01 ha and also along with the haul roads as transportation corridor. The strategy worked out for development of green belt consists of following:

- Broad leaf trees growing above 10m in height should be planted along the roads, offices and infrastructure facilities.
- Plantation of trees should be undertaken in appropriate encircling rows.
- Generally local/indigenous fast growing trees & shrubs should be planted.
- The trees should be protected by plantation of non palatable shrub species to avoid browsing by animals.
- Placement of tree guards to be provided to save the plants.

Identification of Sites for Plantation:

The identified plantation sites should be free from over head telephone lines, electric poles and other industrial emergency installations so that there will be no obstacle in the plant growth. In the Gangaramchak & Gangaramchak Bhadulia Coal mining project, plantation shall be developed in the following areas:

- Along the transportation roads inside and outside the ML area
- Along the ML area boundary
- On the bank of the river
- Around office, rest shed & parking places
- Around waste dump areas as well as in the dump slope
- Over the vacant and non-mineralized area within the lease area
- On backfilled areas and on mining upper benches/slope (where overburden material is not available for backfilling) of mine pits after closure of the mine pit.

Plantation along Mine Lease Boundary:

Plantation is being carried out all along the lease boundary in the safety zones and other undisturbed areas. Once the mined out areas are reclaimed, plantation will be carried out in the backfilled area after stabilization of the dumping grounds.

Efforts will be made towards plantation of the native species which includes but not limited to:

Bougainvillea (<i>Bougainvillea sp.</i>) Kul (<i>Zizyphus sp.</i>) Krushna chuda (<i>Delonix regia</i>) Duranta (<i>Duranta sp.</i>) Bhursunga (<i>Murriya exocitica</i>) Sita Phal (<i>Annona squamosa</i>) Sunnari (<i>Cassia fistula</i>)	Siris (<i>Albizia lebbek</i>) Neem (<i>Azadirachta indica</i>) Amba (<i>Mangifera indica</i>) Bada Chakunda (<i>Cassia siamea</i>) Karanja (<i>Pongamia pinnata</i>) Baheda (<i>Terminalia bellirica</i>) Harida (<i>Terminalia chebula</i>)

Plantation in Selected Areas within the Lease:

In the proposed plan, green belt will be developed in vacant areas particularly around the dumping yards, mining pits, etc. Mixed plantation will be done to take care of different heights and rates of growth. Species suggested for such areas are:

Siris (<i>Albizzia lebbeck</i>)	Panasa (<i>Artocarpus heterophyllus</i>)
Dimiri (<i>Ficus racemosa</i>)	Palas (<i>Butea monosperma</i>)
Krushna chuda (<i>Delonix regia</i>)	Karanja (<i>Pongamia pinnata</i>)
Tentuli (<i>Tamarindus indica</i>)	Mahula (<i>Madhuca longifolia</i>)
Neem (<i>Azadirachta indica</i>)	Jamu (<i>Syzygium cumini</i>)
Amba (<i>Mangifera indica</i>)	Bahada (<i>Terminalia bellirica</i>)
Osta (<i>Ficus religiosa</i>)	Harida (<i>Terminalia chebula</i>)
Bara (<i>Ficus bengalensis</i>)	Sal (<i>Shorea robusta</i>)
Bada Chakunda (<i>Cassia siamea</i>)	Sita Phal (<i>Annona squamosa</i>)

Plantation around Office Buildings, Stores, along Roads, etc.:

Plantation will be carried out around office buildings, stores and other buildings, along the side of connecting roads. Species suggested for plantation, mostly ornamental plants are as follows:

Bada Chakunda (<i>Cassia siamea</i>)	Siddha (<i>Lagerstroemia parviflora</i>)
Sunnari (<i>Cassia fistula</i>)	Sisso (<i>Dalbergia sissoo</i>)
Krushna chuda (<i>Delonix regia</i>)	Osta (<i>Ficus religiosa</i>)

Karanja (<i>Pongamia pinnata</i>)	Amba (<i>Mangifera indica</i>)
Neem (<i>Azadirachta indica</i>)	Siris (<i>Albizzia lebbeck</i>)
Bara (<i>Ficus bengalensis</i>)	Tentuli (<i>Tamarindus indica</i>)
Kadamba (<i>Anthocephalus kadamba</i>)	Debadaru (<i>Polalthia longifoila</i>)
Tagar (<i>Ervatamia divaricata</i>)	

Plantation along the Transportation Road:

Plantation along the transportation road will commence on the very first year of mining. Since this area is more prone to dust pollution, plant species tolerant to such pollution will be planted. The row of plants on the inside row should be smaller species and those facing outside should be taller species. The species suitable for this zone are as follows;

Am (<i>Mangifera indica</i>) Jamun (<i>Syzygium cuminii</i>) Osta (<i>Ficus religiosa</i>) Bada Chakunda (<i>Cassia siamea</i>) Sunnari (<i>Cassia fistula</i>) Jhaun (<i>Casuarina equisetifolia</i>)	Sisso (<i>Dalbergia sissoo</i>) Debadaru (<i>Polyalthia longifoila</i>) Karanja (<i>Pongamia pinnata</i>)Neem (<i>Azadirachta indica</i>) Krushna chuda (<i>Delonix regia</i>) Tentuli (<i>Tamarindus indica</i>)

Plantation on Waste Dump:

Plantation on the reject's dump cannot start till dumping activities cease at least in a dump and the site is prepared for plantation. Once dumping is complete in the dump, a path will be cleared to the designated area so that the basic inputs (water, manure and seedlings) can be carried up to the site. Next, a layer of topsoil shall be spread over the area and roughly leveled. Coir mats shall be spread over the surface followed by showing of grass seeds /plantations of seedlings on the soil layer to stabilize the dump slope.

Plants selected for plantation in and around the reject's dumps should have pollution tolerance nature, fast growth rate, glabrous/pendulous leaves and large crown volume to surface area of fluttering leaves. The species selected will be from among Osta (*Ficus religiosa*), Karanja (*Pongamia pinnata*), Acacia (*Acacia leucophloea*), Sitaphal (*Annona squamosa*), Subabool (*Leucaena leucocephala*), Neem (*Azadirachta indica*), Barkoli (*Zizyphus mauritiana*), etc.

Plantation on Top of Dumps:

Trenches of 45cm X 45cm will be dug on the flat top of the dumps and the excavated material will be used to form a bund on the dip side of the trenches to retain maximum water in the trenches during rains. Suitable benches will be made on the waste dumps and a size of 60cm X 60cm pits will be dug on the benches at 2m intervals and exposed for 10 – 15 days to sun. The pits will be filled with a mixture of topsoil, organic manure and phosphoric fertilisers. Saplings will be planted in these pits once monsoon has commenced to ensure maximum survival of the saplings. Initially hardy pioneers

species, *Acacia catechu*, *Acacia leucophloea*, *Azadirachta indica*, *Annona squamosa*, *Lucaenaleucocephala*, *Zizyphus mauritiana*, etc will be planted to help build up the soil.

Plantation on Dump Slopes: Plantation on slope of the dumps will commence as soon as the first bench is ready. The terraces on the slopes will be sloped inward. 0.5m to 0.75m deep pits will be dug at an interval of 1 to 1.5m and filled with a mixture of topsoil and organic manure. There will be open masonry drains on the terraces. These will receive water from the higher terraces and convey it to the next lower terrace.

Before the commencement of the monsoon the slopes and terraces will be covered with a layer of soil (mixed with suitable mechanical soil binder) and sprinkled with water. Just before the commencement of the monsoon seeds of grasses and small shrubs will be sprinkled on the soil covering of the dump slopes or seedlings of such plants will be planted on the slopes.

Plantation on Backfill Areas and Mining Benches Slope (where back filling is not possible) of mine pits:

Plantation on the mining benches cannot commence till all the mining activities from the pit ceases. Once the abandoned pit is backfilled & leveled, a layer of topsoil will be spread over the area. Grass seeds/seedlings will be planted on the soil layer to stabilise the soil. It will be followed by plantation of shrubs and tree species which are indigenous to the region.

Plants selected for plantation on the mining benches shall be draught hardy in nature, with fast growth rate, glabrous/pendulous leaves and with large crown volume to surface area of fluttering leaves. The species selected for the purpose are Neem (*Azadirachta indica*), Subabool (*Leucaena leucocephala*), Karanja (*Pongamia pinnata*), Gulmohar (*Delonix regia*), etc.

Stretches of open land in the lease area which will not be covered by any activity will be selected for developing forest. Plantation there will commence from the initial years of the mining and plantation will be expanded in such areas in progressive stages. The trees will be watered using the treated discharges from mine pit. These plantations will be protected/maintained for 26 years. Tree guards shall be provided around each new plantation.

Proposed Plantations: Over the proposed area, fine dust particles collected from garland drains and settling tanks will be spread & suitable nutrients may have to be added for proper growth of plants. M/s West Bengal Power Development Corporation shall purchase healthy seedlings of desired numbers from the nearby nursery during the month of June. The company also wishes to give seedlings free of cost to the interested local peoples for plantation in their waste lands.

Plantation within the ML area will take place. In total 56.72 ha, out of 186.42 ha. of the lease area will be covered under plantation by the end of the mine life apart from 101.77 ha of forest land over which also plantation shall be carried out. Till the conceptual period, 141800 saplings shall be planted in addition to the existing plantation area of 26.03 ha (5.43 ha over safety zone, undisturbed area and 20.6 ha over reclaimed area).

Post plantation care includes replacement of casualties, weeding, soil working, manuring, watering, protection from grazing and fire. This scheme and selection of plant species are mainly based on the utility to local people, local soil & climatic conditions.

4.12 IMPACT ON WILDLIFE:

Presence of Reserve & Protected Forests within 10 km may results in interference of the human activities with the wild habitats. The mining activity and other ancillary activities such as blasting, dumping of waste and over burden, movement of vehicles, etc. shall threaten the wild animals and interfere in their life cycle. The most possible impacts on wild life are being illustrated below:

- Dust pollution due to mining activities.
- Noise pollution due to movement of vehicles and mining machineries.
- Increase in human interference into the forest shall result in alterations in breeding and nesting of animals.
- Dumping of garbage and resulting water & air pollution due to mining and allied activities shall interfere with their living.

However, the forests in the buffer zone support faunal species which have become habituated to prevailing conditions. Similarly, the fauna in the core zone in the vicinity of the mine is restricted to few common small species. But after the mine is closed and the plantations developed on the abandoned mine area will attract back at least some of the animals displaced / scared away by the project.

No significant impact is anticipated on larger species because the project area as well as the buffer zone is not part of any National park, Wildlife Sanctuary, Biosphere Reserve, Tiger Reserve and Elephant Corridor. So no such human –wildlife conflicts are reported in the study area.

4.13 MITIGATION MEASURES FOR REDUCING IMPACTS ON WILDLIFE:

There are no Protected Forests, wildlife sanctuary or corridor within 25km radius of the ML area. No doubt, certain irreversible changes will take place in the locality due to mining. However, to minimize such impacts as far as possible, wildlife present in and outside the zone of influence can survive without much interference as they become habituated to the mining process. Efforts shall be put forward to raise the awareness level of the people of the locality to conserve the wildlife & help them in surviving. Various short term as well as long term measures shall be taken in & around the mining area in order to improve habitat condition and security of wildlife.

Wildlife conservation measures have been proposed in the following broad categories:

Best Mining Practices:

I. Reduced Disturbance to Wildlife:

Tree plantation is an effective means for reducing disturbance to wild animals. Noise attenuates much more rapidly in areas with tree cover than in areas without vegetation. Tree plantation can help prevent multiple impacts ranging from dust pollution, noise pollution and providing safe cover to the wild animals. Tree plantation is, therefore, recommended in form of greenbelt as an effective means of preventing disturbance to wild animals in the mining lease area.

It is recommended to create a 3m wide greenbelt along the roads, a 5m wide greenbelt around colony and infrastructure and a plantation at density of 2500 plants per ha on intervening land. The trees planted should be of native species with thick leaf cover to be effective as greenbelt.

II. Minimizing Coal Fire:

There should be a well-designed and maintained firefighting system in the mine to deal with possibilities of fire. Water sprinklers should be provided at appropriate places to deal with spontaneous combustion of coal. Fire hydrants of adequate specification should be kept ready at strategic locations in case of any emergency.

III. Fire Protection:

Fire occurrence may go up around the lease area due to rise in anthropogenic pressure created due to increase in population. Suitable fire protection measures like fire lines and fire watching shall be ensured in the forest patches in cooperation with the forest dept. during dry seasons. They should be maintained throughout the plan period. Two local youth can be engaged for five months every year during fire season and equipped with simple fire fighting tools.

IV. Environmental Education and Awareness Among of Work Force:

Presence of increased work force including truck drivers and attendants may lead to increase in firewood collection and poaching. The problem may get aggravated due to the presence of contract labour. There should be mandatory checking of vehicles leaving the mines by security staff to prevent such activities.

A regular education, training and awareness program should be conducted for the work force and local people to sensitize them to wildlife conservation and animal welfare through various communication modes involving NGOs having capability and expertise in the field.

V. Awareness Programme in Village:

Improvement of rural economy for minimizing their dependence for on forest growth (Eco-development) can be done by educating and assisting people to choose the alternative livelihood such as poultry farm, growing vegetables and Mushroom, small scale business, raising nurseries for forest and horticulture species, cultivation of medicinal plants, minor technical jobs, small mechanical works like cycle repairs, electrical repairing and wiring, welding and fabrication work etc.

VI. Noise Pollution Control:

Noise from vehicle movements, mining activities like drilling & blasting is detrimental to the wild animals. The vehicles shall be checked at regular intervals and maintained properly besides using right types of muffling mechanism so that noise level remains within 70 dB. The blasting operations will be restricted to day time only and particularly between 12 noon to 2pm, so as to cause minimum disturbance to animals when they are out for their requirements during late evening and night.

VII. Dust Pollution Control:

The road surfaces and active benches shall be sprayed with water twice a day except on rainy days in order to prevent the fugitive dust emission from mining operation, movement of vehicles. The ore should be made free from dust by spraying water on it before transportation and covering the trucks with tarpaulin during movement. Overloading of trucks /tipper shall be strictly prohibited. Thick vegetation should be maintained around the mining pit to absorb dust and to minimize noise.

VIII. Soil & Moisture Conservation:

Wherever necessary staggered contour trenches 5 mts in length and 0.5 mts in depth may provided around the ML area to check soil loss and to conserve water in order to improve sub-soil water. This will also help to reduce fire incidents. The contour trenches may be planted up with suitable indigenous species preferably those which have fodder value.

IX. Landscape Planning:

It is desirable that the overburden dumps should be natural in appearance and suitable for re-vegetation. The dumps should be properly constructed keeping in view slope profile, run-off control and topographical features of the area. Some important features of the landscape are as follows:

- a. The landscape should have hillocks with gentle slopes and waterways in a natural and aesthetic manner.
- b. The landscape should merge with the existing landscape in the surrounding area.
- c. The slopes of overburden dumps should be gentle as per the guidelines issued by Director General Mining Safety (DGMS).
- d. There should be no unwanted low-lying areas that can cause water collection and water logging, except the designated water bodies.
- e. Planning should be done for the direction in which water will flow. Waterways should be created and linked to existing waterways on the upstream and downstream side.
- f. The landscaping should be done aesthetically so that the appearance of the restored mine is very natural and appealing including meandering streams.

Standard Mining Practices:

Several standard good mining practices have been in use in the mining sector. Some of the standard practices recommended for the proposed project are:

- a. Dust suppression by sprinkling water on the haul roads;
- b. Appropriate chutes / hoods at coal transfer points to prevent fugitive dust;
- c. Covering the haul trucks with tarpaulin to prevent dust emission;
- d. Controlled blasting only during day time;
- e. Matting, grass seeding and vegetation for stabilizing surface of the dump;
- f. Peripheral greenbelt and plantation along roads, around colony and CHP;
- g. Regular maintenance of vehicles;
- h. Water leaving the mine will meet the standards prescribed by the regulatory authorities;
- i. Check dams and gabion structures to prevent soil erosion from dumps;
- j. Proper garland drains equipped with baffles to prevent wash offs; and
- k. Sumps should have adequate capacity.

These measures in combination with the other best practices will help in minimizing the identified impacts.

4.14 IMPACT ON SOCIO-ECONOMIC ENVIRONMENT:

Analysis of various aspects of the study reveals that the Gangaramchak & Gangaramchak Bhadulia Coal Block mining project shall have major beneficial and more or less negligible adverse impacts on the following domains;

- The proposed project is not going to cause any damage to the existing rural economy of the study area, instead it may help agriculture by way of providing supplementary income which may result in increase investment in agriculture and

consequently, agricultural production.

- The project has strong positive employment and income effects, both direct as well as indirect.
- The project is likely to speed up the growing view on importance of education among the people of the study area.
- With the mining activity due to increase in vehicles & transportation activity, the communication facility is likely to improve.
- With the opening up of the mine, the public infrastructural facilities like school, college, skill development training institutes, hospitals/health centres of the region shall improve.

Apart from overall beneficial impact of the project on the local people of the region, it is felt necessary to augment facilities in the fields of education, health and social awareness including concern for ecology. These are presented in a summarized form in the following statement;

Environmental Attributes

Nature of Impact

Employment

Beneficial

Education

Beneficial

Service, trade/commerce

Beneficial

Public utility/education, social awareness

Augmentation

Healthcare facilities

Augmentation

4.15 IMPACTS DUE TO TRANSPORTATION OF MINERAL:

Overburden will be transported to the designated OB dump areas as shown in the Stage Plans through 35 TRDT's. Coal transportation from coal face to temporary stack yard will be done through 15-25 T RDT.

Coal will be evacuated by road only.

Necessary safety arrangements and dust control arrangements will be implemented in the conveyor arrangements.

The details of end use plants are given below:

Table No. C4-6: End use Plants and their configuration & capacity.

S. L. No.	Name of Specified End Use Plants	Configuration	Capacity
1.	Santalidih Thermal Power Station.	2 x 250 MW	500 MW.
2.	Kolaghat Thermal Power Station.	6 x 210 MW	1260 MW.

3.	Bakreswar Thermal Power Plant.	5 x 210 MW	1050 MW.
4.	Bandel Power Station.	4 x 60 =240 MW 1 x 210 = 210 MW	450 MW.
5.	Sagardighi Thermal Power Plant; Unit 1 & 2.	2 x 300 MW	600 MW.
6.	Sagardighi Thermal Power Plan – Unit 3 & 4.	2 x 500 MW	1000 MW.

Supply of coal from this mine will eliminate the scope of coal import and the power plant can get a consistent quantity and quality of coal as per designed criteria. The efficient operation of this power plant will meet the power demand of the Nation.

The anticipated impacts on existing environment shall be as follows;

- ☐ Dust Pollution
- ☐ Noise Pollution
- ☐ Increase in Gaseous Pollutants like SO₂, NO_x

4.16 MITIGATION MEASURES FOR REDUCING IMPACTS OF TRANSPORTATION:

Following control measures shall be implemented to minimize the impacts of transportation;

- Installation & maintenance of automatic water sprinklers.
- Sprinkling of water by water tanker, two times- a -day.
- Regular checking to discourage overloading of Transportation vehicle.
- Thick vegetation should be maintained around the mining pit to absorb dust and minimize noise.
- During transportation materials shall be covered to prevent any fall down or blown away.
- Proper maintenance of Transportation vehicles.
- No horn shall be blown up in morning & evening hours during the plying of vehicles to allow easy movements of wild animals.
- No mineral transportation shall be done during night time.
- Regular Air Quality Monitoring to check increment of pollutants.
- Lighting of the mine pit & official vehicles should be kept at the minimum, the head light should be shaded black and dipper should be used.

To arrest dust pollution, water will be sprinkled on the transportation road by a 12 KL capacity tanker and installing automatic sprinklers daily two times.

Front end loader-dumper combination shall be deployed for Coal transportation from coal face to temporary coal stock yard for shallow depth.

From the main coal Stock yard, coal will be transported to the Hazaratganj railway siding on the Andal Sainthia chordline of Eastern railway at a distance of about 12.5 km. Sized and picked coal will be loaded into rail wagons by pay loaders. A provision of ground stock has been envisaged. Distance of the different end use plants with respect to Bankura and Durgapur railway stations are given in below table.

Table No. C4-7: Distances of different End Use plants of WBPCL from Gangaramchak and Gangaramchak Bhadulia Coal Mine.

Name of End Use Plants	Distance in km.
Santaldih TPS	75.25
Kolaghat TPS	163.32
Bakreswar	17.83
Bandel	147.77
Sagardighi TPP, Unit 1 & 2	104.21
Sagardighi TPP, Unit 3 & 4	104.21

4.17 OCCUPATIONAL HEALTH & SAFETY:

The mining process involves activities like drilling, blasting, excavation, hauling, jigging, transportation which may result in accident like rock fall, fire, explosion, fall from height, mobile equipment accidents, entrapment and electrocution. All these activities involve operators who are susceptible to accidents if proper safety precautions are not taken and the equipment's are not maintained properly. The working personnel in the mine area are also exposed to occupational health hazard conditions which emanate due to dust emissions, ergonomic problems, exposure to sun, stagnant water in mine pits, etc; whereas the safety hazards have immediate ramifications resulting in simple injuries like bruises to fatal injuries like disablement and death, the health hazards manifest after long years sometimes ranging from 10-15 years.

As observed during the field survey and data collected from health care centres of the study area, the most common existing diseases reported so far are Malaria, Diarrhea, Hypertension, Diabetes etc. No such disease related to coal dust have been reported so far.

Occupational Health Hazards and Mitigation Measures:

Project proponent has concern and will take full responsibility for the protection of the workers against sickness, disease and injury arising out of their employment and have adopted certain principles with regard to occupational health services, like establishing and maintaining a safe and healthy working environment which will facilitate optimal physical and mental health in relation to work. Project proponent will also adopt following occupational health measures;

- (a) Identification and assessment of the risks from health hazards in the workplace;
- (b) Surveillance of the factors in the working environment and working practices which may affect worker's health, including sanitary installations, canteens and housing; and
- (c) Advice on planning and organization of work, including the design of workplaces, on the choice, maintenance & condition of machinery and other equipment and on substances used in work.

Identification of Health Hazards and Mitigation Measures:

The mining environment and the stress experienced by the work man can spell following health effects. The below table gives in brief the hazard that a miner is exposed while exercising his duty and preventive measures that the mines owner needs

to take to overcome the problem.

Table No. C4-8: Occupational Health Hazards & Project Specific Mitigation Measures

Sl. No.	Hazard Category	Nature of Hazard	Cause	Mitigation Measures
1.	Physical	Traumatic Injury	Rock fall, fire, explosion, mobile equipment, accidents, fall from height, entrapment and electrocution.	• Risk analysis would be done and necessary preventive action would be taken. • The directives of Director General Mines' Safety would be followed. • Safety appliances like safety belts, safety helmets, goggles, face masks, respirators wherever necessary would be used.
		Related to higher level of noise – hearing impairment	Noise is almost ubiquitous in mining. It is generated by drilling, blasting, cutting, material handling, ventilation, conveying and ore processing. Controlling noise has proven difficult in mining and noise-induced hearing loss and	• Miners will be provided with earmuffs /earplugs as personnel protective equipment. • Wherever possible the noise generating equipment / machinery like conveyor belts will be having enclosures to arrest noise level propagation.
			remains common in all type of	• The noise exposure limit of 90(dBA) should be adhered to.
			mining activity.	
		Whole body	Whole body vibration is commonly experienced whilst operating mobile equipment, such as load-haul-dump units, trucks, scrapers and diggers. This can cause or exacerbate pre-existing spinal disorders. Poorly maintained roads & vehicles contribute to the problem also.	
		vibration-		• Machines like diggers, scrapers,
		Exacerbate		excavators, trucks would be
		pre-existing spinal		maintained properly.
				• Haul roads inside the mine would

		disorders /generate		be maintained properly. • Viding Risk factors as detailed below.
		spinal		
		disorders		
			Hand-arm vibration syndrome	Concerted maintenance of machines and reduction of exposure time will mitigate this problem. Use of anti- vibration tools and anti-vibration gloves, safe work practice and employee education will be helpful.
		Hand Arm	is encountered with the use of	
		Vibration-	vibrating tools such as air leg	
		Calpal hand	rock drills, pneumatic	
		syndrom	hammers. Hand arm vibration	
			can be the cause of Calpal	
			hand syndrome.	
			Miners in open caste mines in	
		Fatal heat stroke /heat exhaustion	tropical locations as the present case are subjected heat and humid conditions which may lead to heat stroke /heat	Based on the weather conditions the exposure time of a miner may be reduced so as to prevent this situation.
			exhaustion.	
			Such exposures are experienced	
		Solar	in surface mining operations	Job planning would be done so that
		Ultraviolet	and are likely to contribute to	outdoor exposures of individual are
		exposures	the occurrence of squamous	reduced.
			cell & basal cell carcinomas.	
2.	Biological	Tropical diseases	The risk of tropical diseases such as malaria and dengue fever is substantial at mining locations in India.	Regular microbiological analysis of water would be done to detect Lagionella contamination or high concentrations of other heterotrophic microorganisms.
			In spite of mechanized mining	
			still some manual handling is	
			involved which contribute to	

			the trauma disorders and	
			resulting prolonged disability.	
3.	Ergonomic	Cumulative trauma disorders	Fatigue in relation to shift work has been subjected to considerable investigation. Sleep deficits, which might be expected in hot locations, have	The miners would be advised not be stressed ergonomically and have to relax in between.
			been shown to cause	
			impairments of cognitive and	
			motor performance among	
			drivers.	
			Due to mental stress and the situations they face in the mines atmosphere detailed below, the miners are subjected to psychological hazard.	• Medical check –up to be done to establish the level of blood alcohol, urinary drug metabolites, breath, etc to ascertain addiction.
4.	Psycho-logical	Drug and alcohol abuse	• Mines are normally at remote locations. As a result there has been a trend towards fly-in-fly – out operations with mine employees separated from their families & communities during the work period.	
			• Fatal & severe traumatic injuries that take place in the mine cast a	
			psychological stress.	

Source: Prepared by P & M Solution services based on in-depth reviews on Occupational Health Hazards in Mining.

Safety Hazards and Mitigation Measures:

Occupational health and safety is very closely related to productivity and good employer-employee relationship. The main factors of occupational health in mines are fugitive dust, noise, vibration and ergonomic problem. Safety of employees and maintenance of mining equipment is to be taken care of as per the Mine Regulations, 1961 and Circulars of DGMS. To avoid any adverse effects on the health of workers due to dust, heat, noise and vibration, sufficient measures have been proposed below.

These include:

- Provision of rest shelters for mine workers with amenities like drinking water, toilets, etc.;
- Provision of personnel protection devices for the workers;
- Rotation of workers exposed to high noise areas;
- First-aid facilities.

Occupational Health Survey of the employees will be carried out at regular intervals as per the directives of Director General Mine Safety. Safety of employees and maintenance of mining equipment is to be taken care of as per the Mine Regulations, 1961 and Circulars of DGMS.

Accidents take place due to unsafe acts or unsafe conditions. The unsafe acts can be avoided by imparting proper training to workmen & by circulating SOP and SMP among them where as unsafe conditions can avoided by proper designing of work place, proper selection of equipment, proper maintenance of equipment, proper housekeeping etc. Following mitigation measures are to be taken in general to avoid accidents in Mines;

- All safety precautions and provisions of Mine Act,1955, CMR 2017, and notifications issued by DGMS time to time will be strictly followed during mining operations;
- Safety appliances such as safety boot, helmets, goggles etc. will be provided to the employees and regular check for their use will be conducted;
- Entry of unauthorized persons will be prohibited;
- Fire fighting and first-aid provisions in the mines office and mining area;
- Training and refresher courses for all the employees working in hazardous premises; Under Mines rules all employees of mines shall have to undergo the training at a regular interval;
- Working of mine, as per approved plans and regularly updating the mine plans;
- Cleaning of mine faces will be regularly done;
- Suppression of dust on the haulage roads;
- Regular maintenance and testing of all mining equipment as per manufacturer's guidelines will be done;
- Increasing the awareness of safety and disaster through competitions, posters and others similar drives.

4.18 EVALUATION OF ENVIRONMENTAL IMPACT:

The environmental impact evaluation follows the identification and quantification of the impacts. The significant impacts, which have been identified and quantified in the previous chapter, are based on the baseline data generated in the field during March, 2022 to May, 2022. Secondary data were collected from Govt. organizations on different

aspects and utilized. Significance of Impacts has two distinct inter-related operations. Firstly it refers to the need to determine the importance of an impact. Secondly the relative importance of impacts in comparison with other impacts of a different nature sometimes is considered as part of the impact interpretation.

Delineation of Project Activities and Environmental Parameters:

The following activities, which are likely to cause potential impacts on environment identified, are as follows:

1. **Site preparation** - It includes removal of overburden, preparation of benches, haul roads & garland drain around overburden dump.
2. **Quarrying** - It includes blasting, drilling, running of diesel pumps and movement of dumpers & vehicles.
3. **Loading & unloading** - Loading and unloading of ores and overburden.
4. **Transportation** - This includes transportation of ore from stack yard to the destination.
5. **Disposal of over burden/mineral rejects** - The activity includes disposal of overburden solid wastes associated with mineral rejects.
6. **Civil works** - Construction of offices, magazine center, garland drain, first aid center, rest shelter, etc.
7. **Processing** - It includes crushing, sorting of ores.
8. **Provision of civic amenities** - Civic amenities such as water supply, power supply, medical facilities, communication, quarters etc. will be provided to the mines workers.
9. **Reclamation through social measures** - It includes afforestation or green belt development, provision of pucca roads for long term use, awareness programme, recreational programme, creation of employment opportunity for the local people, etc.
10. **Water Sprinkling** - Regular sprinkling on haul roads & on over burden dumps and water spray before & after blasting.
11. **Reclamation through improved mines management** - It includes construction of garland drain around quarry & waste dumps, provision of check dams, periodical clearing of drains, provision of small stone/rock barriers across the drains, plantation of grasses & bushes along the drains, avoiding loose sediments/OB in the working benches during monsoon, provision of pucca roads for long term use, discharge of mines water effluent to garland drains followed by necessary treatments before discharge to outside, on time maintenance of vehicles and machineries, provision of medical facilities for the workers, training to the employees for safety & first aid, cultural & recreational activities, drinking water facilities and environmental awareness.
12. **Reclamation through soil conservation & biological measures** - Reclamation of waste dumps by plantation of suitable species & green belt development along the periphery of lease area, employee residence area and avenue plantation along the road sides.

Environmental Attributes:

Some of the impacts identified in various phases are insignificant and do not warrant much attention whereas some other are very important especially with respect to the present project. The objective is to identify those impacts which are significant and require a detailed analysis for decision making or formulating adequate management

measures. The following 14 nos. of environmental parameters have been taken into considerations which are likely to be affected due to various activities of the project:

1. Air quality
2. Surface water resource
3. Ground water resource
4. Water quality
5. Noise level
6. Health
7. Employment / trade/ commerce
8. Land use & Soil Characteristics
9. Geological resource
10. Aesthetic beauty
11. Human settlement
12. Economic aspect
13. Forest & Ecology
14. Public utility / Literacy / Awareness

CHAPTER-5

ANALYSIS OF ALTERNATIVES

5.0 INTRODUCTION:

The Gangaramchak and Gangaramchak Bhadulia coal block was initially allotted to M/s Bengal Emta Coal Mines Limited in the year of 2003, the authorized mine operator brought this mine into production in the year of 2003. The Hon'ble Supreme Court of India vide its judgement dated 25th August 2014 and order dated 24th September 2014 canceled the allocation of all 204 coal blocks which included the Gangaramchak and Gangaramchak Bhadulia block.

Subsequently this block/mine has been reallocated by the Ministry of Coal (MoC) to WBPDCCL vide allotment order no 103/8/2015/NA dated 31.03.2015. Coal reserve of Gangaramchak and Gangaramchak Bhadulia coal block is well established in the approved Mine plan. Prior allottee M/s Bengal Emta Coal Mines Ltd. has obtained Environmental clearance for 1.00 MTPA from MoEF & CC vide letter no-. J-11015/375/2006-IA-II. (M) dated 17th May 2007 and further Environmental clearance of the block has been transferred to M/s The West Bengal Power Development Corporation Limited (WBPDCCL) from M/s Bengal Emta Coal Mines Ltd. (BECML) on 20th December 2018. Present proposal is for obtaining Environmental clearance (EC) for 3 million TPA of Targetted coal production & 4.50 million TPA of Peak Production capacity from the same coal block.

5.1 SITE SELECTION:

Selection of suitable site for a project is as important as selecting a technology and suppliers. Factors which are taken into account for selection of site are good quality of deposit, availability of manpower, water, infrastructure and ease of transportation. The mines are site specific, hence no other factors other than mentioned above can be considered to evaluate the alternate sites.

Factors taken into consideration while selecting the site:

- Occurrence of coal at the specific site.
- Estimated geological reserve.
- Transportation facility for materials & manpower.
- Overall impact on environment and mitigation feasibility.
- Socio – economic background.

As mining is a site specific project and the deposits of required quality and grades are naturally occurring, so the selection of suitable site in mining environment is ruled out. Gangaramchak and Gangaramchak Bhadulia coal mine is an operative mine and it has been already established as suitable project in terms of its reserve, quality, grade and transportation facility. The coal of Gangaramchak & Gangaramchak-Bhadulia Mine is being

utilized at End Use Plants of WBPDCCL situated at STPS, Santaldih, Purulia district, KTPS, Mecheda, Purba Medinipur district, BKTPP, Bakreswar, Birbhum district, BTPS, Tribeni, Hoogly district, SgTPP, Manigram, Murshidabad district. There is huge demand of coal in West Bengal for Power generation and other utility. Thus, wining of coal at the rate of 3 million TPA from this project is highly essential and the expanded capacity of coal from this project can also partly fulfill the immediate requirement of WBPDCCL.

5.2 MINING TECHNOLOGY SELECTION:

There are many mining technologies by means of which mineral can be excavated. The occurrence of Coal seams has been established up to a depth of 124.77 meter through detail exploration of the Block with a borehole affecting density of 21.64 BH/Sq. Km. The depth of occurrence of the Coal seam and nature of deposit itself has decided the opencast nature of the deposit. Thus, mining up to a depth of 90 meter has been planned by open cast mechanized method in the approved Mine plan.

On the other side, following criteria does not support underground working for the current project:

- The subsidence in underground mines may endanger the working in consideration of presence of Hingla river in the South and West of the block boundary.
- Working dispatch with highly mechanized underground system will be economically unsuitable.
- The stripping ratio of the mine is above 5 which is very much suitable for opencast mining.
- Volume of extractable reserve shall be reduced by underground method of mining.
- Working by open cast means of mining is comparatively safer than underground method.

Thus, the said coal block shall be worked after expansion also by opencast mechanized means.

The following method of opencast mining were compared.

- Dragline Mining
- Shovel Dumper Combination
- Surface Miner
- Electrically operated machineries

Opencast mining method is selected in view of varying thickness of coal seams. Possibilities of higher size hydraulic shovel or rope shovel or dragline has been ruled out due to varying thickness of seam as well as due to less reserve and shorter project life. Applicability of surface miner also considered due to limited reserve and short life, surface miner are being deployed to excavate 0.3m thick seams also. Electrically operated machineries are not considered due to reliable power supply in the area.

OB will be loosened through conventional drilling and blasting. Removal of OB will be done through hydraulic shovel in combination with rear dumpers. Coal will be won through surface miner. Pay loader and trippers will be used for coal removal and transportation to the stock yard. However, due to operational restrictions, there are few areas where surface miner operation could not be carried out. To increase the recovery of coal from those areas, occasional drilling and blasting is suggested.

5.3 TRANSPORTATION:

Coal from Gangaramchak and Gangaramchak Bhadulia coal mine is being transported through PWD road up to Hazarathput Railway siding. Tripper/dumpers are used for transportation of coal from Mine to railway siding. Coal is being shifted to different power plants of WBPDCCL from Hazarathput Railway siding by rail.

The coal of Gangaramchak & Gangaramchak-Bhadulia Mine is catering to power plants of WBPDCCL situated at STPS, Santaldih, Purulia district, KTPS, Mecheda, Purba Medinipur district, BKTPP, Bakreswar, Birbhum district, BTPS, Tribeni, Hoogly district, SgTPP, Manigram, Murshidabad district. Power plants of WBPDCCL are situated at several places in West Bengal and distance from Gangaramchak & Gangaramchak-Bhadulia Mine to plants varies from 75 Km to 165 Km in various directions. Thus, installation of conveyor or any other mode of transport system for transportation of only 3 million TPA of coal from mines to siding and onward movement looks not viable. Considering life of the mine and remaining reserve of coal, installation and construction of conveyor system is also not recommended. A river namely Hingla is passing in between Gangaramchak and Gangaramchak Bhadulia coal mine and Hazarathpur railway siding which also act as a constrain for installation of any permanent structure like conveyor etc. for coal transportation.

CHAPTER-6

ENVIRONMENTAL MONITORING PROGRAMME

6.0 INTRODUCTION:

Regular monitoring of various environmental parameters is necessary to evaluate the efficiency of the management programme so that appropriate corrective measures can be taken in case there are some drawbacks. A large part of the sampling and measurement activities will be concerned with long term monitoring aimed at providing an early warning of any undesirable changes or trends in the natural environment that could be associated with mining and allied activities. This is essential to determine whether the changes are a response to a cycle of climatic conditions or are due to the mining and allied activities.

In particular, a monitoring strategy is required to ensure that all environmental resources, which may be subjected to contamination, are kept under review. Monitoring of the individual elements of the environment is necessary. The Gangaramchak and Gangaramchak Bhadulia Open cast Mine project has already obtained EC for 1.00 MTPA of coal production. Thus, Environmental monitoring is being done by the Project Proponent and reported to the concern authorities time to time as per the statue. However, during the present EIA study a monitoring strategy has been suggested which shall be implemented after expansion of production from 1.00 million TPA to 3.00 million TPA.

To meet the above objective an "Environmental Management Cell" (EMC) has been formed at Bakreshwar Thermal Power Plant of Birbhum dist., which is being headed by qualified person. Environment management related issues of Gangaramchak and Gangaramchak Bhadulia Coal Mine project are being monitored by the EMC of Bakreshwar Thermal Power Plant. The same EMC will be responsible for implementation of Environmental Management Plan (EMP) and post operation monitoring after expansion also. The officials of the EMC will meet frequently to assess the progress and analyze the data collected during the preceding month. A full-fledged Environmental Laboratory with adequate manpower has been established at Bakreshwar Thermal Power Plant. A NABL Accredited agency will be hired to execute the Environmental Laboratory related activities like various environmental monitoring works as envisaged in the project. The following items will be considered under the monitoring schedule.

6.1 ACTIVITIES TO BE MONITORED/INSPECTED BY EMC:

6.1.1 Slope Failure:

A scientific study for slope stability for pit and OB Dump is carried out by Dr. Indrajit Roy of Birla Institute of Technology, Ranchi in the year 2019. The suggestions cum recommendations as per the study shall be implemented. EMC shall be in regular touch with the mining department in this regard and for implementation of the recommendation as per the study. Regular examination will be carried out to look for slope failure on mine faces and overburden benches. Any abnormal condition, if observed will be brought to the notice of concerned department and immediate corrective measures shall be undertaken.

Implementations of Real time Slope Monitoring system such as SSR or MSR shall be implemented during operational stage besides manual monitoring through EDM, crack meters, etc.

6.1.2 Soil Erosion:

Regular observation for Soil erosion will be made in bench slopes/ dump slopes and backfilled areas. Various measures will be adopted before of the arrival of monsoon and periodical cleaning and maintenance of settling ponds shall be undertaken. Soil quality will be monitored and reported to the concern authorities as per the standard norms.

6.1.3 Drainage System:

Emphasis is being given to prevent the catchment water from entering into the Mining Pit. The periodical inspection of the Garland drains is being done. Cleaning of the garland drains wherever necessary shall be done before the monsoon. All the mine pit water shall be pumped and channelized through these garland drains. Siltation ponds and settling pits shall be monitored periodically. This checking and cleaning will be rigorous before and during the monsoon season.

6.1.4 Re-vegetation and Green Belt Development:

Schedule planned for greenbelt development shall be checked after every year and any alteration required shall be implemented. Post plantation status shall be regularly checked in every season. Phasewise development in the areas of plantation including rate of growth, survival rate etc., shall be recorded systematically after expansion also. The format is given in Table No.C6-1 shall be filled every year for revising the schedule for the following year.

Table No.C6-1: Format to Record/Monitor Plantation

Sl. No.	Description
1.	Area(s) under plantation /vegetation
2.	Post plantation work involved
3.	Period of plantation
4.	Type of plantation a) Tree Species b) Shrubs
5.	Type of plant saplings/ seedlings/ grass species/ shrub species planted
6.	Distance between plant species/ between row of plant
7.	Type and amount of fertilizer used
8.	Interval of watering
9.	Method and period of post plantation care
10.	Survival rate of plant species

11.	Response of species to a) Time of seedling (season) b) Interval of watering c) Type and quantity of fertilizer based
12.	Density of afforested area a) Pre-mining condition b) Post mining condition

6.1.5 Water Quality Monitoring:

Surface Water Quality monitoring is being done at Hingla Dam and ground water monitoring for drinking purpose is being carried out near mine office of Gangaramchak and Gangaramchak Bhadulia Mine. Water quality monitoring shall be carried out regularly after expansion also to ascertain any impact due to the mining and allied operations. Ground water quality, surface water quality, treated and untreated mine discharge water, ground water level, surface water flow measurement, surface run- off etc shall be monitored and analyzed for the parameters specified by Central and State Pollution Control Board as well as per the Environmental Standards for coal mines, GSR-7742 (E), dated 25.09.2000. The periodicity of the monitoring shall be fixed referring the stipulations in the statutory approvals.

6.1.6 Noise Level Monitoring:

Various activities such as drilling, blasting, vehicular movements, sizing etc. would contribute to noise in the core zone. Environmental noise assessment can be divided into two separate categories, one related to noise sources and other related to potential receivers. Two quantities are needed to describe completely the strength of the source, i.e. i) Sound Power Levels and ii) Directivity. Measurement of noise level shall be monitored by the Environment Management Cell of the user agency with the help of a recognized NABL approved laboratory as per the procedure laid down by CPCB and DGMS. Ambient Noise Monitoring Shall also conforms to the Standards for Coal Mines, vide Notification GSR 742 (E) dt. 25th September, 2000. Frequency of the monitoring shall be maintained as per the statutory requirements. Presently, noise level monitoring is being done at three locations namely Office camp & security barrack, weigh bridge of mine and Junction road towards mine.

6.1.7 Emissions and Air Quality:

Dust prevention and control actions are being taken at work zone. To monitor the effectiveness of dust control, it will be necessary to compare background levels of airborne dust with conditions downwind, and back this up with an adequate meteorological measurement.

Monitoring of ambient air quality shall be carried out by the Environment Management Cell of the user agency with the help of a recognized NABL approved laboratory as per the standard and frequency fixed by Central/ State Pollution Control Board and MoEF & CC.

Frequency of the monitoring shall be maintained as per the statutory requirements. Monitoring shall be carried out for the parameters as stipulated in statutory permissions. Particularly for Core zone AQ monitoring Standards for Coal Mines will be followed. Location of monitoring station for AAQ monitoring in core and buffer zone are discussed in chapter 3 of this EIA report. Based on preliminary field survey i.e., topography, population distribution, meteorological conditions etc., network of stations in core and buffer zone of the project for ambient air quality monitoring is designed.

Necessary instruments/equipment shall be made available at site to monitor and analyse the parameters as stipulated in statutory permissions. Sampling and analysis will be carried out as per CPCB guideline. In case, in any location, the dust concentration is above the prescribed limit, immediate measures shall be taken to minimise the pollution level and shall be monitored on routine basis.

Presently AAQ monitoring is being carried out at 4 locations namely near Office camp, Junction road towards Mine, mine weigh bridge and near security barrack and AAQ monitoring report is being submitted to the concern offices.

6.1.8 Meteorological Parameters:

Meteorological station will be installed at project site which will help in recording the following parameters regularly.

- Wind speed and direction (on a suitable tower, 10m above ground)
- Rainfall
- Temperature
- Relative humidity

Regular generation of Meteorological data shall be monitored by the Environmental Mang. Cell (EMC) which will help in identifying and adopting various mitigative measures.

❖ Monitoring Equipment and Consumables:

A full-fledged Environmental Laboratory with adequate manpower has been established at Bakreshwar Thermal Power Plant. A NABL Accredited agency may be hired to execute the Environmental Laboratory related activities like various environmental monitoring works as envisaged in the project etc.

a) Air Quality and Meteorology:

The following equipment and consumable items shall be operational in the laboratory:

- Respirable Dust Samplers;
- Personal sampler;
- CO Monitor;
- Weather station (automatic recording);
- Spectrophotometer (visible range);
- Single pan balance;
- Relevant chemicals as per IS:5182; and
- Chemical /Glasswares.

b) Water and Wastewater Quality:

The following equipment is recommended:

- BOD incubator;
- Refrigerator;
- Oven;
- Stop watch;
- Thermometer;
- pH meter;
- Distilled water; and
- Relevant chemicals and glasswares

c) Noise Levels:

Sound level meter to record noise levels in different scales like A, B and C with slow and fast response options and vibration meter.

6.1.9 Occupational Health:

The process of excavation /quarrying & sizing leads to some health hazards. The most significant occupational health impacts are Noise Induced Hearing Loss (NIHL) and Occupational Lung Disease (OLD) due to inhalation of dust. As per Mines Rules, 1955, medical examination of employees at the initial stage and periodically, is being done by a qualified medical officer provided by the project proponent and the same shall be continued up to the end of mine life. Facilities for checking levels of dust in the workplace will be provided. Each group of mine workers will be monitored at regular intervals.

Occupational safety and health are very closely related to productivity good employer-employee relationship. The philosophy of 'prevention is better than cure' will be seriously followed on primacy basis as management policy. The factors of occupational health in Gangaramchak and Gangaramchak Bhadulia coal mine project are mainly dust & noise.

There will be regular health check-up of the mine workers and immediate attention will be paid for the patients with primary respiratory infections coughing, sore throat, Asthma, Breathlessness, expectoration, and chest pain. Details of Pre-placement Medical Examination and periodical Medical Examination Schedule is described below:

Table No. C6-2: Medical Examination Schedule

Type of Medical Check up	Year	% of total employment	Status
Pre-placement (Initial) medical Examination (IME)	1 st year	100%	Since it is a brown field project, IME is Completed
Periodical medical Examination (PME)	Every year	20%	Is being done on yearly basis

(Refer: The Mines Rule, 1955, Initial & Periodical Medical Examination)

6.1.10 Socio-economic Development

The EMC will be in regular touch with surrounding villages to monitor the implementation of various developmental schemes made by the mine authorities. They will also monitor & keep record of fulfillment of the demands made by the villagers in the public hearing. They shall also consider any immediate requirement which can be taken care of.

6.1.11 Monitoring of Blasting activities and its effect

The uppermost layer of soil (2 to 3 meter) is relatively soft in nature and will not require drilling and blasting. Thus, it will directly be excavated by the excavators. The remaining hard overburden and partings are to be drilled and blasted before excavation. Rotary blast hole drills of 160 mm diameter has been proposed for OB removal. Coal will usually won through surface miner but occasional drilling and blasting shall require for wining of coal.

A separate blasting study has been done by CSIR - CENTRAL INSTITUTE OF MINING & FUEL RESEARCH (Council of Scientific & Industrial Research) Barwa Road, Dhanbad – 826 015 in the year of 2020 for Gangaramchak and Gangaramchak Bhadulia Coal Mine project. Scientific Advice for optimization of blast design parameters at Gangaramchak and Gangaramchak Bhadulia Coal mine has been given by CSIR as recommendation in the report. The recommendation of CSIR needs to be duly monitored by the EMC.

6.2 MONITORING SCHEDULE:

To evaluate the effectiveness of environmental management programme, regular monitoring of the important environmental parameters will be taken up. The environmental monitoring followed by analysis and generation of report shall be carried out effectively through a recognized laboratory on regular basis. the reorganization certificate of the monitoring agency and calibration certificate of the instruments used will be regularly checked by the EMC. The frequency of monitoring of different parameters is given in the table below.

Table No.C6-3: Environmental Monitoring Schedule

Parameter	Frequency	To be Conducted by	Location
Ambient Air Quality			
PM ₁₀	Twice in a week	Recognized Monitoring Agency	Minimum 2 at core zone and in Conformity with the Standards for Coal Mine, Vide GSR No. 742 (E), 25 th September, 2000; 6 at buffer zone.
PM _{2.5}	Twice in a week	Recognized Monitoring Agency	2 at core zone 6 at buffer zone
SO ₂	Twice in a week	Recognized Monitoring Agency	2 at core zone 6 at buffer zone
NO _x	Twice in a week	Recognized Monitoring Agency	2 at core zone 6 at buffer zone
CO	Twice in a week	Recognized Monitoring	2 at core zone 6

		Agency	at buffer zone
Noise levels			
As per prescribed CPCB standards	Twice in month	Recognized Monitoring Agency	2 at core zone 5 at buffer zone
Surface Water Quality			
Parameters as per IS : 2296- Class C	Once in a quarter	Recognized Monitoring Agency	3 at buffer zone
Ground Water Quality			
Parameters as per IS : 10500	Once in a quarter	Recognized Monitoring Agency	1 at core zone 2 at buffer zone
Soil Quality			
Soil Quality	Once in a quarter	Recognized Monitoring Agency	1 at core zone 4 at buffer zone

The environmental standard for coal mines, GSR-742 (E), dated 25.09.2000 may also be followed as applicable. Monitoring shall be carried out for parameters as stipulated in statutory permissions.

6.3 COST OF ENVIRONMENTAL CONTROL MEASURES:

Gangaramchak and Gangaramchak Bhadulia Coal Mine project is a running project. Thus, system for environmental control measures are already in place. The costs regarding implementation of EMP for expansion up to 3.00 MTPA from 1.00 MTPA are presented under various headings in the table below. Additional capital cost towards Environment Protection after expansion has been estimated as Rs. 110.5 lakhs and total recurring cost per annum has been estimated as Rs. 26 lakhs. Therefore, recurring cost for Environment Protection would be around Rs. 78 lakh for the balance 3 years of life of mine. .

Table No.C6-4: Cost of Environmental Control Measures

Particulars	Details of Capital Investment	Details of Recurring Cost
Air Pollution Control	Rs 45 lakhs	Rs 10 lakhs
Water Pollution Control	Rs 40 lakhs	Rs 3.5 lakhs
Noise Pollution Control	Rs 2.5 lakh	Rs 0.5 lakhs
Environment Monitoring	---	Rs 5 lakhs
Occupational Health	Rs 8 lakh	Rs 4.5 lakhs

Green Belt Development and Maintenance	Rs 15 lakhs	Rs 2.5 lakhs
Total	Rs 110.5 lakhs	Rs 26 lakhs

Apart from the above, a substantial cost of Rs. 1677.4 lakhs has been estimated in the approved Mine plan of Gangaramchak and Gangaramchak Bhadulia Coal Mine Project towards mine closure activities which includes progressive closure of the mine, Dismantling of Infrastructure & Disposal or rehabilitation of Mining Machinery, Technical & Biological Reclamation of Mined out of land and OB Dump, Post Closure Management and Supervision and others. The said amount shall be deposited in ESCROW account as security deposit against the mine activities to be carried out for the closure of the mine.

There are several cost provisions which are common to both in recurring environmental cost and also listed in the mine closure cost. WBPDCCL is committed to adhere the activities as listed and required to be performed in the project in order to the conditions of the Mine Closure Activities and prevailing Environmental Norms.

Environmental audit of various activities including budgeting, financial management and monitoring of environmental parameters during progressive and post closure phase with reference to environmental management will be done. Monitoring of Phase-wise Reclamation Programme also will be undertaken as per approved Mine Plan/PMCP/FMCP. Environmental Monitoring report will be submitted to MoEF & CC, SPCB, CPCB, etc as per norms.

CHAPTER-7

ADDITIONAL STUDIES

7.0 INTRODUCTION:

As per generic structure of the EIA/EMP report prescribed under EIA Notification dated 14.09.2006, this chapter consists of public consultation, disaster management, social impact assessment and R&R Action plan. This chapter deals with identification of hazards and disaster and preventive measures for disaster. Certain types of hazards can disrupt normal activities abruptly and lead to disaster- like fires, inundation, failure of machinery, explosion to name a few. Disaster management plan is formulated with an aim of taking precautionary step to control the hazard propagation and avert disaster and to take such action after the disaster which limits the damage to the minimum.

The dump & slope stability study has been carried out by Dr. Indrajit Roy of Birla Institute of Technology, Ranchi for design of pit configuration, ultimate pit slope, dump slope and to suggest methods of monitoring the slope stability including precautionary measures to maintain dump & pit stability.

Detail hydrogeological study for Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project has been carried out by Central Mining Research Institute, Dhanbad.

Scientific Advice has been given by CSIR - CENTRAL INSTITUTE OF MINING & FUEL RESEARCH in their study report for optimization of blast design parameters at Gangaramchak and Gangaramchak Bhadulia Coal mine, Dist- Birbhum, W.B. to safeguard nearby structures of the adjacent village.

7.1 PUBLIC CONSULTATION:

Public Consultation is one of the important aspects of environmental impact assessment which is covered under MoEF & CC notification on environmental clearance issued on 14th September 2006. The aspect of public consultation is to be followed as per the said notification. In the present case, the proponent, WBPDCCL is hereby applying to SPCB, West Bengal for conducting Public Consultation for Enhancement in Coal Production from Gangaramchak and Gangaramchak -Bhadulia Coal Mine.

7.2 RISK ASSESSMENT & HAZARD IDENTIFICATION:

Risk: The risk is defined as the "chances or possibility of accidental losses or undesired consequences". It can be defined in terms of either probability or frequency & the consequences. The risk arises from both a hazard and some uncertainty about its effects.

Hazard: A 'Hazard' is defined as a source of potential harm to people, property or the environment. In mining sector, the use of explosives is a major source of potential hazard. During the use of explosives, a slightest negligence may cause premature initiation causing injury to persons or damage to equipment and due to sudden release of chemical energy can create havoc.

Risk Assessment normally involves identification of hazards, risk associated with it and to workout strategy to reduce the significant consequences. Hence, there is a need to be aware that there is always a risk of an accident and steps can be taken to prevent it from happening. It is also necessary to understand the risks due to the mining operations and the purpose of Risk Assessment. In Risk Assessment, 'Hazard' and 'Risk' are often used. Objective of Risk Assessment is to forecasting any unwanted situation, Estimating damage potential of such situation, Decision making to control such situation and Evaluating effectiveness of control measures.

Natural hazards are mostly inevitable but not disasters. A disaster is the result of impact from hazards on society, on infrastructures, cities. Disasters lead to losses of lives or property, and effects of disaster depend on the vulnerability of the elements at risk and ability of the system to cope with disaster. For effective disaster management, it is necessary to evaluate risks at the mines in a careful manner, evaluate and then take steps for mitigating them. Whatever we may plan to do, 'Safety of the people' shall assume the paramount importance in the midst of all our planning. Hence stress must be given to carefully plan rescue & evacuation responses & training aspects of the Disaster Management Plan. Following procedures will be followed for effective management of any disaster in the mine.

Step – 1	:	Identification of risk
Step – 2	:	Identification of persons at risk
Step – 3	:	Removal of hazardous material
Step – 4	:	Evaluation of the risk
Step – 5	:	Control measures to be taken
Step – 6	:	Maintaining Assessment records
Step – 7	:	Review

The opencast mining activities involve certain types of hazards during operation and post operation period, which can disrupt normal activities abruptly and lead to disaster like fires, failure of machinery, explosion, to name a few. The impending dangers or risks which need to be investigated addressed, disaster management plan formulated with an aim to taking precautionary steps to avert disaster and also to take such action after the disaster which limits the damage to the minimum. Nevertheless, the following natural/ manmade problems may be encountered during the operation of open cast mining at the Gangaramchak and Gangaramchak Bhadulia opencast coal mine of the West Bengal Power Development Corporation Ltd (WBPDC).

- A. Failure of Benches of OB and Coal.
- B. Failure dump slope
- C. Blasting in Opencast Mines
- D. Fire in Coal Benches/Coal Stack Yard
- E. Accidents due to lack of proper space in movement in Mine.
- F. Surface fire (Electrical and Oil)
- G. Accidents due to Machinery

A. Failure of Benches of OB and Coal:

The benches in the overburden rocks are proposed upto 10 meter height 40 meter width for the operational zones. On these 40 meter horizontal benches, regular movement of dumpers and shovels shall take place. Any sudden failures of the vertical face would cause dangerous situations to the top horizontal bench and would move large quantity of debris to the lower horizontal benches, thereby causing serious mishap to the equipment and persons deployed at both the horizontal bench. In order to prevent such incidents, a comprehensive slope monitoring system will be implemented under the safety management program of the mines. Implementation of Real time Slope Monitoring system such as SSR or MSR will be evaluated after expansion of the project besides manual monitoring through EDM, crack meters etc. Any chances of slope failure identified by the monitoring system will be attended with highest priority and appropriate measures based on the type of failure will be followed. Based on nature of failure, grouting, ground anchoring, retaining walls, wire netting etc. methods shall be adopted. Fault zones and other weak zones will be monitored with added frequency.

A pre-monsoon audit will take place at least one month prior to the onset of monsoon. Based on the audit report, a monsoon planning will be prepared and implemented. Dump and pit stability study report of Gangaramchak and Gangaramchak Bhadulia coal mine is already in place which is prepared by Dr. Indrajit Roy of Birla Institute of Technology, Ranchi. The study has covered design of pit configuration, ultimate pit slope, dump slope and to suggest methods of monitoring the slope stability including precautionary measures to maintain dump & pit stability.

B. Failure of Dump Slopes:

The surface dump has been benched at 30 meter height. Although individual OB bench slopes at its natural angle of repose i.e.- 37° the overall slope has been reduced to 27° by leaving a 30 meter wide berm between two successive benches. This reduces the chances of OB slope failure and subsequent damages. At any point of time, reverse sloping on the top of the dumps will be followed. Toe drains and weep holes will be provided to drain out the water from the loose overburdens. Terracing will be done as much as possible in the dump slopes before plantation/ slopes will be covered through grass turfing. In few strategic areas, covering through Geotextiles will be evaluated and if found suitable shall be implemented. Guard wall and retention walls of appropriate size shall be provided in the toe of the dump. Backfilled dumps once stabilized shall be technically and biologically reclaimed. Dump heights above the average ground level will be limited to 30 meter. Thus, failure of backfilled dumps in post closure phase is not envisaged, except otherwise near the left out void area. The exposed dump surface facing towards the water body will be covered through wire netting, and proper terracing will be done to prevent such failure. Regular dump slope monitoring will be done through real time slope monitoring system and appropriate preventive measures will be taken if such chances of failures are identified.

C. Blasting in Opencast Mines:

In general drilling and blasting has been envisaged as a mining process. Necessary study has already been conducted by the competent organization for the project. Vibrations due to blasting may cause damage to the nearby structures if appropriate control measures are not adopted.

Fly rock is another possible damage causing outcome of blasting. There are many factors which influence fly rocks. These are like long explosive columns with inadequate stemming column, improper burden, loose material or pebbles near holes and long water columns in the holes.

The following control measures have been envisaged to reduce ground vibration within statutory limits:

- a. The peak particle velocity (PPV) of ground vibration will be kept below 10mm/s for 8-25 hz frequency range through optimally controlled blasting techniques, after necessary field trials.
- b. Drilling and charging pattern will be formulated, with less explosives charge etc, after field trials.
- c. Use of suitable initiating sequence and millisecond detonators.
- d. Reduction of amount of explosives charged per day optimally.
- e. To contain fly rocks, stemming column will not be less than burden of the hole. Blasting area will also be muffled, if necessary, to stop fly rocks propagation.
- f. Blasting will not be carried out when strong winds are blowing towards habitation areas. Blasting will be done during midday time and never at night.
- g. Surrounding villages within 1 km radius of blasting will be regularly inspected for any visual cracks on walls and feedback will be gathered to investigate the reasons for these and for reassessing the charge per delay from time to time.
- h. Vibration study will also be carried out at appropriate times to firm up most ideal and optimal blasting parameters.
- i. Controlled blasting to avoid tension cracks which may endanger the stability of bench slopes in the mine.
- j. Short delay detonators to be used in preference to detonating fuse.
- k. In case of using detonating fuse, it should be covered with 750 mm thick cover of sand or drill cuttings.
- l. Proper care & supervision during blasting by a competent and experienced person.

All precautions related to control of fly rock is taken during the blasting operations. Safety zone of 500m as per statutes will be maintained from the quarry faces. The nearest rest shelter is also away from the blasting operation. It is planned for blasting only in daytime on a particular hour, when the movements of the people are restricted & minimal.

Blasting is a regular activity at mining site. Whenever blasting is done in an opencast mines ground vibrations are generated outward from the blast area and cause damage to surrounding surface structures. Blast induced ground vibrations cause socio-economic problems for mine managements as well as to the people residing in vicinity of these mines. The ground level vibration would be of particular interest if there are important / huge structures within the danger zone. For coal mining at Gangaramchak and Gangaramchak Bhadulia coal mine, there are no significant / huge structures in the vicinity of 10 km radius.

Scientific Advice has been given by CSIR - CENTRAL INSTITUTE OF MINING & FUEL RESEARCH in their study report for optimization of blast design parameters at Gangaramchak and Gangaramchak Bhadulia Coal mine, Dist- Birbhum, W.B. to safeguard nearby structures of the adjacent village.

D. Fire in Coal Benches/Coal Stack Yard:

Spontaneous heating of Coal may cause fire in its Coal benches, Coal yards etc. Extraction of coals will made maximum possible from the coal benches and spillage coals will be removed before moving to another bench. This will reduce the chances of fire. Nevertheless, if any Coal benches are to remain idle for a period more than 15 days, the same shall be properly dressed & cleaned from loose Coal or fines at the time of stoppage.

Heights of coal stack yard will be less than 10 meters to avoid spontaneous combustion at the stack yard. Fixed type sprinkler and firefighting arrangements are already in place and will be installed at the coal stock yards.

E. Accidents due to lack of proper space in movement in Mine:

Workers around shovel, dumper, dozer, drill, and other HEMM must be warned to keep out of blind area so that operator may be able to see them clearly. Audiovisual alarms are used for pre warning person around this machine. To overcome shortage of space, strict discipline will have to be inculcated in workmen and supervisors. Haul roads are planned with sufficient widths to prevent accidents in the mines. CC TV camera's will be installed in the strategic location of the mine to supervise the mine activities more closely and for operational improvement to increase safety levels.

F. Surface fire (Electrical and Oil):

The surface fire in this mining project could precipitate at two points which are as follows.

- (i) There are risks of surface fire which may be caused due to spillage of HSD stored in the warehouse.
- (ii) There are also risks of spontaneous fire caused from Electrical points and transformers installed in the mines.

In case of any electrical fire, the personnel on duty shall inform the mines manager and Personnel trained in dealing with electrical fires will be informed. The fire area will be cordoned off till the fire is fully extinguished and remain so until all wreckage is cleared away. After affecting necessary repairs, the power will be restored. The clearance for restoration of power shall be given only by the mines manager.

Spillage of HSD and resultant fire constitutes a potential risk. However, looking at the daily consumption, the quantity of the oil, which can spill shall not be much and the risks can be easily controlled. Sufficient nos. of portable fire extinguishers shall be provided at strategic locations to take care of any eventuality.

As soon as any fire is reported, the mines in-charge shall assume the function of disaster controller. In case of serious fire and depending on the gravity of the situation, the Mines Manager may be summoned to assume charge. Personnel trained in dealing with fires will be summoned. Meanwhile the hospital will be informed to handle casualties. The fire area will be cordoned off till the fire is fully extinguished and remain so until all wreckage is cleared away.

G. Accidents due to Machinery (both Transport & Non-transport Machinery):

Machineries engaged in both transport & non-transport activities can be a cause of accident if awareness is not created among the employees. Following are some likely causes of accidents by both transport & non-transport machinery and the preventive measures to avoid accidents;

- Use of sub-standard equipment or machinery parts can result in accidents or breakdown. Standard machinery with authorized spare parts must be used.
- During reversal operation of vehicles, there is every possibility of accident. To avoid any mishaps the helper must be at the back of the vehicle to assist in reversing. All safety gears like Back horn, camera etc. shall be installed or in built in every HEMM.
- Unauthorized driving of vehicles, mostly by helpers should be prohibited.
- Unauthorized riding of machinery & vehicles by persons not concerned with them should be prohibited.
- Awareness should be created to discourage any attempt to ride moving vehicles.
- Overloading a vehicle can be a cause of mishaps and should be avoided.
- Driving vehicles in an intoxicated stage should be prohibited.
- Use of sub-standard equipment or machinery parts can result in accidents or break down. Standard machinery with authorized spare parts must be used.
- Never try to clean moving parts of any machinery without informing the concern person.
- Protection guards of some moving parts must be in place and should not be removed when the machine is running.
- A statutory provision of the fence, constant education, training etc. will go a long way in reducing the incidence of such accidents.

7.3 DISASTER MANAGEMENT PLAN:

Mining and allied activities are associated with several potential hazards to both the employees and the public at large. A worker in a mine should be able to work under conditions, which are adequately safe and healthy. At the same time the environmental conditions should be such as not to impair his working efficiency. This is possible only when there is adequate safety in opencast mines. Hence mine safety is one of the most essential aspects of any working mine. So, it is essential to carried out a detailed study covering identification and assessment of risk and recommendation of the measures to prevent damage to life and property against such risks.

7.3.1 Identification of Hazards:

The mining activity has several disaster prone areas. A check list depicting likely disaster events due to the mining activity is presented in **Table 7.1**.

Table No. C7-1: Check list for likely disaster in Open cast mine

S. NO.	Activities	Human Risk		Ecological Risk		
		Severe	Non-severe	Land	Air	Water
1.	Drilling and Blasting	X		X	X	X
2.	Extraction of Coal		X	X	X	X
3.	Removal of OB and Storage		X	X	X	X
4.	Transportation of Coal	X		X	X	
5.	Use of Machinery		X	X	X	
6.	Drilling and Development Work	X		X	X	X

There are various factors, which can create disaster in mine. These hazards are as follows:

- a) Blasting
- b) Rock burst
- c) Overburden failure/sliding
- d) Heavy machinery

Blasting

Most of the accidents from blasting occur due to the projectiles, as they may sometimes go even beyond the danger zone, mainly due to overcharging of the shot-holes as a result of certain special features of the local ground. Fly rocks are encountered during initial and final blasting operations. Vibrations also lead to displacement of adjoining areas. Dust and noise problems are commonly encountered during blasting operations.

Land Sliding in Overburden Dump & Mine Pit

The high overburden dumps may cause landslides. High overburden dumps created at the quarry edge may cause sliding of the overburden dump or may cause failure of the pit slope due to excessive loading, thereby causing loss of life and property. Siltation of surface water may also cause runoff from overburden dumps.

Heavy Machinery

Most of the accidents during transport of dumpers, trucks and other heavy vehicles are often attributable to mechanical failures, in which the factor of human errors cannot be ruled out.

7.3.2 Disaster Management in Open-Cast Mines

Measures Suggested to Avoid Accidents Due to Blasting are as Under:

- 1) Shots shall not be fired except during the hours of the day light or until adequate provision is made of artificial light; then the holes charged on any particular day shall be fired on the same day,
- 2) Shots, if fired after hours of the day light should be muffled so that the flying fragments from the blasting material do not project beyond a distance of 10 meters from the place of blasting,
- 3) Adequate blasting shelters or other protection shall be provided at all times,
- 4) The shot fired shall give sufficient warning by effective signals over the entire area falling within a radius of danger zone,
- 5) If a single shot exploder is used or if blasting is done with ordinary detonator the shot-firer shall not fire more than sixty shots in one shift, but if multishot exploder is used the number can be one hundred and twenty,
- 6) During the approach & progress of electrical storm, adequate precautions shall be taken,
- 7) No shot hole shall be drilled in the overburden above the underground galleries.

Blasting shall be carried out as per the provisions contained in the Circulars issued by the Directorate General of Mines Safety (DGMS). When the quarry face reaches near surface features (roads, etc.) controlled blasting shall be adopted after due trial and with the approval of the Directorate General of Mines Safety to avoid danger of fly rock vibration.

Measures to Prevent the Danger of Overburden are as Follows:

- 1) A sturdy stone wall should be built around the toe of each active dump at a distance of about 50m from the toe.
- 2) To prevent the failure of overburden slopes, especially during rainy season, following precautions need to be taken against this hazard:
 - ❖ Proper terracing of the dump slopes, with maximum bench height of 30 meters,
 - ❖ In flat areas the dumping operations have come to an end, the slope angle should be flattened by about 50 lower than the angle of repose which varies from site to site but it is generally expected to be around 25°.
- 3) Planting vegetation as early as possible over the overburden dump slopes.
- 4) The drainage channels along the overburden dump toe provided additional protection.
- 5) While doing this, a distance of over 15m should be left between the overburden dump and the bench, and
- 6) If the pit is abandoned, the bench and overburden dump should be separated from each other by digging a trench of 6 to 10m width.

Measures to Prevent Accident Due to Trucks and Dumpers:

- 1) All transportation within the main working should be carried out directly under the supervision and control of the management.
- 2) The vehicles must be maintained in good repairs and checked thoroughly at least once a week by the competent person authorized for the purpose by the Management,
- 3) Road signs should be provided at each and every turning point specially for the guidance of the drivers at the night,
- 4) To avoid danger while reversing the trackless vehicles especially at the embankment and tipping points, all areas for reversing of lorries should as far as possible be made man free, and
- 5) A statutory provision of the fences, constant education, training etc., will go a long way in reducing the incidents of such accidents.
- 6) Haul tracks should be oriented essentially perpendicular to the bream, while unloading.
- 7) Generally, Oversize rocks should be dealt within pit by secondary blasting. Load consisting of large rocks must not be carried to the edge. This is unsafe and may damage equipment. Such load must be dump in side and pushed over the edge by dozers.
- 8) Dumping of overburden or waste material by dumpers and dozers should follow certain general precautions. A typical dump platform is illustrated in Figure-5.2

Measure for Dump Management and Stabilization:

The dump slopes being constituted of loose soil and rock are prone to serious erosion during heavy rains and suffer from weathering if left exposed which may lead to skin type failure. The protection of slope surface reduces the gully formation, the surface erosion and chances of skin failure, thereby increasing the stability of dumps. If necessary, the following or any other measures determined by the Civil Engineer may be implemented.

- a) In the construction of dump, care must be taken to ensure that there is no impoundment of water on the dump surface after the rains. Such impoundment of water is highly detrimental to the dump stability as the water will slowly enter the dump and when dried may lead to formation of tension, cracks and sometimes adversely affecting the frictional parameters of the dump material resulting in decrease in the dump stability. To avoid such situation, a proper drainage of the dump top surface is necessary. The system requires that the dump top is uniformly graded /sloped for easy flow of water and number of drains at suitable intervals is maintained to collect and take away the water from dump top surface.

In addition, it is necessary to have a full drainage system to prevent water standing on or uphill of the dump and to transmit that water away from the dump. It may include cut off drains at the top of the slope to reduce erosion and possibly some monitoring system on high dumps.

- b) Ring dumping to provide intermediate benches and to reduce length of slopes
c) Regarding to reduce slope angle
d) Benching either formed during dumping or subsequently
e) Installation of pack walls or other hand terracing

All slopes should be individually designed to suit site conditions in accordance with good engineering practices and the need for biological restoration.

It is, therefore, suggested that at the proposed project before formation of dumps, all the above stated recommendations should be taken into account and necessary actions to be taken accordingly.

Safety Measures

All prevailing statutory provisions applicable to the opencast mines are to strictly adhere to. To prevent danger due to inrush of water during rainy season to open pit, garland drain to made all around each quarry so as to divert storm water into seasonal nalla. Moreover, adequate pumping capacity shall be provided to deal with peak rainfall.

Fire fighting organization along with emergency organization etc., as per the DGMS's Circular shall be maintained at the mine during its operation. The Standing Orders shall be framed and regular mock rehearsal shall be carried out to keep the mine personnel up-to-date for dealing with any eventuality.

During day to day operation, model traffic rules shall be followed to avoid any road accident due to movement of HEMM. An efficient communication system shall be maintained within the mine premises so that immediate action can be taken in case of emergency.

Maintenance Facilities

A Well equipped workshop shall be maintained to carry out day to day maintenance job so as to avoid the failures of HEMM.

First Aid

Workers sustaining injury or having any ailment during work must be attended immediately. To Serve the Purpose a first aid center is proposed in the project. Adequate arrangement must be provided in terms of medicines and attendants in the first aid center, so that primary help/assistance can be extended to the deceased. For the movement of the ailing/-injured persons, ambulance van is provided in the roll of vehicles for the project. Some of the unavoidable measures listed below are more practicable and should be ensured to get fulfilled:

- i. A plan has to be drawn in advance to tackle the situation.
- ii. A number of employees and executives have to be trained in the Risk Management
- iii. One Officer should be entrusted with the job for each shift.
- iv. HEMM, viz Dozer should be ready available at the site. It should be kept at a high level that the sudden flooding does not cause any obstruction to its movement/ operation.
- v. In case of heavy rains, machinery deployed inside the mine should be shifted from low-lying areas to avoid drowning. All electrical connections should be cut off in case it is observed that the flood is likely to be unmanageable.
- vi. The Store should be instructed to keep extra pump set tools, tackles, lights, rain coats, etc., in the Store in sufficient numbers to avoid any problem at the last moments during such occasion. Similar instruction has to be given to the medical Section.

The following conclusions may be drawn from the above discussion:

- a) Coal mining is associated with a number of hazardous.
- b) These hazardous can be identified and assessed which has been done for this project.
- c) Preventive measures against identified risks have been provided in this report.
- d) With adoption of such protective measures, the operation of the mine would be safe.

7.4 CARE & MAINTENANCE DURING TEMPORARY DISCONTINUANCE (HEAVY RAIN/STROM):

Following measures would be taken up to deal with the unforeseen circumstances that may arise due to temporary discontinuance of the mine especially during monsoon season;

- All heavy machinery engaged in the mine & crushing would be withdrawn and brought to the safe place so that these do not get buried due to bench collapse, if any, and get damaged during the period of discontinuance.
- At the entrances and strategic points, sentries/watchmen will be posted to guard the mine areas and explosive magazine. They will be provided with mobile phones /walky-talkies to contact the mine authorities/police for help during emergency.
- The mine area will be kept illuminated during nighttime, after State Electricity Board restores the electric power supply. Audible warning sirens will be established at the mine office to be used during emergency so that prompt help can be received from proper sources.
- Managerial, supervisory, and competent persons of the mine would be engaged for supervising machinery, maintenance & housekeeping of the mine areas, as per needs.

7.5 DISASTERS IN THE MINES:

The complete mining operation at the Gangaramchak and Gangaramchak Bhadulia Mine is being carried out under the management control and direction of a qualified mine manager holding a First-Class Manager's Certificate of competency granted by the Directorate General of Mines Safety (DGMS), Dhanbad. The DGMS have been regularly issuing standing orders, model standing orders and circulars to be followed by the mine management in case of disaster, if any. Moreover, mining staff will be sent to refresher courses from time to time to keep them alert. However, following natural /industrial hazards may occur during normal operation.

Natural Phenomena leading to Disaster:

The possibilities of occurrence of the natural phenomena in the Gangaramchak and Gangaramchak Bhadulia Coal Mine Project which might leads to disasters and mitigating measures to be taken for their management is discussed below;

- i. Land Slides:** The topography of the mines under consideration is slightly undulating, it is almost plain land (94 m to 121 m MSL) and therefore there is no steep rise of elevation to cause landslide or avalanches due to heavy rain, which may warrant contingency plan for their management.
- ii. Subsidence:** The mine is not in the seacoast, which may be susceptible for subsidence due to effect of continental drift or effect of plate tectonic phenomena. The mine is also not an underground mine which could cause subsidence if the evacuated mine area is not filled properly.
- iii. Flood and Inundation:** The Gangaramchak and Gangaramchak Bhadulia Coal Mine of WBPDCCL in Birbhum district of West Bengal is not in the delta region of any river and hence there is remote possibility of the area getting flooded due to heavy rain in its catchment. But there is possibility of flash flood in the stream running in the mines, which may be a temporary feature, which does not interface with human habitation or communication. Therefore, there is no need for making any contingency plan to meet the situation.
- iv. Cyclone:** The target area under consideration is not in cyclone or super cyclone zone and hence not prone to cyclone.
- v. Fire:** There may be misfire, etc. in the camp /office, etc. for which fire extinguishers will be provided and minimum firefighting instrument like water spraying is to be provided in the mines to meet the exigencies.
- vi. Earthquake:** The seismic map of India indicates that the project area is located in the state of West Bengal is in Seismic zone III, but hardly any ominous tremor has been felt in the target area any time before. Therefore, the target area is not prone to earthquake for which contingency plan will be required to meet the emergency.
- vii. Volcanic Eruption:** The target area is not in the seismic activities zone which is prone for volcanic eruptionsthat warrant emergency management planning.
- viii. Tsunami:** The target area is not in the seacoast or near a port so that it could be affected by Tsunami andfor that matter contingency plan for its management.

7.6 SOCIAL IMPACT ASSESSMENT:

The project proponent shall consider the following general measures for the socio-economic development of the nearby villagers.

- Mining and mineral handling involve transportation activity is expected to generate employment. Project authorities shall engage the local people for material transportation or at least for loading and unloading.
- A section of local youth shall be trained in phases so that they can take up some jobs (mining contractor ship, building contractor ship, supply of mining materials, operation of heavy machinery and also small-scale rural business developments) of their own (self-employment) or in mines (on contract basis) or elsewhere.
- Purchase facilities and cultural improvement will also be developed due to mining.
- Medical, communication and educational facilities will be improved.
- The project shall provide regular grant to neighboring schools and constant encouragement for cultural activities in local villages.

7.7 R & R ACTION PLANS:

There is no R & R involve in this project.

7.8 HYDROGEOLOGICAL STUDY:

Hydrogeological study has been carried out by Central Mining Research Institute, Dhanbad for Gangaramchak and Gangaramchak-Bhadulia coal mine project in the year of 2006.

It has been evident from the investigation that groundwater occurrence and storage in the study area are mainly controlled by the geological structure and formation of the area. The ability of geological formation to store and transmit water is depended on its formation parameters, such as porosity and hydraulic conductivity.

The area has wide range of geological formation ranging in age from Archaean to recent. While Archaean and Gondwana formations continue the major parts, quaternary alluvial is restricted to the topographic depressions along the river channels in the form of thin vanner. The Archaean metasedimentaries consisting of schists, granites and gneisses with associated bands of quartzite and amphibolites. These consolidated groups of rocks occupy greater part of area and form as a continuous chain of low hills and small isolated hillocks. Groundwater in such rocks circulates to a limited extent through the secondary openings represented by joints, cracks, fissures and such other planes of discontinuity. The weathered residuum of the hard rocks as well as the fractures, joints, fissures, faults and other zones of discontinuity are the principle repositories of ground water in the area. The weathered zone is usually of limited thickness; fractures and joints generally close up with depth. The thickness of weathered mantle in the hard rock of area is about 15-25 meter in the topographic lows. Groundwater in the weathered and fracture zones of hard rocks occur under unconfined condition. Groundwater circulating through fracture zone is sometimes held under pressure.

The Gondwana sediments form the semi-consolidated formations and are better water potential zone. The splintery shales of Talchir and basal pebbles bed, the variegated Barren Measure shales and the sandstones in general, are known to constitute good aquifers at many places. Ground water occurs under unconfined condition in the weathered mantles as observed in the dug wells and semi confined condition in the deeper aquifers.

Hydro geological condition together with climate, geology and topography influences the occurrence and movement of groundwater in this region. The area lies in the tropical region where climate is characterized by very hot summer and cold winters. Summer is typically from mid March to mid June. South west monsoon lasts from mid-June to September. The average rainfall of the area is 1180mm, out of which 24% is lost as surface runoff, 63% through evapotranspiration and only 13% is enter into the subsoil and reached the aquifer. Average number of rainy days is 70 and average rainfall on a rainy day is 17.56 mm. Average rainfall in a rainy day during monsoon is 53.00 mm. Maximum rainfall in a single day of rainy season is 105 mm. Groundwater in entire region is potable with pH ranging between 7 to 7.5 & total dissolved solids between 240 to 300 mg/lit. Water levels observed in dug wells in the area indicate that the ground water depths vary from 1.90m to 17.75 m.

Catchment area is considered as the maximum open excavated area. It was considered that the seepage through backfilled area, strata and surface is 20% of water inflow due to direct rainfall. Pumping capacity is provided on the basis of pumping the accumulated water of the maximum rainfall/day in 5 days with 20 hours pumping per day. 25% reserve pumping capacity is kept standby.

Based on the above pumping requirement of the mine is worked out as follows:

- Catchment area: 0.8 sq.km.
- Water inflow to the catchment area due to direct rain on the day of maximum rainfall is 84000 cum/day.
- Seepage through backfilled area, strata and surface run off 16800 cum/day.
- Total make of water 100800 cum/day.
- Total pumping capacity 1008 cum/hr. In addition 25% of the above total pumping capacity has been kept asstand by.
- The head of the pump has been estimated as 150m.

Based on the above data the pump capacity is found as 2000 cum/day. Total requirements of pumps are asfollows:

- 6 pumps of configuration (Main pump 300 cum/hr* 150 m head* kw Suction pipe dia 200 mm and delivery pipe 200mm)
- 3 pumps of configuration (Main pump 150 cum/hr* 150 m head* kw Suction pipe dia 200 mm and delivery pipe 150mm)
- 3 pumps of configuration (Intermediate pump 150 cum/hr* 150 m head* kw Suction pipe dia 200 mm and delivery pipe 150mm)
- 1 Slurry pump of LPS*70 m head.

- To deal with the muddy water and sump cleaning 4 nos. of slurry pumps of capacity 13.88 LPS*41 m. head have been envisaged.

The open pit mining and accompanied dewatering in this area over a longer period of time is likely to alter the physical and chemical characteristics of the aquifer system. Open pit mining would destroy the natural aquifer system due to overburden removal and causing steep hydraulic gradients around the mine excavating area. The flow path of the groundwater can be affected significantly. Mining activities lowered the groundwater levels. Shallow dug wells and tube wells in the affected area can either go dry or yield less. Existing drainage divides may be altered. Blasting associated with mining enhances the secondary porosity in the vicinity of the mine area and culminates in higher percolation rates. As mining progresses mine spoils are replaced in the mine pit and recontoured and reclaimed to approximate pre-mining conditions. This would locally alter the groundwater quality and will increase leaching of ions and decreases of surface low. The dissolved solids concentration solids concentration may be as much as two to four times the natural concentration.

The study reveals that in the sub-watershed, the stage of groundwater development is 18.9%. On the basis of observation, it can be commented that at present there is no dearth of groundwater potential in the area. By adopting proper technology, the resource can be identified and tapped to meet the growing water demands in buffer zone areas as well as for mining purpose. Based on the observations during the study the following things were recommended:

- Observation wells need to be constructed up gradient and down gradient from the mine to evolve a realistic picture of the area of groundwater decline due to mine dewatering. Aquifer parameters for this entire monitoring network should be determined for future comparison.
- Periodic water quality data is another important area where further data is required. These data should contain details of all the surface water and groundwater bodies.
- Quantitative records of the mine water discharge should be maintained for assessing the problem of inflow into mines from time to time and seek remedial measures. Mine effluent should be chemically analysed periodically for all major ions, trace elements, and other constituents for submission to Pollution Control Board. Few sites may be earmarked for automatic monitoring of pH, specific conductance and temperature.
- A slump need to be provided at the lowest point of the quarry and delivery pipes will be laid along the side of the quarry so that the length of delivery pipe as well as friction can be minimized.
- As Hingla and Ajay Rivers would be the main drainage into which pumped mine water would be discharged, the river may have to be gauged before mining to obtain pre-mining parameters. Preparation of flow duration curves would be of great importance. A permanent gauging station should be established in the downstream reaches for monitoring the mine induced effects on stream flow and also to measure the quantity of mine discharged water. It would be essential to have a fully equipped meteorological station for collection of data within the mine block.

- Near to the mining areas water system is prone to disturbance and in such areas the water can be tapped from deeper zones by means of deep tube wells and proper rain water harvesting methods as well as utilizing the pumped & treated mine water for any domestic or irrigation purpose. So, it is necessary to adopt suitable water conservation technique like contour bundings, rain water harvesting etc., for artificial recharge for better management of rainwater and proper utilization of available water resources.
- Although there will be no major problem in the ground water due to the mining activities as mine water discharge do not contain toxic material. But it requires regular monitoring of ground water quality and precaution should be taken to mitigate future damage of aquifer.

7.9 DUMP & PIT STABILITY STUDY:

West Bengal Power Development Corporation Limited (WBPDC) requested BIT Mesra, Ranchi to carry out the scientific study for design of Pit configuration, ultimate Pit slope, and Dump slope. The study has been done and subsequently dump and pit stability report has been prepared by Dr.Indrajit Roy of Civil and Environmental engineering department, Birla Institute of Technology, Mesra in 2019.

The Slope stability study is important owing to the influence of slope angle upon the safety and the economics of the open cast project. The geo-engineering parameters considered for the study are as follows:

- Cohesion and angle of internal friction, bulk unit weight of dump material.
- Cohesion and angle of internal friction, bulk unit weight of foundation material.
- Geometric profile of the dump.
- Water table below external dump.
- Seismicity of the area where the dump is situated.

The dump material consists of sandy soil and fragmented sandstone and was tested by large box shear test apparatus in the lab. Other than laboratory tested values, back analysis was carried on the existing dump profile which is standing at limiting equilibrium. A number of possible representative cohesive values of dump material are considered and corresponding values of angle of internal friction of dump mass is obtained by stability analysis for which the factor of safety becomes around 1.0. Similarly a number of possible representative values of angle of internal friction are considered and corresponding cohesive values of dump is obtained for which the factor of safety becomes around 1.0. For the stability analysis Fellinius method was implemented.

Seismic forces are considered as per "Indian standard of criteria for earthquake resistant design of structure (fifth revision) IS 1893:2002". The peak ground acceleration coefficient is determined as 0.59 m/Sec^2 which covers both seismic and blast vibration effect as both vibration and earthquake does not occur simultaneously.

A factor of safety of 1.05-1.10 is envisaged here for design which considers maximum seismic acceleration.

To determine the most probable failure surface Iteration method is applied. Bishop's simplified method was also used for calculating the most critical failure surface more accurately. According to the stability analysis study the existing internal dump was recommended as safe. However, it was recommended for continuous monitoring to detect possible instability of the dump so that appropriate remedial measures can be taken.

Pit slope stability study was carried out by limit equilibrium method considering planer failure, wedge failure and also circular failure. A site-specific computer programme was developed for back analysis of existing highwall to estimate the shear strength parameters by back analysis with other known parameters like bulk density of rock mass, slope geometry, tension cracks, plane of weakness within the rock mass, influence of ground water within the tension crack, effect of seismicity and blast vibration effect. Other than carrying out laboratory analysis of rock samples at the rock mechanics laboratory, back analysis of fractured rock mass in the highwall cracks is carried out to determine representative value of cohesion & angle internal friction of rockmass in the fracture zone.

After consideration of the following parameters stability analysis is carried out:

- Shear strength parameters.
- Slope geometry of existing cross section.
- Existing tension cracks.
- Discontinuity planes and its orientation within the rock mass.
- Influence of ground water within the tension crack.
- Seismicity and blast vibration effect.
- Shear strength parameters of black cotton soil.

After the analysis it was found that for the slope for existing height of 35 m is safe from safety point of view and the present quarry batter is safe from the stability point of view. For the final quarry batter maximum recommended slope is 60° and it should be filled and packed up during in pit dumping. Other than maintaining the above slope during working, following precautionary measures are recommended to be taken up for safety working:

- In case of any presence of fault day lighted working, the potential failure block against fault plane was suggested to remove as early as possible.
- Monitoring of highwall benches need to be carried out and recorded at a interval of seven days. In case of any horizontal widening of crack to the tune of more than 5 cm in any highwall bench, the working zone near to that bench should be declared as danger zone and any mining activity need to be stopped.
- For the mining operation of overburden, the maximum height and width of the working bench should be 10 m and 20 m respectively. For the final bench it should be 10 m and 4.5 m.
- In case of coal mining, maximum height and width of working bench was recommended as 6m and 3m respectively.

7.10 BLAST DESIGN STUDY:

Report for optimization of blast design parameters at Gangaramchak and Gangaramchak Bhadulia Coal mine, Dist- Birbhum, West Bengal to safeguard nearby structures was prepared based on the study done by Central Institute of Mining and Fuel Research. This study was carried on January and the report was prepared on July, 2020.

Altogether ten (10) blasts were conducted at different benches of the Gangaramchak and Gangaramchak Bhadulia Coal mine Dist- Birbhum, W.B and forty (40) vibration data were recorded at different locations in the periphery of the mine. Level of vibration was recorded during the blasting. Analysis of the rock fragments were done in the laboratory. Based on the field recorded data and analysed lab data the following things were observed:

1. The maximum level of vibration recorded was 8.052 mm/s with dominant peak frequency of 16.13 Hz at 100 m back side of blast free face (towards village) due to the blast conducted at 3rd bench (105 mRL bench) on 07.01.2020. The vibration recorded at 400 m at mine office from the same blast was less than 0.5 mm/s (trigger limit). In this blast 3,040 kg of explosive were distributed in 56 holes and were detonated with explosives weight per delay of 110 kg.
2. The maximum magnitude of vibration recorded near mine office was 1.413 mm/s at peak dominant frequency of 20.5 Hz. The blast was conducted using maximum explosive charge weight per delay of 100 kg and total explosive charge of 2,550 kg. The office was at a distance of 300 m from the blasting face.
3. The peak dominant frequencies of ground vibrations recorded were in the range of 5.875 - 38 Hz. The dominance of frequency falls in the range of 8 Hz – 25 Hz. However, the significant number of data has also been recorded with frequency of blast vibration below 8 Hz. Accordingly, the blast induced ground vibration should be restricted within 5 mm/s for safety of nearby structure not belonging to owner as per DGMS circular 7, 1997. The blast vibration limit may go up to 10 mm/s for the structures belonging to the Owner as per DGMS standard.
4. The maximum air over-pressures recorded at back side of blast face (near fourth bench) at a distance of 110 m was 124.7 dB(L) due to the blast conducted at third bench (105 mRL) of Gangaramchak and Gangaramchak Bhadulia Coal mine on 28.12.2019. The surface and down-the-hole connection were made with Nonel. In this blast, the total explosive detonated in this blast round was 540 kg whereas explosives weight per delay was 40 kg.
5. The fragmentation analysis of the blasted muck pile was carried out using image analysis. The average mean size of the rock fragment was 87.987-99.970 mm (diameter of an equivalent sphere) and the most common size of the block was 150-300mm (diameter of an equivalent sphere) after excluding the fine size of the fragmented rock in analyses. The maximum size of the boulder was in the range of 1.286 to 1.339 m (diameter of an equivalent sphere).

6. The propagation equation for the prediction of blast vibration has been established for the mine. The Maximum Charge Weight per Delay (MCPD) to be detonated in a blast round has been computed for the different distances using predictor equation considering 5mm/s as the safe limit of vibration.
7. The total explosive charge in a blasting round for day-to-day blasting at the mine has been computed considering 5mm/s as the safe limit of vibration.
8. All the recorded vibration and air overpressure data at concerned locations were well within the safe limits. There was no ejection of flyrock during the study period.
9. The rock fragmentation was very good in most of the blasts. Nonel initiation system has added advantages in comparison to D-cord initiation system because it detonates the explosives in the blast holes from the bottom of the hole at sub-grade level and reduces the ejection of fly rocks significantly.

Based on the above mentioned observations, the following things are recommended;

- Sample blast design has been suggested in for day-to-day blasting at the mine. The blast design should be followed with judicious modifications as per site condition in order to control blast induced ground vibration within statutory limits.
- The maximum explosive charge weight per delay and total explosive charge in a blasting round should be followed for day-to-day safe blasting at the mine with due control on blast induced ground vibration near surface structures within statutory limits.

CHAPTER-8

PROJECT BENEFIT

8.0 MAJOR BENEFIT:

The coal of Gangaramchak & Gangaramchak-Bhadulia Mine is for utilization in End Use Plants of WBPDCCL situated at STPS, Santaldih, Purulia district, KTPS, Mecheda, Purba Medinipur district, BKTPP, Bakreswar, Birbhum district, BTPS, Tribeni, Hoogly district, SgTPP, Manigram, Murshidabad district. There is huge demand of coal in West Bengal for Power generation and other utility. Thus, wining of coal at the rate of 3.00 million TPA from this project is highly essential and the expanded capacity of coal from this project can also partly fulfill the immediate requirement of WBPDCCL.

The proposed expansion from 1.00 MTPA to 3.00 MTPA (200% increment) will bring economic benefits to the state by the way of Royalty for mineral and to the local people by way of direct and indirect additional employment opportunities.

The project is of utmost importance to the area/ region for interest of mineral development and shall greatly contribute to improve the socio-economic conditions of the local habitants. The operation of the mine after expansion will bestow various social and economic benefits to the local communities of the area in addition to providing better employment opportunities. Proposed expansion of the project shall improve social infrastructure of the area, apart from increased financial benefits accruing to state and central agencies by way of taxes, royalties, cess etc.

The operation of the project is being carried out in a sustainable way with a target to develop human and environment together with an eco-friendly mining method. Overall, after expansion also it will not have adverse impacts on any of the environmental or socio-economic parameters. Thus, environment & socio-economic point of view, the proposed production level shall be feasible for all purpose.

With the expansion of the project, a new horizon shall emerge to the local people for their social upliftment. There will be no adverse effect of mining on the socio-economic status of the people rather the expansion will help in improvement of the standard of living of the people. Apart from overall beneficial impact of the project on the local people of the region, it is felt necessary to augment facilities in the fields of education, health and social awareness including concern for environment and ecosystem.

8.1 IMPROVEMENTS IN THE PHYSICAL INFRASTRUCTURE:

The mining project in the locality helps in improvement of the physical infrastructure like roads, vehicles for public transportation, water and sanitation facility, house and rest shed for the mine worker, safety equipment for the mine workers etc.

8.2 OTHER TANGIBLE BENEFITS:

Apart from overall beneficial impact of the project on the local people for expansion, the following measures will be taken up by the project proponent as periphery development project;

- Planting of economically important & fruit bearing trees in the open spaces around the mining lease area which is accessible to the local people.
- Indirect employment opportunities to local people in contractual works like housing construction, transportation, sanitation, for supply of goods and services to the project and other community services.
- Marketing and business establishment facilities will also increase in nearby area by expansion of this project.
- Improvement in communication, transport, education, community development and medical facilities.
- Overall change in employment and income opportunity.
- The State Government will also be benefited directly from the proposed project, through increased revenue from royalties, excise duty etc.
- Development of socio-economic status of the people of the project area & decrease in rate of migration from villages through awareness programme, training, etc.

8.3 PERIPHERAL DEVELOPMENT ACTIVITIES:

The capital cost of Gangaramchak and Gangaramchak Bhadulia coal mine project is Rs. 111.5 crores. Hence, estimated CSR cost of Rs 22.5 Lakh for Gangaramchak and Gangaramchak Bhadulia coal mine will be given.

Table C8-1: Breakup of CSR Cost

S.No.	Particulars	Cost (in lakhs)
1.	Skill Development Training to the youths from nearby village	12.00
2.	Books Distribution in Primary school Bastavpur village	1.00
3	Road repairing-spreading of Moorum	2.50
4	Water supply	7.00
	Total	22.5

CHAPTER-9

ENVIRONMENTAL MANAGEMENT PLAN

9.0 INTRODUCTION:

The impact identification and prediction as well as the mitigation measures have been mentioned in Chapter 4 of this report. For effective implementation of the mitigation measures, management plan (Administrative Aspects) needs to be prepared. The objectives of the management plan are to:

- Monitor the effectiveness of mitigation measures;
- Ensure that the efficient operation of mitigation measures is implemented;
- Establish systems and procedures for this purpose and;
- Take any necessary action when unforeseen impact occurs;

The sole objective of Environmental Management Plan (EMP) is to control the adverse impact of a developmental activity. The EMP consists of mitigation measures to be adopted, environmental monitoring & institutional measures (financial estimates and organizational set-up). Looking at the size of the mines and quantity of production, it is evident that the proposed activities will have no considerable impact on different environmental components. To mitigate such adverse impacts, even though negligible, environmental management plan have been integrated into the process of mine planning so that appropriate remedial measures shall be implemented from the beginning. This chapter proposes Environmental Management Plan (EMP), which will be an integral part of the mining project for minimizing the adverse impacts and to ensure the sustainable development of the area.

Keeping in view the mitigation of the adverse environmental impacts due to mining, the EMP has been worked out with the following objectives:

- Reclamation of the mined-out area wherever and whenever possible.
- Restoration of landscape as near to its original form as far as possible, consistent with the economy of mining operations, keeping in view the drainage pattern, geological stability, vegetation etc.
- Minimization, mitigation and wherever possible elimination of degradation of land and deterioration of quality of air as well as water.
- Making least disturbance to the water regime and water quality.
- Least disruption to the existing basic ecological status in the mining area during mining, which will be conserved and protected.
- Improvement of the overall flora scenario of the area.
- Establishment of an environment, in which the activities presently being carried out may change for the better without disruption or disturbance to the socio-economic condition.

Anticipated Potential Impacts due to expansion of the project and Suggested Mitigation Measures are furnished below in Table No. C9-1.

Table No. C9-1: Anticipated Potential Impacts and Suggested Mitigation Measures

Sl. No.	Item	Anticipated Potential Impacts	Suggested Mitigation Measures
1	Air Pollution Control	The mining activities involves various processes such as, loading & unloading, mining extraction, transportation, drilling, blasting, sizing of coal etc. which are likely to contribute towards air pollution in the area. The effect will be localized and is mostly due to fugitive emission of dust particles.	• Maintenance of water tanker & machineries for water sprinkling. • AAAQ monitoring. • Proper Maintenance of mines haulroad. • Surface miner will be deployed for sizing of coal. • Regular checking & maintenance of vehicles & machineries will be carried out. • PUC certificate to be checked judiciously.
2	Water Pollution Control	As per the hydrogeological investigation carried out within the study area, ground water table level varies from 1.90 to 17.75m bgl. Whereas the proposed mining activities shall be carried out up to a depth of 73m from average ground level. Therefore, the seepage of groundwater shall occur as and when water table is intersected. Ion leaching from overburden material due to weathering causes increase of dissolved particles into the infiltrated water to aquifer. Surface water shall be contaminated by mine run of water.	• Observation wells need to be constructed up gradient and down gradient from the mine to evolve a realistic picture of the area of groundwater decline due to mine dewatering. Aquifer parameters for this entire monitoring network should be determined for future comparison. Periodic water quality data is another important area where further data is required. These data should contain details of all the surface water and groundwater bodies. Quantitative records of the mine water discharge should be maintained for assessing the problem of inflow into mines from time to time and seek remedial measures. Mine effluent should be chemically analysed periodically for all major ions, trace elements and other constituents for submission to Pollution Control Board. Few sites may be earmarked for automatic monitoring of pH, specific conductance & temperature.

		• As Hingla and Ajay Rivers would be the main drainage into which pumped mine water would be discharged, the river may have to be gauged before mining to obtain pre-mining parameters. Preparation of flow duration curves would be of great importance. A permanent gauging station should be established in the downstream reaches for monitoring the mine induced effects on stream flow and also to measure the quantity of mine discharge water. It would be essential to have a fully equipped metreological station for collection of data within the mine block. • Rainwater harvesting using land surface is less complex way of collecting rainwater and can be done in the mining areas. • For water conservation -contour bund, recharge pit, settling pond, coco filtration etc. can be done. • Pond shall be the post mining use of land in the ML area. It shall fulfill the water need of the area for agriculture and will also be used for pisciculture. • Construction of garland drain around the dump. • Construction & maintenance of garland drain around mining pit. • Construction of 2 settling ponds & it's collecting drains. • Masonry Construction of catch pits to arrest the clay mixed water from the ROM Stack yard. • Construction of toilets with septic tank & soak pits.

3	Noise Pollution Control	In the mechanised open-cast mine, mining operations such as drilling, blasting, excavation, loading and unloading, movement of dumpers, etc are expected to generate noise.	• Mining machineries fitted with upgraded silencer and noise pollution control facilities. • Suitable PPE is being provided to the exposed workers.
4	Land Management (Topsoil, Reclamation etc.)	During the course of Mining topsoil, overburden will be disturbed. The overburden generated shall be dumped temporarily. Some of the civil construction shall remain after cessation of active mining. These infrastructure facilities shall benefit the site.	• Top soil will be scrapped and stored in the designated place. Further, topsoil will be used for plantation and reclamation during the progressive and final mine closurephases. • Concurrent backfilling will be carried out and OB will be used for backfilling. • Re-handling of the surface dump. The material will be used in concurrent backfilling.
5	Biodiversity	Out of 150 Ha. of mine lease area, around 101.77 ha. area comes under forest land. Necessary forest clearance (stage I & II) has been obtained before commissioning of the Mining activity in that forest land.	• The massive afforestation on abandoned mining benches, overburden dumps and other areas shall match well with the forests in the study area to the maximum possible extent, to provide a uniform land use befitting to the location. • Afforestation has been planned in a manner, which will actually increase the bio-diversity of the local ecosystem. • Conditions and guideline of the Forest clearance is being duly complied.

6	Greenbelt	Will compensate the damage to vegetation due to setting up and operation of the mine. Will prevent the spread of fugitive dust generated due to mining and allied activities. Will attenuate noise generated by the mine. Will reduce soil erosion. Will help stabilize the slope of over-burden dumps. Will increase green cover and improve aesthetics. Will attract animals to re-colonize the area when the mine is abandoned.	• Broad leaf trees growing above 10m in height should be planted along the roads, offices and infrastructure facilities. • Plantation of trees should be undertaken in appropriate encircling rows. • Generally local / indigenous fast growing trees & shrubs should be planted. • The trees should be protected by plantation of non palatable shrub species to avoid browsing by animals. • Placement of tree guards to be provided to save the plants.
8	Occupational Safety and Health	The mining processes may result in accident like rock fall, fire, explosion, fall from height, mobile equipment accidents, entrapment & electrocution. All these activities involve operators who are susceptible to accidents if proper safety precautions are not taken and the equipment are not maintained properly. The working personnel in the mine area are also exposed to occupational health hazard conditions which emanate due to dust emissions, exposure to sun, stagnant water in mine pits, etc.	• Provision of safety shoes, dust mask, safety goggles, ear plugs, safety helmets, etc to workers. • Construction of Rest Shelters & First Aid Centre. • Annual health check-up of workers & health camp. • Ambulance for workers and villagers. • Training to Staff. • Guideline of DGMS will be strictly adhered.

Beside the above, Environment Awareness camp will be conducted among the locals for sustainable development.

9.1 BACKGROUND OF ENVIRONMENTAL MANAGEMENT PLAN:

Keeping in view of the impacts and mitigation measures, the formulation of Environmental Management Plan(EMP) is based on the following consideration:

- a) Proposed project activities
- b) Air and water pollution control
- c) Work zone environment improvement
- d) Solid waste management
- e) Biological reclamation and landscaping
- f) Occupational hazards and safety
- g) Environmental monitoring facilities
- h) Environment management costs

Many of the areas of environmental management planning require multidisciplinary approach. Therefore, the measures envisaged in the report are to be regarded as guidelines and depending upon the continuing advice to be taken from experts of relevant fields like forestry, soil chemistry, ground water etc. the suggested schemes are to be detailed and if necessary to be modified from time to time to meet statutory requirements. Further, in the light of experience likely to be gained during the initial years of operation, proposed schemes may require periodic modification/ updating.

9.2 ADMINISTRATIVE & TECHNICAL SET-UP FOR MANAGEMENT OF ENVIRONMENT:

9.2.1 Environment Management Cell:

The implementation of the mitigation measures and monitoring of environmental parameters and effective communication with various Govt. institutions needs suitable organization set up and the success of any environmental management plan depends on the efficiency of the group responsible for implementation of the programme. Therefore, the cell will be headed by a full time Environment Manager. Regular monitoring of environmental parameters is necessary to evaluate the effectiveness of the management programme so that suitable preventive/ corrective action can be taken in case there are some draw backs in the proposed programme.

A separate Environment Management Cell (EMC) will therefore be set up at site level after expansion of the project which will look after the environment related parameters of the proposed Mine. The environmental cell should be under the control of a suitably qualified & trained professional with adequate authority & due responsibility.

The Environmental cell will also be looking after for preparation of environment statement, carrying out internal environment audit on periodical basis, preparation of compliance status report for Consent to establish, Hazardous waste authorization & Consent to operate etc. 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 condition during coal mine operation.

9.2.2 Manpower:

The Environment Management Cell (EMC) will be headed by the Manager (Environment) and the other members of the cell will include a Geologist, Asst. Mines Manager/Mining Engineer, a Gardener to supervise & monitor plantation activities and one field assistant. However, casual laborers shall be employed for plantation, drain cleaning, assisting in monitoring activities, etc. as and when required. Manpower requirement is given in following Table No. C9-2.

Table No. C9-2: Manpower Requirement for Proposed EMC

Qualification	Description	Specialization	No.
M. Tech / P. G./ B.Tech	Environment Manager	Environmental Science	1
B. E (Mining)	Mines Manager	1 st Class Mine Manager	1
P. G.	Geologist	Mine Geology	1
B.Tech. / B.E/ M.Tech / Diploma	Mining Engineer	Asst. Mine Manager /Mining Engineering	1
Skilled	Plantation (Supervisor)	Skill & Experience	1
Skilled	Gardener’s Helper		1
Total			6

9.2.3 Training Facilities:

To achieve the objective of Environmental Pollution Control, it is essential not only to provide latest pollution control and monitoring measures but also to provide trained manpower resources to operate the same. In Project, training facilities will be developed for environmental control and also specialized courses by various environmental institutes will be organized. The training will cover the following fields.

1. Awareness of pollution control and environmental protection.
2. Operation and maintenance of pollution control equipment.
3. Afforestation and post plantation care of plants.
4. Field monitoring maintenance and calibration of monitoring instruments.
5. Knowledge of norms, regulation and procedures.
6. Occupational health and safety.
7. Disaster Management.

Plantation work, drains and sump cleaning etc. shall be done through departmentally or by Mine Developer & Operator and machinery operators shall be taken from mine operation section as and when required by the environmental section.

9.3 DUTIES OF ENVIRONMENT MANAGEMENT CELL:

In order to carry out the above monitoring /inspection in a systematic manner EMC shall practice the following:

- EMC shall chalk out a site based strategy to control pollution. The strategy should include formulation of code of actions for controlling air, water, noise, soil pollution, phase wise afforestation scheme and also actions to be taken in respect of socio economic development. Frequency of monitoring/ sampling and inspection of various parameters / factors will also be planned.
- EMC shall oversee that environmental control measures are implemented as per approved action plan.
- Water and Energy conservation programme shall be formulated.
- Identify and record the constraints in respect of environmental planning and implementation.
- Systematic documentation of all the field monitoring and laboratory analysis results.
- Analyze the monitoring results and inspection findings. The results can be compared with various Standards/ Norms. EMC will prepare periodic progress reports which will include the analysis and inspection results. Environmental audit results and actions taken should also be systematically documented.
- Plan the management responsibilities defined for various environmental matters. This should be displayed in the notice board in the office of EMC.
- Keep watch on flow pattern of streams/ nala/ rivers in the buffer zone and keep vigil on the efficiency of water management system.
- Keep log of all observation in a systematic manner.
- Keep analysis/ results received from laboratory in proper sequential manner.
- Development of schemes for water conservation, rainwater harvesting and reuse of treated wastewater.
- Carry out Internal Environment Audit
- Interact with H. Q. officials and also with State/ Central Government departments as per requirement basis.
- Preparation and submission of EC, CTO, HWA Compliance reports and other statutory returns (Environment Statement, HW Return etc.) as applicable.

To carry out the above-mentioned jobs properly, adequate staff shall be appointed. The services of retired forest officials shall be taken on requirement basis for effective implementation of plantation schemes. For development and maintenance of facilities like drainage, ditches, settling tanks etc. assistance from the projects civil engineering department will be taken. The entire monitoring programme shall be carried out effectively through a recognized agency on regular basis. However, casual laborers shall be employed for plantation, drain cleaning, assisting in monitoring activities, etc. as and when required.

Important records to be maintained by EMC are given in Table No. C9-3.

Table No.C9-3: Important Records to be Maintained by EMC

Sl. No.	Particulars
1.	Field monitoring results for air, water, meteorology
2.	Inspection records of slope failure, land erosion, drainage, socioeconomic development
3.	Format to record /monitor plantation measures
4.	Nursery records
5.	Environmental and related standards/ norms
6.	Records pertaining to statutory consents & approvals
7.	Code of actions for pollution control in defined areas
8.	Periodic Medical Examination (PME) records
9.	Records pertaining to laboratory equipment maintenance and calibration
10.	Complain register (Environmental Pollution)
11.	Records on water and electricity consumption
12.	Periodic progress records
13.	Environmental audit records
14.	Records of annual budgetary requirement and allocation for pollution control

9.4 APPROVED ENVIRONMENTAL POLICY:

Corporate Environmental Policy forms the foundation of environmental improvements made for the business, as defined by senior management. M/s West Bengal Power Development corporation limited (WBPDC) has a declared Environment, Health and Safety Policy approved by the Board of Directors which outlines a business' aims and principles in relation to managing the environmental effects and aspects of its operations. It is strictly monitored that no infringement/ deviation/ violation of the environmental or forest norms/conditions take place.

Endorsement of the Policy towards Environment, Health and Safety are as follows;

- Social /Environmental Sustainability Reporting.
- Corporate Accountability.
- Communication via responsibility reporting and its effect on firm value.
- Maintaining a safe working environment.
- EHS strategies aligned with organizational goals.
- Drive EHS throughout the organization.
- Developing a culture of sustainability.
- EHS impacting current and future regulatory practices.
- Providing high environmental expertise and know-how.

Corporate Environment Policy and CSR policy of WBPDCCL have been enclosed as **Annexure-VII**. WBPDCCL will make every effort to:

- Operate their mining facilities as per standard prescribed procedures so as to comply with various environmental norms.
- Adopt the highest environmental standards in all areas of mining operation, meeting and exceeding all relevant legislative requirements.
- Assess our organizational activities and identify areas where to minimize impacts.
- Publicize their environmental position.
- Train employees in good environmental practice and encourage employee involvement in environmental action.
- Reduce risks from environmental, health or safety hazards for employees and others in the vicinity of our operations.
- Adopt an environmentally sound transport strategy.
- Aim to include environmental and ethical considerations in investment decisions where appropriate.
- Assist in developing solutions to environmental problems.
- Continually assess the environmental impact of all our operations.

Corporate Social Responsibility Activities:

The "Corporate Social Responsibility Policy" of M/s West Bengal Power Development Corporation Limited (WBPDCCL) will be followed and implemented for the Community Development Projects in the vicinity of the proposed Gangaramchak & Gangaramchak Bhadulia open cast Coal mine project.

The Community Development Projects of WBPDCCL are aimed at communities of the targeted villages, the endeavour being to improve the quality of life of the people. In order to make a long term impact, the concentration would be on providing access to basic amenities on water, sanitation, roads, health, education and relevant infrastructure.

The company will ensure CSR spends in every financial year, at least two percentage (or the percentage as may be fixed by the Government from time to time) of the average net profit of the company made during the three immediately preceding financial years towards CSR activities in pursuance to its "Corporate Social Responsibility Policy".

As part of the company's commitment towards Corporate Social Responsibility, Community development activities have been taken up across 5 major verticals of Education, Health, Training /Empowerment, Infrastructure Up-gradation, few of which are mentioned as follows:

- 1) **Training for self – employment:** WBPDCCL will make adequate arrangements for development of entrepreneurship, technical and professional skills for self-employment, under the guidance of the local administration. Training on Tailoring, Tie and Dye, Applique & Patch Work, Machine Embroidery, Computer Knowledge to women and Mobile repairing, Masonry, Plumbing, Electrician, Computer Knowledge, Driving etc. for men, shall be planned to be imparted. Suitable training shall be

organized at the cost of project authority to upgrade their existing skills for those engaged in traditional occupations/handicrafts/handlooms. For opening new avenues for self-employment in the region, training could be imparted on food processing, mushroom cultivation, computer courses, poultry farming, dairy farming, sewing etc.

- 2) **Merit Scholarship Scheme:** WBPDCCL shall introduce a Merit Scholarship Scheme for the wards of the local families to improve and encourage the literacy and educational standards in the study area and to create a pool of potential candidates.
- 3) **Strengthening the Education Sector:** There are existing Primary and Middle Schools. However, facilities in these schools could be strengthened by establishment of computer lab, Providing sports item & practical lab equipment, books for library, white washing, repair and maintenance of the schools, organising Extracurricular activities in the school, etc.
- 4) **Strengthening the Health Care:** The Project proponents would provide mobile medical van for assisting ailing villagers. They would also interact with State Officials for improving health Facilities.
- 5) **Sports Promotion:** To organise training for youths in sports like hockey, football and archery which are very predominant sports in this area. Distribution of Sports items/uniforms to the village sports teams and organizing sports competition.
- 6) Misc. community development activities such as organizing/donating in cultural events, fairs & festivals etc. on recommendation of district administration.

The main focus of CSR activities will be on sustainable development, inclusive growth and to address the basic needs of the deprived in surrounding communities of the project site. The philosophy and spirit of CSR will be consistent with the provisions of the Companies Act, 2013 and applicable amendments.

9.5 HEALTH AND SAFETY POLICY:

The company identifies safety and health of the personnel as integral part of work aspect at every level. Hence, the following step shall be taken;

- Provide adequate and continuous training to all personnel especially those who will be engaged in operation of heavy machinery;
- Prepare an over-all safety & health manual giving general requirements of leadership, planned inspections, job analysis & procedures, emergency preparedness, organizational rules, necessity and use of protective equipment, health control, etc.;
- Systematic evaluation & measurement of system performance at all operational levels and continuously update the over-all safety & health manual;
- Carrying out regular publicity campaigns to effective personnel safety and health consciousness and
- To employ a person as in-charge for planning, training & safety and make him responsible for implementation of safety and health policy.

9.6 SYSTEM OF REPORTING OF NON-COMPLIANCE:

A separate department "Environmental Management Cell (EMC)" shall be there at Gangaramchak & Gangaramchak Bhadulia Coal Mine to look after the monitoring, requirements and Reporting of Non Compliance. The Wing shall be under the overall supervision of the Lessee and responsible for monitoring of the implementation of the various actions which are to be executed by the agencies specified in the EMP. The Cell shall report on a regular basis to the Director (Mining) , West Bengal Power Development corporation limited; who then inform the important matters to the Board of Directors.

EMC will monitor the implementation of environmental norms / conditions (EC, CTO, HWA etc.) and reports any deviations to the Mine Manager. The Mine Manager will take suitable corrective measures with the guidance of Environmental Manager. The non-compliance, if any, which require the intervention of higher authorities will be brought to the notice of Unit Head.

The Unit Head will inform the deviations / non-compliance to The Chief Executive Officer and concerned Functional Director.

Monthly review meetings will be conducted by General Manager/Unit head/Director (Mines) for reviewing the compliance of EC / FC / CGW A/ CTO/HWA conditions.

In addition to the above, Deputy General Manager (Corporate Environment Cell) will review weekly/fortnightly and apprise non-compliance of EC/CTO conditions to Director (Planning & Projects) and Director (Mines), who in turn apprise the Chairman & Managing Director and Board of the company.

Dedicated manpower/resource will be deployed by the Environmental Management Cell (EMC) for compliance and execution of environmental parameters at Unit level. EMC will also responsible for continual improvement and sustainable development of the project/unit.

The Cell shall be headed by the Mines Manager and Environment Manager and the other members of the cell that will include a Geologist, Environmental Officer/Environmental Engineer and a Mining Engineer. The roles and responsibilities of each member are discussed below;

Mines Manager: He shall be responsible for planning and implementation of the control and protective measures. He shall supervise for the environment related activities within the project area on daily basis. He shall co-ordinate with the other team members for proper allocation and functioning of the pollution control and monitoring equipment including the land reclamation and water sprinkling trucks. He shall co-ordinate with the outside agencies including contractors for monitoring and controlling the tasks related to green belt development, afforestation and other social and biological reclamation. He will be responsible for monitoring of the progress of implementation of environmental control measures and will be reporting directly to the Mines Owner/Nominated Owner and or Board of Directors of the Company. Mining engineer will work under the guidance of Mines Manager to ensure eco friendly and scientific mining.

Environmental Manager & Environmental Engineer: They shall be responsible for coordinating with the recognized monitoring agency for collecting water, air, soil samples and analysing water and air samples as well as collecting statistics of health of workers and population of surrounding villages. They will be responsible for maintaining the schedule, duration and parameters to be monitored. They shall also supervise the implementation of environmental protection measures viz, water sprinkling/spraying creation of storm water drains, garland drains, culverts and other protective measures/ arrangements. They will be the overall in-charge of biological reclamation and plantation scheme to be carried out in and around the mine lease area and maintenance of green belt etc.

Following are the responsibilities of Environment Manager and Environment Engineer.

- To identify, access, interpret, determine applicability and communicate to Unit Head regarding environmental compliance obligations from various government and non-government authentic sources i.e. MoEF&CC/CPCB/SPCB/CGWA websites or subscription to the various journals/periodicals etc.
- To update legal requirements periodically and communicate across units.
- Evaluation of status of compliance of the applicable compliance obligations
- In case of any gap/issues/violations identified with respect to the applicable compliance obligations during self-compliance review/inspections/audits/observations from statutory bodies or other stakeholders, then adequate controls, corrections, corrective and preventive actions to restore compliance status shall be taken and prevent the reoccurrence of the deviations/violations.
- Submission of compliance condition status to the regulatory bodies as per requirement (annual statutory returns, CTE/CTO/HWA compliance reports etc.)

Geologist: He will be responsible for timely submission of the Mining Plan/ Revision of Mine plan etc. and implementation of Progressive Mine closure Plan and Final Mine Closure Plan. He will be responsible for supervising and guiding environmental team on geological, aspects in the pollution control management, such as groundwater, etc. Geologist will be also responsible for sustainable Mining practices.

Mining Engineer: He will be responsible for providing technical inputs necessary from the mining operation's point of view, in managing the environment. He will work under the guidance of Mines Manager and in close association with the geologist and environmental engineer.

9.7 HIERARCHICAL SYSTEMS OF REPORTING:

The Hierarchical Systems of the Company to deal with various environmental norms are given below:

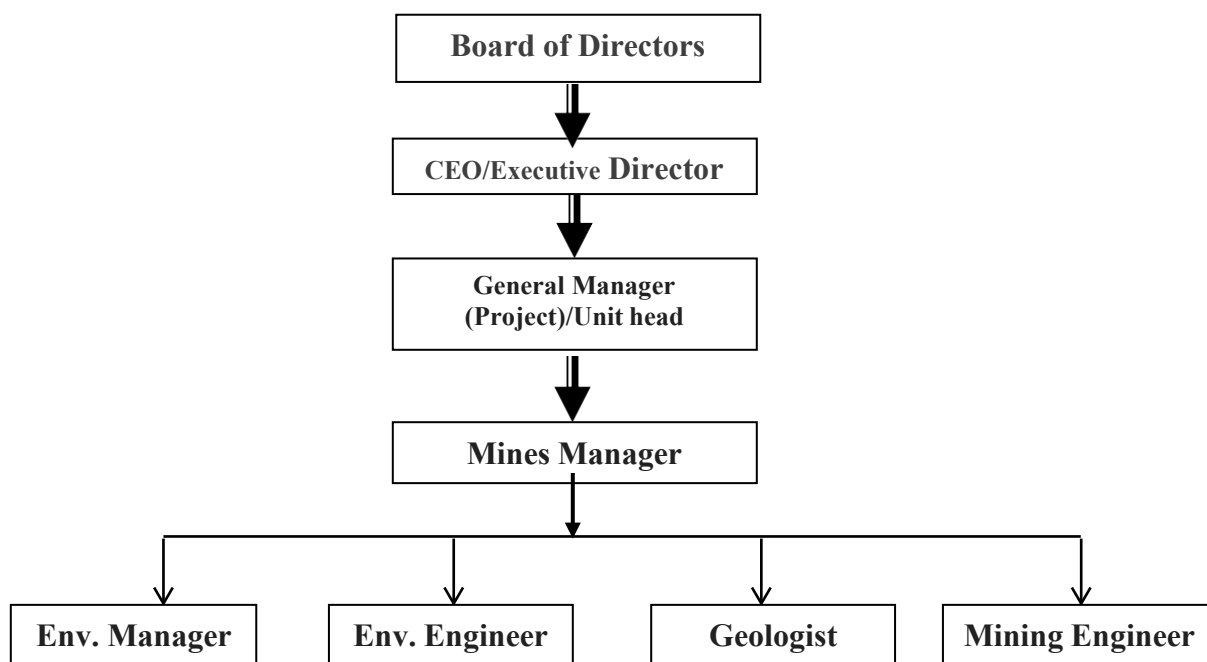


Fig. No.C10-1: Hierarchical Systems of Reporting

9.8 UPDATING OF EMP:

The action plan of EMP shall be updated every year with respect to the results achieved and proposed activities for next year. Any new regulations considered by SPCB /CPCB shall be taken care of. Budget sanctions shall be made while updating EMP.

CHAPTER-10

SUMMARY & CONCLUSION

10.0 INTRODUCTION:

The Gangaramchak Block represents an isolated narrow elongated strip of coal bearing sediments of about 9 km in length in Trans-Hingla area of the Raniganj Coalfield in the district of Birbhum, West Bengal. The project is located in village Basavpur, Tehsil Khoyrasole, Dist-Birbhum Of West Bengal state

The Gangaramchak and Gangaramchak Bhadulia coal block was initially allotted to M/s Bengal Emta Coal Mines Limited in the year of 2003, the authorized mine operator brought this mine into production in the year of 2003. The Hon'ble Supreme Court of India vide its judgment dated 25th August 2014 and order dated 24th September 2014 cancelled the allocation of all 204 coal blocks which included the Gangaramchak and Gangaramchak Bhadulia block. Subsequently this block /mine has been reallocated by the Ministry of Coal (MoC) to M/s West Bengal Power Development Corporation Limited (WBPDC) vide allotment order no 103/8/2015/NA dated 31.03.2015.

The block is defined by the latitudes 23°48'20.812"N to 23°49'28.016"N and longitudes 87°12'20.292"E to 87°13'52.172"E. It is included in the Survey of India Topo Sheet No. 73M/1 and in the Sheet No. 16 of the geological map of the Raniganj Coalfield published by the Geological Survey of India. Administratively the Block falls under Khayrasole Police Station of Birbhum district.

Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mining Project comprise both forest and non-forest lands. It has obtained Environmental clearance for 1.00 MTPA from MoEF & CC vide letter no-. J- 11015/375/2006-IA-II. (M) dated 17th May 2007 and further Environmental clearance has been transferred to M/s West Bengal Power Development Corporation Limited (WBPDC) from M/s Bengal Emta Coal Mines Ltd. (BECML) on 20th December 2018. The project area of the block is 186.42 ha includes Mine lease area of 149.42 ha. Forest clearance for 101.77 ha was obtained by WBPDC from MoEF&CC vide letter no8-45/2018-FC dated 29th October 2018 (Stage I) & F.No-8-45/2018 dated 10th April 2019 (Stage II). The project has already obtained Environmental Clearance for production of 1.00 MTPA of coal. The current EIA study is conducted for obtaining Environmental clearance for enhanced production capacity of 3.00million TPA.

The coal of Gangaramchak & Gangaramchak-Bhadulia Mine is being utilized at End Use Plants of WBPDC situated at STPS, Santaldih, Purulia district, KTPS, Mecheda, Purba Medinipur district, BKTPP, Bakreswar, Birbhum district, BTPS, Tribeni, Hoogly district, SgTPP, Manigram, Murshidabad district. There is huge demand of coal in West Bengal for Power generation and other utility. Thus, wining of coal at the rate of 3 million TPA from this project is highly essential and the expanded capacity of coal from this project can also partly fulfill the immediate requirement of WBPDC.

10.1 Exploration and Geological Resource & Reserve:

During the first approved Mining Plan of The Gangaramchak and Gangaramchak-Bhadulia Coal mines, the quarriable reserves has been estimated as 10.58 million tons out of 13.68 million reserve. Remaining 3.10 million tonne of coal reserve have been kept for underground provisions. Basic considerations for estimating the geological reserve within 149.42 ha of mining boundary were as follows:

- Estimation of reserves was restricted up to workable limits of the seams. The workable seam thickness was taken as 1.0 m.
- Shaly coal and Carbonaceous shale Low (having ash and moisture more than 40% and up to 65%) occurring at the roof and/or floor of a coal seam has been considered as part of the seam while arriving at the effective thickness for estimating the Reserve.
- Reserves have been calculated based on the in-band thickness (I-100) of seams. In-band (I-100) thickness of seam has been delineated including combustible bands (Ash +Moisture >65% to <75%) up to 100 cm.
- The areas of heave zones of faults have been excluded from the estimation of Reserve.
- Since Kasta seam shows non-coking characteristics, the reserve has been determined on the basis of GCV values determined for the seam overall samples.
- For the purpose of tonnage estimation, grade wise specific gravity as defined in the ISP 2017 has been considered.

10.2 Location & Accessibility:

The area is approachable by road only. The Khayrasole-Panchra road connects the block with the Raniganj - Suri Road, (NH-14) at Panchra. Another unmetalled road connects both Gangaramchak and Bhadulia Collieries, at Khayrasole. Raswan Railway Station, on the Andal-Palasthali section of the Eastern Railway, is located about 4 km south west of the block. Kazi Nazrul Islam Airport is situated about 22 km (aerial distance) away from the project site. The district head quarter at Suri is located about 45 km away (aerial distance).

10.3 Environment Impact Assessment (EIA) Study:

Environmental Impact Assessment is carried out in the Gangaramchak & Gangaramchak-Bhadulia Mine. Study of meteorological conditions is an integral part of environmental impact assessment studies. The meteorological data recorded during the study period is very useful for proper interpretation of the baseline information regarding Gangaramchak & Gangaramchak Bhadulia Block Opencast Coal Mine project and surrounding area for air dispersion. Accordingly, a meteorological station was set up within the leasehold area. Monitoring of meteorological parameters was carried out from March, 2022 to May, 2022.

10.4 Climate:

The district of Birbhum experiences dry and hot summers with temperatures often rising above normal. During summers, the mercury rises well above 40°C (104°F). As for the direction of the wind, it is always blows from the south-east. The climatic conditions in the western and eastern side of the district are different. While the western side is dry and extreme, it is relatively milder on the eastern side. The summers in Birbhum usually start from middle of March and lasts till the middle of June.

The arrival of the month of June marks the onset of monsoon in Birbhum. The district boasts of a high average rainfall. However, it is observed that the western region of the Birbhum district receives higher rainfall as compared to the eastern region. The difference between the annual average rainfall in Rajnagar (1,405 millimeters) and Nanoor (1,212 millimeters) is an example of this. Monsoon in Birbhum lasts till the middle of the month of October.

Winters in Birbhum are pleasant and enjoyable, with mercury dropping to about 10°C (50°F). While the day time is pleasingly cool, with the fall of evening temperature lowers further, making the nights chilly and cold. During winters, wind usually blows from the north-west direction. The winter starts from December and last till the month of February. Due to such favorable conditions, winters is deemed as the best time to visit this historic and significant district in West Bengal.

10.5 Ambient air quality:

8 (Eight) monitoring stations were set up in the study area. The minimum and maximum level of PM_{2.5} recorded within the study area was in the range of 22.62 µg/m³ to 58.13 µg/m³ with the 98th percentile ranging between 30.06 µg/m³ to 57.93 µg/m³. The minimum and maximum level of PM₁₀ recorded within the study area was in the range of 50.12 µg/m³ to 90.58 µg/m³ with the 98th percentile ranging between 63.40 µg/m³ to 89.92 µg/m³. The minimum and maximum concentration of SO₂ recorded within the study area was 4.31 to 9.81 µg/m³ with the 98th percentile ranging between 7.13 µg/m³ to 9.78 µg/m³. The minimum and maximum level of NO₂ recorded within the study area was in the range of was 9.18 µg/m³ to 18.15 µg/m³ with the 98th percentile ranging between 12.18 µg/m³ to 18.13 µg/m³. The minimum and maximum level of CO recorded within the study area was in the range of was 0.25 mg/ m³ to 1.98 mg/ m³ with the 98th percentile ranging between 0.60 mg/m³ to 1.82 mg/ m³.

10.6 Water Quality:

Water is available in the form of surface water & ground water. Water quality parameters of 3 (three) Surface and 3 (three) Ground water resources within 10km radius of the study area have been studied to assess the water environment and evaluate anticipated impact of the project. The analytical results of surface water samples at different location for various parameters reveal that all the parameters comply with "IS 2296: Class C" standards indicating their suitability for drinking and other purposes after conventional treatment followed by disinfection. The analytical results of groundwater samples showed all the parameters are within the prescribed limits as per IS: 10500 standards for drinking water.

10.7 Water Requirement for the Project:

Daily 150 KL water is used in the mines for the following purpose.

Purpose	Water Requirement (KL)
Drinking and domestic purpose	15
Dust suppressor	90
Green belt development	45
Total	150

10.8 Noise Quality:

6 (Six) noise monitoring stations were identified keeping in view the nature of the monitoring location i.e., residential areas in villages, schools, roads, etc for the assessment of the existing noise levels in four directions. At all the six stations, the values of noise observed in some of the areas are primarily owing to vehicular traffic. Assessment of hourly night time Leq (Ln) varies from 38.5 to 52.8 dB (A) and the hourly daytime Leq (Ld) varies from 51.1 to 60.02 dB (A) within the study area. It is, therefore, concluded that the noise levels within the study area are well within the specified standards. However, the higher values of noise are observed in those villages, which are located adjacent to the road, primarily due to the vehicular traffic movement and other anthropogenic activities.

10.9 Soil Quality:

Soil samples were collected from five different sampling locations and were analyzed for the soil structure, texture, moisture content, nutrient level and other chemical parameters. The presence of organic carbon, N, P, K and moisture retaining capacity of the topsoil indicates that the soils will support plant growth. The soil samples of nearby agricultural field are having good nitrogen, potassium, and phosphorus percentage to support plant growth.

10.10 Ecological Study:

The ecological study reflects the potential of a regional ecosystem and its biological components. In India, the biological diversity of plants and animals varies from region to region on account of their diversity and density. Producers (plants), consumers (animals), and decomposers (microbes) govern the whole cycle of ecology. Plant and animals both are interdependent on each other.

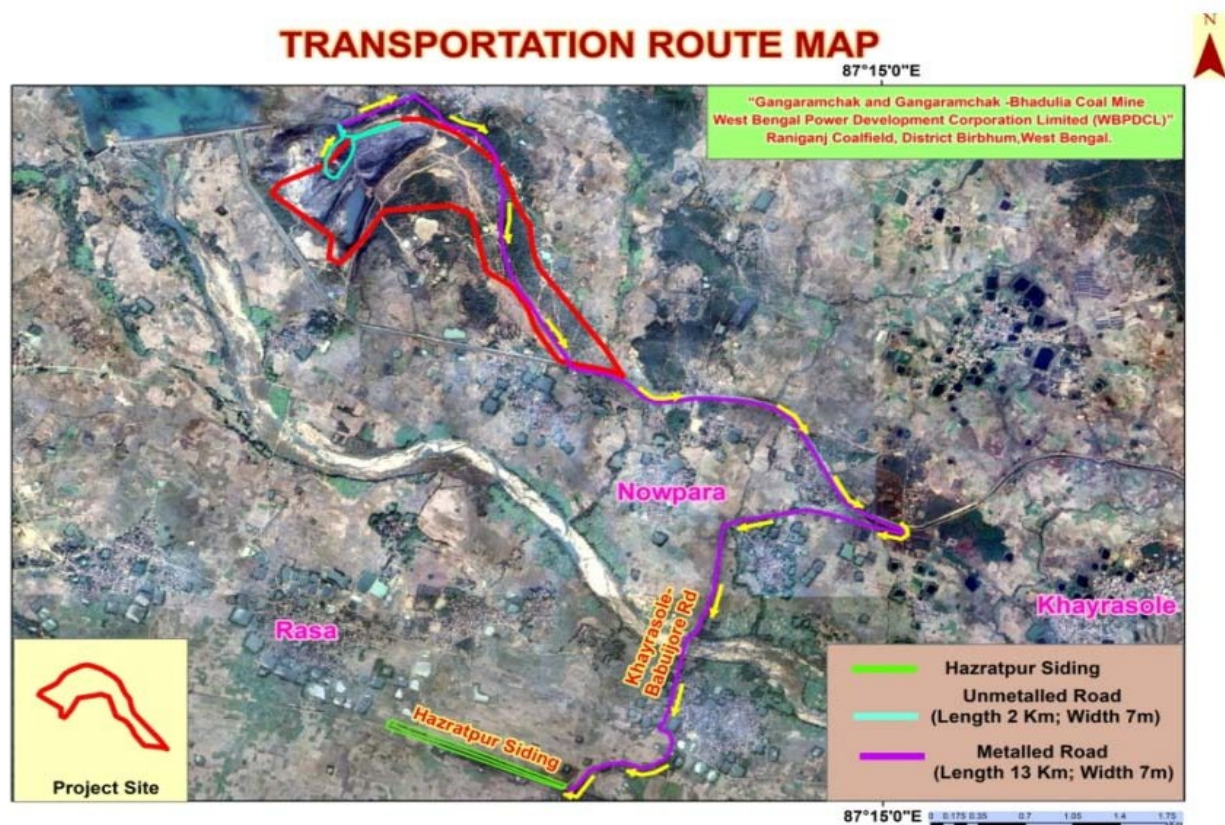
The biological study is essential to understand the impact of any mining project on the existing flora and fauna of the study area. Studies on various aspects of the ecosystem play an important role in identifying sensitive issues for undertaking appropriate action to mitigate the impact, if required.

The environment baseline data generation report in respect to the flora-fauna has been prepared to assess the current ecology & biodiversity scenario of the study area and then based on the proposed project activities, to carry out Environmental Management Plan. The plan will identify and address the impacts, where these are adverse in nature, and thereafter design mitigation measures to manage such impacts in a manner as to conserve the environment and ecology of the area. Conservation of biodiversity is essential for sustainable development.

10.11 Traffic density study:

Coal of -100mm size is being dispatched to the Power plants of WBPCL by road and rail mode. The siding is situated at Hazarathpur village which is nearly 15 km away from the mines by road. The coal is being transported to the siding by deploying 70 to 80 trucks duly covered by tarpaulin during night hours. 2 no of Water sprinklers are being used during the Transportation for spraying water in the road. In order to transport 3.0 Million tons per annum additional 120 trucks would be required.

	Number of Trips/day	Capacity of tripper-T	Quantity per day-T	Working day in a year	Total qty in a year	MTPA
Existing	134	25	3350	300	1000000	1.00
Proposed	400	25	10000	300	3000000	3.00



10.12 Project Benefit:

To overcome the power demand of the country, India needs several power projects to be implemented. Till date, India's 60% power demand is fulfilled through thermal power generation. The growing demand of power for development of the other core segment such as Steel and Aluminum sector's need for implementation of new power plants are inevitable. Coal produced from this project is linked to STPS, Santaldih, Purulia district, KTPS, Mecheda, Purba Medinipur district, BKTPP, Bakreswar, Birbhum district, BTPS, Tribeni, Hoogly district, SgTPP, Manigram, Murshidabad district as discussed above. Enhancement of coal production up to 3.00 million TPA from this project will reduce the gap between the demand and supply and will contribute to rise the GDP of the West Bengal State as well as country. The proposed mine will bring economic benefits to the state by way of Royalty for mineral and to the local people by way of direct and indirect employment opportunities.

Benefit to economy due to this specific expansion project will be substantial. The national economy will gain to the extent of several crores by the way of wages payable to about 380 numbers of employees for another 3 years and it is expected that around 1000 numbers of additional persons will get indirect employment for this expansion. There is huge demand of coal in West Bengal for Power generation and other utility. Thus, winning of coal at the rate of 3.00 million TPA from this project is highly essential.

The project is of utmost importance to the area/ region for interest of mineral development and shall greatly contribute to improve the socio-economic conditions of the local habitants. The mining project shall improve social infrastructure of the area, apart from increased financial benefits accruing to state and central agencies by way of taxes, royalties, cess etc. With the commencement of mining activities, a new horizon shall emerge to the local people for their social upliftment.

Apart from overall beneficial impact of the project on the local people of the region, it is felt necessary to augment facilities in the fields of education, health and social awareness including concern for environment and eco-system.

10.13 Socio-economic study:

As per the census records 2011, the total population of Birbhum district as per 2011 Census is 35, 02,404 out of which 30, 52,956 reside in rural areas and 4,49,448 are from urban areas. The literacy rate for the State has increased from 25.0% in 1951 to 76.3% in 2011 whereas for the district it has increased 19.9% in 1951 to 70.9% in 2011 Census.

Decadal growth rate was observed as 16.1% during the decade of 2001-11. Rural decadal growth rate has followed a similar trend and reached to 10.7% in 2001-11 from 34.8% of 1951-61 after few ups and downs. The density of total population of the district has increased from 320 per sq. km. in 1961 Census to 771 per sq. km. in 2011 Census. The sex ratio of district Birbhum in 2011 Census is 956 of which rural is 955 and urban is higher than that of total and rural with 963.

The total Work Participation Rate of the district has remained slightly higher than State average since independence with exceptions in Census 1961, 1971 and 2011 when district averages (31.2, 26.7 and 38.0 respectively) were lower than the State (33.2, 27.9 and 38.1 respectively). The rural areas also follow a similar trend with exception in 1961, 1971 and 2011. In Census 2011, the district Work Participation Rates for total, rural and urban areas were 38.0, 38.3 and 36.3 respectively.

10.14 Environmental management programme (EMP):

Apart from the above, mitigative measures have been proposed on anticipated potential impacts like installation & maintenance of automatic sprinklers along the haul road. Purchase & maintenance of water tanker & machineries for water sprinkling. AAQ monitoring. Construction & maintenance of mines haul road. Use of surface miner for sizing of coal, Masonry Construction of catch pits to arrest the clay mixed water from the ROM Stack yard, Construction of toilets with septic tank & soak pits, Water Treatment Plant for domestic use of mine pit water, massive afforestation on abandoned mining benches, development of water harvesting pond etc.

To evaluate the effectiveness of environmental management programme, regular monitoring of the important environmental parameters will be taken up. The environmental monitoring followed by analysis and generation of report shall be carried out effectively through a recognized laboratory on regular basis. the reorganization certificate of the monitoring agency and calibration certificate of the instruments used will be regularly checked by the

EMC. The frequency of monitoring of different parameters are discussed in Chapter8 of EIA report.

10.15 Project Cost:

Estimated Capital cost for the Gangaramchak and Gangaramchak Bhadulia coal block project is 111.5 crore.

CHAPTER-11

DISCLOSURE OF CONSULTANTS ENGAGED

Centre for Envotech and Management Consultancy (P) Ltd. (CEMC) is an ISO 9001:2015, ISO 45001:2018 & ISO 14001:2015 certified leading Forest and Environmental consultancy empanelled by State Pollution Control Board (SPCB), Odisha. It was established in 2005 & its registered office is at Plot No. 522/3458, Pahal, Bhubaneswar-752101, Odisha. The consultancy/firm has well-furnished laboratory equipped with modern scientific instruments for analysis of various physico-chemical parameters of soil, water and air. The technical team of CEMC (P) Ltd. has wide experience in Mineral Exploration & Mining, Environmental Impact Assessment/Environmental Management Planning and Environmental Monitoring, Forest Diversion Planning, Development of Various Projects like Industry & Building Projects, in Commissioning of Various Pollution Control Devices, Air Quality modeling and Hydrogeological survey, and other technical assignment for various industries. CEMC Pvt. Ltd. is Accredited by National Accreditation Board for Education and Training (NABET), Quality Council of India (QCI) as 'A' Category Consultant Organization for carrying out EIA Studies in Mining of Minerals, Irrigation, Thermal Power, Coal Washery, Mineral Beneficiation including pelletisation, Metallurgical industries (ferrous and Non-ferrous), Highways, Common Municipal Solid Waste Management Facility, building and large construction projects.

CEMC Environment Laboratory got recognition by MoEF&CC, Govt. of India, under Environment (Protection) Act, 1986 and accredited by National Accreditation Board for Testing and Calibration of Laboratories (NABL- An Autonomous body under Department of Science and Technology) in accordance with the standard ISO/IEC 17025:2017.

Our aim is to provide sustainable development for the growth of Industries, a one stop service provider for all types of Industries/Mines related projects, particularly relating to environmental issue.

CORE TEAM:

The level of expertise available with us and the infrastructure we have made is imperative for us to think about of the consultancy in fulfilling its mandate of providing highest quality of works to their clients on monitoring of air, water and soil in mining and urban areas, GIS and geographical analysis, biodiversity and resource mapping of forest covers and their modeling, preparation of EIA, EMP of various projects. To make these activities successful the expert members in respective fields with their expertization are mentioned below:

KEY PERSONNELS OF THE COMPANY

Mr. Debashish Mishra (EIA coordinator, FAE-EB)	
Qualification	M.Sc. (Botany), PG Diploma in Environmental Management
Experience	Fourteen years of experience in environment and socio-economic sector, mostly dealt with following assignments. Assisting in Preparing EIA /EMP report, Study of flora & fauna, Development of plantation strategy, Study the quality of top soil and suggest methods for it's conservation & reuse, Sampling, analysis and characterization of soil, Study on the impact of environmental factors on livelihood, Documentation of medicinal plants, Organize seminars, workshops & meetings on conservation, propagation & cultivation of medicinal plants.
Mr. Dayananda Pandey (FAE-AP,WP,AQ,N)	
Qualification	M.Sc. (Environmental Science)
Experience	He has experience in data collection, preparation of documents for submission to MoEF, preparation of presentation for obtaining ToR, preparation of EIA/EMP report, Preparation of final presentation for EC.
Dr. Nihar Ranjan Das (FAE-LU, SE)	
Qualification	Doctorate Degree in Urban Development & Environmental Issues. Master degree in Geography. Post Graduate Diploma in Remote Sensing and GIS during 2001.
Experience	He is considered to be an expert in Remote Sensing and GIS Application in Land use planning and Geological Exploration. He provided expert consultancy in Remote Sensing Application to Large number of Govt. Departments and public and private sector undertakings. To his credit he has also provided consultancy for large number of projects in different areas related to ground and surface water resources and preparation of maps related to Forest Diversion Proposals based on the latest guidelines of Forest Conservation Act, 1980 and Wild Life Protection Act, 1972. He is the life member of various scientific societies.
Mr. Joydeep Banerjee (FAE- HG, G)	
Qualification	M.Sc in Geology
Experience	He has experience hydrology & hydro geology section, assessment of hydro-geological impact due to the project along with precaution measures. Study the approved mining plan & prepare the geological part & mining details with reclamation of the project.
Er. Anata Prasad Barik (FAE-SHW,RH)	
Qualification	B.Sc. Engineering (Chemical)
Experience	He has experience in data collection, preparation of documents for submission to MoEF, preparation of presentation for obtaining ToR, preparation of EIA/EMP report, Preparation of final presentation for EC.

Dr. Dilip Kumar Pandey (FAE-NV) Empanelled	
Qualification	M.Sc. in Environmental Science and Ph.D. in Environmental Science (Dehradun)
Experience	He has experience in presentation of EIA/EMP reports for EC at MoEF/SPCB, coordination for preparation of EIA/EMP, supervising the baseline data collection in respect of Ecology Biodiversity, Noise and vibration parameters.
Dr. Rabindra Kumar Mishra (FAE –SC) Empanelled	
Qualification	Post Doctorate Degree in Germination Ecology. Doctorate Degree in Forest Ecology. Master Degree in Botany.
Experience	He has experience in survey of aquatic Biodiversity, study of physico - chemical behavior of soil and water, Survey, research and documentation on project related impact of disturbance on forest ecosystems, Preparation of EIA and EMP. Attended many International Workshops on various biological topics. Life Member of Indian Science Congress Association and Odisha Botanical Society, Bhubaneswar.
Mr. Sudhansu Kumar Dash(FAE-SE)	
Qualification	Master of Social Work (MSW)
Experience	He has experience in presentation of EIA/EMP reports for EC at MoEF/SPCB, coordination for preparation of EIA/EMP, supervising the Social Impact Assessment data collection in respect of socioeconomic survey.

DECLARATION BY EXPERTS CONTRIBUTING TO THE EIA:

EIA/EMP Report for Proposed **Enhancement in Production of Coal upto 3.00 million TPA** in opencast method from **Gangaramchak & Gangaramchak-Bhadulia Coal Mining Project** over 186.42 ha. In Village Bastabpur, Tehsil - Khoyrasole, Dist.- Birbhum, West Bengal of **M/s West Bengal Power Development Corporation Limited**.

The Baseline data was generated by MoEF & NABL Accredited Laboratory M/s Centre for Envotech and Management Consultancy Pvt. Ltd., Bhubaneswar. The work order for the Pre-feasibility Report & EIA/EMP was placed on M/s Centre for Envotech and Management Consultancy Pvt. Ltd., Bhubaneswar.

The Environmental measurements for one season baseline data is generated by M/s Noida Testing Laboratory, Noida for which necessary NOC for utilizing the baseline data for preparation of Draft EIA/EMP Report is obtained.

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

EIA Coordinator:

Name: Mr. Debashish Mishra

Signature and Date: 

Period of Involvement: February 2022-till date

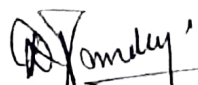
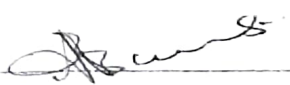
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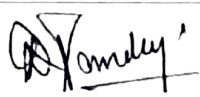
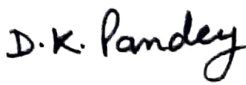
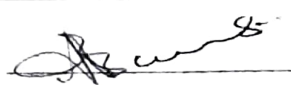
Associate EIA Coordinator:

Name: Mr. Dayananda Pandey

Signature and Date: 

Functional Area Experts:

Sl. No.	Functional Area	Name of the expert/s	Involvement (period and task)		Signature and date
1	Air pollution monitoring, prevention and control (AP)	Mr. Dayananda Pandey	Period:	February 2022-till date	
			Task:	Prediction of Air Pollution and its Impacts & Mitigation Measures. Interpretation of Baseline Environment.	
2	Water pollution monitoring, prevention and control (WP)	Mr. Dayananda Pandey	Period:	February 2022-till date	
			Task:	Prediction of Water Pollution and its Impacts & Mitigation Measures. Interpretation of results, comparison with limits for writing in present baseline scenario.	
3	Solid and hazardous waste management (SHW)	Er. Ananta Prasad Barik	Period:	February 2022-till date	
			Task:	Identification of nature of waste, categorization, and quantity of generated waste. Prediction of waste pollution and its management.	

Sl. No.	Functional Area	Name of the expert/s	Involvement (period and task)		Signature and date
4	Socio-economics (SE)	Dr. Nihar Ranjan Das	Period:	February 2022-till date	
			Task:	Secondary data of Census of India, 2011. Socio-Economic Survey; Socio Economic Impact Assesment.	
5	Ecology and biodiversity (EB)	Mr. Debashish Mishra	Period:	February 2022-till date	
			Task:	Ecological and biodiversity survey. Identification of species (flora and fauna) and preparation of ecology section in EIA/EMP report.	
6	Hydrogeology (HG)	Mr. Joydeep Banerjee	Period:	February 2022-till date	
			Task:	Hydrogeological survey for assessing aquifer distribution of the area. Water resource evaluation of the area. Pre-monsoon & Post-monsoon collection of water level & quality data.	
7	Geology (Geo)	Mr. Joydeep Banerjee	Period:	February 2022-till date	
			Task:	Geological survey for assessing aquifer distribution of the area. Water resource evaluation of the area. Pre-monsoon & Post-monsoon collection of water level & quality data.	
8	Soil conservation (SC)	Dr. Rabindra Kumar Mishra	Period:	February 2022-till date	
			Task:	Identification of existing quality of soil. Prediction of Impact and its management.	
9	Meteorology, air quality modeling and prediction(AQ)	Mr. Dayananda Pandey	Period:	February 2022-till date	
			Task:	Study of primary data, Air Quality Modelling and its interpretation.	
10	Noise and vibration (NV)	Dr. Dilip Kumar Pandey	Period:	February 2022-till date	
			Task:	Prediction of Noise Pollution & its Mitigation Measures. Review of the section of noise and vibration and recommended mitigation measures for control of noise and vibration.	
11	Land use (LU)	Dr. Nihar Ranjan Das	Period:	February 2022-till date	
			Task:	Satellite image interpretation and preparation of land use map of study area, prediction of impact on land use pattern (existing & proposed), suggest mitigation measures.	
12	Risk Assessment and hazard management (RH)	Er. Ananta Prasad Barik	Period:	February 2022-till date	
			Task:	Assess risk due to project and prepare chapter on disaster management plan & safety measures.	