VOLUME- III

SIA REPORT,HYDROGEOLOGICAL REPORT & HYDROGEOLOGICAL REPORT (AS PER GEC 2015)

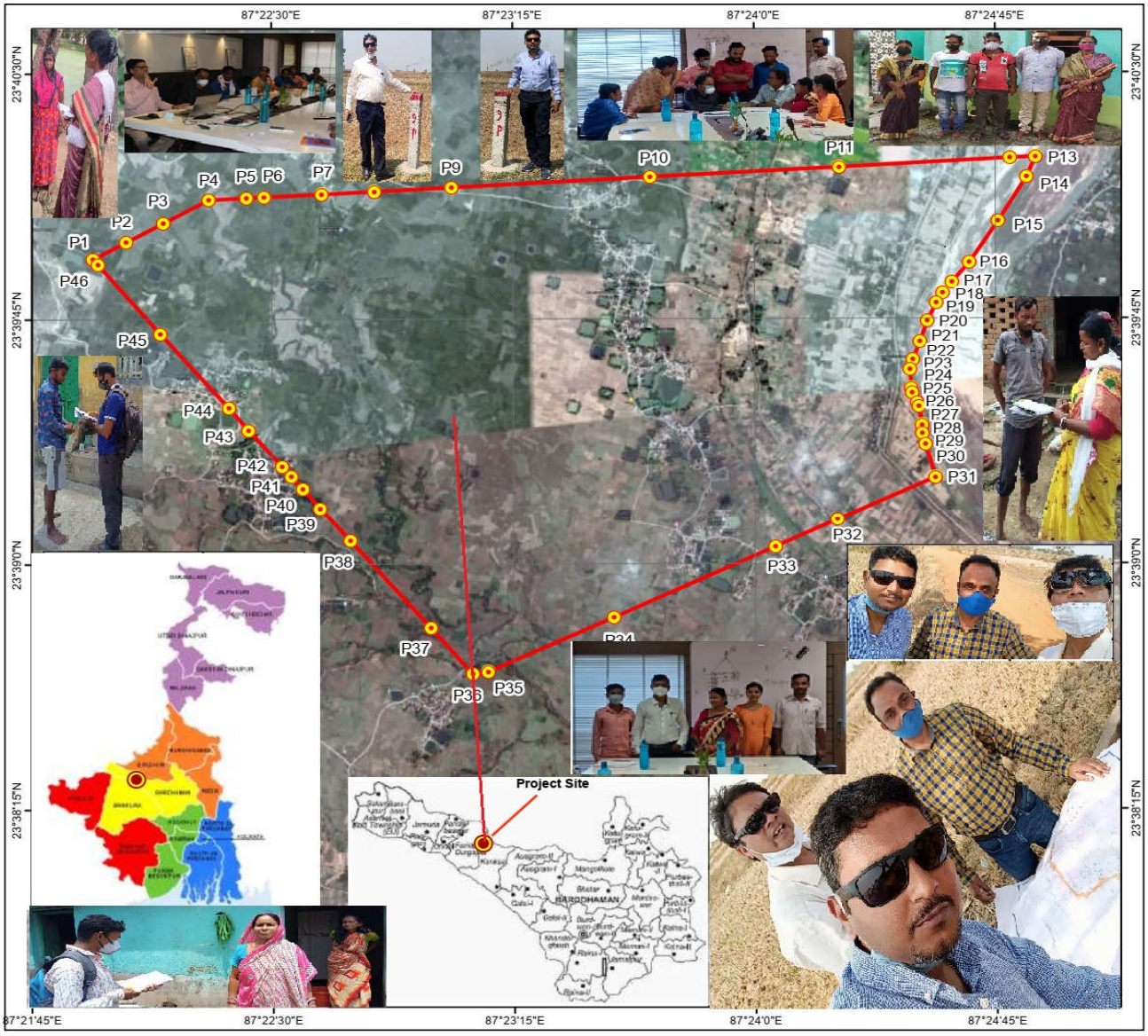
SOCIAL IMPACT ASSESSMENT AND R & R STUDY

For Jagannathpur (B) Coal mines block of Raniganj Coal field area

District Paschim Bardhhaman, West Bengal

(TOR No IA-J-11015/27/2021-IA-II(M) dated 2nd June 2021)

Final Copy: 1st November 2021



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Social Impact Assessment Service Order No: PPTPL/DRHS/001/2020-21
Dated: 30th March 2021
Georeferencing Map Preparation Service Order No: PPTPL/DRHS/0001/21-22
Dated: 2nd July 2021

Study Period: 1st April 2021 to 31st August 2021
Draft Report: 1st Sept 2021
Draft Final Report: 7th Oct 2021
Pre Final Report: 25th Oct 2021
Final Report: 1st Nov 2021

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Preface

The provision made RFCTLA-RR Act 2013 and it subsequent amendments, made the Social Impact Assessment a challenging task when we deal coal mining sector. It also becomes more complicated to explore the displacement of population to justify whether the Rehabilitation and Resettlement is applicable or not? Besides, to search, the processes of analyzing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment by doing commercial profitable business. Further, it also brings more ecologically, socioculturally and economically sustainable and equitable environment, such that SIA promotes community development and empowerment, builds capacity, and develops social capital (social networks and trust) under predefined framework.

Exploring the socio-economic conditions of the people in the command area which are likely to get submerged and get affected; with various types of impact within and outside the project cycle. Conducting a bench-mark survey in the command area to assess the likely change in the gender role, social index with Quality of life and economic index in the villages of the project area as per the objectives defined for the current study. The integration of physical data using modern technology of Remote sensing and GIS is a mammoth task in itself making all allied topics under the subject realms of SIA more complicated and challenging too.

The untiring efforts made by the team of DRHS Consulting Services under the leadership of Dr. Harshit Sinha (NABET approved SIA expert) for timely completing the study by covering all aspects as highlighted in the extra Ordinary notifications, in exercise of the power conferred by sub-section (3) of Section 1 of RFCTLA-RR Act 2013 (30), and compile a detailed report divided into seven chapters. Chapter one narrates the back ground of the project while chapter two describe the study design of SIA. Chapter three give the detail description of Land records and Chapter four divulge the survey enumeration and estimation. Chapter five reel off the social impact assessment with framework within and outside the project cycle with different population groups and allied topics. Chapter six estimates the costing details of the interventions with mitigation strategies and the report ends with chapter seven decipher recommendation and conclusions.

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Acknowledgements

We appreciate the set vision by the Promoters (Shri Sanjib Patwari from M/s Rashmi Group and Shri Lalit Kumar Beriwal from M/s Shyam Steel Manufacturing Ltd), for promoting business with responsibility for the upcoming company M/s Power Plus Traders Pvt. Ltd, sets an example for integrating social, environmental and ethical responsibilities into the governance of business, to ensure long term business success, competitiveness and sustainability.

My sincere thanks, to Shri L.B. Chourasia, Vice President, from M/s Rashmi Group, and Mr. Deepak Chaudhary, Vice President-Commercial from M/s Shyam Steel Manufacturing Ltd in believing me and provide us an opportunity to become the part of this interesting assignment, for the project on Social Impact Assessment study in context to EIA and R & R Study. We are also very thankful for the technical support and guidance given in relation to the Jagannathpur (B) Coal mining block from Mr. Kodumuru Srinivas Rao (CEO); Mr. Lokesh Kumar Ray (VP) from Mining Division of M/s Power Plus Traders Pvt. Ltd and Mr. Bijayen Srivastava (Sr. Manager Environment & Pollution) from M/s Rashmi Group. The office desk support given by Mr. Bikash Kumar Meharia (Sr. F&A Officer); and Mr. Abhijit Mitra (Executive A&A), was very efficient in making the allied task of this assignment into timely executions.

This mammoth evaluation would have been not possible in five months (despite of Pandemic lock down period of two months), without the untiring support from our team members of DRHS Consultancy Services, by Mr. Swaroop Tripathi (Mining & GIS Expert), Mr. Poleen Thakur (Sr. MSW); Mr. Anand Mahapure (BSW); Ms. Sangeeta Gamit (BRS); Mr. Mayur Parmar Data Entry operator and Mr. Aakash Sinha Accountant. We would not forget the burden undertaken for the filed data collection by the local investigators.

Above all, my sincere thanks to senior Director from DRHS Consultancy Services Dr. Monika Sinha (Gender & Environment Botanist) for providing insight for data collection, data analysis, data illustration techniques and in finalization of this report.

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Acronyms and Abbreviations

BDO	Block Development Officer
BRS	Bachelor in Rural Studies
BSW	Bachelor of Social Work
CBA	Coal Bearing Area
CBDPA	Coal block Development and Production Agreements
CMDPA	Coal Mine Development and Production Agreement
CER	Corporate Environment Responsibility
CHC	Community Health Centre
CHP	Coal Handling Plant
CIMFR	Central Institute of Mining & Fuel Research
CMR	Coal Mines Regulations
CSIR	Council of Scientific and Industrial Research
CSR	Corporate Social Responsibility
DCH	District Census Handbook
DDO	District Development Officer
DGMS	Director General of Mines Safety
EIA	Environment Impact Assessment
EMP	Environment Management Plan
FCC	False Colour Composition
FGD	Focus Group Discussion
HH	Household
HFL	Highest Flood Level
HQ	Head Quarter
ISRO	Indian Space Research Organization
KM	Kilometre
KLD	Kilolitres per day
LISS	Linear Imaging Self-Scanning Sensor
LHD	Load haul dumper
LHCM	Low height continuous miner
LPG	Liquefied Petroleum Gas
MLA	Mining Lease Area
MMDR	Mines and Minerals (Development and Regulation act)
MT	Million tonnes
MTPA	Million tonnes per annum
MSW	Master of Social Work
NH	National Highway
NRSC	National Remote Sensing Centre
NSSO	National Sample Survey Organisation
PHC	Primary Health Centre
PMAY	Pradhan Mantri Aawas Yojana
PTPL	Power Plus Traders Private Limited
QOL	Quality of Life
RCC	Reinforced Cement Concrete
RFCTLARR	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement
RS	Remote Sending
SIA	Social Impact Assessment
TDO	Taluka Development Officer
TCE	Tata Consulting Engineers Ltd.
WMDTCL	West Bengal Mineral Development & Trading Corporation Ltd.

Executive Summary

Introduction: There is a recognizable shift in the country in consolidating the energy options currently. Renewable energy sources like Solar and Wind are being preference, encouraged and trusted as energy upgrades to meet the growing energy demand in the country. However, the energy mix can be considered as approbatory but not equal to the characteristic and role of coal. The alternative source of energy can supplement but cannot considered as preferred substitute coal owing to the coal reserves in India. As per the Geological Survey of India report (2019) Coal reserves have been estimated at 326.05 billion tonnes. The reserves have been found mainly in the States of Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Telangana and Maharashtra.

Further, the core objectives of Ministry of Coal that are linked to its vision of securing the availability of coal to meet the demand of different sectors of the economy in an eco-friendly and sustainable manner and the overall mission of augmenting production through Government companies as well as the captive mining route by adopting state-of-the-art, clean-coal technologies; enhancing exploration efforts with thrust on increasing proven resources and developing the necessary infrastructure for evacuation of coal under predefined protocols.

The commercial coal mining itself is not a new concept either. Prior to de-allocation of the coal blocks by the Supreme Court of India, and indeed even after the new legislative framework has been approved by the Indian parliament, several coal blocks were and have been allotted to state-owned entities for commercial mining. M/s Power Plus Traders Private Limited have been allocated Jagannathpur B coal mine with order No: NA-104/4/2019-NA dated 13th February 2020, under vesting order under clause (b) of sub rule (2) of rule 7 and sub-rule (1) of rule 13. From the office of the nominated authority constituted under section 6 of the Coal Mines (special Provision) Act, 2015, O/o Nominated authority, Ministry of Coal, Govt. of India, Shastri Bhavan, New Delhi (Refer Ltr. No-NA-104/4/2019-NA dated 23.06.2021 excluding 12.72 Ha CBM overlap zone from Mining Lease Area of Jagannathpur B and the same was certified by CMPDIL vide Ltr. No CMPD/BD/C (886-A)/E-571279/1-12834 Dated 17.09.2021).

Background: The block is almost rectangular in shape with the entire boundary being defined by straight lines except the eastern boundary which is curvilinear in shape having 46 pillars as indicated in Figure 1.1. The block is bounded by a number of Coal Mines viz. Rangamati B in the north, JAGANATHPUR A block in the west and Bistupur-Dandeswar in the south. Ajay River is on the east of the block. The block is well connected by road and rail. The area displays a gentle undulating topography with elevations ranging from 66m in the North West to <56m in the south and east (considering the R.L. values of the JBB series of boreholes w.r.t M.S. L). The elevation increases in North and North West direction. The major part of the block is covered by soil/alluvium and forms the cultivated land. Ponds are scattered over the entire area. The main drainage of the area, Tumni Nala in the west and Ajay River is in the eastof the block. There are many small & large ponds in the area, which are mostly used by the villagers for domestic purposes.

Thus, the purpose criteria listed in the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 is largely related, when acquiring the land as specified in Mining Lease Area (MLA) for undergoing the quarrying of the coal through underground mining. Owing to aforesaid Act of Land acquisition, M/s Power Plus Traders Private Limited hired third party evaluator (external expert) M/s DRHS Consultancy Services (refer WO No: PPTPL/DRHS/0001/2020-21; dated 30th March 2021) to conduct Social impact study under the Right of Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act of September 2013 No. 30 and also incorporating extraordinary Part II Section 3 sub section (i) and incorporating The COAL MINES (SPECIAL PROVISIONS) ACT, 2015 NO. 11 OF 2015 and mines and minerals (development and regulation) Amendment act, 2015 no. 10 of 2015 (and thereafter subsequent amendment being done in 2020) with following major objectives.

Objectives:

- To study the present socio-economic conditions of the people in the command area of the link mines, submergence area of mines & barrage and to assess the likely effect of the project in improving the socio-economic conditions of the people.
- To assess the environmental impacts related to the location, design, structure and operation of the project. The impact due to project location should discuss the resettlement and rehabilitation of displaced families, assessment of loss of forest, natural reserves, bio-physical impact etc.
- To assess the socio-economic conditions of the people in the mining command area by conducting a bench-mark survey in the command area sample and to assess the likely economic impact of the project.
- To assess the area of mining using satellite imagery and integrating the with Geographical Information system for slope analysis, Land cover and land use, DME, demarcating MLA boundaries with GPS coordinates of pillars etc
- To assess the economic economic impact. Qualification, in monetary terms, of the benefits that would accrue from improvement of various sections of society. Wherever it is non-quantifiable in financial terms, a qualitative assessment in economic terms may also be provided.
- Identify and recommend steps to mitigate or enhance negative or positive aspects of change while developing the Rehabilitation & Resettlement / Social Impact Management Plan with initiative taken under social and infrastructure development through reserved fund of CER/CSR/EMP funds for the project area.

Methodology: The project site visited by the external appointed Team of SIA expert, who apart from doing field investigation will meet the concerned Government officials and collected all documentary evidence as well. Besides, the concern land records of the concern parties were acquired from the prevailing PWD office records of the district administration, to understand the positive or negative aspects of mitigations. The desired level of survey (Village/Households/Thematic Survey) is being done by the respective experts and other field investigators after three days orientation and training workshop. The household level study would be conducted through 10% households in villages (may/may not shifted) as well as focus group

discussions (FGDs) with the villagers, community leaders and the concerned authorities would be conducted in sample villages. Village level Quality of Life and economic Index were calculated using weighed index method and socio-economic index and poverty level were calculated at household level.

Further verified the commercial purchased or acquired the for agriculture and non-agricultural land. The calculation of the solatium in case of land acquisition or commercial purchase of land as per the circle rates was made owing to the status of land when acquired as un-productive barren land was done. Apart from compensation, preliminary action plan for Rehabilitation and Resettlements and Social Impact Management Plan has been conducted after detailed primary and secondary data analysis. Based on the Community Need Assessment, a detailed action plan for the social and infrastructure development plan was made using the designated CER fund.

The land-use & land cover map of the 5 km radial study area from the periphery of project site has been prepared using Resource SAT-2 (IRS-P6), sensor- LISS-4 having 5.6 m spatial resolution and date of pass 4th March 2021 satellite image with reference to Google Earth data and the IRS-P5- Cartosat-I data having 2.5 m spatial resolution and date of pass 04th April 2021. In order to strengthen the baseline information on existing land use pattern, the following data covering approx. the proposed project site is lies between latitude & longitude 23^{0}38’38.29” N- 23^{0}40’12.25” N-87^{0}21'56.93"-87^{0}24'41.74"E for proposed mining area and whole 10 Km radius 23°33'13.99" to 23°45'26.99" N & longitude 87°16'00.31" to 87°30'38.52" E and the elevation is about Plain land about 44 m to 98 m for mining area as well as whole 10 km radius.

Land use pattern of the study area as well as the catchment area was carried out by standard methods of analysis of remotely sensed data and followed by ground truth collection and interpretation of satellite data. The digital image processing was performed on Freeware GIS software - QGIS 2.2 software system on high-configured computer. This software package is a collection of image processing functions necessary for pre-processing, rectification, band combination, filtering, statistics, classification, etc. In conclusion the satellite data were used to deals with the physical natural set up of the Mining Lease Area which is related to the analysis of contour, terrain, slop, Land use and land cover etc. that is directly related to the mining activities. The impact of COVID situation and quality monitoring of primary data were also done during the field work.

Major Findings: This is being narrated under four headings:

1. **Land Assessment:**

- Jagannathpur-B coal block is located in the Raniganj coalfield of West Bengal. Talchir is the oldest sedimentary formation exposed along the north-western margin of the basin. The Barakar, Barren Measures, Raniganj and Panchet Formations are exposed successively from north to south. The rocks in the greater part of the area dip towards south. The block has a monotonous cover of alluvium/soil except some scattered patches of laterite distributed throughout the block.

- The terrain could be described as a mixed terrain of community plantation, agriculture and mining lands covered with a network of natural watercourses, which are facing the adverse effects of soil erosion from the mining areas as well as some portion of undulating terrain.
- The distribution of LULC of MLA shows that from the total 856.68 sq hector MLA 90.17% belongs to agriculture area and about 3.02% is of Barren land. The water bodies occupy only 2.25% and the human settlement covers only 1.40%. The public use amenities and other building covers only 0.60%. Overall, it is concluded that by large the area of Agriculture and barren land covers 93.19% in the MLA area and a fine planning of underground mining is planned taking consideration of agriculture as well barren land. The commercial purchase of land plots for doing underground mining in MLA is, by large being done from these two land categories.
- Proposed underground mines of Coal mines of PTPL is comes under the Damodar River basin, here in DEM represents the area having the slope and contour elevation gentle to moderate slope and having 50m to 75 m range and DEM is the simplest form of digital representation of topography of the project area.
- The area as a whole represents a gently slope, drained by a number of North West to South East flowing river were present. The area whole represents the Damodar River basin. In the present study the slope is categorized into seven classes.
- The studies show that 52.01 % of the total study area comprising of 8.56 sq. km comes under nearly level slopes followed by gentle slope which is about 33.72 % and moderately gentle (14.27 %) and steep slopes (Nil). Moderately steep sloping landforms account also Nil of the area. There are no any very steep and very high steep slopes are present in the study area.
- The total mining lease area allocated under Jagannathpur Coal mining block for M/s Power plus Traders Pvt. Ltd is 856.68 hectors (after amendment excluding CBM block overlap) but the geological boundary remains the same. From the total MLA of 856.68 hectors, about 55.5% of the area has been used for underground mining. Among these seven blocks, the maximum extraction of coal is supposed to be done in block D and G. (*as indicated in Figure 3.1 in the report*). The pink area represents the barrier between villages and physical features (6.3%), followed by the constructed building areas (1.6%) and the green area represents the road distance area (1.0%). The unused land areas are the highest (35.6%) that can be used as alternative/addition, to the plots from A to G where in future there is any possibilities of households' constructions.
- Almost all the land plots among these blocks are in the process of purchasing on commercial basis. The land plots are vacant or barren or are demarked as agriculture land. The life of the mine, as per the Mining Plan, is 70 years and the depillaring operation will continue till the end of the mine life. Utmost care is being planned to fortified the land plots when purchased to avert any major human accident while doing depillaring. These land plots demarcated as vacant or as barren land or identified as agriculture land plot in the official record of Revenue inspector and the details of land yet to be purchased are

indicated in Annexure 8. Since the official record and our physical verifications (during household survey) confirms non-existence of any human habitat, the question of displacement of the population is totally ruled out, thereby confirming non applicability of any Rehabilitation and Resettlement program in the community.

2. **Village survey:** The village level survey was conducted to know about the social cultural and economic pattern existing in the project area. This was conducted in all 36 sample villages largely with help panchayat members and other older people of the villages using village information sheet through focus group discussion.
    - As per the panchayat records, the total BPL families HH was largely restricted in 28% of the sample villages in the range of 51- 100 BPL families HH; followed by 25% of the villages having greater range from 201 – 1500 BPL Families in the villages
    - Only 25% of the villages reported having emigrant and around 28% villages reported to have migrant from these sample villages.
    - About 67% of the villages reported to have at least one Panchayat members to be female.
    - At majority, Hindu religion was reported with resident households in 83% of the sample villages followed by Muslim religion found in the household of to be only 11% villages.
    - About 90% of the population are under graduates (includes school passed out non-working population), 7% of working population having graduate degree, 3% with post graduate degree and only 1% are having technical degree or are professionals.
    - About 42% of the working population in the villages are either cultivator/farmer and nearly 22% of working population are agriculture labour there making a total of 64% of the population livelihood are based on agriculture sector. This followed up by 29% earns their livelihood by working as casual labour; 5% are associated their earning by doing small or big petty business and only 1% of the population are engaged in service sector either with government or private sector.
    - About 69% of villages to have in migration because there is increase in population and household numbers from 2011 census secondary data to current primary survey data of 2021. One of the astonishing results was with the 88% MLA villages reported in migration from the total 9 MLA villages in Paschim Bardhhaman district.
    - About 67% of the villages reported to have open drainage system and only 8% of the villages reported having close drainage system in the house hold of the villages. It is surprising to note that 25% of the villages have no facilities of drainage system. Overall, only 8% of the villages are having closed drainage system.
    - Majority (69%) villages reported get drinking water as from handpump or boring. While only 22% of the villages got piped taped water through fully functioning overhead tanks. Only three percent of villages used open well as

their source of drinking water while 6% of the villages are having more than one source of drinking water. Overall, only 22% of the villages are having safe piped drinking water through tap connected to overhead tanks.

- Anganwadi centre was the most reported in 92% of the villages, followed by Primary School (42%); Village Cemetery (33%); Low fair ration shop (28%), Bus stand (19%) and post office in 11% of the villages. Overall, it seems on an average 32% of the villages are reported having availability of the such essential public infrastructure facilities.
- Paddy being the major crop of the resident villagers in all 36 sample villages. Nearly 12% of the villages reported having secondary crop depended upon the seasonal and market demand. The secondary pattern of the crop are Jute, green vegetable, potatoes, mustard and wheat are cultivated on their land.
- Village level analysis of QOL index shows that the maximum average weighted score point in village is 7.4 points score and the minimum is 2.1 points score while the average point score for villages in the radial distance of 10 km from the project site is 4.6-point score. From the total 36 villages, about 33% had poor QOL status 11% had fair, 42% had good and only 14% of the villages had excellent QOL status. Overall, 56% villages Quality of Life Index fall from Good to excellent.
- Village level analysis of Eeconomic index shows that the maximum average weighted score point in village is 4.9 points score and the minimum is 1.5 points score while the average point score for villages in the radial distance of 10 km from the project site is 2.6-point score. From the total 36 villages, about 39% had poor EI status, 56% had fair, and only 2% of the villages had excellent EI status. Overall, 95% villages Economic Index fall in poor to fair.

3. **Household Survey:** Within the 36 sample villages, about 10% of the household were interviewed to explore the social and economic condition of the resident in the households of the villages. As per 2011 census, the total households as per census 2011 was 7898 and nearly 820 households were interviewed.
    - About 820 household surveyed having total population of 2942, making family size to be 4 persons per family. The population density is 676 persons per square km.
    - Among the total population surveyed, 53% were male and 47% were female making male and female ratio as one male is to 0.9 female. The sex ratio of the project area is 896 females per thousand males while for 0-5 population it is 1019.
    - At majority Hindu religion population (90.3%) dominates, followed Muslim (9.7%) population in the households of the sample villages.
    - The villages population largely consist of higher caste groups (43.4%) population. The Scheduled Caste population (37.8%) is higher than the other backward caste (14%) and Scheduled Tribes (5%).
    - The household population composition shows that 58% of the population are married and 36.7% of the population are either found bachelor/ unmarried/Single/Not eligible for marriage.

- About 52.4% in the age cohort 21-50 is most fertile and active age population group in the household of the sample villages.
- The female literacy from the total population comes around 30.3%. which is less to the male literacy (36.3%).
- The work participation is of female population is 1.6%, which is very less when compared to male population (32.2%).
- The primary education passed is mostly dominating (39.3%) in all age groups of the population. The literate group with no formal education is also more prevalent among the resident household population and is just half (18.4%) to the population having primary passed grades. This is followed up with secondary passed 17.4% of household population in the villages.
- The proportion of illiteracy is only 7.7% among the population and equally the same proportion (7.1%) of the population reported to be below five years. However, secondary/higher degree passed household population is just 10%
- The household population reported dominating agriculture sector (19.7%) profession followed by 5.7% unskilled worker working largely as causal labour while only 1.4% reported to have skilled professional workers.
- By large non-working female, 29.5% reported to be sharing household domestic responsibility as housewives and nearly 22.8% of young population reported as student.
- About 5% of the population reported doing big/small business and 6% reported unemployed owing to the current pathetic condition arises from lock down because of pandemic of Corona virus.
- Only 1.8% of the population were found engaged as professionals and service class in either private/government sector.
- Overall, it was observed that 66% of the household population reported not doing any commercial activities for their livelihood - as being found as housewife, student, unemployed, aged and being small children in the age of 0-5 years.
- About 90.6% reported occupied by Hindus families and rest 9.4% by Muslim families.
- Caste wise composition shows majority of the households occupied by the higher caste (44.5%); than Scheduled Caste (37%), Other backward class (13%) and Scheduled Tribe (4.6%) being the lowest.
- Household trend shows more inclination of the resident families to nuclear family system (82%) as compared to joint family system (18%).
- About 99% of the household reported owned by themselves, largely living in pucca constructed house (50%) and the remaining occupied in semi pucca (21.5%) constricted house. About 27.2% of the households are constructed as kuccha and only 1.3% households found to be constructed as hut
- Looking up the facilities 40% of households reported to have more than three rooms and 54% has two rooms only. Further 85% of the households reported have separate bathroom and among these 10% reported to have open bathrooms; 7% reported partially closed and majority (83%) reported to have closed bathrooms.

- The utilization of toilet was largely (74%) confined to their own toilets in the house and 14.5% reported to utilize in sharing. However, 11% of the household reported to defecate outside reported to have no toilets at their house. Only 10% of the household reported connected with modern flush system, while 16% reported connected with septic tank and 25% with soak pit. Further only 26.7% regularly clean their toilets and 58% reported occasionally cleaning their toilets. While only 12% household reported to have sewage connection.
- Separate kitchen is an important criterion for hygiene living and 92% of the household reported possessing separate kitchen in their house. By large majority (67%) reported using LPG gas for cooking. About 69% reported to have piped water connected with/without overhead tank for dinking purpose while 49% of the household use water from ponds, open well, river/canal and boring/well for the domestic purpose and 51% household reported possessing the facilities of piped water with or without overhead tanks. However, 99% of the household have electric meter connection.
- About 22% of households reported having agriculture land and majority was acquired by Pucca houses (68%).
- Paddy being the major crop and around 27% of the household reported having secondary crop depended upon the seasonal and market demand. The secondary pattern of the crop are Jute, green vegetable, potatoes, mustard and wheat.
- About 75% of the households reported to have either one or more than animals for their own consumptions.
- Taking account, the type of houses 60% of the pucca houses by large reported possessing the livestock.
- The possession of the household items was largely reported among pucca houses (55%), while the semi-pucca (21%) and kuccha (23%) household almost share equal proportion of household items.
- Looking the house occupancy for huts (N=11) the major profession contributing to annual income is from cultivators (54.5%) and agriculture labours (63.6%) and the average annual income group lies in range of Rs.36000-60000.
- Kuccha house it is agriculture labour (71%) with annual income group ranging from Rs.24000-36000.
- In the semi pucca houses the major profession contributing to annual income is cultivators (30.7%), agriculture labour (46.0), unskilled workers (15.3%) and small petty business (10.8%) are major contributor in family household annual income group ranging from Rs.24000 to Rs.100000/.
- The trend for the major profession in the household annual family income for Pucca house is similar to that of semi pucca houses - as cultivators (53.9%), agriculture labour (32.4%), small petty business (16.3%) and unskilled workers (14.1%) with family income group ranging from Rs.60000 to Rs.250000/.
- The major profession contributing the household family income are cultivators (38.5%); agriculture labour (46.2%); unskilled labour work (12.3%)

and petty business (11.5%) in the income group range from Rs.24000 to 250000/-.

- The average response reported by the households for the support from local panchayat in developing mandatory infrastructure was 56% and for services was 60%. While overall, 77% of the household reported having support and help received from the panchayat members for providing drinking wate; ration and job card; constriction of toilet etc.
- The gender equality is reflected in three parameters, the proportion of joint decision making in the family is considered to be reasonably good (73.4%) however women participation as professional is very poor (1.6%) and the same is also true for the participation at village level samiti (2%). It gives the idea of female discrimination with low significance to the right of equality.
- The total sex ratio as well of children in the age cohort 0-5 years is reasonable better and a better yard stick to measure gender equality. In the project region right of accessibility in the household is good and shows female preference to avail such household facilities.
- Female literacy rate is low compare to male and hence required many genders empowerment programs in the project area.
- Here average mean value (Rs.2592/month) of monthly expenditure is considered as poverty line which indicated that 21% of the household is below poverty line - suggest the poverty level in the project area is reasonably good. While the average per capita expenditure in the household is Rs.742/month, of which 37% of the household are below the average mean of per capita expenditure of the households. About Rs.24/day/per person in the household family is the rural poverty line in the project area
- Village level analysis of (SEI) Socio-Economic Index shows that the maximum average weighted score point in village is 8.9 points score and the minimum is 0.6 points score while the average point score for villages in the radial distance of 10 km from the project site is 2.2-point score. From the total 820 households, about 2% had very poor SE status; 31% had poor; 45% had fair, 20% had good and only 2% of the villages had excellent SEI status.

4. **Social Impact Assessments:** The Social Impact Framework was largely analysed using seven parameters Viz., Land, People, Livelihood, Quality of life, Environment, Development, Institutional Group, and impact within project cycle. The methodology of SIA can be applied to a wide range of planned interventions and can be undertaken on behalf of a wide range of actors, and not just within a regulatory framework. However, we have designed SIA framework based on The RFCTLARR (Compensation, RR, Development Plan) Rules 2015 Here we are looking in context to the commercial activities being under taken by Jagannathpur B coal mine mines. It explores the project aspects and activities there by studying their impact on physical factors (largely matching EIA report) and social impact explored largely on livelihood, displaced population, different groups, social & cultural aspect, public utilities and during project cycle as indicated in below Tables.

(i) Physical Environment:

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)	-During the rainy season there is a great possibility that run off water is assembled in the mining area making the routine operation difficult and could be a threat for the lives of the working employee	-Run-off water and mine water is led into settling ponds, then to water treatment plants; after treatment, some portion of water will be used for domestic mine use and the rest will be let into the natural drainage system. -The sewage from the pit head facility shall be treated in STP. The treated sewage will be used for non-potable purposes and greenbelt watering. -The processed wastewater will be passed through oil-water separator and subsequently through settling tank prior to reuse.
2	Deposition of pollutants emitted to air into the land or into water – air quality	-The major operations producing dust are drilling, blasting, hauling, loading, transporting and crushing. As a result, fugitive Emission are mainly caused particulate matter and gases including methane, Sulphur dioxide, oxides of nitrogen and carbon monoxide. -The vehicular traffic on haul roads has been identified as the most important cause of fugitive dust emissions and can contribute as much as 85% of the dust emitted from an opencast coal mine. -Water released from the mine site may result in the deposition of suspended solids. This will be deposited in the passage of underground mining site. As a result, the regular operation may get stuck.	-It is advisable to use dust extractors with drills and use suitably designed water sprays at the transfer points to suppress the dust. -Settlement of Suspended solids will be done in settlement tanks before discharging. -Deposition of dust on land and plants from air due to mining activities and transportation will be there which will be minimized through sprinkling. -It is advisable to plan for the development of green belts around the areas having mining and associated activities
3	Change in land use during regular operation	-Land is used for inclines, shaft and other infrastructure like office buildings, CHP, workshops, WTP, STP stores, substation, stock Yard, Weigh Bridge etc. -The flat area in both external dumps and backfilled area will be able for plantations, whereas the sloping areas and areas with approach roads/safety berms will be re-graded for stabilization andgrasslands	-Restoring the land to its pre-mining land use or to a use, that is consistent with thesurrounding land fabric. -Maintaining the long-term stability of affected land to match with the community and commercial needs the development such as parklands, flora & Fauna sanctuaries, and play- grounds with ecological, tourist and commercial values will be planned.
4	Impact on Natural Drainage System	-The main drainage of the area, Tumni Nala in the west and Ajay River is in the east of the block. There are many small & large ponds in the area, which are mostly used by the villagers for domestic purposes. -Only the groundwater seepage will form thesource water for mining drainage. The water will be automatically drained to the sump	-Adequate provision of pumping for draining out the seepage water from the sump will be provided and the working face will be kept dry. Care must be taken to protect the drainage bore hole from damage while blasting. Underground mine also does not involve any excavation, dumping or re-handling of wastes unlike in case of opencast mines.

		in underground working at the lower most part of the mine.	-Total waste/ reject (stone debris) generated through out the life of the mine has been estimated as about 0.32Mcum, which is produced during drainage of stone drifts for approach from one seam toanother seam / inclines/ shafts
5	Impact on Ground Water	-Ground Water Quality: Mining operation and acid drainage can also affect groundwater. Older tailing ponds that were constructed without impermeable bases have generated acidic drainage that causes ground water contamination. Acidic water migrates into ground water and eventually lose its acidity and able to dissolve heavy metalpresent in rocks and contaminate ground water quality. -Lowering of water table: In the process of mining, when digging is undertaking below the water table, inflow of ground water occurs.	-it is suggested to place an impermeable barrier at the base of the tailing pond to prevent acidic drainage seepage. -It is suggested for the pumping of water for the inflow of the ground water

NOTE: Source of Sr. 3,4, & 5 is from EIA report of M/s PTPL, Kolkata by M/s Green C, Kolkata

(ii) Social Environment

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Tourism & Asthetic	-Shibpur Road at a distance of about 4.20 Km SE from project to connect Joydev Kenduli pilgrim area will be affected with the traffic movement of the coal mines However, suspended particles in the air is evident due to traffic movement	-Alternative arrangement for the movement of the traffic would be done during the peak/festival season Shibpur Road such that the incoming supply of the raw material and outgoing coal movement is not affected. -Settlement of Suspended solids will be done in settlement tanks before discharging.
2	Areas occupied by sensitive man-made land uses	-The major man-made area occupied in the vicinity of 10 km are Temple: Durga Temple, Kendula 3.78 km SW Hospital: Jhanjra Area Hospital 10 km WNW School: Kalipur Primary School 7.5 km WNW -College: Sanaka Medical college, Malandighi 9.6 km SSE Details of the sensitive manmade land uses is given as additional attachment	-The structure (Temple/ Hospital /School etc) of man-made land use pattern in the radial distance of 10 km would be an asset for the project in developing tourism site, facilitating the treatment for the workers and in providing education to the ward of the workers. However, whenever there is a demand for upscaling the facilities through designated Company's CER/EMP for Social and infrastructure development funds.
3	Areas occupied by nature physical land uses	-The major natural area occupied in the vicinity of 10 km are village ponds; lakes, nallas, rivers, drainage etc will no longer have effect on the environment as the underground separates them with sufficient barrier	-The natural assets will have sufficient barrier in the under-ground mining points to desired natural assets points. -However, whenever there is a demand for upscaling the facilities through designated Company's CER/EMP for

			Social and infrastructure development funds.
4	Culture and Social Cohesion	-With the advent of the Jagannathpur (B) coal mining, a lot of in migration will result. -Jagannathpur (B) coal mining area comes Raniganj which is famous for illegal coal theft from the mining from coal mafias. It is expected that current mining also fall in the same trap. -Under the political structural setup, village panchayat specially for the mining villages will have greater power to make the project viable	-It is expected that near 1200 population will have in migration -Proper fortification from the dispatch units directly to the commuting vehicle with good inventory system connected to GIS is proposed -It is proposed to execute all area development with the support of local panchayat needs in coordination with them

(iii) Public Utilities

1	Social infrastructure	-Schools in the mining lease areas are either old and requires substantial repair work and in some villages the schools even don't exist. -Scarcity of drinking water is another major problem reported in the nearby villages	-The desired level of renovations in the schools will be done through designated Company's CER/EMP for Social and infrastructure development funds. -The company also plan for boring sweet water and thus as per the demand of nearby villages will share with the community
2	Physical infrastructure	-The village in the MLA and some villages adjacent to MLA does not have road accessibility and resident population largely commutes on kuccha road.	-Mining Plan had already proposed to build 9 km pucca road

(iv) Direct and indirect impacts

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Direct Impact[1]	-Since there is no acquisition of the land in the villages belonging to the villagers, no displacement of families in the project area is projected -The livelihoods of the skilled (Rs.80000/ annum) and casual labours (Rs.60000/ annum) will gain boom in their income through employment in Jagannathpur Mining lease area	-Since there no displacement of the families, it is expected to have welfare of the families in the MLA through CER/EMP for Social and infrastructure development funds. -It is expected to recruit 60% each unskilled worker (Rs.24000/ month) to semi-skilled (Rs. 25000/ month) workers as well skilled (Rs.26000/month) in the specified scale from local villages coming in the radial distance of 10 km
2	Indirect Impact[2]	-There is great chance to develop local household ancillary which supplies local made, hand gloves, mask, sanitizer apron, employees uniform etc -Area development like automobiles spare part and repair shop, local Manpower contractor, Small petty shops etc will come in the vicinity of the mining area.	-It is suggested that such activities should be supported by the company's designated CER funds for development programs related to infrastructure and services. -The company should develop an inventory of such facilities so that annual maintenance of the desired service in MLA is outsource to these agencies to acquire their services as and when required

1 "Direct impacts" will include all impacts that are likely to be experienced by the affected families (i.e. Direct land and livelihood losers)

2 "Indirect impacts" will include all impacts that may be experienced by those not directly affected by the acquisition of land but those living in the project area

(v) Differential impacts

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Impact on women, children, the elderly and the different abled	-The female literacy rate in the project area is only 30%. The participation of the female working for livelihood is very poor 1.6% in the project area -Only 49% of the children are reported going to Anganwadi centre in the normal setup.	-The company should promote female adult literacy program and Smart anganwadi centres with the help of designated funds of CER/EMP for Social and infrastructure development funds related to infrastructure and services soft work like gloves, apron, uniform making etc should be giving to Mahila Mandal groups from local villages.
2	Gender Impact Assessment	-There wide gap of female participation in the profession ie., the working population of female is very small. -On an average 50% of the female population have better access to the household amenities -Only 2% of the women reported acting as head of village level samiti.	-The company should have the policy for gender equality by recruiting female members at various cadres. -It is proposed that with the designated funds of CER/EMP for Social and infrastructure development funds related to infrastructure and services and hence preference should be giving construction for toilet and bathroom under PPP model. -All local development programs in the villages should be run with local leader ship of resident women leaders.

(vi) Cumulative impacts

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Measurable and potential impacts of other projects in the area along with the identified impacts for the project in question	-There are many other industries and mines in 10 km radius. The nature and range of the pollutants from mines is mostly related to localized air pollution, pollution due to transportation and blasting	-Regular monitoring of the air monitoring at various mine sites would be done to control the air pollution with sound strategy that minimize the air pollutions in MLA as well in surrounding areas.
2	Development of Public Infrastructure	-Here transportation sector will boom as there would large vehicular movement. Besides widening of the road would require to reach the project site for the disposal of waste material. -From State highway to the project site, Restrictions on traffic movement hours which are staggered with respect to peak traffic hours. This mining has been established in the busy industrial belt and hence with its advent, there is great possibilities to develop potential commercial market (Grocery shops; small petty business; etc) in the nearby vicinity of the industries -There will be increase in real estate business to construction labour colonies as well as high rise building to carter the demand of	-During Construction and in regular operation, heavy vehicles will be used to transport finished products from the project site, it is recommended that the road should wide enough for two-way movement with proper sign board and direction symbols. -Separate entry and exist gate shall be provided and trained security guards shall be deployed to ensure proper management and movement of vehicles within premises -The industries should initially support to build some infrastructure like approach road to the / within the villages from its CER/EMP for Social and infrastructure development funds related to infrastructure and services such as upgrade the surrounding public amenities (like toilets; dispensary,

		incoming labour as well high skilled workers. New road, and rail traffic including new oraltered routes and stations, ports, airports duringconstruction and regular operation of the coal mines	creation hall etc) in consultation to the local village panchayat authorities such that a base is developed for the potential market. -The operation of mining block shall generate additional road and rail traffic for Transportation of coal. Nearly 6.5 km of new road will be constructed to connect the incline with the Duel more. The road is connecting the site with Shibpur Road. Shibpur Road is directly connected with the NH 60 which finally connects Ukhra Railway siding with the project site.

NOTE: Impact on those not directly in the project area but based locally or even regionally

(vii)Impacts at different stages of the project cycle

(1) Pre-construction phase

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Interruption in the delivery of services	-Due to non-availability of the approach road, -Non-involvement of the local resident population for unskilled jobs	-MLA Plan had already proposed to build 9 km pucca road -One of the ccompany's policies is to give preference to local resident population
2	Drop in productive investment	-Low productivity indicates that resources are not utilizing their skills and competencies to their maximum potential which increases company's resourcing costs. -Lower work rate (or productivity) results in poor performance of employees which ultimately affects both quality of and quantity of deliverables. -Poor productivitycauses delays in project timelines so as deliver of project on time	-Addressing the training needs as well increased employee engagement and improvement in morale that will eventually reduce employee burnout -Target based planning with resource efficient manpower will avoid the risk of drop in productive investment.
3	Land speculation owing to Land use pattern of Mining Lease Area (MLA) Plan	**-Total Mine Lease area is 856.68 ha.** Agriculture: 599.01 ha, Township: 15.05 ha, Water bodies: 70.09 ha, Roads: 3.34 ha. Grazing: 25.84 ha Barren:69.12 ha Community/Others: 15.60 -Govt. Non-Forest Agricultural 31.63 ha Barren/other use 27.75 **Total 856.68 ha**	-The company initiated theactivities with the following --Land use pattern: -Excavation Area: 0.0 ha -Top Soil Dump: 0.0 ha -External Dump: 0.0 ha -Safety Zone: 0.0 ha -Green Belt: 8.49 ha -Infrastructure areas: *24.14 ha -Other uses**: 442.85 ha -Undisturbed area: 381.20 ha **Total: 856.68 ha** * 24.14 comprises of 1.03 ha UG entries + 0.20 Settling pond +22.91 Facilities **442.85 Ha area disturbed by subsidence
4	Stress of uncertainty	-Delay in the procurement of the manpower and material; tools and mandatory permission for operating mines -Any natural or a manmade calamity raises the stress for the situation in loss of materials and other halted business operations	-It is advisable for proper execution plan the manpower and material supplies the stress of uncertainty could be lowered -It is advisable to prepare a robust back-end plan so that the business operation is in continuations

(2) Construction phase

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Displacement and relocation	-Since the project activities is underground and the Mining plan takes care without disturbing any natural features and human settlement (without any displacement) there is no proposal of R&R program.	-The company is in the process of purchasing the desired plots for mining operation on commercial basis. The details could be referred in chapter 3.
2	Vehicle and machine will generate noise	-Underground mechanized/ semi-mechanized mining method is proposed for the mining project. These are high noise generating machinery in the range of 60-100 dB (A). Fully mechanized machines like -Continuous Miners, Road headers and LHD machines are required for extraction. Noise and vibration will occur, the quantum of which is subject to strata under blasting. -Some noise is anticipated through heavy vehicular movement while bring the raw material and taking away the finished to the project site.	-Necessary mitigation like acoustic enclosures, housing of noise generating machineries in closed area/room, proper maintenance & lubrication should be done to control noise level. -Controlled blasting technique will be used as per the guide lines of DGMS. Plants & Machinery shall be provided with suitable devices to reduce the noise level and shall be maintained well within the statutory requirements. Thus, Anti-vibration pads are/will be provided wherever applicable. Regular maintenance lubrication is/will be done. Acoustic enclosure is/will provide to DG Set. -They should produce noise not more than 80 db(A). If the noise exceeds threshold limit of 80db(A), earplugs shall be provided to the operator as per the guide lines of DGMS
3	Influx of migrant construction workforce	-Impact of the project during construction phase will be positive, as it will upgrade the socio-economic status of local inhabitants by providing employment opportunities from nearby villages. This will increase direct / indirect employment opportunities and ancillary business development to some extent for the local population. -The manpower requirement for the proposed project is being expected to generate some permanent jobs and secondary jobs for the operation and maintenance of plant. It is estimated that influx of about 1000 semi-skilled & UNSKILLED and labour construction workforces from the surrounding villages will get livelihood	-Temporary employment generated during construction and commissioning of proposed project will have slight beneficial impacts on economic environment. -The company have framed the policy that all recruitments of non-technical (Temporary/ Permanent) should be made from the surrounding villages.
4	Health impacts on those who continue to live close to the construction site	-Use of substances or materials, which arehazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and water suppliesChanges in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)	-The hazardous materials are engine oil, lube oil, transformer oil etc., which will be stored in leak proof drums located within fortified area. Hence, no contamination due to accidental rupture anticipated.

		-Mining and transportation activity will generate PM10 and PM2.5 in ambient air, which can affect health of vulnerable groups in nearby villages.	-Proper hygienic condition will be maintained by sprinkling gabazine powder and chloroquine tablets in and around the Mine Lease Area in order to avoid incidence of any water-borne diseases. -However, with proper mitigation measures such as sprinkling of water, use of dust extractors, etc., the incremental ground level concentration will be kept low.
5	Construction activities at project sites	-The total ML area is 856.68 ha. The present land use of the lease area is mainly agricultural land with open scrubs and some vegetation cover. Core infrastructure like Mine office, stores, workshop, canteen, first aid center, Coal Handling Plant (CHP), Magazine etc. shall be constructed that may affect the land use pattern of the area and will disturb the Natural and Man-made habitat	-The total ML area is 856.68 (includes 8.49ha proposed for plantation and 24.14 ha area proposed for Infrastructure). The present land use of the lease area is mainly agricultural land with open scrubs and some vegetation cover. -Construction will be done in such selective piece of land in a way that it will have minimum effect on Physical and man-made features. Moreover, the total mining activity is underground (Mechanized/Semi –mechanized Bord & Pillar method).
6	Handling of Material, Storage, Leakage, use or spillage of hazardous materials	-There could be possibilities of spillage of hazardous materials during regular operations in the dyked mining area. -The waste produced from driving the main inclines and the shaft sinking and the waste produced during the roof ripping as well as from the cross-fault drifts will also lead to produce waste as by products. -Total waste/ reject generated throughout the life has been estimated as about 0.32M cum	-The hazardous materials are engine oil, transformer oil etc., which will be stored in leak proof drums in dyked area. Hence, no contamination anticipated. -To use the waste rock to construct the transportation (coal evacuation) roads; -To fill low lying areas elsewhere within ML for improving safety from water; -Any balance rock will be kept in reject stack on surface for which provision has been made. -Roof ripping and the cross-fault drifts waste produced will be usually disposed of below ground in goavs, low lying areas and available spaces along UG galleries while the rest will be taken out to surface by rope haulage, which is mainly meant for material transport from surface to underground workings and vice versa.

(3) Operation phase

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Reduction in employment opportunities compared to the construction phase	-About 500 direct unskilled contractual labours will be dismissed after the construction and commissioning work at the mining site.	-It is expected to double -indirect employment. Or to accumulate unskilled work force in other similar mining area.
2	Economic benefits of the project	-Its is expected to produce 0.8 MTPA with unit rate of Rs. 2000 /ton. This coal will be used in in burning the furnance for producing steel in the factory.	-Coal to Shyam Steel Manufacturing Limited will be directly transported by road to EUP. -Coal to Orissa Metailiks Private Limited, RashmibCement limited will

			be transported to nearby UKHRArailway siding which is 19 KM away, by trucks, from where it will be transported by Rail to EUP.
3	Benefits on new infrastructure	-Facilities for long term housing of operational workers in the Mining Lease Areas	-The residential buildings and allied facilities of Jaganathpur– B Underground Coal Projects not visualized. Essential Quarters and Dormitory will be developed in 0.35ha area. -Only 0.03ha area is proposed as resting area for the employees and drivers. Essential Quarters and Dormitories will be develop for night shift employees
4	New patterns of social organisation	-The local village panchayat bodies will be largely involved in area development programs as well local in developing the public utilities in rural areas	-Adequate dialogue with the local bodies/ local population for development of water structures, strengthening of health and education services, Provide temporary employment generation opportunities to local people, especially in unskilled categories.
5	Employment Generation	-Temporary employment generated during construction and commissioning of proposed project will have slight beneficial impacts on economic environment. -Under the current project, it is estimated to generate employment of nearly 1956 individuals during Construction and Commissioning phase. -Additional indirect employment of around 1,000 persons is expected comprising of goods and service providers.	-The company should frame the policy that all recruitments of non-technical (Temporary/ Permanent) should be made from the surrounding villages. -The proposed project will generate employment for many peoples. Most of them in skilled and semi-skilled category will be coming from nearby villages.
6	Industrial Security & Safety	-Some health and safety hazards are anticipated to affect the persons employed in the project during construction, commissioning and in regular operation Phase (refer B3). -Major risks and uncertainties to the project viz., proximity to river, adjacent working, geo-mining disturbances, slope stability and remedial measures suggested -Besides, proposed overall slop of the quarry and OB dump, dump height, strata control, fire and spontaneous heating, gas leakage monitoring, danger from inflow of water, disaster management etc could be the major cause of accident	-All the risks and hazards will be identified through the principles of Hazard identification and Risk Assessment and Safety Management Plan will be prepared and implemented as per Reg.104 of CMR 2017. -The Mines Act 1952 and all the regulations and schedules of CMR 2017 relating to opencast and underground mining shall be adhered to and implemented in order to maintain day to day safety. -Appropriate safety zone margin around the Magazine will be kept as per the guidelines given in Schedule VIII of The Explosives Rules, 2008. -A Commitment from the Company Board that entire mining operation will be carried out as per the Statutory provision given under Mines Act 1952, Coal Mine Regulation 2017 and & specific permission will be required the company will approach the concerned authorities. The other safety measures as mentioned in

			the Mining plan (I) and related Acts (II) are mentioned in Annexure 15

(4) De-commissioning phase

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Loss of economic opportunities	-The running business turn around and profitability will immediately be crashed out in the market toward liquidity of the company -The unemployment will be on rises as most of the employees would be restrain from working.	-The loss of the business could be compensated by converting the company reserves into share/debenture/joint venture in forthcoming companies. -The unemployment could be reduced by serving the employee three months prior notices by settling their allowance, salary and retirement benefits.
2	Environmental degradation and its impact on livelihoods	-Lead to after-use of the site created void, ruins and land excavated area as pit or large fill area, could have an impact on the environment -The MLA Could be affected by natural disasters (e.g., floods, earthquakes, landslides, cloudburst etc) causing environmental damage. -Raniganj area is coming under Moderate Earthquake Zone (ie Zone –III). -Being near a river, the flood durations and flood level may affect the aquifers. Many natural drains may pass over the lease area with chances of developing wetlands due to land undulations formed due to subsidence. Because of mining subsidence, the cumulative effect on terrain and landform mainly embodies terrain undulation, land use pattern and land cover change.	-The mine will be closed as per Mine Closure Plan. 393.92ha area will remain untouched. Settling Pond, Road, and Green Belt will be 0.20ha, 22.91ha and 8.49ha respectively. 1.03ha will remain as closed UG gate. -Most of the construction done in MLA would be earthquake proof. -Run-off water will be pumped out mine water will be led to settling ponds and after removal of Suspended Solids, a part will be utilized for domestic purpose, sprinkling, etc. and the excess will be discharged into natural drain. -The sewage from the pit head facilityshall be treated in STP. -The treated sewage will be used for non-potable purposes and greenbelt watering. Workshop wastewater will be passed through oil-water separator and subsequently through settling tank prior to reuse.
3	Long-term dismantling or decommissioning or restoration works	-Reclamation works will be done largely during the regular operations -Currently no dismantling or decommissioning or restoration works is proposed.	-Plantation will be carried out on both sides of the newly constructed road, around all the facilities area like mine infrastructure area, magazine building, shaft sites etc. -However, at the end of life of mine, all transportable Plant & Machinery, which have working life, will be removed from the leasehold and transferred to other mines of the company. All fixed equipment viz. Workshop P&M. HT transformers, Pumps etc. shall be transferred to other mines or auctioned off.
4	Inland, coastal, marine or underground waters	-The field visits shows that Ajay River Adjacent E Tumuni N, Inside PS Kunur N 4.2km WSW, Italhala N 7.8km WNW, Sal N 8.7km NE and Hingla N 3.8km N are present in the radial distance of 10 KM and may be affected during the regular operation.	-As per the Mining plan none of the physical features (River or nulla) on the ground will be affected as the mining activities will executed at a safe distance (25-50 meters) away from the said Physical features.

5. Cost Analysis:

- The current Social Impact Assessment and Rehabilitation and Resettlement study criteria is largely based on format defined by the Extra Ordinary notifications in exercise of the power conferred by sub-section (3) of Section 1 of RFCTLA-RR Act 2013 (30), Published by Ministry of rural Development (Department of Land Resources), New Delhi (on Thursday December 19, 2013/ AGRAHAYANA 28,1935 – 5318 GI/2013). Thus, the rehabilitation and resettlement act are not applicable as there is no **displacement of the population** with the advent of the Jagannathpur (B) of Paschim Bardhhaman district of West Bengal. Thus, calculation of cost for acquired lands(s) from the community for the preparation of R&R mitigation and economic plan is not applicable, as by large the Land plots in mining lease area is commercial purchased.
- Jagannathpur B Coal block is a Underground mine. This is a coal block and the proposed mining life will be more than 60 years. The total cost of the Jagannathpur (B) Coal Mine project for M/s Power Plus Project Pvt Ltd is estimated to be Rs.350.72 crores as indicated in table 6.1. From the total cost, the cost is pre operative expenditure is 7.2% and the remaining 92.8% is post operative. Among the post operative expenses, 5.7% expenditures are done as fixed cost, 25.7% as Construction of Inclined, Drift & Shaft; 42.8% for Plant and Machinery and 9.2% as other project expenditure.
- As per the guidelines of the MoC, the cost of the mine closure is to be computed based on the total project area involved in the project. The updated cost of the mine closure is estimated to be **Rs. 117.33 Crore**. From the total, about 79.5% of the Mining closure fund will be utilized for the progressive closure, 16% for the technical and biological reclamation of mined out land and OB dump and rest 1.6% in dismantling infrastructure, 1.1 post closure management; 0.5% safety and security and 1.3% for other mining closure activities will be utilized.
- The Social Management plan is based on EMP for Social and infrastructure development funds allocated budget for social and economic development of the resident population in the villages falls in the radial distance from the Project site. The current project is new establishment for coal mining at Jagannathpur (b) coal mining area of M/s Power Plus Project Private Limited with the total cost of Rs. 350.78 Cr. Owing to this, a Need Assessment Survey was carried out by third party among 820 households to understand the social and infrastructure demand in the community. The approximate cost of CER/EMP for social and infrastructure development budget comes near Rs.5.26 Cr.

(6) Recommendations: The Social impact study conducted in relation to EIA and R&R, the following points are suggested below:

a) The satellite data captured and analysed using GIS digital elevation model for doing the **slop analysis** to understand the flow of Strom water and garland drains around the subsidence area, it is suggested to make suitable drainage

system to avoid logging of water in the centre of subsidence troughs as it would affect the surface topography. Further, owing to the land use classification for the actual ground topography, it is suggested to erect embarkment with an elevation above HFL on the western side of the Ajay River.

b) As per the CSIR-CIMFR and **the terrain analysis done using satellite data**, it is suggested that the predicted maximum compressive strain and tensile strain at the surface of 10.0 mm/m and 9.1 mm/m respectively would lead to development of cracks with crevices of 60 to 100 mm at the surface. The surface cracks formed during extraction should immediately be filled in with soil/mitti to prevent breathing of air and inflow of water to the underground workings.

c) There is no evidence of displacement of any residential population among the plot purchased for doing the underground mining activities. Sufficient barrier from the human habitats or any physical features as observed in the Jagannathpur (B) mining lease area ruled out any possibility to include R & R mitigation plan. Even while doing land use and land cover analysis using satellite data, seven sectors, were identified for extraction of coal and by large to be done in sector D and G. Further about 6.3% area demarcated to develop barriers between villages and physical features and only 1.6% of the land area marked as construction of building and village habitats and 1% represent as green area. Still the unused land areas are the highest (35.6%) that can be used as alternative/addition, to the plots from A to G where in future there is any possibilities of households' constructions.

   Further, it was observed that Underground mining of Coal was also reported in similar setting coal mining area in Lachipur Colliery in Kajora and in Shyam Sunderpur Colliery in Ukhara village of Andal Sub Division of Durgapur. Since the land plots are commercially purchased from the community in the MLA for doing underground coal mining, the Rehabilitation and Resettlement program is not applicable.

d) The total cost of the project is Rs.350.68 Cr, of which 93% of the budget is being reserved for the on-site operations and 7% is being reserved as pre operative budget. The pre operative budget includes the 2% cost of CER/ EMP for Social and Infrastructure development budget which is around Rs.5.26 Cr. A tentative provision of separate budget has been for the mining closer activities, whose budget is estimated around Rs.117.33 Cr. The demand of the community varies from the time to time and also according to the need of the individual household families as well for their resident villages. It is suggested that the management of the PTPL should conduct regularly need assessment study from a NABET Certified Social Sector expert. Any deficient in CER/EMP budget should be compensated with the 2% CSR allocated budget in future, so that the social charity and philanthropic activities are continued for poor and under privileged groups residing in the MLA and in surrounding villages. Equally, it should become a practice to conduct impact assessment of the CSR/CER/EMP social and infrastructure development activities using 17 UN Sustainable Development Goal indicators.

e) The proposed project and allied activities will provide direct & indirect job opportunities. Temporary employment generated during construction and commissioning of proposed project will have slight beneficial impacts on economic environment. The company have framed the policy that all recruitments of non-technical (Temporary/ Permanent) are to be made from the surrounding villages. It is expected to recruit 60% of unskilled and casual workers from the surrounding villages. Estimates were made for increase of their income level by three folds from the current average income of these work force.

f) The role of any NGOs nor any local groups (Mahila/Youth) was reported active in the participation of any development community activities. However, it becomes apparent to support gender empowerment activities owing to the weak data reported on gender participation and gender equality. It is suggested to have at least 10% local recruitment for the casual work in the coal mining exploration reserved for female. Besides company efforts should also be made to promote green area with the help of women groups and also to take initiative for household-based activities for items required in the mines viz, mask, gloves, apron, uniform etc from the local Mahila groups under the cooperative efforts.

g) Though the morbidity of the disease's sufferings .is under reported in the period of ongoing pandemic, but the focus group discussion done at the village level suggest to have high morbidity of diseases, Typhoid, Malaria, Gynological problems, upper respiratory tract infections, skin infections etc. Thus, community express acute need of treatment door step in the villages. It is suggested to start ambulance services to organize medical camps at villages level.

h) School attendance is reasonably good as reported in the focus group discussion. However, in this era of pandemic, presently it was not reported in household survey because of lockdown. The villages in the mining area and near to the mining areas needs renovation and repair work reported by the respective panchayats of the villages. Besides, deficiency of items like school bags, books and note books, school fee etc. requires constant support of doing charity, especially for the wards coming from very poor family. Apart from such support, it also recommended to start scholarship scheme for the under privileged children in such villages.

i) It is mandatory to implement all related right based, welfare based and sustainability approach to be adopted for the employees as well for the local resident community according to the prevailing laws of the country that ensure implementation of Social Safeguard policies on the behest of the current project. This also includes local villagers/sarpanch as a committee member of Disaster Management Plan because for any untoward incident/accidents, the local people will be an asset for rescue and relief operations.

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1: Detailed Project Description

1.1 Introduction:

There is a recognizable shift in the country in consolidating the energy options currently. Renewable energy sources like Solar and Wind are being preference, encouraged and trusted as energy upgrades to meet the growing energy demand in the country. However, the energy mix can be considered as approbatory but not equal to the characteristic and role of coal. The alternative source of energy can supplement but cannot considered as preferred substitute coal owing to the coal reserves in India. In India, what makes coal such a preferred energy fuel is its abundance, availability and affordability; because of reliable energy is a correlate of economic growth and human development. Coal, being reliable, continues to serve the country as its primary commercial energy provider and will remain a mainstay in Indian power generation for decades to come.

As per the Geological Survey of India report (2019) Coal reserves have been estimated at 326.05 billion tonnes. The reserves have been found mainly in the States of Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Telangana and Maharashtra. Today the major coal producing companies and others shows that the estimated geological resource of coal in India stood 326.50 billion Tonnes as of 31s April, 2021 (MSR, MC Jan 2020-21).

As per Annual Report of Coal (2020-21), the overall production of coal was projected at 810 MT. However actual raw coal production is 489.567 MT (Provisional figures till Dec 2020) against the annual target of 828.50 MT. During the period April 2019 to March 2020, the actual production was 729.10 MT compared to 728.718 MT during preceding year 2018-19 and showing a growth of 0.05%. Earlier, there has been a continuous increase in overall consumption of coal over the years. Consumption / actual supply of coal (including import) increased from 713.39 million tonnes in 2012-13 to 841.56 million tonnes in 2016-17. Since 2015 onwards, The Ministry of Coal found very active in the execution of the overall responsibility for determining policies and strategies in the allocation, exploration and development of coal and lignite reserves, and sanctioning of important projects of high value.

Further, the core objectives of Ministry of Coal that are linked to its vision of securing the availability of coal to meet the demand of different sectors of the economy in an eco-friendly and sustainable manner and the overall mission of augmenting production through Government companies as well as the captive mining route by adopting state-of-the-art, clean-coal technologies; enhancing exploration efforts with thrust on increasing proven resources and developing the necessary infrastructure for evacuation of coal under predefined protocols.

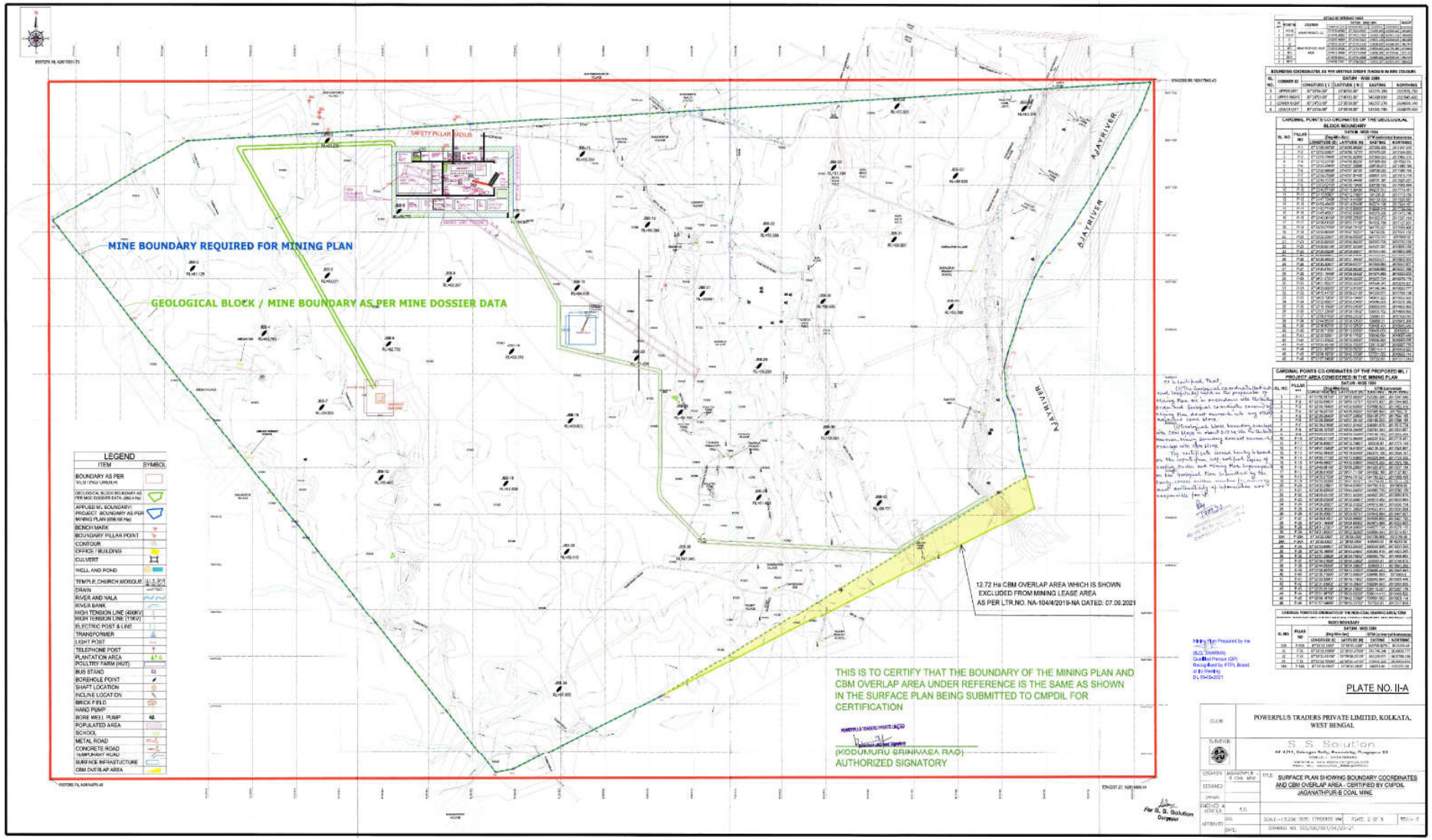
1.2 Background:

The Ministry of Coal has recently published a white paper for public discourse and suggestions on policy initiative that compel to bring in private participation in commercial coal mining. The so-called commercial coal mining itself is not a new concept either. Prior to de-allocation of the coal blocks by the Supreme Court of India, and indeed even after the new legislative framework has been approved by the Indian parliament, several coal blocks were and have been allotted to state-owned entities for commercial mining. M/s Power Plus Traders Private Limited have been allocated Jagannathpur B coal mine with order No: NA-104/4/2019-NA dated 13th February 2020, under vesting order under clause (b) of sub rule (2) of rule 7 and sub-rule (1) of rule 13. From the office of the nominated authority constituted under section 6 of the Coal Mines (special Provision) Act, 2015, O/o Nominated authority, Ministry of Coal, Govt. of India, Shastri Bhavan, New Delhi (Refer Ltr. No-NA-104/4/2019-NA dated 23.06.2021 excluding 12.72 Ha CBM overlap zone from Mining Lease Area of Jagannathpur B and the same was certified by CMPDIL vide Ltr. No CMPD/BD/C (886-A)/E-571279/1-12834 Dated 17.09.2021).

The block is almost rectangular in shape with the entire boundary being defined by straight lines except the eastern boundary which is curvilinear in shape having 46 pillars as indicated in Figure 1.1. The block is bounded by a number of Coal Mines viz. Rangamati B in the north, JAGANATHPUR A block in the west and Bistupur-Dandeswar in the south. Ajay River is on the east of the block. The block is well connected by road and rail. The area displays a gentle undulating topography with elevations ranging from 66m in the North West to <56m in the south and east (considering the R.L. values of the JBB series of boreholes w.r.t M.S. L). The elevation increases in North and North West direction. The major part of the block is covered by soil/alluvium and forms the cultivated land. Ponds are scattered over the entire area. The main drainage of the area, Tumni Nala in the west and Ajay River is in the east of the block. There are many small & large ponds in the area, which are mostly used by the villagers for domestic purposes.

The Durgapur city township (also Railway station) is close to the area at 15 Km connected through metaled road. The block is situated at 20km North of NH-2 (currently National Highway 19). Jhanjhra is 6 km on the north side of the block. Road distance from the block to Muchipara More (on NH-2) is about 25.5 km (6.5 km to Deul More (on NE of the block) and further 19 km to Muchipara from where Durgapur siding is 4 km across the NH-2. NH-2 (Andal More) can also be approached from the block by a west trending road via Ukhra Station. The details of the project size, location, capacity, outputs, production targets, cost, risks are summarized in table 1.1

Figure 1.1 Location of the Pillar of Jagannathpur (B) Coal Mines



Source: Mining Plan Vol II M/s Power Plus Traders Pvt Ltd, Kolkata- West Bengal

Table 1.1: Basic Description of Mines

Name of the Mine	Jaganathpur - B
Latitude	23o 38’ 39” to 23o 40’ 15” N
Longitude	87o 21’ 56” to 87o 24’ 53” E
Coal Field	Ranigunj Coalfield
Villages	Jotebalaram, Srikrishnapur, Amdahi, Jaganathpur, Sundipur, Basudevpur, Binodepur, Rajhat, Sashipur, Dubrajpur, Majidanga, Dandeswar
Tehsil/Taluka	Bardhaman
District	Bardhaman;
State	West Bengal
Mining Lease Area	856.68 Hectors (excluding 12.72 Ha CBM overlap zone)
Life of the Project	66 years
Starting Date of the Mine as per CMDPA	13th Dec 2025
Rated Capacity as per CMDPA	0.8 MTPA
Production Schedule as Opening permission (meeting provisions of CMDPA if any)	As Tentatively 13-11-2025. per opening permission (NOTE: Production schedule will be in line with Approved Mining plan)
End Use of Coal/Lignite as per allotment order ifany	Sponge Iron and Captive Power Plant
Minimum and Maximum Depth of working "m"	Min: 46 m (Seam R-IX) Max: 480m (Seam R-lll/ll)
Seams not considered fo Mining with Reasons	R-VI, not developed in this block R-IV, Working thickness not available
Gross Geological Reserve	191.020 MT
Net Geological Reserve	166.824 MT
Blocked Reserve	65.784 MT (w.r.t. Net Geological Reserves)
Mineable Reserve	101.040 MT
Extractable Reserves	50.023 MT
% of Extraction/recovery	29.99%
Balance Extractable reserve	50.023 MT
Cost of the Project	350.72 Cr
Associated Risk	Overheads increase if the progress of work is not as per the Schedule Plans and will in turn make delay in production

Source: Mining Plan Report, Vol 1 & II of M/s Power Plus Traders Pvt Ltd

1.3 About the Company:

Jagannathpur-B Coal Mine had been allotted to WB Mineral Development & Trading Corporation Ltd. (WMDTCL) earlier. They had carried out some exploration by engaging CSIL for drilling. Tata Consulting Engineers Ltd. (TCE) prepared a Geological Report & submitted the same in January, 2011. Subsequently, this block was deallocated under SC order and reallocated to "Powerplus Traders Private Limited" (PTPL) in February, 2020 by MOC (GOI) through its vesting order (Ref: NA-104/4/2019-NA Dt. 13-02-20). As the first step to develop underground mines in the block, PTPL procured the GR (2011) from MOC (Refer Ltr. No-NA-104/4/2019-NA dated 23.06.2021, dated 21.12.2020 and dated 04.02.2021, excluding 12.72 Ha CBM overlap zone from Mining Lease Area of Jagannathpur B and the same was certified by CMPDIL vide Ltr. No CMPD/BD/C (886-A)/E-571279/1-12834 Dated 17.09.2021) and reviewed the data.

The Jagannathpur B coal mine is allocated to M/s Power Plus Traders Private Limited, considered to be a successful bidder is a joint venture of Orissa Metaliks Private Limited, Rashmi Cement Limited and Shyam Steel Manufacturing Limited), incorporated in India under the Companies Act, 1956 with corporate identity number U10100WB2012PTC183435, whose registered office is 39 Shakespeare Sarni, 6th floor; Kolkata 700017West Bengal INDIA . The other brief details of the company are indicated in table 1.2.

Table 1.2: Basic Description of Mines

Sr	Owner of Specified End use of Plant (JV Partners)	Shareholding of the JV Partner in the Bidders (%)	Coal Allocation for the JV Partners in the bidder (%)	Name of the Specified end use	Address	Configuration (TPD/MW)	Capacity (MTPA/MW)	Total Coal Entitlement (MT)
1	Orrisa Metaliks Private. Limited	54%	54%	Sponge Iron Plant Unit I & Unit IV	Village – Gokulpur P.O -Shyamraipur District West Midnapur State West Bengal 721301	Unit I: 3x100 TPD Unit IV: 1x600 TPD	Unit 1:1095 MTPA Unit 4:219 MTPA	21.36 MT
2				Captive Power Plant	Village – Gokulpur P.O -Shyamraipur District West Midnapur State West Bengal 721301	1 x 25 MW; 1 x 6 MW	31 MW	6.41 MT
3	Rashmi Cement Limited	23%	23%	Sponge Iron Plant Unit I	PO and district Jhargram, West Bengal - 721507	5 x 100 TPD	0.1825 MTPA	11.87 MT
4	Shayam Steel Manufacturing Limited	23%	23%	Sponge Iron Plant Unit I, II & III	Jemua Mouza Mejia Block, District Bankur, West Bengal 722143	Unit I: 1x300 TPD Unit II: 1x100 TPD Unit III: 1x100 TPD	Unit I:0.1095 MTPA Unit II:0.0365 MTPA Unit III:0.0365 MTPA	11.87 MT

Source: M/s Power Plus Traders Pvt. Ltd, Kolkata, West Bengal.

Powerplus Traders Private Limited is a Private Company incorporated on 03 July 2012. It is classified as Non-govt company and is registered at Registrar of Companies, Kolkata. Its authorized share capital is Rs. 500,000,000 and its paid up capital is Rs. 2,500,000. It is inolved in Mining and agglomeration of hard coal [Includes under ground or open-cut mining of anthracite, bituminous or other hard coal; cleaning, sizing, pulverizing and other operations to improve the quality; operations to recover hard coal from culm banks; manufacture of briquettes or other solid fuels consisting chiefly of hard coal and in-situ gasification of coal.] The details of the company share holdings and allocation of extracted coal. The company under the Company Act of 2013 has Article of Associations.

1.3a Objectives & Functions: -

a) To carry out in India and elsewhere the trade or business of mining of coal, washing and beneficiation of coal, coal carbonization, conversion of coal to coke, coal to oil, coal to gas, coal to thermal power and to transport the same by conveyer belts, road, rails pipelines and overhead transmission lines either independently or in association with others and to purchase, take on lease, hire or otherwise acquire, whether in India or abroad, and either singly or jointly any mines, quarries, easements, lands and hereditaments or other property incidental for the aforesaid, ground, mining and other rights, grants, patents, permissions, concessions and to prospects, explore, examine, work, raise, bring to surface, extract, pump, drill, operate, exercise, develop, quarry, assay, refine, distill, amalgamate, manipulate, wash, process, beneficiate, blend, reduce, crush, cut , size, prepare for market and generally to on all kinds of business of mining, exploring, drilling, manufacturing, producing, processing, refining, liquefaction, re-gasification, compression, beneficiation, washery, crusher, distributing, trading, importing, exporting, storing and transporting of all kinds of elements including all types of coal, lignite, coke and all other material of every kind needed for or resulting from the mining, manufacturing, production or processing of coal; coke and other by products of every kind; hydrocarbon products of substances; fossil fuel and/or all sorts of major and minor and minor minerals, metal and mineral substances of all kinds; equipment's, machineries, ancillaries, spares, stores or any other item essential to undertake such activities/services successfully; conversion of coal to coke/coal to oil to gas/coal to thermal power; to undertake contract for seismic activities or surveys, research, data collection and interpretation and all other technical, non-technical or specialized services in the aforesaid field and to install, operate and manage all necessary plants, mines establishments and works.

b) To mine quarry or beneficiate coal and manufacture coke and other by products of coal, purchase or otherwise acquire all minerals and other material of every kind needed for or resulting from the mining, manufacturing, production, or processing of coal, coke and other by products of every kind and for this purpose to install and manage all necessary all necessary plants, mines, establishment work, exploration, development, production, processing, value addition, transportation, distribution of coal, coal bed methane, hydrocarbon, other energy resources and minerals, and energy resources products and their by-products.

c) To carry out the purchase of all equipment used in- exploration programs, including but not limited to; geophysical equipment, geochemical equipment, laboratory equipment, survey equipment, administration and data processing equipment, vehicles, camping equipment, and related filed equipment in mining programs including but not limited to; safety equipment, mining equipment, metallurgical equipment, milling equipment, laboratory equipment, engineering equipment, building materials, survey equipment, administration and data processing equipment, vehicles of various types, housing furniture and building materials and also all equipment required in mineral, coal and hydrocarbon processing beneficiation, refining, smelting, coal conversion to coke, oil, gas, thermal power, coal and bulk material handling facilities; pipe line layout, power transmission etc.

d) To carry on the business of buying, selling, importing, exporting, producing, trading, manufacturing or otherwise dealing in all products made of iron and steel, coking coal, manganese, limestone, refractory and other allied industries and for that purpose to install, operate and manage all necessary plants, mines, establishments, works.

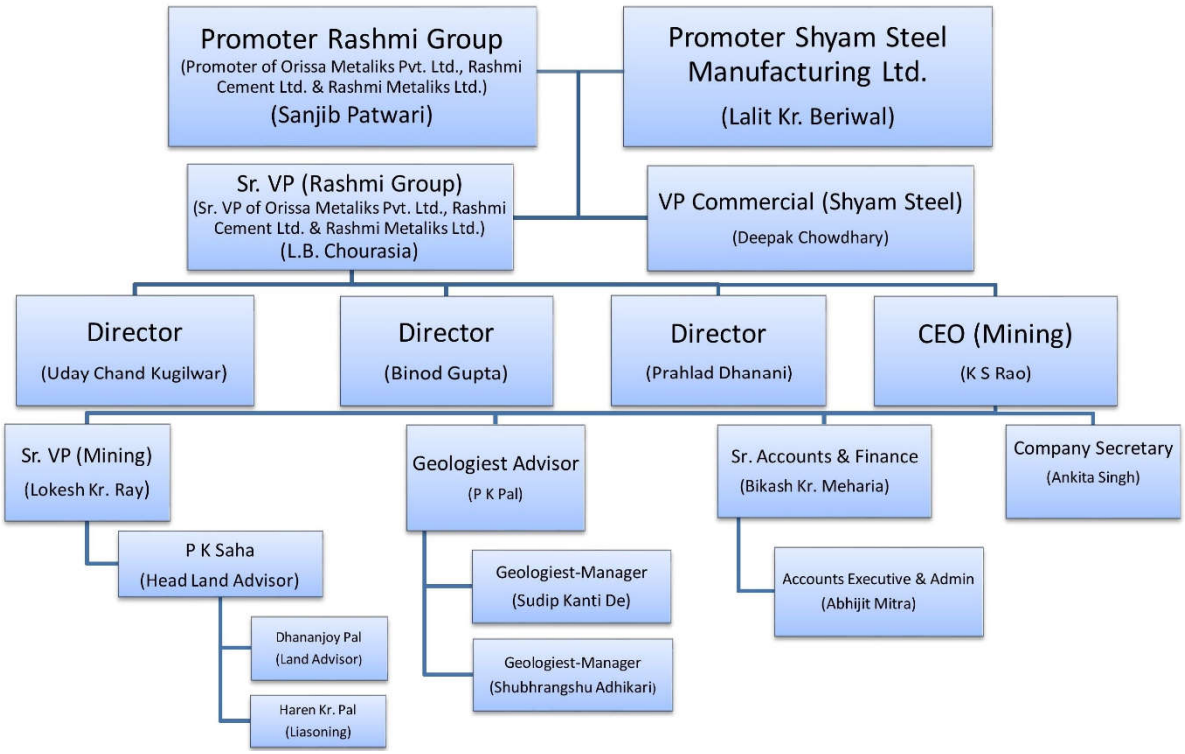
1.3b Share Holders and Board of Directors:

The Promotors of M/s Power Plus Traders Pvt. Ltd are Mr. Sanjib Patwari from Ms/ Rashmi Group-Kolkatta and Mr. Lalit Kumar Bariwal from Shyam, Steel-Kolkatta. Directors of Powerplus Traders Private Limited are Prahlad Dhanani, Binod Gupta, Uday Chand Kungilwar, While the Organogram of the is indicated in Figure 1.2. The information of Shareholders as on 27th June 2012 is as under in table 1.3.

Table 1.3 Details of Shareholders M/s PTPL, Kolkota as on 31st March 2021

Shareholder's Name	Type of Share	No of Shares	%
Orissa Metaliks Private Limited	Equity	135,000	54.00
Rashmi Cement Ltd	Equity	57,500	23.00
Shyam Steel Manufacturing Limited	Equity	57,500	23.00
		250,000	100.00

Figure 1.2 Organogram of M/s Power Plus Traders



1.4 Project Descriptions:

1.4a Phases of project:

The phase at the project site can be classified in three construction stages as Construction of Utilities above ground; Core construction core underground captive mine site; and activities related to mining closure:

1.4aa Construction Above the Ground:

About 24.14 Ha of land is required for establishment of infrastructure, which is required for working of the coalmine Jagannathpur B. Complete facilities near to the site are very important for coal production. It is imperative to develop core infrastructure like power, road, telecommunication, housing, service buildings viz. office, store, first aid center, canteen, etc. for a large number of employees for the project. The details of the ancillary facilities are indicated in ***Annexure 1.***

1.4ab Core Construction underground captive mine site:

The core underground construction is being done in three parts as development stage; production stage and depillaring stage and the details are as follows:

Development Stage: Two EBZ 260 / Equivalent Type Road headers are planned to drive two inclines after initial excavation up to 80m long (approx.) and RCC box cut of sufficient strength. After drivage up to 357 m, we will touch RIX seam. Immediately, one of the road headers is engaged for connection to the air shaft, for establishing ventilation to the workings. These two road headers are then engaged to drive reverse inclines of 1566m length, which connects / intersects all the seams from RVIIIT to RIII/II seams. After driving to the end of the inclines, these two road headers are used for developing inter-seam tunnels from one sector to another sector as planned, in advance, to facilitate the deployment of production machines without interruption to production.

Production Through Development of Coal Seams, Stage I: After touching or opening of RIX seam, one Continuous miner along with Twin bolter, Feeder breaker, shuttle car and other ancillary equipment will be engaged for coal production. As the seam is opened further, four numbers of LHD's with their ancillary equipment will be engaged for production as planned. The details / salient features of the equipment and method of working are given below:

UG Mechanized/semi mechanized bord & pillar:

- Low height LHD with Solid blasting for 1.2m to 2.5 m thickness;

- Low Height Continuous Miner (LHCM) for 1.5m-3.2m thickness;
- Standard Height CM for - 2.5m to 4.5m;
- The seam II/III, the bottom most seam, with thickness up to 8.8 m is proposed to be depillared from 58th year, and if an advanced Continuous Miners (CM) or other technology offering higher extraction becomes available at that time, the same could be tried after relevant approval.

    - 6 heading development panels up to 3m height or up to seam height, and road width of 6m is planned. Pillar sizes are envisaged in line with Regulation 111 of CMR 2017 depending upon depth.
    - Freshly exposed Roof will be supported by 4nos. x 1.8m length full column resin grouted roof bolts in galleries to achieve support density which will decided after detailed study by a reputed scientific institute and approved by DGMS.
    - The total seam will be developed in the same pattern, leaving coal pillars from inbye to outbye of the coal seam/ sector, upto the boundary of the seam/ sector.
    - In LHD panel, 4LHDs are envisaged.
    - In continuous miner panel, the LHCM is envisaged along with 2 shuttle cars and 2 Twin Boom Twin Rig roof bolters and one feeder breaker.
    - During retreat from the panel, the pillars are extracted by Fish and Tail method (for pillar size 19.5mX19.5m and 25.5mX25.5m) and by Split and Fender method for larger size pillars.
    - Trunk conveyor will be 1000 / 1200 mm, around 3m/s with average capacity of 500 tph.
    - Underground bunkers of sufficient capacity will be constructed at suitable locations.

Production Through Development of Coal Seams, Stage II: Immediately after the reverse inclines touch the **RVII seam,** one road header will be engaged to drive a connection to air shaft and establish ventilation to the workings. After the ventilation is established in RVII seam, another Continuous Miner with all its ancillary equipment like shuttle car, feeder breaker, twin bolters etc., will be engaged for coal production as planned. 4 numbers of LHD's with their ancillary equipment are also planned to engage for production. It is planned to engage similar equipment as in the production stage I, as it is convenient for procurement, maintenance of the machinery and spares management etc.

Depillaring Stage: Once the development of coal pillars was completed up to the boundary of the coal seam / sector, depillaring panels will be formed as per the Rules and regulations stipulated CMR 2017.

- Apply and obtain permission from DGMS (Director General of Mines Safety) for depillaring operations.

- After obtaining permission from DGMS, and fulfilling all the conditions specified in the permission like land acquisition, construction of protective works, subsidence survey, diversion of nallahs/ roads/ villages etc., fencing of surface area over depillaring panels and etc.

- Depillaring / extraction of the standing coal pillars will be done by Fish and Tail method (for pillar size 19.5mX19.5m and 25.5mX25.5m) and by Split and Fender method for larger size pillars, or variations thereof, as approved by DGMS, allowing the roof in the area of extraction to cave in /collapse.

This roof caving may lead to subsidence on the surface and may create cracks and potholes on the surface, through which there is a chance of air leaking into underground workings / goaf area causing fire in the goaf. The above problem is mitigated by filling these cracks and potholes by regular inspection and dozing. Moreover, Nitrogen / carbon-dioxide flushing may be done into the goal in the event of heating / fire to make the underground workings safe.

After extraction of all the available coal in the depillaring panel, the panel will be completely isolated as per the DGMS permission conditions. The sequence of extraction of depillaring panels will be from out-bye to in-bye of the coal seam/ sector from the boundary to incline connection point. Once the upper seam is extracted completely, the machinery will be shifted to lower seam as planned. During extraction of coal pillars in the lower seam, it will be ensured that the upper seam's isolated goaf's are free from water. The above prescribed Development and Depillaring stages continue till the end of life of the project. Once all the coal from Seam III/II is extracted as per the planned schedule, the mine will be closed as per the approved Mine Closure plan.

1.4ac Activities related to mining closure:

All the safety measures as laid down in the approved mine closure plan will be implemented.

Water Quality:

Existing Water bodies:

1. Ajay river perennial river is flowing (from north to south) along the eastern boundary of the block.
2. There is a seasonal nala aligned from north to south flowing almost along and in between the roads mentioned under point 2 and 3 above.

3. There is another seasonal nala (Tumni), also N-S aligned, flowing almost parallel to the western boundary for most of the span but finally touching the western boundary and exiting the southern boundary.
4. Additionally, there are a number of shallow depth ponds in almost all the villages.

Measures to be taken for protection of water bodies:

- This mine is an underground mine.
- No diversion of any surface drainage channel is envisaged.
- It also does not involve any excavation, dumping or re-handling of wastes unlike in case of opencast mines. The only activities involved in this case will be limited to dismantling of the surface facilities. Due care will be taken for protection of the surface water bodies by surrounding them by garland drains and catch pits directing any flow towards the settling ponds existing for that purpose. Therefore the erosion, sedimentation and silting in the water bodies will be will be negligible.
- No specific treatment is likely to be required before release of the water from the area under demolition/ dismantling. However, the water quality will be regularly monitored during the full span of post mine closure period of 3 years and appropriate control measures will be adopted to prevent pollution of surface water bodies in the area.
- Any contamination of ground water sources is not anticipated from leaching etc. as no such materials or waste will be required to be handled.

AIR QUALITY: This mine is an underground mine.

- It also does not involve any major dust generating activities like excavation, dumping or rehandling of wastes unlike in case of opencast mines. The only activities involved in this case will be limited to dismantling of the surface facilities and demolition of buildings. Another source of air pollution will be the fuel (Diesel/ Petrol) consumption resulting into fumes generation.
- Due care will be taken for protection of the air quality from the dust and fumes generating sources.
- The water spraying will be practiced before and after demolition of buildings and dismantling of sheds/ machines etc.
- The fuel oil using equipment being used during the dismantling and transportation will be maintained well and tested for emission regularly.
- However, the air quality will be regularly monitored during the full span of post mine closure period of 3 years and appropriate control measures

will be adopted to prevent pollution going above the permissible levels in the area.

Restoration of land used for infrastructure: All the infrastructure facilities are proposed to be dismantled as given in *Annexure 2*.

Disposal of Mining Machinery:

- All machinery and installations shall be removed from the site.
- Machinery will either be transferred to other sites of the Company (if applicable), sold off or disposed off as a scrap.

SAFETY & SECURITY:

Measures to be implemented to prevent access to surface opening for underground working, excavation etc.

The following safety and security measures will be adopted during final mine closure activities of the Under Ground Mine:

1) All surface openings to underground work sites will be backfilled and levelled to blend in with the surrounding topography, or will be concrete-capped.

2) All access roads will be condemned and a fence or embankment meeting regulatory standards will be built.

3) subsidence will occur in the area where full pillar extraction is done and allowed the roof to cave in. surface land above the depillared panels will be properly fenced off, all the cracks which are extended to surface will be properly filled by dozing and all other precautions will be taken as stipulated by DGMS.

4) For stability of surface structures beneath which in underground some pillars will be left for protection of the structures.

5) The left-over pillars in underground mine cannot be guaranteed for stability on long term. If any problem arises due to instability of pillars fencing will be built around the problematic area.

6) Only authorized personnel will be allowed to carry out abandonment and post-project monitoring activities.

7) No coal has been left on the ground to prevent accidental fire.

8) All the boreholes, subsidence affected area, cuttings in the mining leasehold area shall be properly sealed so as to prevent access to these.

9) All the electrical/ mechanical equipment such as shaft, Incline, conveyor belt etc./ facilities shall be decommissioned suitably so as to prevent any accident.

10) The drainage pattern of the reclaimed area will be properly planned to divert the surface water flow during monsoon.

11) Monitoring facilities have been established for monitoring the soil/ air/ water quality, effectiveness of reclamation measures etc.

The provisions of Coal Mines Regulations/Rules/Circulars of DGMS would be strictly followed during mine closure operations. Safety training will be imparted to the employees for protection against land slide/ fall, moving equipment, precautions during blasting operations, protection against accidental fire or electric shock etc. In case of any temporary discontinuance, security guards will be provided to prevent stray animals or persons entering the mine. Temporary fencing with notices will be put up.

1.4b Examination of alternative site:

This is proposed coal mine having underground mining process and its lease area about 856.68 ha with proposed production capacity 0.8 MTPA for which Mining Lease has to be granted by Govt. of West Bengal. As the first step to develop mines in the block, PTPL procured the GR (2011) from MOC (Vide MOC's letter No. NA-104/4/2019-NA Dt. 06-03-20) and reviewed the data. The mine plan has been prepared and going to be submitted for grant of mining Plan from MOC-GOI. The present site Jagannath Coal block has been incurred in the year 2010 and investigation carried out thereafter and after thorough investigation coal seam has been identified in the present area. The location of incline and shaft 1 was chosen in sector 3, because of the following reasons:

1. The property has a number of strike faults with high throws up to 80 to 250m; and due to the existing alignment of faults, very small fault free zone is available for locating the incline.
2. The location of inclines and shaft 1 was at higher altitude comparing to the nearby location, and it is planned above HFL at that area. This will prevent sudden flooding of mine workings through the inclines and shaft.
3. Incorp of any of the seam is not available throughout the coal block.
4. Availability of land: about 120 acres of land is required for inclines and others infrastructure like office building, CHP, workshops, WTP, STP stores, substation, stock yard, Weigh Bridge etc. As land is available at this particular location, it has been selected for incline and other infrastructure.

5. In addition to the above, Shaft 1 was planned at this particular location, because the distance between incline connection point in R-IX seam and R-VII seam should be as shorter as possible.
6. Nearer to the available road and away from villages, which will reduce the related air and noise pollution in the villages

1.4c Core design features and size and type of facilities:

Jaganathpur B coal block is proposed to be developed and worked as an underground coal mine. The salient features of the coal block are:

- Multiple coal seams of varying thickness
- Seam depth ranges from shallow to deep (over 450 m)
- Highly faulted strata
- Presence of surface features like villages, ponds, roads and Nallahs

Keeping the above in mind, the following key mine planning / design features have been worked out:

a) Mode of entry underground
b) Sequence of extraction of the multiple coal seams
c) Method of working / extraction of the coal seams
d) Choice of mining machinery for coal extraction and transport

These points may be further elaborated as follows:

a) Chosen Mode for Entry Underground: Coal reserves can be accessed in a number of ways, the choice of which is influenced by factors such as strata, depth, number of seams to be extracted and volume of production. The choice usually lies between Shafts (which are vertical connections between the surface and the coal seams) and Inclines (which are sloping connections). The former is preferred where the coal deposit is deep seated and the latter where the coal seams are near the surface. Inclines also facilitate the transport of large volumes of coal in a simpler manner than in case of shafts which require more costly and complex infrastructure. In this case, the upper coal seams are near the surface and can be easily accessed by short inclines enabling early coal production. The volume of output is also high at 0.8 to 1.2 million tonnes per annum which can be more easily transported out of the mine by belt conveyors installed in the inclines. The ground / strata is relatively soft facilitating quick drivage of inclines by road heading machines.

b) Sequence of Extraction of the Multiple Coal Seams The coal seams are proposed to be extracted from top downwards i.e. the shallowest seam will be extracted first followed by the next seam lying below it and so on. This will enable the roof strata to cave in after coal extraction and settle down before the next seam below it is extracted. Thus, the upper strata is de-stressed enabling better roof control and safer mining.

c) **Method of Working / Extraction of the Coal Seams:** The Bord and Pillar (B&P) method of mining has been chosen in preference to the longwall method in view of the geologically disturbed nature of the strata which does not provide adequately large and geologically undisturbed zones suitable for longwall mining. The B&P method allows for the formation of smaller coal panels / zones which can be independently extracted before moving to the next coal panel / zone. Another major reason is the need to protect certain surface features like village dwellings / structures, ponds, Nallahs and roads. Unlike the longwall method, the B&P method allows development of roadways and selective extraction of coal pillars taking the surface features into consideration.

d) **Choice of Mining Machinery for Coal Extraction and Transport:** High-capacity belt conveyors have been chosen for coal transport from the coal face to the surface. This fits in with the B&P method as well as the mode of entry by inclines and the surface coal handling plant. The technology of coal extraction is proposed to be by Continuous Miner package which has been proved to be very successful in India and overseas for B&P method of mining. It has several unique advantages:
   - Much more flexible than longwall method
   - Less capital intensive than longwall equipment
   - Can extract a wide range of seam thicknesses
   - Can be easily transported into the mine through the inclines without the need for special transportation requirements
   - Highly mobile enabling quick transfer from one part of the mine to another
   - Enables modern roof control methods like advanced technology high speed resin roof bolting making mining safer.
   - Highly productive

1.4d Need for ancillary infrastructural facilities:

Complete facilities near to the site are very important for coal production. It is imperative to develop core infrastructure like power, road, telecommunication, housing, service buildings viz. office, store, first aid centre, canteen, etc. for a large number of employees for the project. The mine is at a distance of about 15 km from thenearest city Durgapur. Facilities such as Workshops, stores, statutory facilities, magazine, sub-stations, office complex, and different community buildings shall be provided as per technological requirement and a sound living condition for the project people. The details of the construction on land (using Land use map) are indicated in ***Annexure 1.***

It should be noted that Garage-cum-workshop-cum-engineering store proposed is meant for regular repairs and maintenance of equipment and trucks etc. for mining operation. The garage and workshop complex comprises repairs bays (for trucks / dumpers and pay-loaders, washing bays), storage rooms, inspection pits, open yard for parking of vehicles.

While the **water requirement** for washing, sprinkling on mine roads for dust suppression and for watering the mine site plantations, will be supplied from pumping installation at mine sump and surface reservoir. Initially the drinking water will be supplied from bore well and later on, when water is available from the mine; it will be met from the mine after treatment. The water will be first stored in overhead tank near the facilities area and distributed through pipe lines to different facilities area for drinking and domestic purposes. Total requirement of water for mining and allied activities is estimated as 615m3/day as detailed in table 1.4.

Table 1.4 Details of the physical establishment requiring water (KLD)

Sr	Estimated Requirement of Water	KLD
1	Underground Spraying after blasting, conveyor transfer points etc.), KL	15
2	Underground water requirement for continuous miner @ 250 lpm/machine for one unit assuming 50% effective operational time (2 nos), KL	360
3	Sprinkling at surface for roads, CHP, coal stack etc., KL	60
4	Fire water makeup, KL	10
5	Plantation @ 15 cum/hac for 2 hac. (Part of plantation), KL	30
6	Vehicles washing @ 2.0 m3/vehicle/day for 15 vehicles considering 50% recirculation, KL	15
7	Drinking water at working place, KL	45
8	For essential quarters, KL	60
9	For peripheral villages (potable), KL	20
	Total KL Per Day	**615**

Source: Minning Plan Vol 1 of Jagannathpur for PPTPL, Calcutta

Besides a large number of transport vehicles will operate on diesel. Hence, a **Diesel Storage** with Capacity 30 KL diesel pump will be established at the mine site. A diesel tanker will also be provided for the transport of diesel to DG sets at mine. At a distance of 500 meters an **Explosive Magazine** will be constructed to develop about 20 tones capacity within the MLA. The **Power** requirement of 15 MW power supply at 33 KV will be drawn from nearest substation Laudoha to the local sub-station from where the power will be supplied to the mine and other functional buildings. An emergency arrangement for power supply has been made by providing a set of 1000 KVA and 500 KVA DG sets, which will take care of ventilation and pumping and other essential services. The requirement of electrical equipment's requiring total electricity (In KV) is shown in ***Annexure 3***:

The description of the other surface activities are as follows:

Coal handling plant:

- The Coal Handling Plant (CHP) is proposed to be located at the top of Incline where the out coming conveyor will discharge the coal into the pit head bunkers.
- The coal will be dispatched from the bunkers of CHPs to the railway siding at Ukhra located at a distance of 19 km from the Jagannathpur B mine.

Transport through the incline:

- The coal produced in the district is loaded to a pony conveyor in LHD district and in shuttle cars in Continuous miner district to transfer it to Gate conveyors. This coal is collected by Trunk conveyors and delivered over to a series of main conveyors. These conveyors will ultimately deliver the coal to the main incline conveyor.
- The coal coming via main incline belt conveyor will directly deliver coal into a series of ground level (GL) bunkers of 2000T capacity. From GL bunkers the coal is transported to crusher house, where the coal is crushed to required size. From crusher house, coal will be transported to truck loading system via an elevated conveyor. A provision for ground stock is also provided which will be liquidated through pay loader.

Transport through the upcast shaft:

- The upcast shafts are meant for ventilation only, no other transport is planned through the shafts, and Main Fan of suitable capacity will be installed on the surface of the upcast shaft, which will produce sufficient air to underground workings.

Material Transport:

- Materials such as timber, roof bolts, grouts/resins, spare parts, cables, lubricants, ventilation-stopping materials etc. are to be transported by the mine to within one pillar of the face.

Transport of waste Rock from underground

- The wastage produced during the roof ripping as well as from the cross-fault drifts will be taken out to surface by rope haulage/belt conveyor depending upon site specific conditions.

Man riding System

- The man riding system will be installed in a manner that transportation for men through man riding chair cars is done at the beginning and the end of the shift through the same route ensuring full and proper safety to persons availing the man riding system. The man riding system will be installed in main incline and reverse cross measure drift from

surface to Seam III/II. Transport of men will also be available through the upcast shaft No. 2 also later in case of requirement.

Surface transport of coal and wastage:

- The surface transport of coal will be done by Coal Tippers pit head stockpile stock yards at railway sidings.
- The wastage produced during drifting will be transported by trucks from the pit-mouth or incline mouth to the low-lying areas, coal transport road construction sites and balance reject/ waste rock yard area delineated at surface.
- The transportation of coal to the nearest railway siding for further transport to different destinations (by railways) will be carried by 20T capacity covered trucks.

14.e Work force requirements (Temporary and permanent):

Manpower requirements are assessed on the basis of 7 days week and 330 days of annual working. The peak manpower of this project has been estimated as 1920 for the mine to be operated departmentally. Manpower under broad heads is given in ***Annexure 4*** and summary is indicated in Table 1.5. A total of 1850 manpower would be appointed to operationalize the mine, of which 16% was allocated for surface activities while 84% were utilized for underground operations.

Table 1.5 Workforce Classification by Office division of Jagannath (B) Mines

Place	Operation	Maintenance	Supervision	Others	Total	%age
Undergorund	920	420	130	0	1470	**81**
Surface	200	60	39	36	335	**19**
Total	1120	480	169	36	1805	**100**
%age	**62.0**	**26.6**	**9.4**	**2.0**	**100**	

Source: MLA Plan of Jagannathpur for PPTPL, Calcutta Note: Includes both Permanent and Temporary Employees

In addition there will be requirement of unskilled manpower for different activities who may be employed by outsourcing. Adding to this, the total picture shows that about 81% of the work force will be supporting the underground operations and only 19% of the workforce required to cater surface activities in the Jagannathpur Mine(B). Owing to the nature of work, about 62% shall employed for operations activities, 26.6% for maintenance, 9.4% for supervision and only 2% as other contractual workers used to take care other surface activities.

1.5 Applicable legislations and policies:

Various activities/codes in conformation with the prevailing statutory provisions, such as Mines act 1952, CMR 1957 and various DGMS circulars & bye-laws need to be formulated for carrying on mining operation. All other statutory requirements related to Govt. licenses, workmen compensation, insurance, minimum wages Act for outsourced manpower, rules imposed by State Govt./ central Govt etc. are to be adhered to. Out of various Acts and Rules, the following find maximum application in mining operation.

1. Administration of the Coal Mines Provident Fund and MiscellaneousProvision Act, 1948 (46 of 1948),
2. Administration of Coal MinesNationalization Act, 1973 (26 of 1973),
3. Administration of the Coal Mines (Conservation and Development) Act, 1974 (28of 1974),
4. rules under the Mines Act, 1952 (32 of 1952)for the levy and collection of duty of excise on coke and coal produced and despatched from mines and administration of rescue fund,
5. Administration of theCoal Bearing Areas (Acquisition and Development) Act, 1957 (20 of 1957),
6. Administration of the Mines and Minerals (Development and Regulation) Act,1957 (67 of 1957)
7. Coal mines Rules 1966
8. Coal mines Act 2015
9. Coal mines Act 2020
10. Mineral-Laws Amendment Ordinance 2020
11. Vocational Training Rules 1966
12. Indian Electricity Rules 1956
13. Factories Act 1948
14. Updated DGMS circulars (8) Recommendations of NSC
15. Recommendations of Tripartite Safety Review committees
16. The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Second Amendment) Bill, 2015
17. The RFCTLARR (Compensation, RR, Development Plan) Rules 2015
18. Land Acquisition, Rehabilitation and Resettlement Act, 2013

2: Description of Study Design

2.1 Rationale:

Today, in the modern-day times in India largely rely upon the commercial (70%) and domestic consumption (30%). With growing demand of the steel industries, a thrust has been given on systematic exploration of coal reserves all over the India especially eastern part of the country. Thus today, the Govt. of India provided adequate capital investment to meet thrive energy demand of the country but was not contributed by the private coal mine owners. Unscientific mining practices adopted by some of them and poor working conditions of labour in some of the private coal mines became matters of concern for the Government. On account of these reasons, the Central Government took a decision to nationalise the private coal mines.

The nationalisation was done in two phases, the first with the coking coal mines in 1971-72 and then with the non-coking coal mines in 1973. In October, 1971, the Coking Coal Mines (Emergency Provisions) Act, 1971 provided for taking over in public interest of the management of coking coal mines and coke oven plants pending nationalisation. This was followed by the nationalisation of all these mines on 1.5.1973 with the enactment of the Coal Mines (Nationalisation) Act, 1973 which now is the piece of Central legislation determining the eligibility of coal mining in India. However, the phase of nationalizing the private coal mining remained at slow pace and could work against the growing demand of coal and hence it was decided to conduct auction of the unexplored coal mines to the private sector.

As per the annual Report of Coal & Mines 2020-21 - based on the demand projection in 'Coal Vision 2030 for coal sector in the country and subsequent demand projection on CIL, a road map to produce 1 BT coal by the year 2023-24 was made in order to reduce both the demand-supply gap and non-essential import of coal in the country. Further, the reports also highlight under the provision of MMDR Act, 1957 and rules made there under, 11 Coal blocks have been allocated to Government Companies (Central/State). Out of these 11, coal blocks, 9 coal blocks are allocated for end use power and 2 coal blocks are allocated for commercial mining/sale of coal. CBDPA (Coal block Development and Production Agreements) has been signed with respect to 11 coal blocks. Further, 4 Coal blocks have been decided to allocate to CIL/its subsidiaries for making them more than 100 MT companies.

Referring the Coal Mines (SPECIAL PROVISIONS) Act, 2015 NO. 11 of 2015 (2) 30th March, 2015, CHAITRA 9, 1937 (SAKA), New Delhi, and subsequently referring Office Memorandums (2017 & 2018) Subject: Directions of the Central Government for auction of coal mines under the CM(SP) Act, 2015 -

the Govt. of India, the allocation of 204 coal mines de-allocated by Honourable Supreme. Under the provision of the Act, a total of 98 coal mines have been allocated till date. Out of this, allocation of 12 coal mines have been cancelled. Out of which remaining 86 coal mines, 26 mines have been allocated through allotment. Out of 26 auctioned mines, 15 mines have got mine opening permission (11 under production). Out of 60 allotted mines, 18 mines have got mine opening permission (13 under production) (Annual Report 2020-21). This allocation will increase coal production in the country and reduce the dependence of industries on imported coal.

Opening up of commercial coal mining for private sector is the most ambitious coal sector reform since the nationalisation of this sector in 1973 Methodology gives highest priority to transparency, ease of doing business and ensuring that natural resources are used for national development thereby bring efficiency into the coal sector by moving from an era of monopoly to competition. Higher investment will create direct and indirect employment. It will also lead to energy security through assured coal supply, accountable allocation of coal and affordable coal The allocation has been done with an aim to generate huge revenue for state governments where these mines are located in the form of upfront amount, royalties and other applicable taxes.

M/s Power Plus Traders Private Limited have been allocated Jagannathpur B coal mine with order No: NA-104/4/2019-NA dated 13th February 2020, under vesting order under clause (b) of sub rule (2) of rule 7 and sub-rule (1) of rule 13. From the office of the nominated authority constituted under section 6 of the Coal Mines (special Provision) Act, 2015, O/o Nominated authority, Ministry of Coal, Govt. of India, Shastri Bhavan, New Delhi.

Thus, the purpose criteria listed in the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 is largely related, when acquiring the land as specified in Mining Lease Area (MLA) for undergoing the quarrying of the coal through underground mining. Owing to aforesaid Act of Land acquisition, M/s Power Plus Traders Private Limited hired third party evaluator (external expert) M/s DRHS Consultancy Services (refer WO No: PPTPL/DRHS/0001/2020-21; dated 30th March 2021) to conduct Social impact study under the Right of Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act of September 2013 No. 30 and also incorporating extraordinary Part II Section 3 sub section (i) and incorporating The COAL MINES (SPECIAL PROVISIONS) ACT, 2015 NO. 11 OF 2015 and mines and minerals (development and regulation) Amendment act, 2015 no. 10 of 2015 (and thereafter subsequent amendment being done in 2020) with following major objectives.

2.2 Objectives:

The following are the main objective to conduct Social Impact Study

- To study the present socio-economic conditions of the people in the command area of the link mines, submergence area of mines & barrage and to assess the likely effect of the project in improving the socio-economic conditions of the people.
- To assess the environmental impacts related to the location, design, structure and operation of the project. The impact due to project location should discuss the resettlement and rehabilitation of displaced families, assessment of loss of forest, natural reserves, bio-physical impact etc.
- To assess the socio-economic conditions of the people in the mining command area by conducting a bench-mark survey in the command area sample and to assess the likely economic impact of the project.
- To assess the area of mining using satellite imagery and integrating the with Geographical Information system for slope analysis, Land cover and land use, DME, demarcating MLA boundaries with GPS coordinates of pillars etc

2.3a Specific Objectives:

The following are the objectives for Social Impact Assessment for the Janganathpur B Coal Mines (Ranigunj Coal Field) district Paschim Bardhaman coal block owned by PTPL, Kolkata as under

a. Both Primary and secondary analysis of demographic profile (human population and livestock) including rate of growth, area, sex ratio, literacy rate, percentage of classified workers, residential houses, villages, towns, etc. in the study area.
   - Infra-structural facilities available in the study area (both Social & Economic).
   - Likely changes in basic amenities and socio-economic aspects like drinking water, power supply, sanitation, education and public health amenities.
   - Likely improvement in livestock and poultry farm population and Grazing lands.

b. Identify the potential of Social and Economic changes and conduct the Impact assessment, through field survey for directly affected families and or for the families whose land or other infrastructure acquisition are to be made

c. Identify the number of families/households are being displaced with the acquisition of the land and conduct census of the displaced families for development of the future Rehabilitation and Resettlement program for the Janganathpur B Coal Mines (Ranigunj Coal Field) district Paschim Bardhaman coal block coal block owned by PTPL, Kolkata

d. Enumerate the potential compensation to be made as per valuation in accordance to the rural circle rates of the state administration for acquisition of land, plus solatium and market rate as per the prevailing the right to fair compensation and transparency in Land acquisition, Rehabilitation and Resettlement Act 2013 & 2015 and THE COAL MINES (SPECIAL PROVISIONS) ACT, 2015 NO. 11 OF 2015 and mines and minerals (development and regulation) Amendment act, 2015 no. 10 of 2015.

e. Explore the Environmental issue caused due to displaced of the population from the project are as well with the advent of the Janganathpur B Coal Mines (Ranigunj Coal Field) district Paschim Bardhaman coal block mines

f. Analyze and highlight the benefits of the project, that will serve the public purpose or not and analyze the potential of cost benefits outweigh the social costs and adverse social impact.

g. The impact of changes in nature of work due to commissioning of the project and the employment generation possibilities, including self-employment.

h. The role on intensive agriculture on the improvement of status among the people including improvement on the cropping pattern practices and input pattern.

i. Gross economical income in the study area at present and future trends. Overall per capita income at present and likely changes in the future.

j. Possible improvement in surface and ground water availability and benefits accrued to irrigated agriculture, drinking water use, wetlands and fisheries and in coal ,mining activities.

k. To assess the economic economic impact. Qualification, in monetary terms, of the benefits that would accrue from improvement of various sections of society. Wherever it is non-quantifiable in financial terms, a qualitative assessment in economic terms may also be provided.

l. Identify the Social safeguard issues pertaining to social protection and enumerate the risk of operation of mining with the community set up in the core mining regions and linked with social development program with mandatory proposed budget under CSR/EMP for Social and Infrastructure Development.

m. Identify and recommend steps to mitigate or enhance negative or positive aspects of change while developing the Rehabilitation & Resettlement / Social Impact Management Plan with initiative taken under social and infrastructure development through reserved fund of CER/CSR/ EMP for Social and Infrastructure Development. funds which will help the Janganathpur B Coal Mines (Ranigunj Coal Field) district Paschim

Bardhaman coal block owned by PTPL, Kolkata administration to complete the project without any conflicts and crises.

n. The objectives of use of satellite data are:

- To develop 10 km map of the project area
- To determine the present land use pattern as per EIA/EMP norms by MoEFCC
- To determine the drainage pattern with slop analysis.

2.3b Methodology

2.3b1 Household and village Survey

- STEP 1: The project site will be visited by the external appointed Team of SIA expert, who apart from doing field investigation will meet the concerned Government officials and collected all documentary evidence as well. Besides, the concern land records of the concern parties were acquired from the prevailing PWD office records of the district administration, to understand the positive or negative aspects of mitigations.

- STEP 2: The desired level of survey (Village/Households/Thematic Survey) would be done by the respective experts and other field investigators.

- STEP 3: The calculation for the fair compensation was largely based on the Government Land Acquisition Act 2013, which is made as per Safeguard norms of the Government Revenue in the form of the Stamp Duty decided for State West Bengal with the revise circle rates for agriculture and non-agricultural land. The calculation of the solatium was made owing to the status of land when acquired as un-productive barren land.

- STEP 4: The household level study would be conducted through 10% households in villages (may/may not shifted) as well as focus group discussions (FGDs) with the villagers, community leaders and the concerned authorities would be conducted in sample villages.

- STEP 5: Apart from compensation, preliminary action plan for Rehabilitation and Resettlements and Social Impact Management Plan will be conducted after detailed primary and secondary data analysis for the aforesaid specific objectives.

2.3b2 Satellite imagery and GIS

The land-use & land cover map of the 5 km radial study area from the periphery of project site has been prepared using Resource SAT-2 (IRS-P6),

sensor- LISS-4 having 5.6 m spatial resolution and date of pass 4th March 2021 satellite image with reference to Google Earth data and the IRS-P5- Cartosat-I data having 2.5 m spatial resolution and date of pass 04th April 2021. In order to strengthen the baseline information on existing land use pattern, the following data covering approx. the proposed project site is lies between latitude & longitude 23°38'38.29"N- 23°40'12.25"N-87°21'56.93"-87°24'41.74"E for proposed mining area and whole 10 Km radius 23°33'13.99" to 23°45'26.99" N & longitude 87°16'00.31" to 87°30'38.52" E and the elevation is about Plain land about 44 m to 98 m for mining area as well as whole 10 km radius. Land use pattern of the study area as well as the catchment area was carried out by standard methods of analysis of remotely sensed data and followed by ground truth collection and interpretation of satellite data. The outcome of land use study is presented below in subsequent tables and figures.

Table 2.1: Details of Satellite Data specification

Satellite/ Image	Sensor	Scene-Spec	Spatial resolution	Date of Acquisition
Resource SAT-1	LISS-4	102-059D	5.6 m	4th March 2021
IRS-P-5	Cartosat-1	R-1-100-56	2.5 m	4th April 2021
For Change detection all LISS-3 Data used				
Resource SAT-1	LISS-3	094-50D	23.5 m	April 2008, Nov-2012 & Jan 2018
Remote sensing data	Scene specifications			
-IRS P6 LISS-4 Scene -IRS-P5 Carto sat-I data	Survey of India toposheet bearing Toposheet No. F45D/6 (old – 73 M/6), F45C/13 (old – 73 I/13), F45C/14 (old – 73 I/14), F45D/1 (Old 73 M/1, F45D/2 (Old-73M/2) and F43D/5 (old – 73 M/6) of 1:50000 scale.			
Google Earth				

The land use pattern of the study area was studied by analysing the available secondary data published in the District Primary Census abstract of the year 2001 & 2011. Salient features of the adopted methodology are given below:

- Acquisition of satellite data
- Preparation of base map from Survey of India topo sheets
- Data analysis using visual interpretation techniques
- Ground truth studies or field checks using GPS
- Finalization of the map
- Digitization using head up vectorisation method
- Topology construction in GIS
- Area calculation for statistics generation
- Masking

The spatial resolution and the spectral bands in which the sensor collects the remotely sensed data are two important parameters for any land use survey. IRS P6 LISS III data offers spatial resolution of 23.5 m with the swath width of 141 x 141 km. the data is collected in four visible bands namely green (Band 2) (0.52-0.59µ), red (Band 3) (0.62-0.69µ), near infrared (NIR) (Band 4) (0.77-0.89µ), short wave infrared band (Band 5) (1.55-1.75µ) with orbit repeat period of 24 days (three days revisit). The shapes, sizes, colours, tone and texture of several geomorphic features are visible in IRS data.

Four spectral bands provide high degree of measurability through band combination including FCC generation, bands rationing, classification etc. These features of the IRS data are particularity important for better comprehension and delineation of the land use classes. Hence, IRS P6 LISS-IV data and IRS-P5 – Carto sat-I data having 2.5 m spatial resolution having pan chromatic imagery has been used for land use mapping.

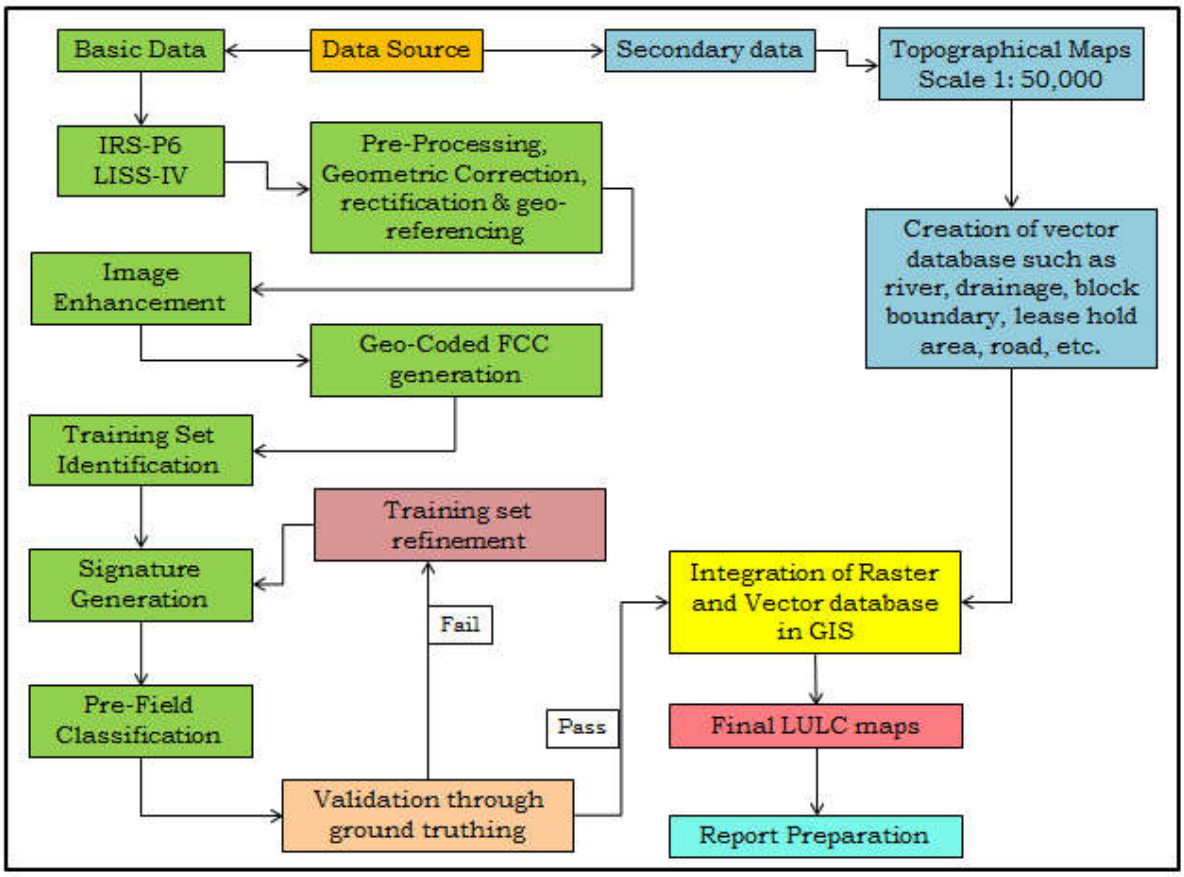
The digital image processing was performed on Arc GIS-10.7.1, ERDAS Imagine 2014 and QGIS 2.2 software system on high-configured computer. This software package is a collection of image processing functions necessary for pre-processing, rectification, band combination, filtering, statistics, classification, etc. Apart from contrast stretching, there are large numbers of image processing functions that can be performed on this station. Arc GIS map 10x is used for final layout presentation.

The satellite data from the compact disc is loaded on the hard disk and by studying quick look (the sampled image of the appropriate area ;) the sub-scene of the study area is extracted. Supervised classification using all the spectral bands can separate fairly accurately, the different land use classes at level II on the basis of the spectral responses, which involve the following three steps:

1. Acquisition of ground truth
2. Calculation of the statistics of training area
3. Classification using maximum likelihood algorithm

The training areas for classification were homogeneous, well spread throughout the scene with bordering pixels excluded in processing. Several training sets have been used through the scene for similar land use classes. After evaluating the statistical parameters of training sets, the training areas were rectified by deleting no congruous training sets and creating new ones. Figure 2.1 represent the methodology.

Figure 2.1 Methodology using Satellite data with GIS for analysis of physical feature



2.4 Sampling

The village level survey was conducted in 18% of the sample villages and within the sample villages nearly 10% of the household's information was enumerated covering 8% of the population indicated in table 2.2.

Table 2.2: Summary of the Sampling villages for household survey

Sr.	Criteria for selection of villages	Sample Villages	Number of Households*			
			Total Households	Total Population	Sample Households	Sample Population
1	Villages in the mining lease area	09	1552	6776	160	575
2	Villages beside Ajay River near to MLA	06	341	1646	40	210
3	Villages in 10 km radial distance	21	6005	26574	600	2158
	Total number of villages	**36**	**7898**	**34996**	**800**	**2943**

*** Note:** The villages are being tallied with Paschim Bardhhaman & Birbhum District Census Handbook 2011,
: While doing HH survey in 2021, the expected sample HH will touch around 900-1000, with 36 village level FGDs and 36 Village Information Sheets. ** The list of 36 sample villages coming the radial distance of 10 km (Refer Annexure 5).

About 194 villages (Figure 1) are located in the 10 km radial distance from the project site (Jagannathpur B Coal Mines (Ranigunj Coal Field) district Paschim Bardhhaman coal block owned by PTPL; Kolkata) and nearly 36 sample villages were selected to conduct household level survey and do the collection of village level information as indicated in figure 2.1 and 2.2 The fixed sampling

includes mandatory 9 villages coming in the mining lease area and 6 villages adjoining to the Ajay river near to mining lease area. The remaining 21 villages were selected randomly from total 174 villages within the 10km radial distance. These 174 villages were first randomly listed and based on the systematic random sampling method (Using 8 as random number), these 21 villages were selected as indicated in ***Annexure 5***.

2.5 Data Collection & Processing tools:

2.5a Village and Household Data

Owing to the objectives of the study the following data tools would be used to gather the information pertaining to Social & Economic Impact Assessment.
Data tool 1: Socio Economic & Culture pattern–HH information-Annexure 6
Data tool 2: Impact Assessment and Suggested mitigation measures
Data tool 3: Enumerating Cost of displaced items of the family (land)
Data tool 4: Project Area assessment tool – Village information-Annexure 7

By large the village level and household data were information analysed using Microsoft Excel 2019.

2.5b Satellite Data

2.5 b1Ground Truth Collection

Both topo sheets and imagery were carried for field verification and a transverse plan using existing road network was made to cover as many representative sample areas as possible to observe the broad land use features and to adjust the sample areas according to field conditions. Detail field observations and investigations were carried out and noted the land use features on the imagery.

2.5 b1 Pre Field Work for Land Use/Land Cover Classification

The False Colour Composite (FCC) of LISS-4 satellite imagery having 5.6 m spatial resolution satellite data at 1:50,000 scale was used for pre-field interpretation work. Taking the help of topo sheets, geology, geo-morphology and by using the image elements, the features were identified and delineated the boundaries roughly. Each feature was identified on image by their image elements like tone, texture, colour, shape, size, pattern and association. A tentative legend in terms of land cover and land use was formulated. The sample area for field check is selected covering all the physiographic, land use/land cover feature cum image characteristics. Figure 2.2a shows the FCC of mining area ML Area proposed coal mines of LISS-4 Imagery including the Mining Lease Area for the 4th March 2021 whereas Figure 2.2b represents the FCC of the 10 km radius.

Figure 2.2a: FCC of Mining area with project location for the year 2021

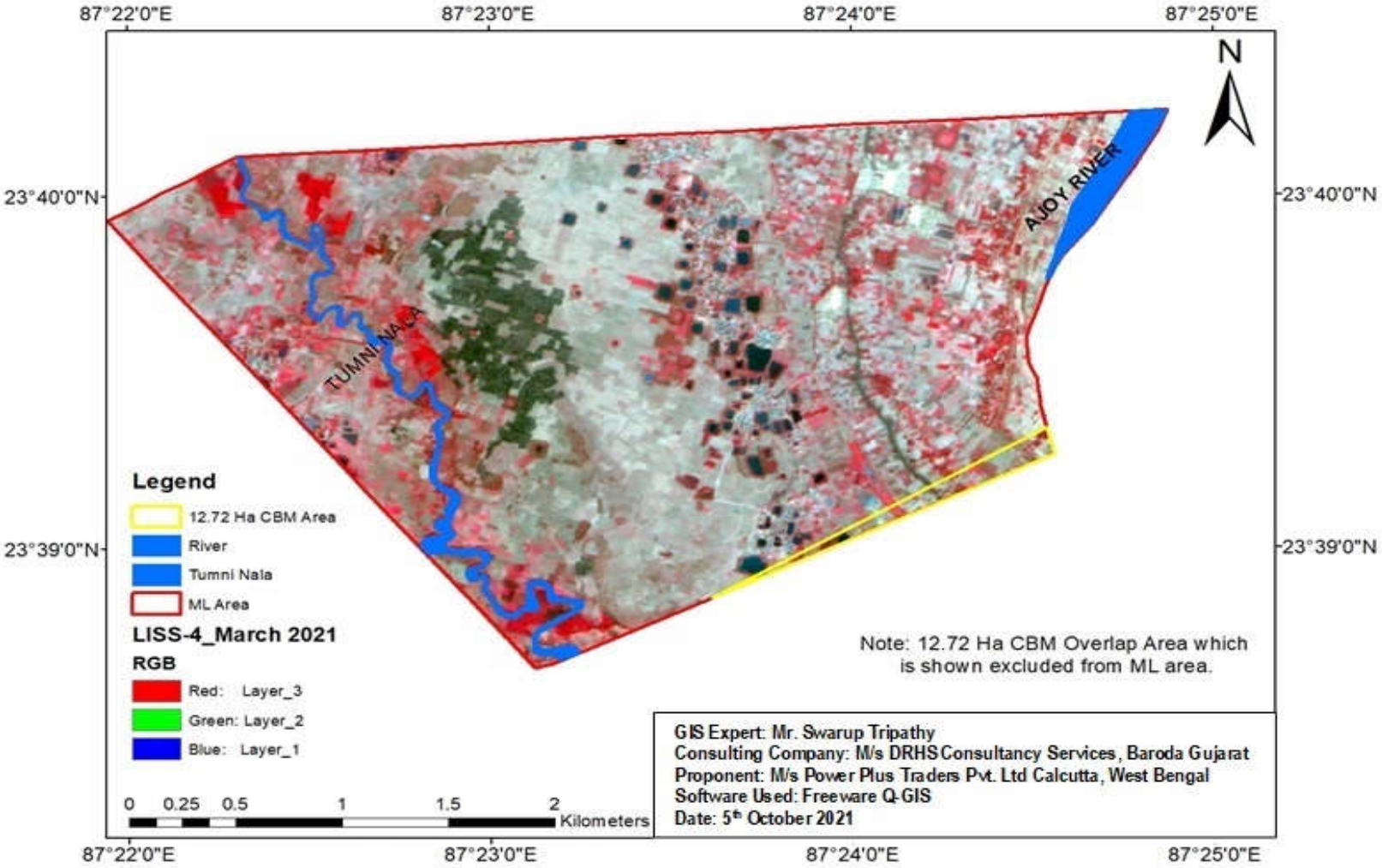
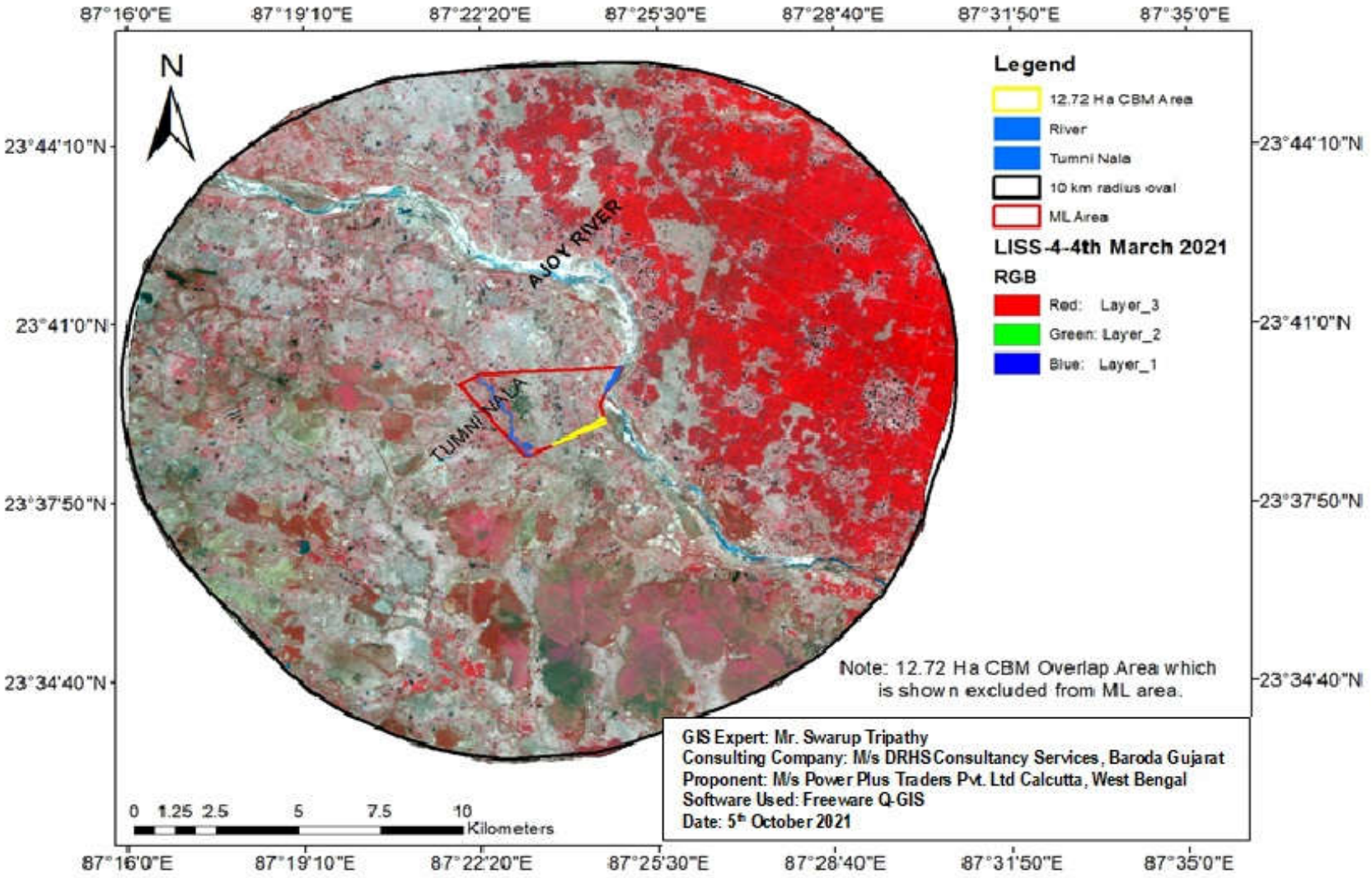


Figure 2.2b: FCC of 00-10 Km radius with project location for the year 2021



2.5 b2 Post Field Work for Land Use/Land Cover Classification

The base maps of the study area were prepared, with the help of Survey of India Toposheets on 1:50,000 scale. Preliminary interpreted land use and the land cover features boundaries from IRS-1, sensor LISS-4 having 5.6 m spatial resolution, False Colour Composite were modified in light of field information and the final thematic details were transferred onto the base maps. The final interpreted and classified thematic map was cartograph. The cartographic map was categorically differentiating with standard colour coding and described features with standard symbols. All the classes were identified and marked by the standard legend on the map. The following Land Cover classes were derived and classified as under:

1. Agricultural land 2. Settlements 3. Dense Forest 4. Open scrub
5. Stone Quarry, 6Water Bodies

2.6 Expected Deliverables:

The following are expected at the end of the SIA study:

- Map of Project Area, Land use and Land Cover with slop analysis
- Socio-Economic Status of the Household
- Calculation of cost for acquired land(s) with Solatium.
- Economic Impact Management Plan
- Social Impact Management Plan
- R&R Management Plan
- Recommendations and Conclusions

2.7 Formation of Team & its Orientation

A two days orientation training was organized where day one was totally involved in the selection of field investigators and supervisor and in identifying their ability to work of the SIA studies. A ten-member team was finalized consisting of about six male field investigator/supervisors and four female field investigators were locally recruited from the project villages. This, easy the process of understanding the grassroot level realities to be reflected during SIA survey. The formation of the team members for SIA studies is indicated table 2.3

Figure 2.3a Point Location of Sample villages in the 10 km radial distance from the project site

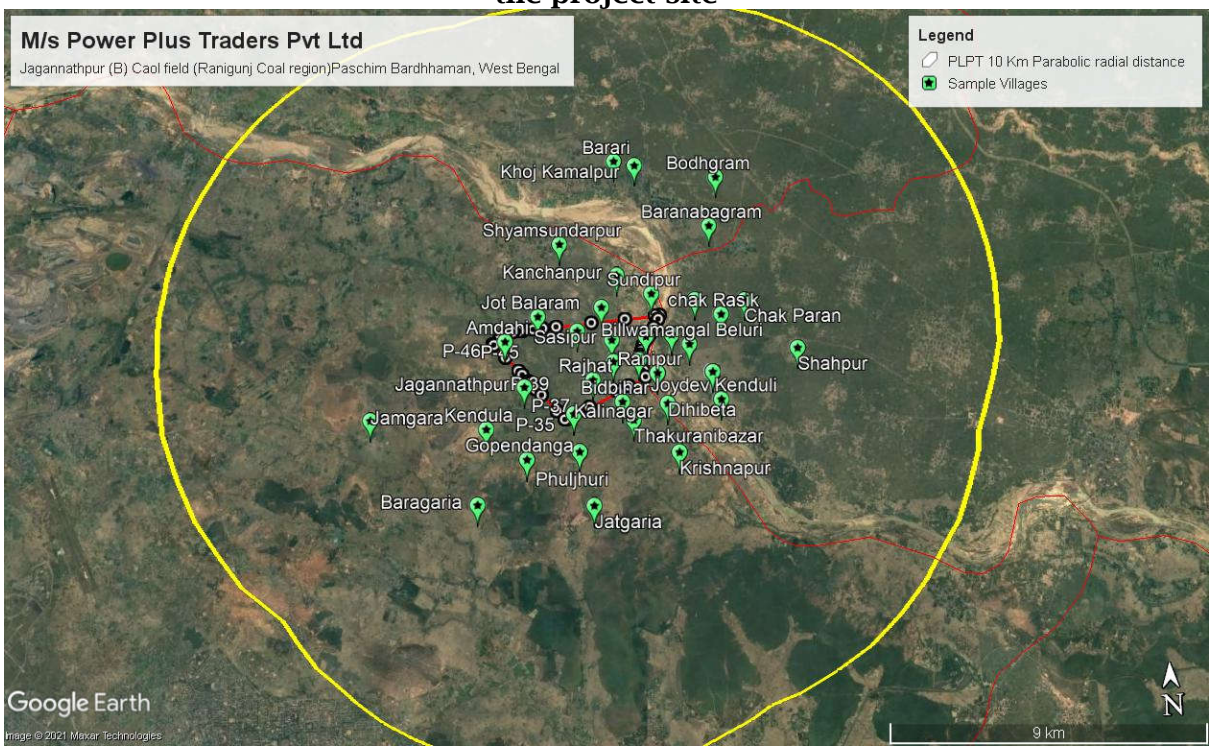


Figure 2.3b Villages in Mining Lease Area of Jagannathpur (B) Coal Block Mining

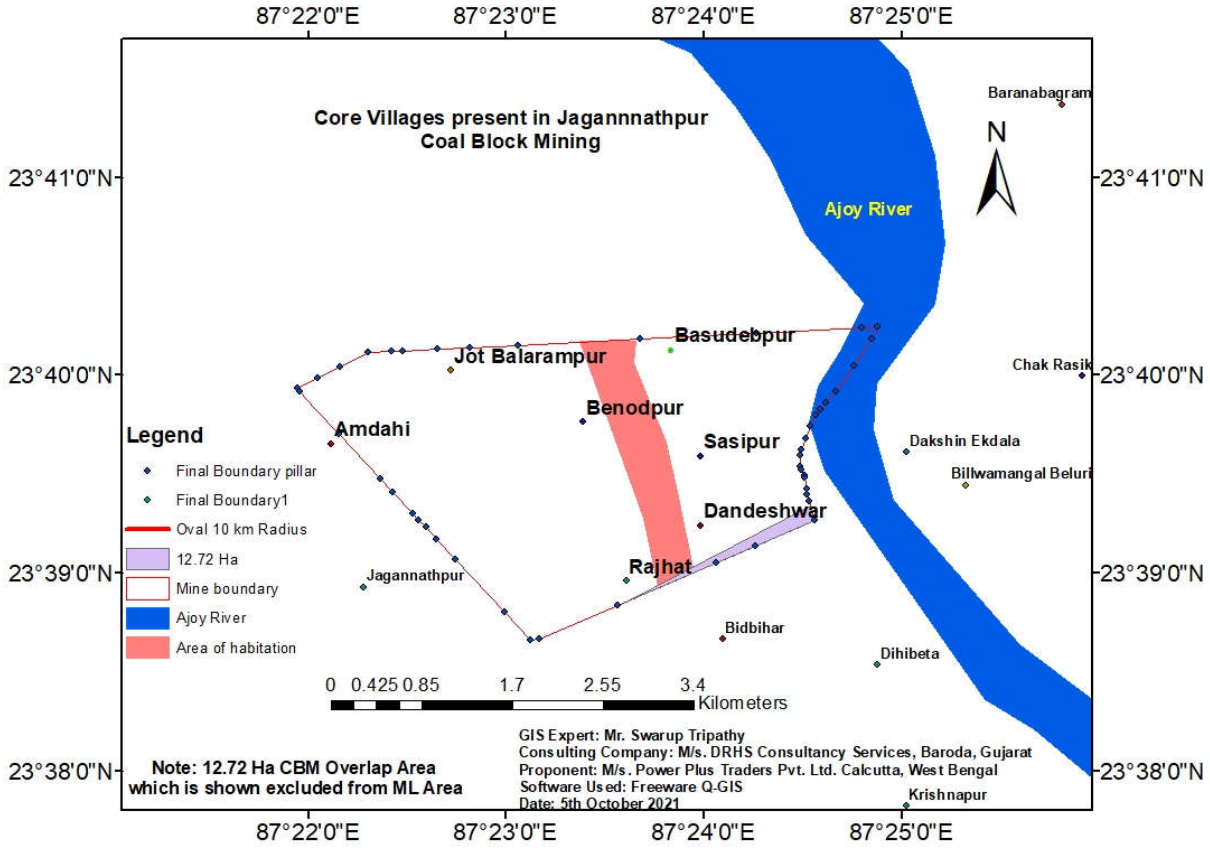


Table 2.3 List of Team members for SIA study

Sr.	Name of the Candidate	Qualifications	Experience	Expertise
CORE TEAM:				
1	Dr. Harshit Sinha*	M.Sc.; PhD - Geography	30 years+	Socio-Economic & Livelihood
2	Dr. Monika Sinha	M.Sc.; PhD – Botany	20 years+	Environment Botanist & Gender
3	Mr. Swaroop Tripathi*	MTech	8 years+	Mining & GIS Expert
4	Mr. Poleen Thakur*	MSW	12 years+	Social Work
4	Ms. Sangeeta Gamit	BRS	15 years+	Rural Studies
5	Mr. Anand Mahapure	BSW	20 years+	Social Work
FIELD INVESTIGATORS:				
6	Mr. Santosh Kumar Chand	HS	2 years+	Field Investigator
7	Mr. Kajol Kumar Ghosh	HS	2 years+	Field Investigator
8	Mr. Jantu Kumar Goswami	BA	2 years+	Field Supervisor
9	Mr. Ananta Pal	HS	2 years+	Field Investigator
10	Ms. Sangita Ghosh	HS	1 year+	Field Investigator
11	Mrs. Nayantara Ghosh	MP	1 year+	Field Investigator
12	Ms. Antima Pal	MP	1 year+	Field Investigator
13	Mr. Subhadip Pal	HS	1 year+	Field Investigator
14	Mr. Mithun Badyakar	MP	1 year+	Field Investigator
15	Ms Sharmila Das	MP	1 year+	Field Investigator

***NABET Approved Consultants; HS Higher Secondary; MP Matric Pass; BA Bachelor of Arts**

The next day orientation workshop was organized where details regarding the survey to be conducted is explained to the team with sample list of the villages as indicated in table 2.1. This is followed up with detailed explanation regarding each variable in village and household survey data tool. A mock drill was also organized among the trainees. The same day field demonstration for doing household and village survey was initiated by senior members (from DRHS consultancy services) in the villages. The next day the team shared field their experience. Based on the feedback received, their doubts and irregularities were sorted out and then finally make all logistic arrangement for the final data collection the data. The orientation training and field survey was conducted immediately after lockdown as indicated in Plate A to F.

Plate A

Plate B

Plate C

Plate D

Plate E

Plate F

Plate G

Plate H

Plate I

Plate J

Plate K

Plate L

2.8 Impact of COVID 19

The study of Social Impact Assessment faced challenges of Pandemic – COVID-19 second wave since the inception of this project in April 2021. Apart from this, West Bengal's Assembly election also delayed our field data collection by two months. The impact of second wave of this Pandemic affected our study as narrated below:

- The team attempted to contact around 1000 households to collect the desired household information's, however it was observed that about 18% of the households refused to cooperate in this regard due to stigma of the pandemic being infectious nature and also due to temporary migration to other places.

- Though the respondents shared all related household information, but the utilization of the health services and attendance at schools were according to the current lockdown situation.

- To a greater extent we adopted the method to calculate preceding month's expenses as per National Sample Survey, the purchasing power of individual household was not actual and largely affected by the Lockdown observed due to Pandemic.

- Similarly, the other recreational and leisure expenses as being utilized in routine, were also found missing and not reported in the monthly expenses due to lockdown.

- While calculating monthly income, it was noticed that the income all-round the year do not remain constant or steady and vary according to the market situation and demand. Even in one household, not every eligible individual is earning and owing to current situation rate of unemployment is very high and have affected household monthly as well total annual income since March 2020. Thus, since last one year, the income figures of individual household have also been affected and thus rough estimates are used to calculate Per capita income and expenses of the family.

However, DRHS consultancy Services along with PTPL followed all norms (Let by the Central and State Level Government) while collecting field data by using Mask, Sanitizer and maintaining social distance from the respondents.

2.8 Quality Monitoring

The data collection was done with several way of quality checks. A few have been devised by setting up special question in the data collection sheets. Spot survey by the field supervisor and manager on the field to cross the information field in data tool was accurate. Beside telephonic calls with the head of the households were done on random basis. The map produced was cross checked with secondary information of similar nature of the data and in order to conduct accurate analysis, the latest satellite data were purchased for the authentic Government sources

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3: Coal Bearing Area Land Assessment

3.1 Land Act

In 2015, with the advent of allocation of coal mining block[3] to the private parties by the Union ministry of coal, it become apparent to choose the legal framework to follow for land acquisition by private coal miners as part of the ongoing commercial coal auction. To ease the mining process under the auction, the Centre had allowed land acquisition under the CBA Act[4]. This had entailed the Centre acquiring land and then leasing it to private miners. However, the coal ministry has proposed that states can choose between the Coal Bearing Areas (Acquisition & Development) Act, 1957, and the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (LARR) Act, 2013[5], the compensation amount remain same under both the acts.

Taking lead from this policy decision and disclosure made in white paper by the Ministry of Coal – the base for commercial coal mining started., Prior to de-allocation of the coal blocks by the Supreme Court of India, and indeed even after the new legislative framework has been approved by the Indian parliament, several coal blocks were and have been allotted to state-owned entities for commercial mining.

M/s Power Plus Traders Private Limited have been allocated Jagannathpur B coal mine with order No: NA-104/4/2019-NA dated 13th February 2020, under vesting order under clause (b) of sub rule (2) of rule 7 and sub-rule (1) of rule 13. From the office of the nominated authority constituted under section 6 of the Coal Mines (special Provision) Act, 2015, O/o Nominated authority, Ministry of Coal, Govt. of India, Shastri Bhavan, New Delhi. (Refer Ltr. No-NA-104/4/2019-NA dated 23.06.2021 excluding 12.72 Ha CBM overlap zone from Mining Lease Area of Jagannathpur B and the same was certified by CMPDIL vide Ltr. No CMPD/BD/C (886-A)/E-571279/1-12834 Dated 17.09.2021).

3 https://coal.nic.in/sites/default/files/2019-08/07-12-2018.pdf

4 An Act to establish in the economic interest of India greater public control over the coal mining industry and its development by providing for the acquisition by the State of unworked land containing or likely to contain coal deposits or of rights in or over such land, for the extinguishment or modification of such rights accruing by virtue of any agreement, lease, license or otherwise, and for matters connected therewith. https://coal.gov.in/sites/default/files/2020-01/CBA_Act.pdf

5 An act to ensure, in consultation with institutions of local self-government and Gram Sabha's established under the constitution, a human, participative, informed and transparent process of land acquisition for industrialization, development of essential infrastructure facilities and urbanization with the least disturbance to the owners of the land and other affected families and provide just and fair compensation to be affected families whose land has been acquired or proposed or proposed to be acquired or are affected by such acquisition and make adequate provisions for such affected person for their rehabilitation and resettlement and for ensuring that the cumulative outcome of compulsory acquisition should be that affected persons becomes partners in development leading to an improvement on their post-acquisition social and economies status and for matters connected therewith or incidental thereto. https://bhoomirashi.gov.in/showfileF.asp?link_id=2&lang=1

3.2 Geology of Land

Jaganathpur-B coal block is located in the Raniganj coalfield of West Bengal. Talchir is the oldest sedimentary formation exposed along the north-western margin of the basin. The Barakar, Barren Measures, Raniganj and Panchet Formations are exposed successively from north to south. The rocks in the greater part of the area dip towards south. The block has a monotonous cover of alluvium/soil except some scattered patches of laterite distributed throughout the block. The stratigraphic sequence in this part of the area and the thickness of the formations are given in Table 3.1

Table 3.1: Stratigraphic sequence in Jaganathpur-B coal block, Raniganj coalfield

Stratigraphic Unit	Lithology (Maximum thickness)
RECENT/ QUATERNARY	Alluvium and sandy soil laterite, lateritic clay and nodules (104 m)
---------- Unconformity----------	
Tertiary Formation	Sticky clay with quartz grains, clay stone, semi consolidated fine to medium grained sandstone etc. (120 m)
----------Unconformity----------	
Panchet Formation	Greenish grey and brownish sandstones; shale and red clays (78.36m)
Raniganj Formation	Micaceous sandstones, grey to carbonaceous shale and coal (352.64m)
Barren Measures	Dark grey arenaceous and micaceous shale with clay, ironstone bands at places (149.09m)

Source: Report on Mining and Subsidence study done by CSIR-CIMFR 2021 for M/s PTPL, Kolkata (WB)

3.3 Background of MLA Land

Jagannathpur-B Coal Mine had been allotted to WB Mineral Development & Trading Corporation Ltd. (WMDTCL) earlier. They had carried out some exploration by engaging CSIL for drilling. Tata Consulting Engineers Ltd. (TCE) prepared a Geological Report & submitted the same in January, 2011. Subsequently, this block was deallocated under SC order and reallocated to "Power plus Traders Private Limited" (PTPL) in February, 2020 by MOC (GOI) through its vesting order (Ref: NA-104/4/2019-NA Dt. 13-02-20). As the first step to develop underground mines in the block, PTPL procured the GR (2011) from MOC (Vide MOC"s letter No. NA- 104/4/2019-NA Dt. 06-03-20) and reviewed the data. As the data was found inadequate, they appointed an expert Geo-Mining Consultant in the 1st.week of August"20 to assess the earlier data & prepare a Revised GR (Refer Ltr. No-NA-104/4/2019-NA dated 23.06.2021 excluding 12.72 Ha CBM overlap zone from Mining Lease Area of Jagannathpur B and the same was certified by CMPDIL vide Ltr. No CMPD/BD/C (886-A)/E-571279/1-12834 Dated 17.09.2021).to address following issues:

- To prepare GR for the block area, as defined in the Vesting Order dt.13-02-2020 and certified by CMPDIL through their letter dt. 10-09-2020. the old GR (2011) covered the area, different and smaller than present block.

- Grading system of coal seams has changed from UHV basis to GCV basis (Gazette notification of MOC No: 22021/1/2008-CRC-II Dt.16-01-2012). Earlier GR (2011) estimated Grade on UHV basis. So, it is essential to rework grades on GCV basis.
- To recommend the scheme for additional exploration (Phase-II) to enhance the confidence level of the resource model to enable designing of reliable long term mine plan for optimum productivity and ensure return on investment.

PTPL has assigned the conversion of Drawings of Geological Report 2011, prepared in National Grid into WGS84 UTM System. Plans(24nos.) were provided as scanned copy (Jpeg format) of along with the Coordinate (XY value) of Boundary Points as per GR (2011). Co-ordinates of the Boundary Points of the block as per Vesting order (NIT) of MOC and Bore Holes in the Block were also provided by PTPL.

ECL authorities entrusted the Job of establishing sufficient number of reference survey stations with a common rectangular grid system covering entire Raniganj Coalfields to Survey of India in 1980 for proper correlation of boundary and workings of different UG coal Mines.

Accordingly, Survey of India established 363 Survey Stations covering Raniganj Coalfield. These stations are popularly known as M-Stations. The Coordinate system is rectangular and based on Cassini-Soldner Projection taking "Modified Everest" as datum, this was named as "National Grid". The Coordinates of its origin (i.e. Intersection of Central Meridian and Central Parallel) was assumed as 100000E, 100000N.

Location Plan of Jagannathpur-B Coal Mine in UTM and also in WGS84 Spherical coordinate system have been prepared from Topo Sheet no. 73 I/13, 73 I/14, 73 M/1, 73 M/2, 73 M/5 AND 73 M/6 (new series) using ArcGIS. Location of Coal Mines, Coal Bearing Areas, ECL Command Area etc. have been taken from Figure 3.1 (GR- 2011). Newly constructed roads which were not available in the Topo sheet or road diverted due to mining activities have been updated from Google Map.

The Jagannathpur B Coal Mine is located in the north-eastern part of the Raniganj Coalfield and covers an area of 8.694 sq.km. It is defined by the latitudes 23°38"39"- 23°40"15" and longitudes 87°21"56"- 87°24"53"and is included in the Sheet No. 73 M/6 of Survey of India. The block is almost rectangular in shape with the entire boundary being defined by straight lines except the eastern boundary which is curvilinear in shape. The details are deciphered in table 3.2

Table 3.2 Environmental settings within the Mining Leasehold area

Sr.	Particulars	Jagannathpur (B) MLA			
1.	Area	Coal Block area 869.40 Ha and lease area 856.68Sq. km/ 2116.9 acers			
2.	Locations	Spread over parts of 16 villages i.e. Jagannathpur, Sundipur, Srikrishnapur, Shyamsundarpur, Sashipur, Rajhut, Binodpur, Dandeswar, Dubrajpur, Jot Balarampur, Binodhpur, Rajhat, Bashudevpur, Majhidanga, Amdahai & Kalinagar Paschim Burdwan-, West Bengal.			
3.	Toposheet of Block Area	73 M/6			
4.	Latitude & Longitude of Block area	$23^0$38'38.29"N- $23^0$40'12.25"N-$87^0$21'56.93"-$87^0$24'41.74"E			
5.	Latitude & Longitude of 10 km Radius	Latitude: 23°33'13.99" to 23°45'26.99" N Longitude: 87°16'00.31" to 87°30'38.52" E			
6.	Current status of the land	Industrial Land/Barren Land			
7.	Elevation above MSL	Plain land about 44 m to 68 m for mining area and whole 10 km radius is about 44 m to 98 m.			
8.	Nearest Highway	SH-14-1.44 km towards E & NH-2-16.20 Km-towards S			
9.	Nearest Railway Station	Durgapur RS-17.96 km SW			
10.	Nearest Airport/Helipad	IAF- Helipad-Panagarh-19.26 km SE			
11.	Tourist Place	Nil			
12.	Places of Archeologically important	Nil			
13.	Protected areas as per Wildlife Protection Act,1972(Tiger reserve, Elephant reserve, Wildlife sanctuaries, National Parks, Conservation reserve and community reserve)	Ramnabagan Wildlife Scantury-5.55 Km Towards SE			
14	Distances of different types of forest within 10 km radius from the mine lease				
14a	Ukhra Protected Forest	1.6km	14h	Durgapur PF	4.2km
14b	Durgapur PF (3 Durgapur PF)	2.7km	14i	Open mixed jungle	7.2km
14c	Ukhra Protected Forest	1.6km	14j	Open mixed jungle	7.5km
14d	Ukhra Protected Forest	5.6km	14k	Open mixed jungle	9.3km
14e	Ukhra Protected Forest	7.6km	14l	2 Protected Forest	10.9km
14f	Protected Forest	12.1km	14m	Chaupahari Protected Forest	14.2km
14g	Protected Forest	11.5km	14n	Open mixed jungle	11.2km
15.	Industrial settlement in 05 km radius	Durgapur Industrial Area- 14.62 Km towards S & Panagarh Industrial Estate-23.73 SE			
16.	Nearest Township	Durgapur-14.62 Km towards S			
17	Distances of water bodies within 10 km radius from the mine lease				
17a	Ajay River	Adjacent	17g	Kasai Kandar	13.0km
17b	Tumuni N	Inside PS	17h	Kopai N	11.3km
17c	Kunur N	4.2km	17i	Bakreswar N	14.0km
17d	Italhala N	7.8km	17j	Bakreswar Kopai Main Canal	11.3km
17e	Sal N	8.7km	17k	Kopai South Main Canal	10.9km
17f	Hingla N	3.8km			
18.	Soil Type	Varied Coloured sands, soil and lateritic alluvium condition			
19.	Seismic Zone	ZONE-III as per IS 1893 - 1975			

Source: Mining Plan report, Vol 1 & II of M/s Power Plus Traders Pvt Ltd

The block is bounded by a number of Coal Mines viz. Rangamati B in the north, JAGANATHPUR A block in the west and Bistupur-Dandeswar in the south. Ajay River is on the east of the block. The area can be approached by road and rail. The block is situated 12 km north of NH-2. It is well connected through metal road with Durgapur city which is only 15 km away and on Raniganj-Andal- Durgapur Road.

The area displays a gentle undulating topography with elevations ranging from 66m in the North West to <56m in the south and east (considering the R.L. values of the JBB series of boreholes w.r.t M.S. L). The elevation increases in North and North West direction. The major part of the block is covered by soil/alluvium and forms the cultivated land. Ponds are scattered over the entire area. The main drainage of the area, Tumni Nala in the west and Ajay River is in the east of the block. There are many small & large ponds in the area, which are mostly used by the villagers for domestic purposes

3.4 Land Procurement Area Analysis

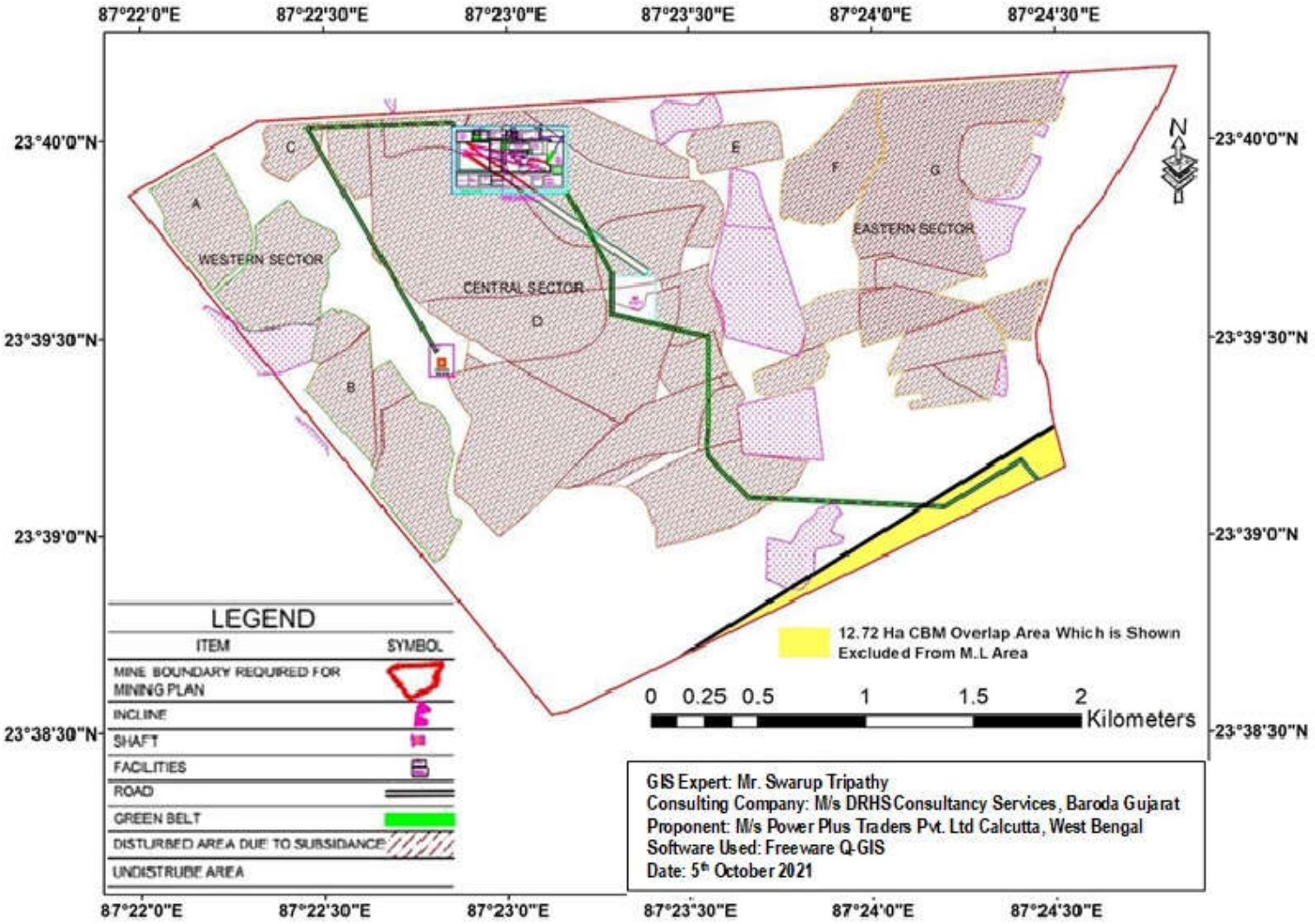
The total mining lease area allocated under Jagannathpur Coal mining block for M/s Power plus Traders Pvt. Ltd is 856.68 hectors (after amendment excluding CBM block overlap) but the geological boundary remains the same. From the total MLA of 856.68 hectors, about 55.5% of the area has been used for underground mining as indicated in table 3.3a

Table 3.3a Area of the blocks identified for doing underground mining for coal as well other

Sectors	Area in Hectare	Area in %
A	17.512	2.044
B	59.103	6.899
C	5.628	0.657
D	264.485	30.873
E	7.792	0.910
F	17.518	2.045
G	103.443	12.075
Sub total	**475.481**	**55.503**
Pink Area	54.133	6.319
Green Belt	8.652	1.010
Other Building	13.291	1.551
Unused Land	305.123	35.617
TOTAL	**856.680**	**100.000**

Among these seven sectors, the maximum extraction of coal is supposed to be done in block D and G. as indicated in Figure 3.1. The pink area represents the barrier between villages and physical features (6.3%), followed by the constructed building areas (1.6%) and the green area represents the road distance area (1.0%). The unused land areas are the highest (35.6%) that can be used as alternative/addition, to the plots from A to G where in future there is any possibilities of households' constructions.

Figure 3.1 Demarcation of boundaries of 7 blocks (A-G) with barriers between man-made and natural bodies



Source: Base map from Report on Mining and Subsidence study done by CSIR-CIMFR 2021 for M/s PTPL, Kolkata (WB)

Among these blocks, a total of 10 coal seams/sections viz. R-IX, R-VIII (T), R-VIII (B), R-VII, R-VIIA&B, RVIIC, R-V (T), R-V (B), R-IV and R-III/II have been intersected. About eleven faults with variable throw have been encountered in the block. The scope of study for mining and subsidence done by CSIR-CIMFR (2020-21), took consideration to cover maximum extraction of coal ensuring no subsidence outside the mine lease area of the coal block. Subsidence prediction has been done using modified influence function method for all the proposed panels of nine seams covering remedial measures

The report further also points out that the coal will be extracted by Bord and Pillar method of mining with caving using continuous miner. Percentage of extraction in a panel varies from 65 to 75 per cent, depending on how efficient the ribs, stooks, stumps etc. are extracted "judiciously" (as per coal mines regulations extant guidelines) while retreating. It has been therefore decided to take 70% as extraction per cent in the panel for subsidence calculation. The depth of seams lies between 45 m and 480 m. All the depillaring panels proposed within these boundary limits land.

Almost all the land plots among these sectors are in the process of purchasing on commercial basis (as reported by the proponent during field survey and referring Mini Plan Vol 1 – Annexure XI) and summarized details of this is indicated in Table 3.3b.

Table 3.3b Summary Status Report of Plot Schedule for Jagannathpur – B Coal Mine, Paschim Bardhhaman for M/s Power Plus Traders Pvt. Ltd.

Sr. No.	Mouza	JL No.	Block	P.S	Status of the Land as LR records dated 9th Oct 2020		
					Total Area	Project Area	
						Area in acre	Area in Hec.
1	Sandipur	4	Kanksa	Kanksa	115.64	55.16	22.32
2	Basudevpur	5	Kanksa	Kanksa	186.70	175.3	70.94
3	Binodpur	6	Kanksa	Kanksa	308.24	306.02	123.84
4	Rajhat	7	Kanksa	Kanksa	427.38	413.97	167.53
5	Sashipur	8	Kanksa	Kanksa	156.39	156.39	63.29
6	Dubrajpur	9	Kanksa	Kanksa	152.41	131.34	53.15
7	Majhidanga	10	Kanksa	Kanksa	105.32	102.27	41.39
8	Dandeswarpur	11	Kanksa	Kanksa	110.4	109.72	44.40
9	Ranipur	13	Kanksa	Kanksa	34.70	7.62	3.10
10	Shyamsunderpur	7	Faridpur	Faridpur	4.58	1.66	0.67
11	Jotbalarampur	8	Faridpur	Faridpur	196.61	178.32	72.17
12	Srikrishnapur	9	Faridpur	Faridpur	27.49	11.88	4.81
13	Amdahi	25	Faridpur	Faridpur	262.42	236.39	95.66
14	Jagannathpur	26	Faridpur	Faridpur	278.82	259.13	104.87
15	Kalinagar	27	Faridpur	Faridpur	6.39	3.06	1.24
				Total	**2373.49**	**2148.23**	**869.38**

Sources: Revised Mine Plan For Jagannathpur (B) Coal Mines Volume I for M/s Powerplus Traders Pvt. Ltd; Kolkata

The land plots are vacant or barren or are demarked as agriculture land. The life of the mine, as per the Mining Plan, is 70 years and the depillaring

operation will continue till the end of the mine life. Utmost care is being planned to fortified the land plots when purchased to avert any major human accident while doing depillaring. These land plots demarcated as vacant/barren land or identified as agriculture land plot in the official record of Revenue inspector and the details of land yet to be purchased are indicated in Annexure 8. Since the official record and our physical verifications (during household survey) confirms non-existence of any human habitat, the question of displacement of the population is totally ruled out, thereby confirming non applicability of any Rehabilitation and Resettlement program in the community.

3.5 Land Physical Features Analysis

The current topics deals with the physical natural set up of the Mining Lease Area which is related to the analysis of contour, terrain, slop, Land use and land cover etc that is directly related to the mining activities. These existing physical features and human settlements give direction for the mining operations and safety measures to be adopted in relation to land use pattern emerging out of it. A series of analysis being done for all physical features by running digital elevation model

3.5a Contour Terrain Analysis

Figure 3.2a represents the contour of ML area of Jagannathpur coal block, whose terrain consists of flat undulating slopes. The terrain is characterized by community plantation area, agricultural land, surface mining pits and spoils dumps. The mining activity in this area has a history of more than 50-60 years. The streams in the neighborhood of the mines are often found to be receiving silts from the mining area. The main sources of this sedimentation of the streams are the barren lands devoid of vegetation and spoil dumps. Figure 3.2b represents the contour map i.e., elevation details of the project site proposed ML area of coal mining area underground process. There are agricultural fields in the vicinity of the areas. Some of these agricultural fields have also received silts carried by rainwater run-offs and overflows from the mining pits. Thus, the terrain could be described as a mixed terrain of community plantation, agriculture and mining lands covered with a network of natural watercourses, which are facing the adverse effects of soil erosion from the mining areas as well as some portion of undulating terrain. Figure 3.2b represents the contour of ML area.

Figure 3.2a: Contour Line Map of ML Area

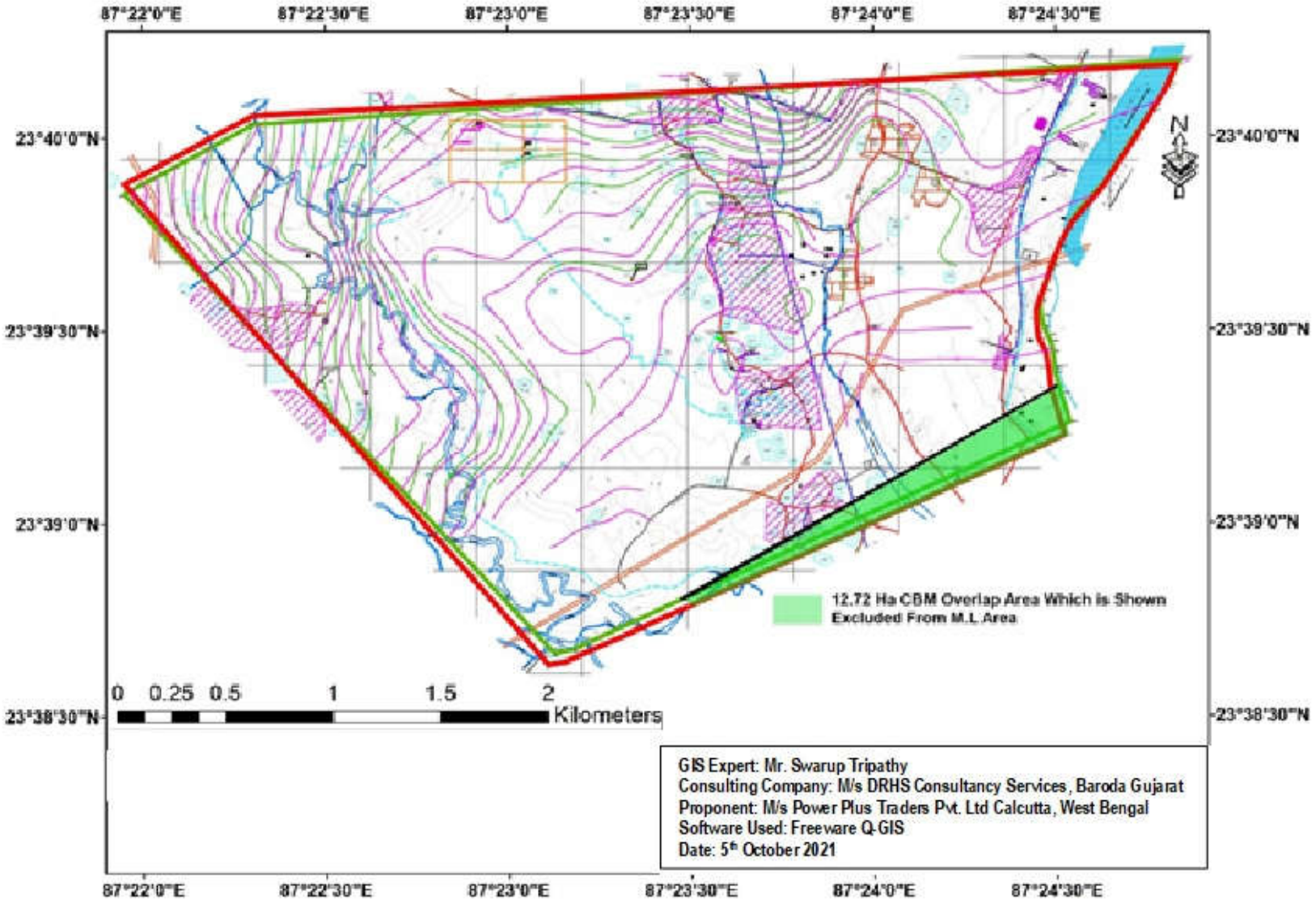
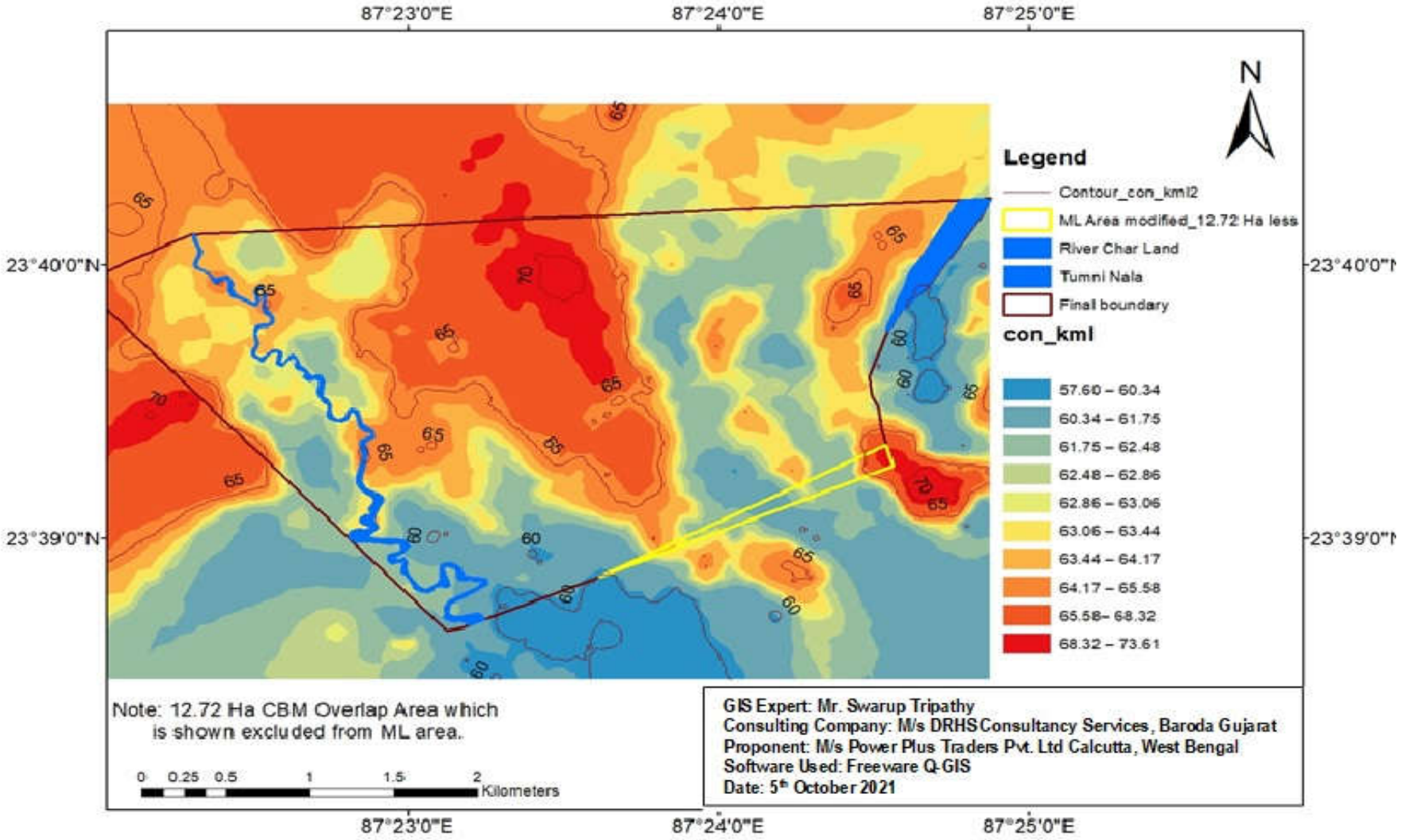


Figure 3.2b Elevation details of the Project site proposed MLA of Coal mining area underground process



3.5b Land use and Land Cover Analysis (LULC) ML Area (856.68 Sq. Km)

The Land Cover classes were extracted following a visual interpretation method or on-screen digitization of the Resource Sat-1 Imagery, sensor LISS-4 having 5.6 m spatial resolution image. These were later verified by using SOI toposheet and Google Earth imagery. Polygon layers for each class were digitized and the respective areas were calculated. The Land Cover classes and their coverage can be seen in the following **tables 3.4** and its distribution is shown in **Figures33a**. The present Land Cover classes are represented in **Figure 3.3b**. Total six major land use/ land cover classes were demarcated in the study area and a thematic map of 1:50,000 scales were generated incorporating these classified categories considering the area of the project. LULC classes were demarcated using Level – III classification system.

Table 3.4 LULC Classification of the MLA

Category	Area in Sq.mt	Area in H.A	Area in %
Agriculture Land	7724400	772.44	90.17
Barren Land	258770.6	25.88	3.02
Green Land	39211.8	3.92	0.46
Community and other use	51386.4	5.14	0.60
Settlement	119611.9	11.96	1.40
Grazing Land	83268	8.33	0.97
Road	97718	9.77	1.14
Water Body	192483	19.25	2.25
Total	**8566849.7**	**856.68**	**100**

The distribution of LULC of MLA shows that from the total 856.68 sq hector MLA 90.17% belongs to agriculture area and about 3.02% is of Barren land. The water bodies occupy only 2.25% and the human settlement covers only 1.40%. The public use amenities and other building covers only 0.60%. Overall, it is concluded that by large the area of Agriculture and barren land covers 93.19% in the MLA area and a fine planning of underground mining is planned taking consideration of agriculture as well barren land. The commercial purchase of land plots for doing underground mining in MLA is, by large being done from these two land categories.

Figure 3.3a: Final Land use map of the ML Area as per mine plan

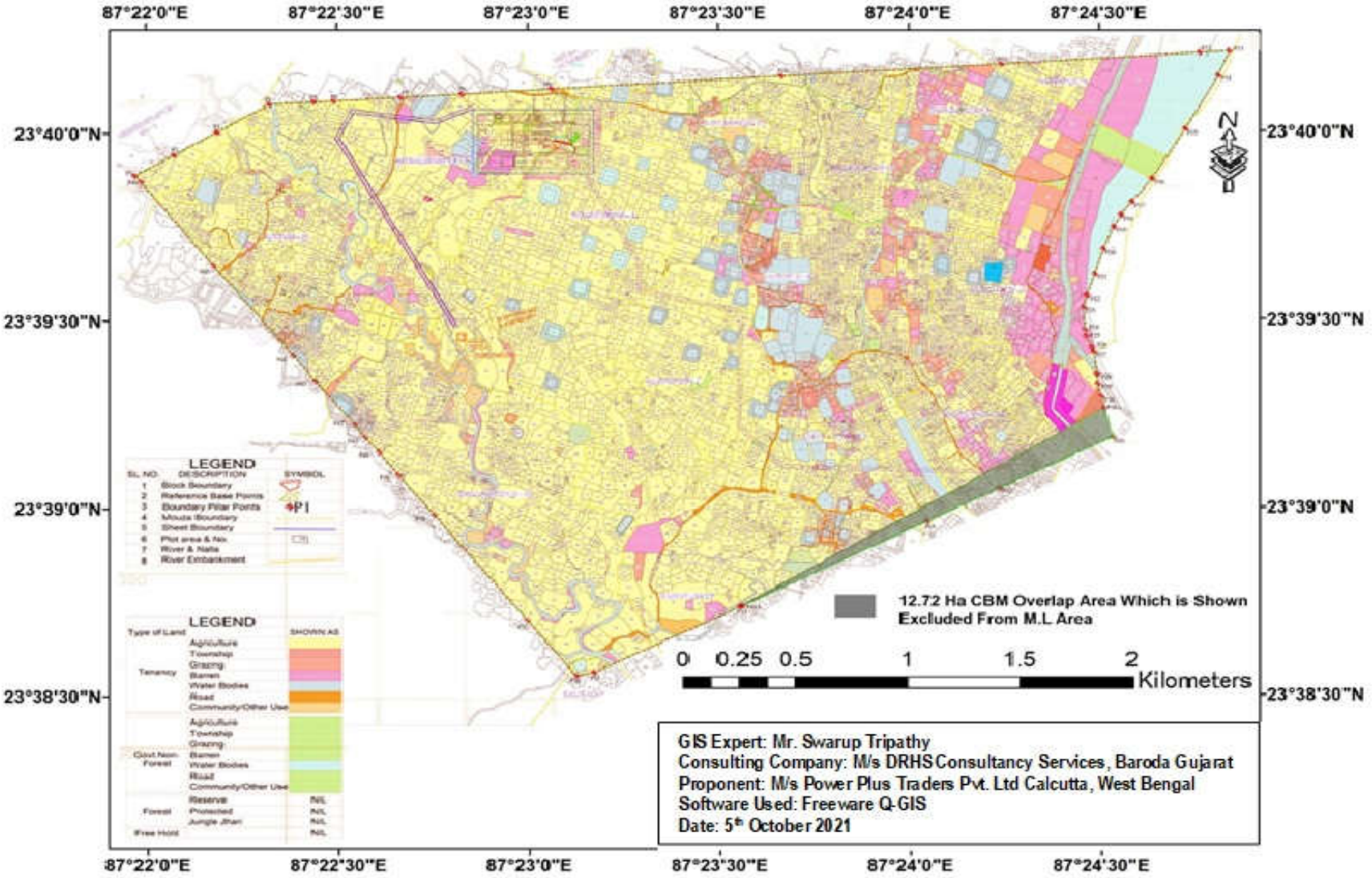


Figure 3.3b: Land use map of the ML Area surface area

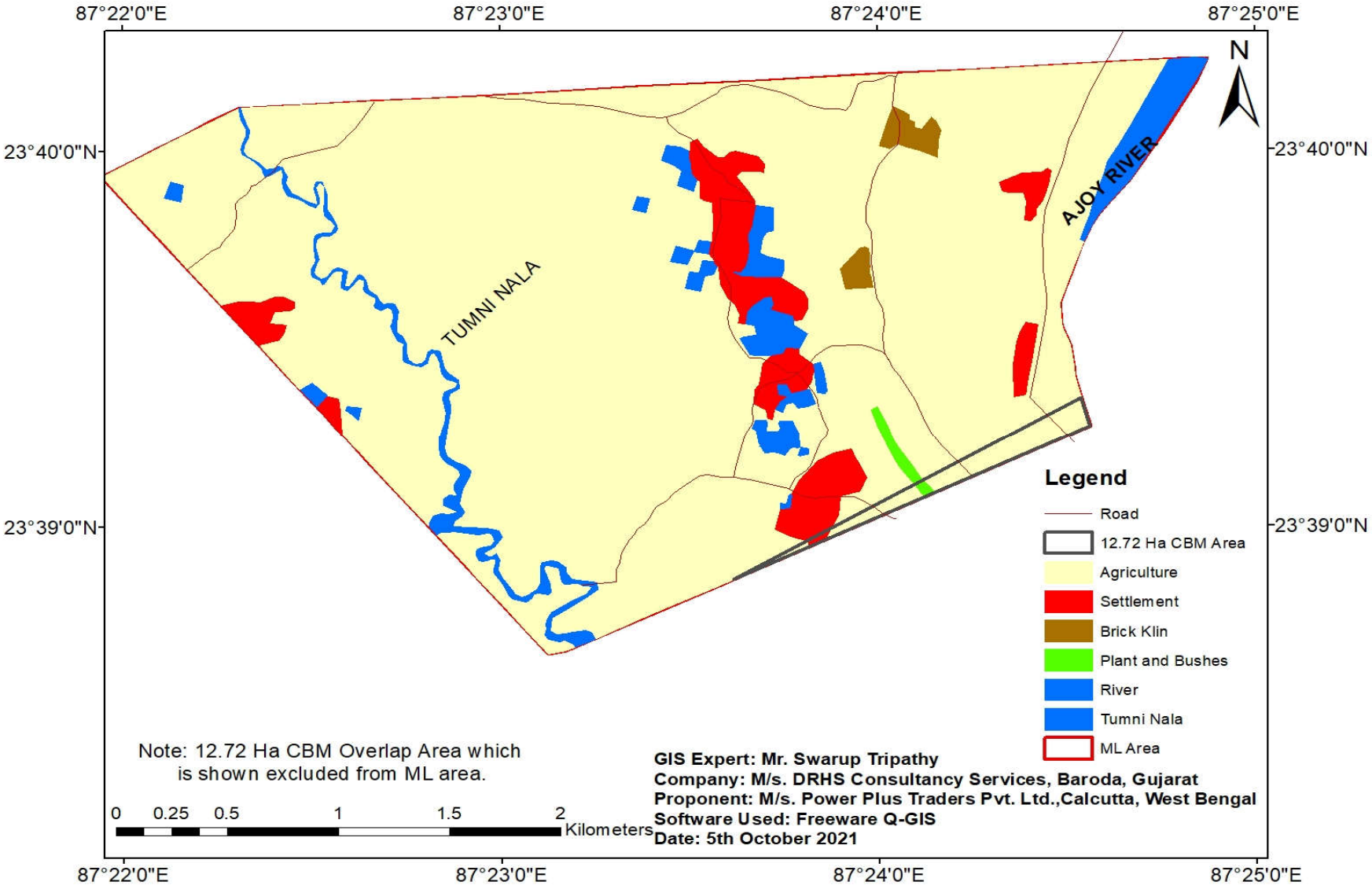
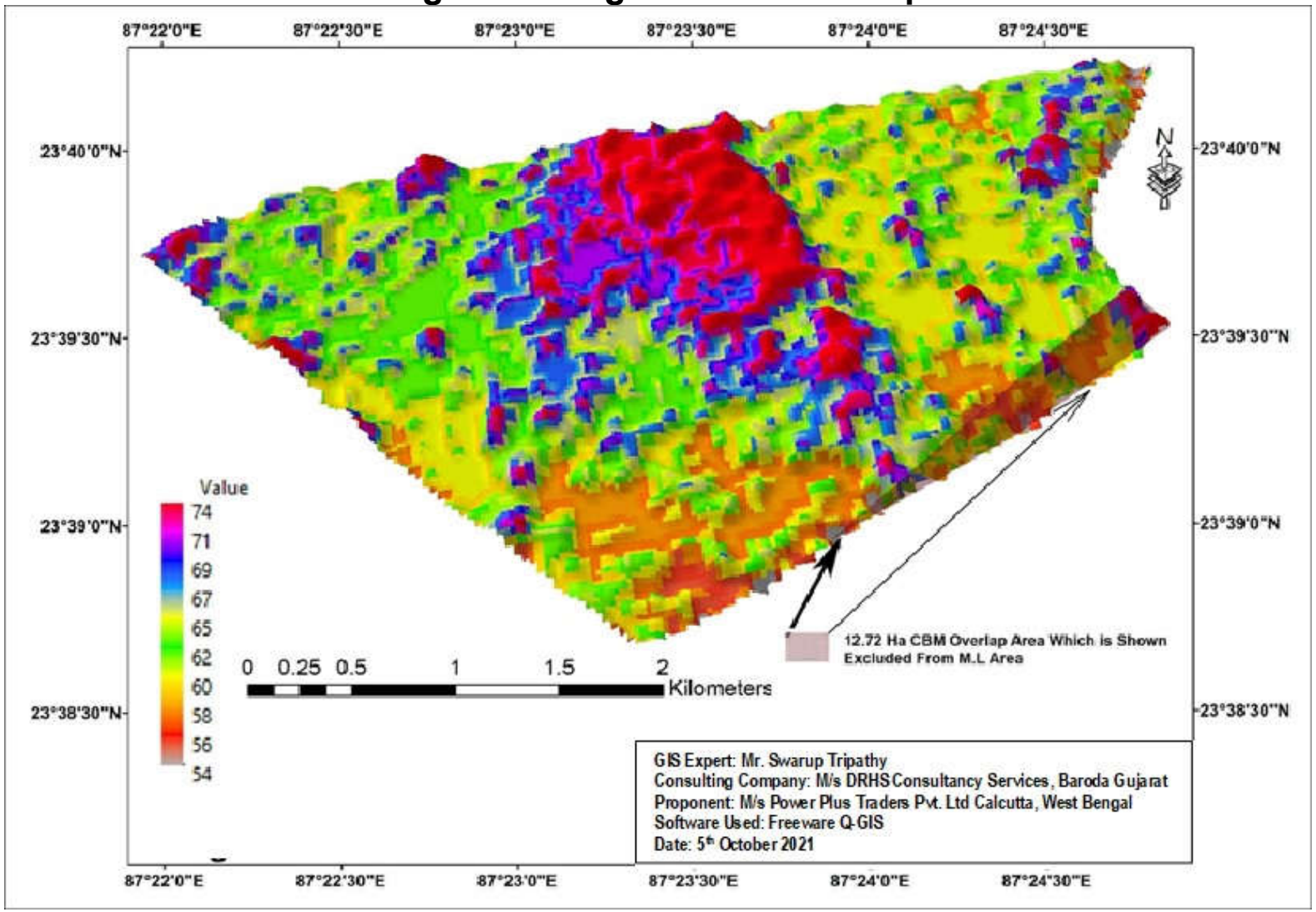


Figure 3.4 Digital Elevation Map



3.5c Digital Elevation Model

Scientific literatures use the terms digital elevation model (DEM), digital terrain model (DTM) and digital surface model (DSM) for different type of geographic studies. The term digital surface model represents the earth's surface and includes all objects on it. In contrast to a DSM, the digital terrain model represents the bare ground surface without any objects like plants and buildings. The term Digital Elevation Model is often used as a generic term for DSMs and DTMs, only representing height information without any further definition about the surface. In this report the term DEM is used as a generic term for DSMs and DTMs. The DEM has been generated from the CartoSat-1 data having 2.45 meter spatial resolution. Figure 3.4 shows the 3D DEM of the coal block of the proposed lease hold area Jaganthpur coal block underground mining area.

Proposed underground mines of Coal mines of PTPL is comes under the Damodar River basin, here in DEM represents the area having the slope and contour elevation gentle to moderate slope and having 50m to 75 m range and DEM is the simplest form of digital representation of topography of the project area. Present DEMs are used to determine terrain attributes such as elevation at any point, slope and aspect are discussed below.

3.5d Drainage and Slope Interpretation

The buffer zone forms a part of Damodar river basin with a general gently slope. The land is flat and mildly undulating. The ground elevation varies from 44 m MSL to 98 m MSL. The area represents partial cultivated land with thin soil cover and rocky ground. Drainage map for mining area is shown in figure **3.5**. The drainage in the core zone is through couple of drains of 1storder. These drains finally join Tumni Nala flowing W direction in the proposed core mining area. All the nadi and small nala joins with Ajoy River which ultimately meets with Damodar River which is adjacent in east direction and distance of Damodar River is about 25 km towards South Direction.

The area as a whole represents a gently slope which is shown in figures 3.6a, b and c drained by a number of E to SE flowing rivers which debouche into the one major river i.e. Ajoy River present in Eastern direction of the project site which adjacent to the ML area. The area as a whole is the basin of Damodar catchment and maximum flow of the water is going towards the Damodar River. There are numerous nala and nadi present in the study area these are indicated in Table 3.5. Various small and large rivulets present in the study area and also various small and large water ponds were present in every part of the study area within the 05 km radius.

Figure 3.5 Status of drainage in MLA of Jagannathpur (B) Coal mine

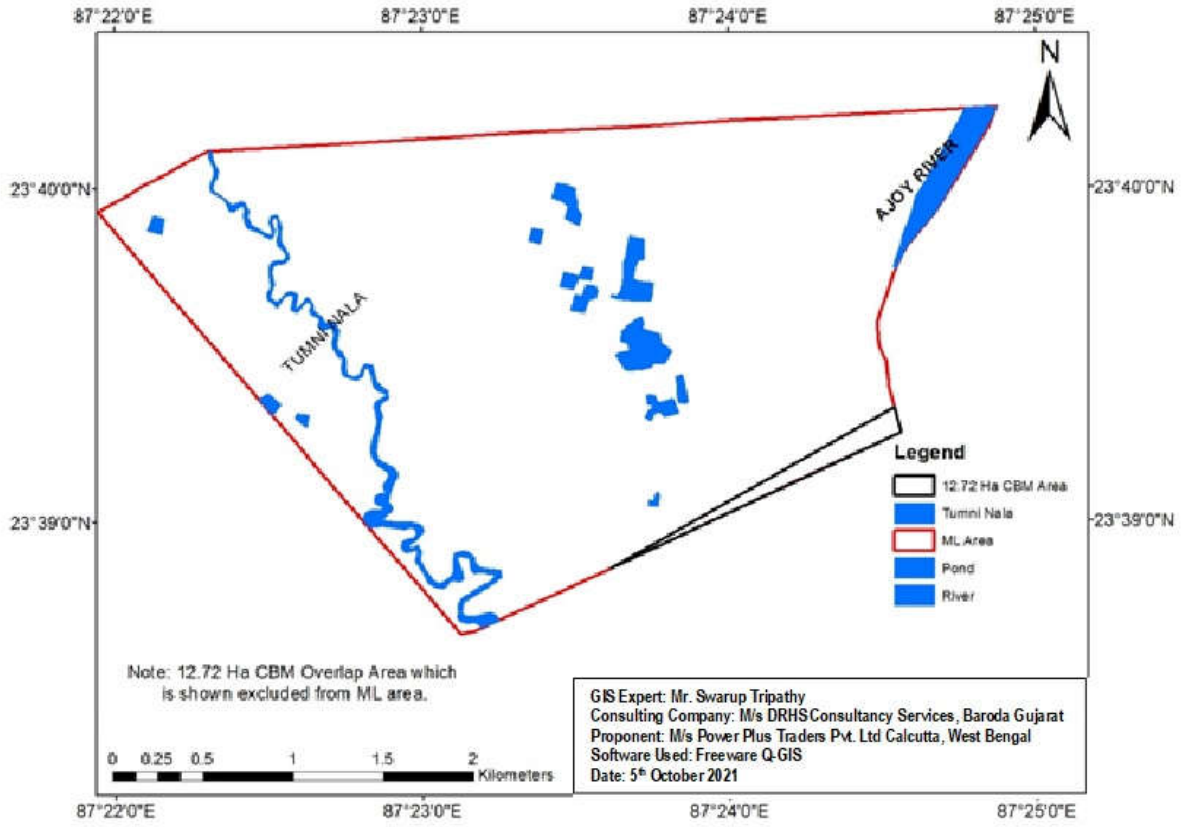


TABLE 3.5: Distance and direction of river/stream/nala present in project site within ML Area

Name of the River/Stream/Nala	Distance from Project Site (Km) Mining Lease	Direction from Project Site
Tumni Nala	Adjacent	Passing at Mining Lease area towards W
Ajoy River	Adjacent	Adjacent to Mining Lease area towards E

Figure 3.6a Slope map of the ML Area

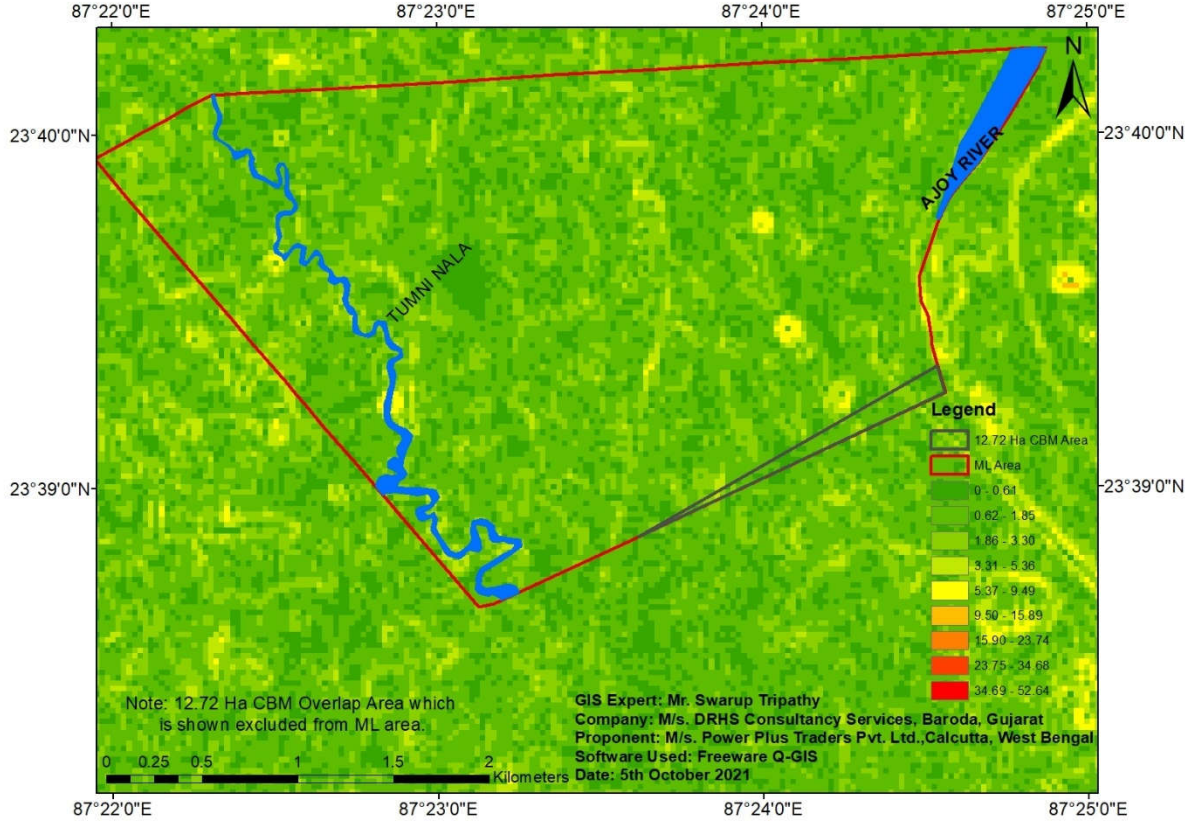


Figure 3.6b Cross Section Of Slope Scale Of The MLA For The Proposed Coal Mining Underground Process NW-SE

Figure 3.6c Cross Section Of Slope Scale Of The MLA For The Proposed Coal Mining Underground Process SW-NE

The DEM generated form Cartosat-1PAN data was used for terrain analysis process such as Slope map and drainage patterns in order to use as a layer in GIS. Slope value of land is important to interpret the environment of the study area. Slope data are calculated in percentage. Slope is the most important and specific feature of the earth's surface form. A thematic map of 1:50,000 scales were generated incorporating these classified categories considering the area of the project. The area as a whole represents a gently slope, drained by a number of North West to South East flowing river were present. The area whole

represents the Damodar River basin. In the present study the slope is categorized into seven classes as indicated in table 3.6.

The studies show that 52.01 % of the total study area comprising of **856.68 Sq. Km** sq. km comes under nearly level slopes followed by gentle slope which is about 33.72 % and moderately gentle (14.27 %) and steep slopes (Nil). Moderately steep sloping landforms account also Nil of the area. There are no any very steep and very high steep slopes are present in the study area. However, the moderately gentle slopes present in an around the various River side area including Ajoy River and some portion of Tumni Nala area. The color-coded slope map represents the terrains in percentage of slope. Table 6 gives the classification of the slope present in the study area as per the norms of Integrated Mission for Sustainable Development –IMSD guideline 1992 and Natural Resources Data Management –NRDMS guideline 1982. Figure 6 shows the slope scale in pie diagram, as indicated in figure 3.7 it represents that slope map of proposed PTPL underground coal mines.

Table 3.6: Slope Analysis of The MLA

Slope Scale	Area Km²	%age of Area	Slope Class
00 to 01	4.52	52.01	Nearly Level
01 to 05	2.93	33.72	Gentle
05 to 10	1.24	14.27	Moderately Gentle
10 to 15	Nil	Nil	Steep
15 to 30	Nil	Nil	Moderately Steep
30 to 50	Nil	Nil	Very Steep
>50	Nil	Nil	Very High Steep
Total	8.69	100	

Figure 3.7 Slop Categorization

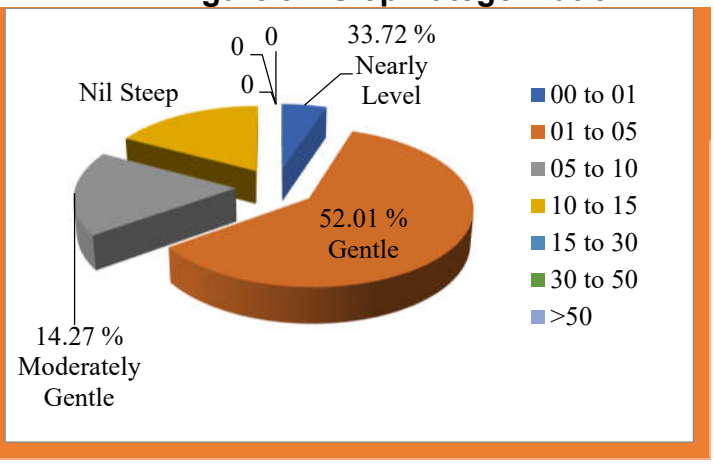
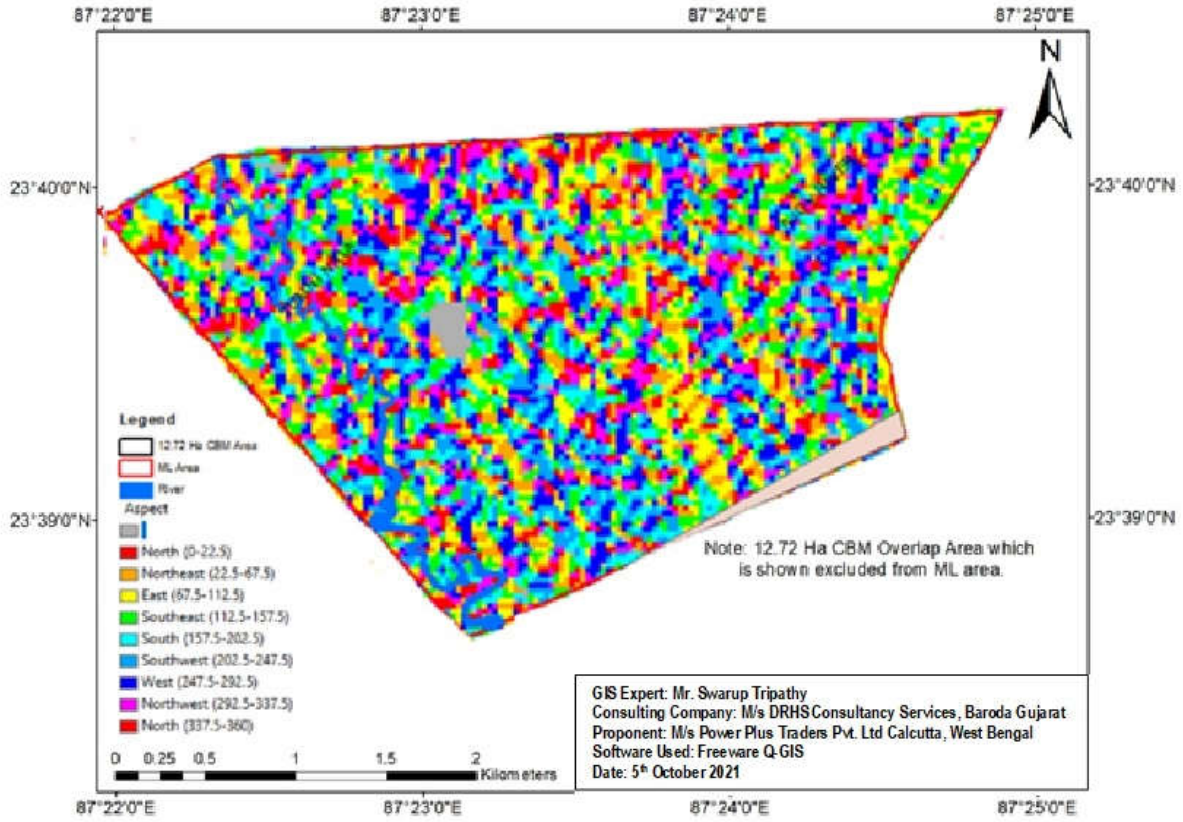


Figure 3.8 shows the color-coded aspect map representing the cardinal direction of the terrain using CartoSat – 1 PAN Data. An aspect map is a spatial organization structure that represents one or more aspects of geographic entities. Aspects are properties of and relations between geographic entities (in the following, the term 'relation' is used to denote unary relations/properties). Examples are the extent of a community plantation area, the name of a city, or the geographic orientation of one place with respect to another place. An aspect can be predominantly geographic (e.g., a geographic category: water area, built-up area) or predominantly spatial (e.g. connectedness of subway stations or distance between locations). In this sense, any cartographic representation can be considered an aspect map. In the present study, the aspect map of the proposed Jagannathpur Coal mining underground process area shows various aspects in the cardinal direction of the terrain.

Figure 3.8 Aspect Map of the MLA



3.6 Land Barrier

The Primary survey points out a number of villages are located within the mining lease area, namely, Shashipur, Dubrajpur, Sundipur, Basudebpur, Ranipur, Dandeswar, Rajhat, Itadanga, Binodpur and Amdahi. The other surface structures and features reported existing are poultry farms, nalas, roads, temples, seasonal ponds, buildings, drain, high tension line, brick field, school etc. Literature survey (Sheorey 2000, etal Saxena 2003) points out some of the recommended maximum values for various surface features and structures are as follows:

a) *Single- storied, multistoried and kutcha building*: strain < 3 mm/m
b) *Surface water bodies*: strain < 3 mm/m
c) *Forest land*: maximum tensile strain of 20mm/m and width of tensile crack of 200-300 mm/m

As the panels are to be extracted by caving method, the proposed panels are designed by taking into consideration the angle of draw (AoD), an important influencing parameter in subsidence engineering. The consideration of AoD defines the extent of subsidence affected on surface or on plane of reference (overlying seam(s) – goaved or developed or virgin as the case may be). AoD provides an answer as to whether no adverse impact of mining-induced subsidence take place outside the mine lease area of the coal block allotted depending on voids created below ground. Hence, establishment of AoD is imperative for the safety of surface and sub-surface structures and thus following dominant factors influencing AoD in the context of Jaganathpur-B coal block were considered for preparation of layout of panels.

As per the report of mining and subsidence done by CSIR-CIMFR (2020-21), the seam-wise subsidence prediction at surface has been done under multi-seam working condition. The value of maximum subsidence, maximum slope, maximum compressive strain and maximum tensile strain are predicted at each grid point with the help of three dimensional subsidence prediction modeling using modified influence function method of all the proposed panels. The layout of all the panels are so designed that no impact of underground mining would influence the surface structures and features lying in the Jaganathpur-B coal block. The predicted maximum subsidence, slope, compressive strain and tensile strain at every five year interval developed due to extraction of panels.

Overall, in the project area, the safety of surface structure was largely depended upon angle of deviation of 22 degree to design for all proposed panels and the maximum anticipated subsidence of 4098 mm would affect the surface topography after mining thus Garland drains will be provided all along the periphery of the subsidence area (this is a DGMS stipulation). The cumulative predicted maximum compressive strain and tensile strain at the surface of 10.0 mm/m and 9.1 mm/m respectively would lead to development of cracks with crevices of 60 to 100 mm at the surface. The surface cracks formed during extraction should immediatelybe filled in with soil/mitti to prevent breathing of air and inflow of water to the underground workings. Further during every decade, the embankment with an elevation above HFL is advisable be erected regularly on the west side of theAjay River subject to actual ground topography.

The existing coal mining blocks in the eastern part of India from Orissa, West Bengal, Jharkhand, Andhra Pradesh and Telangana witnessed similar type of situation existing for the operations of the underground coal mining at a safe distance near to human habited. At least two case studies were prepared doing primary survey as mentioned below:

CASE 1 Name of the Mine:	LACHIPUR COLLIERY
Address of Mine:	Kajora More (Beside National Highway- 2) 2 Km south of Kajora Gram Railway Station, P.O- Kajora Gram Pin- 713338 Police Station- Andal Sub Division- Durgapur
District State:	District- Paschim Bardhaman; State- West Bengal
Location Coordinates of the Mine:	Latitude- 23* 19 55" N & 23* 25 10" N Longitude- 87* 05 32" E & 87* 14 28" E
Nature of Mine:	Public Mine/ Eastern Coal fields of Coal India Limited
Year of initiation of Operation:	Since 1958
Type of Mine:	Under Ground
Extracting Material/Item:	COAL
Mining Lease Area:	570 Ha
Life of the Project:	50 Years Projected
When Last EC Granted:	February-2021 (Mine under Cluster-10) Amendment Approved




Brief Description of the Mine:

This is the Picture of Lachipur Colliery, Kajora Area, ECL. All these images show, densely populated colonies besides mining infrastructure. the headgear of the mines are seen beyond colonies.

Lachipur Colliery is a conventional underground Coal mine operated by Kajora Area of Eastern Coalfields Limited (A subsidiary of Coal India Limited). The Six Lane National Highway- 2 from Kolkata to Delhi passing about 200 m away from the mine entrances. Andal – Saithia Railway Line is passing about 50 m away from the mine entrances.

The Mine is worked in three seams R- IX, R- VIII Top and R-VIII bottom. The method of workings is conventional Development and Depillaring with Sand stowing and few cases in Caving. The Mine is Degree-II, Inclination of the seam is 1 in 14, Thickness varies from 4.0 m to 6.0 m. Grade of Coal is –B.

The Mine lease area is full of Surface Structures Like ECL office and employee colony, Bustee, Highway and District Road, Railway line, India Power company extra high voltage substation, private and public houses and colony, Mandir, Petrol pump, Shops and small market etc. A perennial Jore is passes over the mine area. 500 Metre radius of the Mine entrances is thickly populated with Buildings and structures.

Source: M/s Power Plus traders Pvt. Ltd.

CASE 2 Name of the Mine:	SHYAM SUNDAR PUR COLLIERY
Address of Mine:	Shyamsundarpur Colliery; P.O- Ukhra; Pin- 713363 Police Station- Andal; Sub Division- Durgapur
District State:	District- Paschim Bardhaman; State- West Bengal
Location Coordinates of the Mine:	Latitude- 23* 37 45" & 23* 39 20" Longitude- 87* 14 30" & 87* 16 30" Altitude- 96.20
Nature of Mine:	Public sector Mine/ Eastern Coal Fields of Coal India Limited
Year of initiation of Operation:	Since 1946
Type of Mine:	Under Ground
Extracting Material/Item:	COAL
Mining Lease Area:	533 Ha
Life of the Project:	Approved for 25 Years from 2020.
When Last EC Granted:	**31.07.2020**




Brief Description of the Mine:

This is the Picture of Mine entrance area of Shyamsundarpur Colliery, Bankola Area, ECL. All these images show, densily populated colonies besides mining infrastructure. the headgear of the mines are seen beyond colonies.

Shyamsundarpur Colliery is an underground mechanised mine under the administrative control of Bankola Area of Eastern Coalfields Limited (A Subsidiary of Coal India Limited). The mine is located within a small town, Ukhra. It is 1.5 Km north of Ukhra railway Station. The Pits are located about 50 m away of District Board road from Andal to Lawdoha/ Jhajra.

The surrounding area of the Pits are densely populated. Two large villages, Ukhra village and Sorpi village is located within the leasehold. Moreover, many surface structures, Shops, Buildings, metaled road, ECL office, ECL employee quarters and colony are located on its surface area.

This is a mechanised underground mine worked by LHD and Continuous miner (Operated by Joy Mining company). This is a Degree II gassy mine with multiple seam workings.
Seam R-IX (Exhausted), AND Seam R-VIII Top Thickness- 2.30 m to 2.80 m
Seam R-VIII Bottom Thickness 4.65 m AND Seam R- VII A Thickness 4.80 m to 5.40 m
R-VIII Bottom seam is worked by Sand Stowing AND R- VII A seam is worked by LHD amd Continuous Miner.
Depth of the seam at Pit Level R-VIII Top- 63 m; R-VIII bottom- 68 m and R-VII- 130 m & 160 m.
Inclination of seam 1 in 15. Grade of coal is B & C.

Source: M/s Power Plus traders Pvt. Ltd.

Overall, it is concluded that that Safety barrier to be left against all other surface features railways, roads, villages, hutments, boundary line of Mining lease area, nallahs, roads, rivers, transmission lines etc. and also the safety barrier to be left against the boundary of the underground coal mines that **will never disturbed** by the underground mining operations / extraction of coal is predicted. In this regard, satellite data and remote sensing technique have been used to mark the accuracy of physical as well human features in the MLA.

Further, at the initial stage of planning, all the safety barriers to be left are calculated for different depths and marked on the plan and the remaining portion of workings are planned for extraction / depillaring of coal after leaving sufficient barriers against surface features to be protected. Utmost care has been taken in marking the underground workings that are to be extracted in each coal seam at different depths. Adding the findings of CIMFR report - All the underground workings are planned for not to disturb any of the surface features after 70 years i.e., three years after the mine was closed, which was clearly illustrated in Subsidence contour plan after 70 years and thus the Rehabilitation & Resettlement Program is not applicable at all.

4: Survey Estimations & Enumerations

As mentioned earlier, two types of survey were initiated for doing Social Impact Assessment among the community. One is related to the sample villages and other is concerned with the sample household in the sample villages. The survey estimations and enumerations are as follows:

4.1 Village Level:

The village level survey was conducted to know about the social cultural and economic pattern existing in the project area. This was conducted in all 36 sample villages largely with help panchayat members and other older people of the villages using village information sheet through focus group discussion.

4.1a Distribution of Sample Village

Distribution pattern of the sample villages in the 10 km radial distance from the Jagannathpur project site shows that of the 13-villages falls in (36%) Birbhum district and majority (64%) 23 villages fall in Paschim Barddaman districts as indicated in below table 4.1

Table 4.1 Distribution of Sample Villages in radial distance of 10 KM for Jagannathpur Mines

District	Birbhum		P. Barddhaman		Total Villages	%age Villages
Block Name	MLA Villages	Non-MLA Village	MLA Villages	Non-MLA Village		
Illambazar	0	8	0	0	8	**22**
Dubrajpur	0	4	0	0	4	**11**
Barabani	0	0	0	1	1	**3**
Faridpur Durgapur	0	1	2	3	6	**17**
Kanksa	0	0	7	9	16	**44**
Burdwan-II	0	0	0	1	1	**3**
Vertical Total	0	13	9	14	36	**100**
Vertical Percentage	**0**	**36**	**25**	**39**	**100**	

The Mining Lease Area (MLA) fall in Paschim Barddaman district and hence out of 23 villages ie., 39% (9 villages) falls in MLA and remaining 61% (14 Villages) of villages falls outside MLA in Paschim Barddaman district. Taluka wise classification shows that 36% of villages falls in Illambazar; Dubrajpur and Faridpur Durgapur block of Birbhum district while remaining 64% falls in Barabani; Kanksa and Burdwan-II of Paschim Barddaman district.

4.1b Location of the villages

Accessibility to the villages is an important component for assessment of the development in the villages. Table 4.2 shows that 64% of the villages are located on the main road leading to easy accessibility; 25% with pucca link

road and only 11% with kuccha approach road. Overall linkage of villages in the project area is providing greater accessibility to the resident population.

Table 4.2 Location of the sample villages

Location of the villages	Birbhum	P. Barddhaman		Total Villages	%age Villages
	Non-MLA Village	MLA Villages	Non-MLA Village		
Main Road	11	5	7	23	64
On Pucca Link road	1	2	6	9	25
On Kuchha Road	1	2	1	4	11
Vertical Total	13	9	14	36	100
Vertical Percentage	36	25	39	100	

4.1c Details of FGSs

The village information was collected among the villagers by large having heterogenous groups as indicated in table 4.3. About 6% of the respondent are Panchayat members, 11% school teachers and 83% from heterogenous group consisting of aged villagers, youths, women and village office Panchayat staff.

Table 4.3 Types of Respondents in Focus Group Discussions (FGDs)

District	Birbhum	P. Barddhaman		Total Villages	%age Villages
Source of Information	Non-MLA Village	MLA Villages	Non-MLA Village		
Panchyat Member	1	0	1	2	6
School Teacher	0	1	3	4	11
Others	12	8	10	30	83
Vertical Total	**13**	**9**	**14**	**36**	**100**
Vertical Percentage	**36**	**25**	**39**	**100**	

The FGDs includes the topics for exploring village information was related with demography, availability and accessibility of public amenities and infrastructure, cropping pattern, classifications of Education and profession, facilities availed in the households of the villages and exploring demand for the village's development.

4.1d Population Characteristic

As per the district census handbook of District Birbhum and Paschim Barddaman (2011), the male population was 51% and female population 49% from the total population of 34996 in the 36 sample villages. The ratio of male and female population is almost 1 : 1. As per the panchayat records, the total BPL families HH was largely restricted in 28% of the sample villages in the range of 51- 100 BPL families HH; followed by 25% of the villages having greater range from 201 – 1500 BPL Families as indicated table 4.4a

Table 4.4a Household Family Characteristic in Sample villages (N=36) in the project area

Reported Villages Population Charterstics		Birbhum	P. Barddhaman		Total Villages	%age Villages
		Non-MLA Village	MLA Villages	Non-MLA Village		
Total BPL Households	1 - 50	1	2	5	8	**22**
	51 - 100	5	2	3	10	**28**
	101 - 150	2	2	1	5	**14**
	151 - 200	2	1	1	4	**11**
	201 -1500	3	2	4	9	**25**
Villages with emigrants	Yes	4	2	3	9	**25**
	No	9	7	11	27	**75**
Villages with migrants	Yes	3	2	5	10	**28**
	No	10	7	9	26	**72**
Female Panchyat Member	Yes	9	6	9	24	**67**
	No	4	3	5	12	**33**
Major Religon	Hindu	10	7	13	30	**83**
	Muslim	3	2	1	6	**17**
Secondary Religon Hindu		2	0	2	4	**11**
	Muslim	5	2	2	9	**25**

Further, only 25% of the villages reported having emigrant and around 28% villages reported to have migrant from these sample villages. About 67% of the villages reported to have at least one Panchayat members to be female. At majority, Hindu religion was reported with resident households in 83% of the sample villages followed by Muslim religion found in the household of to be only 11% villages. However about 25% villages reported to have occupancy of households having 'Muslim' as secondary religion. Further, an analysis of proportion of resident population for education and profession in the villages was done as indicated in table 4.4b and details are referred in *Annexure 9*.

Table 4.4b Average of proportion of population reported by Education and Profession in Sample villages of the project area

Category of working population	Birbhum	P. Barddhaman		%age Villages
	Non-MLA Village	MLA Villages	Non-MLA Village	
By Education*				
Below/ Under Graduate	88	90	92	90
Graduate	8	8	6	7
Post graduate	4	2	2	3
Professionals	1	1	1	1
By Profession				
Cultivator/Farmer	47	38	39	42
Agricultural Labour	21	25	22	22
Casual Labour	25	31	32	29
Petty Business	5	6	6	5
Service	1	1	2	1

* Field survey data from FGDs in sample villages. It also includes population having degree of under Graduate and schoolings but are not working.

The above table 4.4 shows mere approximate to give the rough idea of possible employment opportunity among the industries located in the project areas. In the project area, 90% of the population are under graduates (includes school passed out non-working population), 7% of working population having graduate degree, 3% with post graduate degree and only 1% are having technical degree or are professionals. During the FGDs, it is brought under notice that the Skill gaps in the existing industries for persons having skilled jobs are largely fulfill by the urban areas while the persons with unskilled jobs are largely taken up from surrounding villages from the project site during construction and operation stage of industries. In usual practice, the Resident of urban area are largely witness having high skilled jobs with higher education of graduate engineers, while the villages near by to urban areas are largely occupied with the un-skilled service sector jobs with education either graduate of under graduate (School level).

Similarly, status of the pattern employment among working population shows that at majority the project area is agrarian in nature of profession. About 42% of the working population in the villages are either cultivator/farmer and nearly 22% of working population are agriculture labour there making a total of 64% of the population livelihood are based on agriculture sector. This followed up by 29% earns their livelihood by working as casual labour; 5% are associated their earning by doing small or big petty business and only 1% of the population are engaged in service sector either with government or private sector. During the FGSs, it was brought into the notice that the causual labour in the area fluctuate inbetween agriculture and industrial sector.

4.1e Population Migration

Migration in the project area among 36 sample villages were based on the comparison of population and household of the Secondary and Primary data. The population and household secondary data of district census handbook of the Birbhum and Paschim Bardhhaman districts for 2011 is compared with village level primary survey data for the year 2021. Difference in the household number and population shows net result of in (+) and out (-) migration as indicated in table 4.5

Table 4.5 Migration Status in Sample Villages (N36) in the project area

Reported Migration in villages	Birbhum	P. Barddhaman		Total Villages	%age Villages
	Non-MLA Village	MLA Villages	Non-MLA Village		
In Migration	10	8	7	25	69
Out Migration	3	1	7	11	31
Vertical Total	13	9	14	36	100
Vertical Percentage	36	25	39	100	

From the table it is very much evident that 69% of villages to have in migration because there is increase in population and household numbers from 2011 census secondary data to current primary survey data of 2021. One of the astonishing results was with the 88% MLA villages reported in migration from the total 9 MLA villages in Paschim Bardhhaman district. The village wise details of in and out migration could be referred in *Annexure 10*. With the advent of Jagannathpur coal mine (A&B) area, there is a great influx of population in the nearby villages for livelihood. Besides, the progressive area of Asansol and Durgapur and their industrial development could also be one of the reasons for influx of the population in the region.

4.1e Amenities

Source of Water for drinking is an important parameter to judge the level of development of the village. Equally safe human excrete disposal is also important parameter to avoid breakup of any epidemic as well promote safe health and hygiene. About 67% of the villages reported to have open drainage system and only 8% of the villages reported having close drainage system in the house hold of the villages. It is surprising to note that 25% of the villages have no facilities of drainage system. Overall, only 8% of the villages are having closed drainage system as indicated in table 4.6.

Table: 4.6 Status of Amenities in the sample villages (N=36) of the project area

Reported villages for the Coverage of Public Amenities	Birbhum	P. Barddhaman		Total Villages	%age Villages
	Non-MLA Village	MLA Villages	Non-MLA Village		
Type of Drainage					
No Facilities	3	2	4	9	25
Open	10	7	7	24	67
Closed	0	0	3	3	8
Vertical Total	13	9	14	36	100
Vertical Percentage	36	25	39	100	
Main Source of Drinking water					
Overhead tank with piped water	2	1	5	8	22
Handpump/Boring	10	7	8	25	69
Open Well	0	1	0	1	3
More than one source*	1	0	1	2	6
Vertical Total	13	9	14	36	100
Vertical Percentage	36	25	39	100	

*Overhead tank piped water; Boring/Handpump; Pond; Open Well

Majority (69%) villages reported get drinking water as from handpump or boring. While only 22% of the villages got piped taped water through fully functioning overhead tanks. Only three percent of villages used open well as their source of drinking water while 6% of the villages are having more than one source of drinking water. Overall, only 22% of the villages are having safe

piped drinking water through tap connected to overhead tanks. Overall, it is observed that there is no significance regarding the status of amenities among the two districts as well between MLA and non-MLA villages.

4.1e Life Style Facilities

The life style facilities in the villages here is reported of the number of resident households possess the desired facilities in the sample villages. The villages show the coverage of the life style facilities among the resident households as indicated in table 4.7.

Table 4.7 Status life style facilities reported in HH of the sample villages in project area.

Reported villages for the Coverage of Facilities	Birbhum	P. Barddhaman		Total Villages	%age Villages
	Non-MLA Village	MLA Villages	Non-MLA Village		
Electric Connection					
100% HH	10	7	12	29	81
99-90% HH	3	2	2	7	19
Fixed Landline/mobile Connection					
100% HH	1	5	5	11	31
99-90% HH	9	2	6	17	47
89-50% HH	2	2	2	6	17
49% HH & Below	1	0	1	2	6
Cable/Disc Connection					
100% HH	0	1	2	3	8
99-76% HH	2	0	1	3	8
75-50% HH	3	2	6	11	31
49-25% HH	6	4	2	12	33
24% HH & Below	2	2	3	7	19
LPG Connection					
100% HH	1	1	2	4	11
99-76% HH	3	3	3	9	25
75-50% HH	7	5	7	19	53
49-25% HH	1	0	1	2	6
24% HH & Below	1	0	1	2	6
Two Wheeler					
100% HH	0	0	0	0	0
99-76% HH	0	0	2	2	6
75-50% HH	1	2	2	5	14
49-25% HH	4	3	3	10	28
24% HH & Below	8	4	7	19	53
Four Wheeler					
0	4	4	6	14	39
1% HH	5	2	5	12	33
2% HH	3	1	3	7	19
3% HH	0	1	0	1	3
5% HH	1	1	0	2	6

About 81% of the villages reported to have 100% household with electric metered connection and nearly 19% villages reported to have only 90-99 of the household having electric metered connection. Overall, the electrical supply in the villages is by large having full coverage among the resident households. Fixed landline connection/mobile is an asset in rural areas where the possibility to get landline/mobile connection largely depend upon the supply side from the concerned authorities. Overall, 87% of the villages reported to have landline/mobile connection. Nearly cable/disc connection reported in the 100% household in only 16% of the villages.

The LPG gas connection is found in 100% housed of only 11% of the villages. Overall LPG connection is found in 76% % of the households reported to have in 36% of the villages. Having two-wheeler in rural areas is largely witnessed as per the affordability as well requirement of the individuals. About 24% of the households in 53% of the villages are reported to have at least one two-wheeler while only 1% of the household reported to have four-wheeler in 33% of the villages. From the above table it is quite evident that the gap between "have and have not" for the household facilities in the villages seems to be slowly narrowing over the period of time.

4.1f Public Infrastructure

One of the important parameters for evaluation of development in rural area is related with the availability and accessibility of essential & vital public infrastructure. Anganwadi centre was the most reported in 92% of the villages, followed by Primary School (42%); Village Cemetery (33%); Low fair ration shop (28%), Bus stand (19%) and post office in 11% of the villages as indicated in table 4.8a. Overall, it seems on an average 32% of the villages are reported having availability of the such essential public infrastructure facilities.

Table 4.8a Availability of essential public infrastructure in the sample villages in project area.

Availability of Public Infrastructure	Birbhum	P. Barddhaman		Total Villages (N=36)	%age Villages
	Non-MLA Village	MLA Villages	Non-MLA Village		
Anganwadi	10	5	12	33	92
Primary School	0	1	5	15	42
Village Cemetary	5	1	6	12	33
Low Fair Ration Shop	3	2	5	10	28
Bus Stand	4	0	3	7	19
Secondary Schools	0	1	5	6	17
Post Office	1	1	2	4	11

While there is total unavailability of vital infrastructure like College, Panchayat office, Railway Station, nationalized and cooperative banks. These facilities are population based and proximity of the physical location for the specified range of area in development plan. Hence analysis was done among villages

where accessibility of both essential and vital public infrastructure is absent as indicated in table 4.8b.

Table 4.8b Accessibility (Km) of essential and vital public infrastructure reported in the sample villages in project area.

Nearest distance (KM) for village having no such public infrastructure	Valid N	Mean	Minimum Distance	Maximum Distance
Distance of Railway Station	36	23	13	50
Distance of College	36	18	5	35
Distance of Panchayat Office	36	4	1	9
Distance of Nationalized Bank	36	10	10	30
Distance of Cooperative Bank	36	11	60	35
Distance of Village Cemetry	36	3	2	15
Average	**36**	**12**	**15**	**41**
Distance of Anganwadi	3	2	1	2
Distance of Primary School	21	1	1	7
Distance of Secondary School	30	4	1	19
Distance of Low Fair Ration shop	8	2	1	3
Distance of Post Office	21	3	1	6
Distance of Bus Stand	17	3	1	6
Average	**17**	**2**	**1**	**7**

The average maximum distance travelled 41 km; minimum is 15 km and mean distance is 12 km by an individual by any means to avail the accessibility of vital public infrastructure which is not present in any of the sample villages. Similarly, an individual has to travel by any means a maximum of 7 km, minimum 1 km and mean distance of 2 km to avail the essential public infrastructure in other places. Further, accessibility to market place and nearest town; headquarter of block, district and revenue inspector office varies according to the location of the villages is shown in table 4.8c

Movement of the population largely depended upon the individual needs. The above table shows average distance travelled to various destinations (market place and nearest town; headquarter of block, district and revenue inspector office) from the sample villages in the project area. Overall, on an average, an individual travels by any means – a maximum 20 kms; minimum 13 kms and mean 17 Kms from the villages to the specified destination in the project area.

Table 4.8c Accessibility of different places from the sample villages in the project area

Category of Places	Name	Minimum	Maximum	Average
Nearest Town	Bolpur	30	35	34
	Durgapur	15	30	23
	AVERAGE	**23**	**33**	**29**
Nearest Market	Banagram	6	13	9
	Dubrajpur	15	18	24
	Gauabazar	3	6	5
	Ilambazar	12	15	13
	Joydev Kunduli	1	10	4
	Kataberiya	2	4	3
	Laudoha	4	8	6
	Shivpur	4	4	4
	AVERAGE	**6**	**10**	**9**
Block HQ	Dubrajpur	12	18	15
	Durgapur	15	15	15
	Faridpur Dungar	9	12	11
	Ilambazar	12	18	15
	Kanksa	19	30	27
	Laudoha	4	12	7
	Panaghar	30	35	32
	AVERAGE	**14**	**20**	**17**
Revenue Inspector HQ	Dubrajpur	12	18	15
	Faridpur D	9	12	11
	Ilambazar	12	18	15
	Kanksa	19	35	26
	Laudoha	4	12	7
	Malandihi	12	12	12
	Shibpur	8	8	8
	AVERAGE	**11**	**16**	**13**
District HQ	Asansole	40	80	59
	Birbhum	36	40	40
	AVERAGE	**38**	**60**	**50**
Overall Project Area Average		**13**	**20**	**17**

4.1g Agriculture practices

As mentioned, in the beginning that the project areas are largely being Agran dominated area, where the resident population by large is depended upon agriculture sector. The village survey in the project area reported paddy being the major crop of the resident villagers in all 36 sample villages. Nearly 12% of the villages reported having secondary crop depended upon the seasonal and market demand. The secondary pattern of the crop are Jute, green vegetable, potatoes, mustard and wheat are being cultivated on their land.

4.1h Development Index

Primary analysis of economic parameters with exact status of amenities is collected by using special village format by doing FGDs in the respective sample village in the radial distance of 10 km from the project site**.** The Economic and Quality of Life index are based on primary data 2021 using weighted index method giving weightage owing to the nature of variables by using Microsoft excel. Data of different variable were converted to uniform score point (from 1 t o10) by calculating desired interval of the said data by knowing the maximum and minimum value. Village level formulae used to calculate socio-economic and quality of Llfe index is as under:

$$V_N = \frac{\sum Di\ Wi}{\sum Wi}$$

Where

- ⇒ **Di = D1, D2, D3**…….. Dn where D1=Sex ratio; D2=Population Density …. N number of any Data set
- ⇒ **Wi = W1, W2, W3**……..Wn where W1=1st Assumption; 2nd Assumption ….. N number of assumptions for given weightage to any data set owing to nature of the data and its importance according to the selected topics of data set
- ⇒ **V here represents villages for N number of villages**

4.1h1 Quality of Life (QOL) Index

The quality of life seems to be poor to fair and needs lot of efforts to improvement. However, it becomes apparent to know the quality-of-life index of the villages coming the radial distance of 10 Km. There are about 15 selective QOL extracted from survey done 2021 from village information sheet in the sample villages of Birbhum and Paschim Barddhaman district for the project area. These QOL variables are verified among 36 Sample villages. Based on the nature of the QOL indicators they are classified into two groups viz. infrastructure and service indicators[6].

The QOL data set for all villages was made uniform by allocating presence of QOL variable as 10 points and absence of the QOL variables in the villages with given no or zero points. The assumption of such allocation of the weightage is related that no QOL can be improved of the villages with infrastructure development followed be strengthening related service sector. Thus, Owing the nature and significance of QOL variables, the infrastructure related variables were assigned 70%, while the remaining Services related QOL variables were given 30% of the weightage. The average score of each variable were taken into each village level analysis. Analysis was carried out based on above explanation for calculating Quality of Index of the villages as indicated

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[6] **Infrastructure**: Anganwadi, Govt. Primary School, Govt. Vocational Training Centre (ITI); Govt. PHC & SC; Total Sanitation Campaign, Metal Road, Commercial Bank and Community Centre
Services: Untreated Tap water, River & Canal, Telephone/Mobile; Public/Private mode of Transportation; Agriculture Credit Society; Self Help Group, and Electric Power Supply.

in table 1.9 and the village level details are narrated in Annexure 11. Average weighted score point is classified into four groups viz, as 2.1-3.4 as poor; 3.5-4.7 as fair; 4.8 – 6.0 as Good and 6.1 and above as excellent QOL.

Table 4.9a: Average Weighted Score point for calculating Quality of Life index of villages in the radial distance of 10 km from the project site

Group of Average Weighted Score point	Performance Group	Frequency of villages	Percentage of villages
2.1 - 3.4	Poor	12	33
3.5 - 4.7	Fair	4	11
4.8 - 6.0	Good	15	42
6.1 & above	Excellent	5	14
Total		**36**	**100**

Village level analysis of QOL index shows that the maximum average weighted score point in village is 7.4 points score and the minimum is 2.1 points score while the average point score for villages in the radial distance of 10 km from the project site is 4.6-point score. From the total 36 villages, about 33% had poor QOL status 11% had fair, 42% had good and only 14% of the villages had excellent QOL status. Overall, 56% villages Quality of Life Index fall from Good to excellent.

4.1h2 Economic Index (EI)

The economic profile seems to be poor to fair and has degraded economic status of the villages. Thus, it becomes essential to know the EI of the villages coming the radial distance of 10 Km. There are about 22 selective EI extracted from survey done 2021 from village information sheet in the sample villages of Birbhum and Paschim Barddhaman district for the project area. These EI variables are verified among all 36 sample villages. Based on the nature of the EI indicators, they are classified into two groups viz. Direct and Indirect Economic Activities[7]. The EI data set of different variables were converted to uniform score point (from 1 to 10) by calculating desired interval of the said EI data by knowing the maximum and minimum value.

The assumption of such allocation of the weightage is related that EI is made owing to the significance of the data (Variables having significance to Direct Economic Activity - 70%, and Variables having significance to indirect economy activities -30%). The average score of each variable were taken into each village level analysis. Analysis was carried out based on above explanation for

[7] Direct Economic Activities involves Status of Commercial and Cooperative bank; Status of ATM & Agriculture credit Society; Status of Manis/Regular Market & Weekly Haat; Status of Production of Agriculture, Manufacturing, Handicraft Commodities; Profession as farmer/Cultivator, Agriculture labour; Casual Labour, Petty and Service Class.
Indirect Economic Activities involves Status of Ponds; Net Sown Area (in Hectors); Status of Public Distribution Shop in the village; Status of Tractor and Cart Driven by animals; Status of Black Toppled Road; Power supply for agriculture & Commercial activities.

calculating Economic Index of the villages as indicated in table 4.9b and the village level details are narrated in Annexure 12. Average weighted score point is classified into four groups viz, 1.5 - 2.4 as poor; 2.5 - 3.3 as fair; 3.4 - 4.2 as Good and 4.3 & above as excellent EI.

Table 4.9b: Average Weighted Score point for calculating Economic Index of villages in the radial distance of 10 km from the project site

Group of Average Weighted Score point	Performance Group	Frequency of villages	Percentage of villages
1.5 - 2.4	Poor	14	39
2.5 - 3.3	Fair	20	56
3.4 - 4.2	Good	0	0
4.3 & above	Excellent	2	6
Total		**36**	**100**

Village level analysis of EI shows that the maximum average weighted score point in village is 4.9 points score and the minimum is 1.5 points score while the average point score for villages in the radial distance of 10 km from the project site is 2.6 point score. From the total 36 villages, about 39% had poor EI status, 56% had fair, and only 2% of the villages had excellent EI status. Overall, 95% villages Economic Index fall from poor to fair.

4.2 Household Level:

Within the 36 sample villages, about 10% of the household were interviewed to explore the social and economic condition of the resident in the households of the villages. As per 2011 census, the total households as per census 2011 was 7898 and nearly 820 households were interviewed. The other household information is as follows:

4.2a Demographic Characteristic

About 820 household surveyed having total population of 2942, making family size to be 4 persons per family. Among the total population surveyed, 53% were male and 47% were female making male and female ratio as one male is to 0.9 female. The sex ratio of the project area is 896 females per thousand males while for 0-5 population it is 1019. The population density is 676 persons per square km. The other background of household characteristic is indicated in table 4.10.

4.10 Household Population Characteristic (N=2942)

Main Group	Sub Group	Birbhum		Barddhaman		Row Total	Row % (N=2942)
		Male	Female	Male	Female		
HH Religion	Hindu	436	346	974	900	2656	90.3
	Muslim	85	95	57	49	286	9.7
HH Caste	Higher Caste	260	199	417	396	1272	43.2
	SC	141	117	445	408	1111	37.8
	OBC	116	123	97	77	413	14.0
	ST	4	2	72	68	146	5.0
Marital Status	Currently Married	282	283	575	566	1706	58.0
	Unmarried	222	127	423	309	1081	36.7
	Widow/Widower	9	25	20	61	115	3.9
	Seperated	7	3	12	9	31	1.1
	Divorced	1	3	1	3	8	0.3
	Married but GONA not done	0	0	0	1	1	0.0
Age Group	5 & Below	37	33	66	72	208	7.1
	6 - 14	53	47	126	142	368	12.5
	15 - 20	62	54	125	117	358	12.2
	21 - 30	113	90	202	181	586	19.9
	31 - 40	94	75	179	200	548	18.6
	41 - 50	60	72	161	117	410	13.9
	51 - 60	63	50	103	79	295	10.0
	60 & Above	39	20	69	41	169	5.7
Education	Literate	363	282	714	608	1967	66.9
	Illetrate	158	160	317	340	975	33.1
Profession	Working	322	5	626	42	995	33.8
	Not Working	199	436	401	910	1946	66.1

At majority Hindu religion population (90.3%) dominates, followed Muslim (9.7%) population in the households of the sample villages. The villages population largely consist of higher caste groups (43.4%) population. The Scheduled Caste population (37.8%) is higher than the other backward caste (14%) and Scheduled Tribes (5%). The household population composition shows that 58% of the population are married and 36.7% of the population are either found bachelor/unmarried/Single/Not eligible for marriage. About 52.4% in the age cohort 21-50 is most fertile and active age population group in the household of the sample villages. The female literacy from the total population comes around 30.3%. which is less to the male literacy (36.3%). The work participation is of female population is 1.6%, which is very less when compared to male population (32.2%). Overall, the literate population for the project area enumerated to 67% and work participation 34%.

4.2b Education

The primary education passed is mostly dominating (39.3%) in all age groups of the population. The literate group with no formal education is also more prevalent among the resident household population and is just half (18.4%) to the population having primary passed grades. This is followed up with secondary passed 17.4% of household population in the villages. The proportion of illiteracy is only 7.7% among the population and equally the same proportion (7.1%) of the population reported to be below five years.

However, secondary and higher degree passed household population is just 10% as indicated in table 4.11.

Table 4.11 Status of Education among the household population in sample villages

Education of Respondents	Age Group of Respondents (2942)								Vertical Total	Vertical %age
	5 & Below	6 - 14	15 - 20	21 - 30	31 - 40	41 - 50	51 - 60	60 & Above		
Primary (1-7)	0	197	113	327	287	159	54	19	1156	39.3
Secondary (8-10)	0	70	94	115	125	75	24	9	512	17.4
Higher Secondary (11-12)	0	1	71	23	7	3	3	3	111	3.8
Under Graduation	0	0	49	18	3	2	1	1	74	2.5
Graduate	0	0	13	38	11	8	4	7	81	2.8
Graduate & Plus	0	0	2	8	5	4	1	0	20	0.7
Technical Training	0	0	1	3	0	1	2	1	8	0.3
Engineering/Diploma	0	0	1	2	1	0	0	0	4	0.1
Literate without formal Education	0	99	14	44	78	116	120	69	540	18.4
Illitrate	0	1	0	8	31	42	86	60	228	7.7
Children 0-5 years	208	0	0	0	0	0	0	0	208	7.1
Horizontal Total	**208**	**368**	**358**	**586**	**548**	**410**	**295**	**169**	**2942**	**100.0**
Horizontal Percentage	**7**	**13**	**12**	**20**	**19**	**14**	**10**	**6**	**100**	

4.2c Profession

As mentioned earlier, the household population reported dominating agriculture sector (19.7%) profession followed by 5.7% unskilled worker working largely as causal labour while only 1.4% skilled professional workers in the population were reported. By large non-working female, 29.5% reported to be sharing household domestic responsibility as housewives and nearly 22.8% of young population reported as student. About 5% of the population reported doing big/small business and 6% reported unemployed owing to the current pathetic condition arises from lock down because of pandemic of Corona virus.

Only 1.8% of the population were found engaged as professionals and service class in either private/government sector. Further only 1.1% of the household population reported working as driver to as indicated in table 4.12. About 6.5% of children reported in the age of 0-5 years of which only 9% reported found going to Anganwadi centre under mid-day meal scheme. Owing to nature of the profession, about 6.8% of casual/unskilled workers and driver reported migrating daily from their resident villages. Overall, it was observed that 66% of the household population reported not doing any commercial activities for their livelihood - as being found as housewife, student, unemployed, aged and being small children in the age of 0-5 years. In the present circumstance of COVID-19 virus, only 34% of the household population reported engaged in some or the other profession for earning their livelihood as indicated in table 4.12.

Table 4.12 Status of Profession among the household population in sample villages

Profession of the Respondent	Age Group of Respondents (2942)								Vertical Total	Vertical %age
	5 & Below	6 - 14	15 - 20	21 - 30	31 - 40	41 - 50	51 - 60	60 & Above		
Cultivator	0	0	2	20	47	47	35	37	188	6.4
Agri Labour	0	2	9	92	120	85	66	16	390	13.3
Unskilled Worker	0	1	5	36	27	15	12	10	106	3.6
Petty Business	0	0	1	17	30	28	22	9	107	3.6
Big Business	0	1	1	3	2	4	3	4	18	0.6
Skilled Worker	0	0	0	12	11	11	6	1	41	1.4
Professionals	0	5	1	6	6	3	5	2	28	1.0
Services (Class 1)	0	0	0	0	1	4	2	1	8	0.3
Services (Class 2)	0	0	0	0	1	0	0	1	2	0.1
Services (Class 3 & 4)	0	0	0	2	2	2	3	2	11	0.4
Driver	0	0	2	15	8	5	1	1	32	1.1
Craftsman/Astisan	0	0	1	0	1	0	0	0	2	0.1
Casual Labours	0	0	0	17	19	22	3	1	62	2.1
Housewife	0	0	54	232	259	176	110	37	868	29.5
Student	18*	358	248	44	3	0	0	0	671	22.8
Unemployed	0	1	34	90	11	8	27	2	173	5.9
Aged	0	0	0	0	0	0	0	45	45	1.5
Children (1-5)	190	0	0	0	0	0	0	0	190	6.5
Horizontal Total	**208**	**368**	**358**	**586**	**548**	**410**	**295**	**169**	**2942**	**100**
Horizontal Percentage	**7**	**13**	**12**	**20**	**19**	**14**	**10**	**6**	**100**	

*** Reported going to Anganwadi under mid-day meal scheme.**

4.2d Background

From the total 820 households surveyed in 36 sample villages, 90.6% reported occupied by Hindus families and rest 9.4% by Muslim families. Caste wise composition shows majority of the households occupied by the higher caste (44.5%); than Scheduled Caste (37%), Other backward class (13%) and Scheduled Tribe (4.6%) being the lowest. Household trend shows more inclination of the resident families to nuclear family system (82%) as compared to joint family system (18%). About 99% of the household reported owned by themselves, largely living in pucca constructed house (50%) and the remaining occupied in semi pucca (21.5%) constricted house. About 27.2% of the households are constructed as kuccha and only 1.3% households found to be constructed as hut as indicated in table 4.13.

Table 4.13 Households[8] (N=820) Characteristic in sample villages

HH Group	HH Sub Group	Birbhum	P. Barddhaman		HH Sub Group Horizontal Total	HH %age (N=820)
		MLA Village	MLA Village			
		No	Yes	No		
HH_ Religion	Hindu	228	148	367	743	90.6
	Muslim	53	11	13	77	9.4
HH_ Caste	Higher Caste	139	95	131	365	44.5
	OBC	69	9	36	114	13.9
	SC	72	53	178	303	37.0
	ST	1	2	35	38	4.6
Type of Family	Joint	36	24	87	147	17.9
	Nuclear	245	135	293	673	82.1
House_Ownership	Owner Occupied	278	157	376	811	98.9
	Tenant	3	2	4	9	1.1
HH_Phyical_Type	Hut	2	0	9	11	1.3
	Kuchha	58	39	126	223	27.2
	Semi Pucca	69	46	61	176	21.5
	Pucca	152	74	184	410	50.0

4.2e Household Facilities

As mentioned above that only 50% of the household reported to have pucca construction while the remaining construction of the houses were semi pucca, Kuchha and huts. Looking up the facilities 40% of households reported to have more than three rooms and 54% has two rooms only. Further 85% of the households reported have separate bathroom and among these 10% reported to have open bathrooms; 7% reported partially closed and majority (83%) reported to have closed bathrooms. The utilization of toilet was largely (74%) confined to their own toilets in the house and 14.5% reported to utilize in sharing. However, 11% of the household reported to defecate outside reported to have no toilets at their house. Only 10% of the household reported connected with modern flush system, while 16% reported connected with septic tank and 25% with soak pit. Further only 26.7% regularly clean their toilets and 58% reported occasionally cleaning their toilets. While only 12% household reported to have sewage connection.

Separate kitchen is an important criterion for hygiene living and 92% of the household reported possessing separate kitchen in their house. By large majority (67%) reported using LPG gas for cooking. About 69% reported to have piped water connected with/without overhead tank for dinking purpose while 49% of the household use water from ponds, open well, river/canal and boring/well for the domestic purpose and 51% household reported possessing the facilities of piped water with or without overhead tanks. However, 99% of the household have electric meter connection as indicated in table 4.14a

8 Construction criteria for type of Households

Type of Houses	Criteria for Wall	Criteria for Floor	Criteria for Roof
a. Hut	Trampoline/Plastic	Mud	Trampoline/Plastic/Leaves/Grass
b. Kuccha	Mud/Mat	Mud	Thatched/Cloth/Leaves/Grass
c. Semi Pucca	Bamboo/Tin	Mud/stone	Asbestos/Bamboo/Wooden log
d. Pucca	Concrete	Tile/Concrete	Concrete

Table 4.14a Facilities availed in the households (N=820) in the sample villages

HH Characterstic Group	HH Characterstic Sub Group	HH Physical Construction Classification (N=820				HH Sub Group Horizontal Total	HH %age (N=820)
		Hut	Kuchha	Semi Pucca	Pucca		
No of room	No Room	3	0	0	0	3	0.4
	One Room	5	18	15	5	43	5.2
	Two Rooms	3	168	110	166	447	54.5
	3 & More Rooms	0	37	51	239	327	39.9
Seperate Bathroom	Yes	9	180	117	390	696	84.9
	No	2	43	59	20	124	15.1
Type_Bathroom	Open	8	57	10	6	81	9.9
	Partially closed	3	35	6	12	56	6.8
	Completely closed	0	130	160	392	682	83.2
Toilet_utilization	Defecate Outside	8	67	9	5	89	10.9
	Shared	0	87	10	22	119	14.5
	Own	0	71	157	383	611	74.5
Type of Toilet	Soakpit	0	7	82	116	205	25.0
	Septic Tank	0	85	13	23	131	16.0
	Modern Flush	0	0	14	69	82	10.0
Freq_Toilet_Clean	Never	0	4	5	19	28	3.4
	Occassionally	0	135	140	205	480	58.5
	Regularly	0	21	20	178	219	26.7
Sewage Line Conn	Yes	0	0	26	56	82	10.0
	No	0	156	166	393	715	87.2
HH_Sept_Kitchen	Yes	0	194	163	397	738	90.0
	No	0	27	13	13	53	6.5
Type_Cooking_Fuel	Cow-dung	6	32	12	19	69	8.4
	Agri-Waste	3	10	2	1	16	2.0
	Firewood	2	47	24	6	79	9.6
	Coal/Charcoal	0	35	30	34	99	12.1
	Kerosene	0	10	0	0	10	1.2
	LPG	0	89	108	350	547	66.7
Source_Drinking Water	River/Canal	0	1	1	0	2	0.2
	Well/Tube Well	1	118	86	108	313	38.2
	Handpump	0	6	4	12	22	2.7
	Piped Water without OT*	0	33	27	41	101	12.3
	Piped Water with OT*	10	65	58	249	382	46.6
Source of water for Domestic use	River/Cannal	0	1	1	2	4	0.5
	Ponds/Tanks	1	38	40	17	96	11.7
	Well/TubeWell	1	103	55	114	273	33.3
	Handpump	0	5	5	12	22	2.7
	Piped Water without OT*	7	19	40	141	207	25.2
	Piped Water with OT*	2	57	34	126	219	26.7
Source of Light	Electricity	10	221	175	410	816	99.5
	Oil Lamp	1	2	1	0	4	0.5

*Overhead Tank

4.2f House Land, Livestock's and Cropping pattern.

About 22% of households reported having agriculture land and majority was acquired by Pucca houses (68%) as indicated in Table 4.14b. As mentioned, in the beginning that the project areas are largely being Agran dominated area, where the resident population by large is depended upon agriculture sector.

The household survey in the project area reported paddy being the major crop and around 27% of the household reported having secondary crop depended upon the seasonal and market demand. The secondary pattern of the crop are Jute, green vegetable, potatoes, mustard and wheat.

Table 4.14b Status of ownership of agriculture land in HH of project area

Frequency Type of HH	Owner of Agriculture land			Total	Percent
	1 Bhiga	2 Bhiga	3 & Plus Bhiga		
Hut	0	0	0	0	**0**
Kuchha	3	2	23	28	**16**
Semi Pucca	4	1	22	27	**16**
Pucca	14	10	94	118	**68**
Total	21	13	139	173	**100**
Percent	**12**	**8**	**80**	**100**	

About 75% of the households reported to have either one or more than animals for their own consumptions. Taking account, the type of houses 60% of the pucca houses by large reported possessing the livestock. The multiple responses suggest that 67% of the households reported possessing a minimum of two types of domestic animals while only 14% of household are having more than 5 numbers of different types of domestic animals as indicated in in table 4.14c.

Table 4.14c Status of livestock in the household (N_820) in the sample villages

HH_Phyical_Type	Type of Animals	No of Animals based on multiple total responses						
		1	2	3	4	5 & Plus	Total	Percent
Hut	Sheeps	9	1	3	2	2	17	1.4
	Goats	2	4	0	1	1	8	0.7
	Cows	6	2	1	0	0	9	0.8
	Total	**17**	**7**	**4**	**3**	**3**	**34**	**2.8**
Kuchha	Sheeps	18	14	0	2	21	55	4.6
	Goats	42	41	6	2	18	109	9.1
	Cows	40	68	8	2	6	124	10.4
	Total	**100**	**123**	**14**	**6**	**45**	**288**	**24.1**
Semi Pucca	Sheeps	2	1	0	0	9	12	1.0
	Goats	15	28	5	0	5	53	4.4
	Buffalos	1	2	0	0	1	4	0.3
	Cows	19	57	8	3	2	89	7.5
	Total	**37**	**88**	**13**	**3**	**17**	**158**	**13.2**
Pucca	Sheeps	105	21	58	39	36	259	21.7
	Goats	37	74	18	9	34	172	14.4
	Buffalos	1	7	0	0	2	10	0.8
	Cows	74	113	32	23	31	273	22.9
	Total	**217**	**215**	**108**	**71**	**103**	**714**	**59.8**
Total Type of HH	Sheeps	134	37	61	43	68	343	28.7
	Goats	96	147	29	12	58	342	28.6
	Buffalos	2	9	0	0	3	14	1.2
	Cows	139	240	49	28	39	495	41.5
	G Total	**371**	**433**	**139**	**83**	**168**	**1194**	**100.0**
	Percent	**31**	**36**	**12**	**7**	**14**	**100**	

4.2g Household Items

The possession of the household items was largely reported among pucca houses (55%), while the semi-pucca (21%) and kuccha (23%) household almost share equal proportion of household items as indicated in table 4.15

Table 4.15 Status of household items (N_820) in the sample villages

Possessation of HH items	Multiple Responses among type of HH				Horizontal Total	Horizontal Percent
	Hut	Kuchha	Semi Pucca	Pucca		
Clock/Watch	9	214	169	394	786	**23.4**
VCR/VCD	0	0	0	1	1	**0.0**
Car/Jeep	0	1	1	2	4	**0.1**
Fan	10	213	175	406	804	**24.0**
Sewing Machine	0	0	3	3	6	**0.2**
Telephone	0	10	11	40	61	**1.8**
Bullock Cart	0	0	1	1	2	**0.1**
Radio/Transistor	3	16	15	75	109	**3.2**
Bicycle	7	195	156	354	712	**21.2**
Refreigeator	0	0	2	30	32	**1.0**
Water Pump	0	1	7	17	25	**0.7**
Television	1	97	135	337	570	**17.0**
Motocycyle	0	17	32	177	226	**6.7**
Tractor	0	0	2	11	13	**0.4**
Spraying Machine	0	1	0	3	4	**0.1**
Verticle Total	30	765	709	1851	3355	**100.0**
Vertical Percent	**0.9**	**22.8**	**21.1**	**55.2**	**100.0**	

Multiple responses suggest that all 16 items as per the status and needs of the household is largely witnessed among the Pucca households. While the common items reported in semi-pucca and kuccha households are watch; fan; bicycle; television and motorcycle. The hut reported possessing by large fan, clock, and bicycle.

4.3h Annual Income

The income of the family profession was estimated by taking average of the last three years annual income, as in the era of pandemic last one year data was not relevant and largely under reported. The total average of family annual income is indicated in table 4.16 and the details based on type of house is shown *Annexure 13*.

Looking the house occupancy for huts (N=11) the major profession contributing to annual income is from cultivators (54.5%) and agriculture

labours (63.6%) and the average annual income group lies in range of Rs.36000-60000. while for Kuccha house it is agriculture labour (71%) with annual income group ranging from Rs.24000-36000. In the semi pucca houses the major profession contributing to annual income is cultivators (30.7%), agriculture labour (46.0), unskilled workers (15.3%) and small petty business (10.8%) are major contributor in family household annual income group ranging from Rs.24000 to Rs.100000/. The trend for the major profession in the household annual family income for Pucca house is similar to that of semi pucca houses - as cultivators (53.9%), agriculture labour (32.4%), small petty business (16.3%) and unskilled workers (14.1%) with family income group ranging from Rs.60000 to Rs.250000/.

Table 4.16 Family annual income in the households (N=820) in the project area

Type of Profession in Households	Income Group (INR) Percentage & Total based on									Total Multiple Responses	Group Percentage
	Below 12000	12001-24000	24001-36000	36001-48000	48001-60000	60001-100000	100001-250000	250001-500000	500001 Plus		
Cultivators	1	2	21	31	37	90	113	10	11	**316**	**38.5**
Agri Labour	2	6	107	59	50	89	57	7	2	**379**	**46.2**
Unskilled workers	1	0	4	14	19	29	30	1	3	**101**	**12.3**
Petty Business	0	0	4	2	14	33	37	1	3	**94**	**11.5**
Big Business	0	0	0	0	1	2	8	0	3	**14**	**1.7**
Skilled Workers	0	0	0	3	2	14	10	0	0	**29**	**3.5**
Professionals	0	0	6	0	0	2	8	1	1	**18**	**2.2**
Service (Class 1)	0	0	0	0	1	1	1	1	1	**5**	**0.6**
Service (Class II)	0	0	0	0	0	1	0	0	0	**1**	**0.1**
Services (Class III & IV)	0	0	0	0	2	1	3	2	0	**8**	**1.0**
Driver	0	0	0	2	4	10	12	0	0	**28**	**3.4**
Casual Labourer	0	0	2	5	16	19	6	0	0	**48**	**5.9**
Housewife	0	0	0	0	0	2	1	0	0	**3**	**0.4**
Pension	2	2	0	1	0	0	0	0	0	**5**	**0.6**
Grand Total	**6**	**9**	**143**	**110**	**136**	**233**	**156**	**11**	**16**	**820**	**100**
Horizontal Percenage	**0.7**	**1.1**	**17.4**	**13.4**	**16.6**	**28.4**	**19.0**	**1.3**	**2.0**	**100**	

For the total households (N=820) in the project area, the major profession contributing the household family income are cultivators (38.5%); agriculture labour (46.2%); unskilled labour work (12.3%) and petty business (11.5%) in the income group range from Rs.24000 to 250000/-. Overall, it is the agriculture sector contributing as major sources of family annual income in the project area.

Overall, in the project area, only 3.5% of the household reported to have increased their family income in business (Small or Big) ranging from Rs.10,000/- to a minimum to maximum Rs. 1,80,000/- with an average mean of Rs. 65,000/. Similar, about 5.2% of the households reported to acquire loan

to run their daily living expenses of the family, ranging from Rs.75,000/- to a minimum to maximum Rs. 2,00,000/- with an average mean of Rs. 1,33,000/. Majority (98%) reported, lock down due to COVID 19 - to be the main reason for the deterioration in their household income.

4.2i Education Practices

Responses in the use of education practices largely affected due to 1st and 2nd waves of the pandemic in the region. At most care was taken in asking the utilization of the school during last three months. The response rate for using education practice remain to only 62% (N=540), of which of the 93% household respondents admitted to have education institution (Anganwadi/Primary school only) in their vicinity of 1 km while the 7% reported to have at a distance ranging from 2-5 km. in the present context of COVID 19, none of the wards of the household respondent admitted sending their children to school during 1st and 2nd waves of the pandemic in the region and the 'lock down' restriction imposed by the authorities. However, before the pandemic, at least 49% admitted sending their ward to Anganwadi centre and only 3% households reported having scholarship for the ward in schools.

4.2j Health Practices

Owing to the severity of the pandemic of infectious in nature by air drop, the responses rate was high with 96% (N=787) of the households responded for the utilization of nearby health institutions. About 39% reported visiting health institution located at a distance of 1 km, while 31% reported at 2 km and the remaining 30% reported visiting health institution at a distance from ranging more than 2 km to 55 km depending upon the severity of the sufferings. Among these, 77% of the household reported visiting local sub centre in their villages, 4.4% to nearest PHC; 13.2% to nearest Government dispensary and the remaining 5.4% reported visiting nearest CHCs or district or private hospitals. The main reasons reported by the household visiting these health institutions during last three months was related with only fever (82%); Fever, cough and vomiting (27%) and Fever with upper respiratory tract infection (16%). The morbidity reporting by the households was largely related and reported in context to COVID 19 on priority make other sufferings as secondary options for treatment. The reasons for visiting of the health institutions is indicated in table 4.17

Table 4.17 Multiple Reasons for visiting Health institution by the HH Respondents

Reasons for visiting health institutions	Multiple total response for Visit of Health Institutions								
	SC	PHC	Govt Dispensary	CHC	Dist Hospital	Pvt Hospital at Taluka /Dist HQ	Pvt Hospital in Metro	Total Responses	Res-ponses in %age
Services are nearby	452	28	57	0	5	22	0	**564**	**71.7**
More Convenient	92	8	11	1	0	15	0	**127**	**16.1**
Treatment is more effective	254	10	47	1	2	7	1	**322**	**40.9**
Treatment/Fee is cheaper	95	4	44	0	2	1	0	**146**	**18.6**
Doctors are always avaliable	151	14	41	0	1	17	1	**225**	**28.6**
Convenient timings	63	1	13	0	0	7	0	**84**	**10.7**
Required Medicines are avaliable	423	14	45	0	5	13	1	**501**	**63.7**
More faith in Institution doctor	197	10	16	0	5	9	0	**237**	**30.1**
Doctor pay personal attention	32	6	7	0	0	17	0	**62**	**7.9**
Horizontal Total	**609**	**35**	**104**	**1**	**6**	**31**	**1**	**787**	**100**
Horizontal Percentage	**77.4**	**4.4**	**13.2**	**0.1**	**0.8**	**3.9**	**0.1**	**100**	

The resident population from the household, by large preferred village level health institutions – Sub centre (77.4%) for taking treatment. This is followed up with Government dispensary (13.2%); Primary Health Centre (4.4%) Private hospital at district head quarter (3.9%) having various reasons. The main reasons reported for visiting health institutions, is in the vicinity (71.7%); availability of desired medicines (63.7%); treatment found more effective (41%); faith in institution doctor (30.1%) and availability of doctors as and when required (28.6%). The affordability of payment of fee/treatment expenses of resident household population largely depended upon either treatment is free or reasonable (18.6%).

4.2k Local Governance

Governance is a system of values, policies and institutions by which a society manages its economic, political and social affairs through interactions within and among the state, civil society and private sector. Though the [9]local governance means providing the all the desired public amenities for the resident population. Such analysis has been already conducted and result would be now incorporated to know the impact among population. Adding to this, local governance is also view issue of the government individual/family official documents. Equally it will also give an idea how the population are enlightened by themselves in acquiring the family and individual official document. Table 4.18 shows status of Governance in the sample households of the project area.

[9] https://darpg.gov.in/sites/default/files/sogr_framework.pdf

Table 4.18 Status of Governance in household (N=820) of the project area.

Sr.	Parameter of Governances	%HH Reported
Infrastructure		
1	Electrification with meter	99
2	Piped* water for drinking purpose	59
3	Piped* water for domestic uses	51
4	Sewage Line Connection	10
5	Having own toilet constructed	76
6	Sub centres in the villages	74
7	Primary Schools with in 2km of village	67
8	Village Cemetery	54
9	Approach Road (Metalled 5%+Cement 85%)	90
10	Community Centre	24
11	Panchayat Office	13
	Average	**56**
Services		
1	Supply of LPG Gas	67
2	Birth Certificate for live children in last 3 months	90
3	Death Certificates for death reported in the family in last 3 months	82
4	BPL Card to BPL Families	67
5	Voter Id Cards of individuals having over 18 years age in the Family	99
6	Employment Guarantee Card	80
7	Ration Card from Low fair shop**	37
8	Weekly Hat	18
9	Mandis for Crop	13
10	Village Street Light	20
11	Formation of Self-Help Group	82
	Average	**60**
Panchayat Helped the community during last six months (77%)		
1	In providing drinking water (N=447)	54
2	Helping to get Ration Card (N=403)	49
3	Generating Awareness for the Government Schemes (N=227)	28
4	Construction of Toilet (N=38)	4.6
5	Providing house under Pradhan Mantri Aawas Yojana (N=5)	0.6
6	Helping to get Job Card (N=3)	0.3
7	Helping to get Pension (N=2)	0.2

*With and without overhead water tank

The analysis for role of governance has been done based on role played by the local administration (involving Sarpanch/TDO/BDO etc) in developing existing infrastructure and services being provided to the resident household population in the project area. The average response reported by the households for developing mandatory infrastructure was 56% and for services was 60%. While overall, 77% of the household reported having support and help received from the panchayat members for providing drinking wate; ration and job card; constriction of toilet etc.

4.2l Gender Empowerment

Though much debate has been done all over the world regarding gender equality and gender empowerment, the principle of gender equality is already **enshrined** in the Indian Constitution in its Preamble, Fundamental Rights, Fundamental Duties and Directive Principles. The Constitution not only grants equality to women, but also empowers the State to adopt measures of positive discrimination in favour of women[10]. Taking lead from this and looking the country's R&R policies, the current study tries to explore gender component without as indicated table 4.19

Table 4.19 Exploring Gender status in the study region

Sr	Parameter of Gender Empowerment	Reported in %
1	Jointly Decision in the HH (N=820) by equal participation of husband & wife	73.7
2	Member of Village level Samati (N=36)	2.0
3	Proportion villages (N=36) Reported having Women as Panchayat member	58.3
4	Proportion of villages (N=36) Reported having Mahila Samiti	27.8
5	Proportion of female members in Mahila Samiti from total females (N=1390)	43
6	Proportion of female literacy over total population (N=2942)	30.3
7	Proportion of professional work participation over total population (N=2942)	1.6
8	Proportion of Women having access to separate Bathroom in HH (N=820)	79
9	Proportion of Women having access bathroom Toilet in HH (N=820)	74
10	Proportion of Women having access separate Kitchen in HH (N=820)	87
11	Proportion of Women having access Piped* water for drinking in HH (N=820)	54
12	Proportion of Women having access Piped* water for domestic uses in HH (N=820)	49
13	Total Sex ratio of women per 1000 males (N=2942)	899
14	Sex ratio for the children in the age group of 0 – 5 years (N=208)	1019

The gender equality is reflected in three parameters, the proportion of joint decision making in the family is considered to be reasonably good (73.4%) however women participation as professional is very poor (1.6%) and the same is also true for the participation at village level samiti (2%). It gives the

[10] https://wcd.nic.in/womendevelopment/national-policy-women-empowerment

idea of female discrimination with low significance to the right of equality. The total sex ratio as well of children in the age cohort 0-5 years is reasonable better and a better yard stick to measure gender equality. In the project region right of accessibility in the household is good and shows female preference to avail such household facilities. However female literacy rate is low compare to male and hence required many genders empowerment programs in the project area.

4.2m Poverty level

Poverty[11] elimination has remained a major challenge since the inception of independence and is India's core national development agenda to create equitable society. Incidence of poverty is estimated by the Planning Commission on the basis of the large sample surveys on household consumer expenditure conducted by the National Sample Survey Organisation (NSSO) on a quinquennial (after every) basis. The NSSO regularly conducts survey on household consumer expenditure, in which households are asked about their consumption of last 30 days and is taken as the representative of general consumption.

Taking lead from this our survey for Poverty line estimation for Jagannathpur (B) coal mines has been based on the consumption expenditure and not on the income levels due to difficulties in assessing incomes of self-employed people, daily wage labours etc, large fluctuations in income due to seasonal factors, additional side incomes as well as data collection difficulties in largely rural and informal economy of India. Here due to lock down in West Bengal immediately after assembly election and prior to assembly election, the national level lock due to pandemic has affected both incomes as well expenditure in the household of the sample village.

Since households may be able to access credit markets or household savings and thereby smooth their consumptions to some degree, consumption expenditures may be able to provide a better basis for determining a household's actual standard of living. Hence, most of the Poverty Estimation Committees proposed that per capita consumption expenditure or household expenses were the right statistical choice for calculating poverty in India[12].

The Social Impact Survey for Jagannathpur (B) coal mines near Durgapur was conducted from 5th July to 20th July 2021 immediately after lock down ended on 30th June 2021. Thus, there is huge variation in the response of expenditure as in previous months, the education institutions, consumer

[11] In India, Poverty can be defined as a condition in which an individual or household lacks the financial resources to afford a basic minimum standard of living. Source: https://rural.nic.in/sites/default/files/WorkingPaper_Poverty_DoRD_Sept_2020.pdf
[12] https://wcd.nic.in/womendevelopment/national-policy-women-empowerment

market (including Malls) and hospitals remains closed and this was the reason that actual picture of these variable does not reflect in the survey as indicated in table 4.20.

Table 4.20 Summary of the household expenditures in the project area

Type of statistical analysis	House Rent Expenditure	Health Expenditure	Children Education Expenditure	HH Kitchen Expenditure	Bath/tollet /Dressing Expenditure	Petrol/ Travel Expenditure	Electricity Expenditure	Miscellenous Expenditure
N	**820**	**820**	**820**	**820**	**820**	**820**	**820**	**820**
No. of HH above AM	0	0	0	761 (93%)	788 (96%)	803 (98%)	793 (97%)	782 (95%)
No. of HH below AM	0	0	0	59 (7%)	32 (4%)	17 (2%)	27 (3%)	38 (5%)
Average Mean (AM)	**0**	**0**	**0**	**1351**	**234**	**188**	**166**	**652**
Std. Error of Mean	0	0	0	38	7	15	7	27
Std. Deviation	0	0	0	1078	210	439	189	783
Minimum	0	0	0	80	25	30	30	50
Maximum	0	0	0	8000	1800	5000	1750	6000

Note: Figures in parenthesis in percentage from the total 820 HH

Owing to NSSO survey methodology, a similar type of attempt has been made in 10% (N=820) of the sample households from the total households in 2942 population. Question regarding previous month expenditure were asked on House rent, heath, education, house Kitchen expenditures, bath/ toilet/dressing expenditure, petrol and travel expenditure, monthly electricity bill expenditure and miscellaneous expenditure. The true picture of health, education and miscellaneous was left out due to obvious reasons as mentioned earlier. Here average mean value is considered as expenditure line which indicated that household below expenditure line for all expenditure varies from 2% to 7% and standard error of mean varies in between 7% to 38%. The comparative analysis of monthly and per capita income and expenditure is indicated in table 4.21.

Table 4.21 Summary of Per month/day household Financial in the project area

Statistical Analysis	Monthly Income	Per Capita Income	Monthly Expenditure	Per Capita Expenditure	Monthly Savings	Per Capita Saving
N	**820**	**820**	**820**	**820**	**820**	**820**
Minimum	1000	333	350	70	360	120
Maximum	75000	24306	20700	5183	66100	21932
Average Mean	**7613**	**2192**	**2592**	**742**	**5021**	**1450**
No. of HH above Mean	782 (95%)	766 (93%)	602 (73%)	520 (63%)	487 (59%)	422(51%)
No. of HH below Mean	38 (5%)	54 (7%)	218 (27%)	300 (37%)	333 (41%)	398(49%)
Std. Mean Error	282	77	85	23	215	59
Std. Deviation	8087	2195	2445	661	6159	1693

Note: Figures in parenthesis in percentage from the total 820 HH

: Total of Monthly income is based on the average of annual income of last three years divide by 12 months

: Total of Monthly Expenditure is based on actual household expenditure reported prior month of the HH Survey

: Total Saving in the household is based on Monthly Income minus Monthly Expenditures

: Per capita Income, Expenditure and Saving is divided by total number of family members in a Household

The expenditure and saving in the households are largely depended upon source of income. The income status of the household was widely affected due to on-going pandemic's lockdown period. During the time of lockdown, there is a normal attitude to spend less and save more. Even over stocking of essential food items raised the expenditure for kitchen items, while the expenditure of miscellaneous is done on items are the need of the family members in the households in the project area.

As mentioned earlier that consumption expenditures is a better basis for determining a household's actual standard of living. Hence, per capita consumption expenditure or household expenses were considered calculating and explain poverty level for the project area of Jagannathpur (B) coal mines in Paschim Bardhhaman district of West Bengal. Here average mean value (Rs.2592/month) of monthly expenditure is considered as poverty line which indicated that 21% of the household is below poverty line - suggest the poverty level in the project area is reasonably good. While the average per capita expenditure in the household is Rs.742/month, of which 37% of the household are below the average mean of per capita expenditure of the households. About Rs.24/day/per person in the household family is the rural poverty line in the project area of Jagannathpur (B) coal mines in Paschim Bardhhaman district of West Bengal.

Different countries and international agencies calculated Poverty line according to their defined parameters in their framework. The current study was conducted with one of objective of upliftment of the poor parallel while doing the commercial activities in sample household covering a small proportion of the population from the total 33k with some limitation due to ongoing lockdown of the current pandemic. Thus, the current poverty level line can't be compared with other poverty line at district, and state in India. One of the studies, done by the Reserve Bank of India (2012) show State of rural West Bengal has poverty line per month to Rs.783 (Rs.26/day) and that of rural India is Rs.816 (Rs. 27/day). Poverty line of the project area for Rs24/day is near to the state of West Bengal.

4.2n Socio-Economic Index (SEI)

The social-economic profile of the households seems to be fair. Thus, it becomes apparent to know the social-economic index of the household sample villages coming the radial distance of 10 Km. There are about 7 selective social-economic (SE) indicators (SEI) extracted from the primary survey carried out in 820 households in sample 36 villages for the project area. Based on the market value and significance of the items in the households the SE indicators

are classified into seven groups[13]. The criteria of points allocation for SE data set for different variables are as per market value of the item as indicated in Annexure 14. The assumption of such allocation of the weightage is related that no SD is made owing to the significance of the data (Land 25%; ownership and HH amenities 20%; HH Total income 15%; possession of HH major items; Possession of HH livestock 15%; an accessibility of education and health institution within the resident villages of the HH – each 5%). The average score of each variable were taken for each household level analysis. Analysis was carried out based on above explanation for calculating SE Index of the households as indicated in table 4.22. Average weighted score point is classified into five groups viz, as 0.6 - 2.0 as very poor; 2.1 - 4.0 as poor; 4.1 - 6.0 as fair; 6.1 – 8.0 as Good and 8.1 and above as excellent SEI.

Table 4.22: Average Weighted Score point for calculating Social Demographic index of villages in the radial distance of 10 km from the project site

Group of Average Weighted Score point	Performance Group	Frequency of villages	Percentage of villages
0.6 - 2.0	Very Poor	15	2
2.1 - 4.0	Poor	253	31
4.1 - 6.0	Fair	369	45
6.1 - 8.0	Good	167	20
8.1Plus	Excellent	16	2
Total		**820**	**100**

Village level analysis of SEI shows that the maximum average weighted score point in village is 8.9 points score and the minimum is 0.6 points score while the average point score for villages in the radial distance of 10 km from the project site is 2.2-point score. From the total 820 households, about 2% had very poor SE status; 31% had poor; 45% had fair, 20% had good and only 2% of the villages had excellent SEI status.

[13] Possession of Land Agriculture and Barren Land (in Bhigas); Total Households income (includes all earning members); Ownership and amenities in Households; Total number and type of live stocks own in the household; Total Households major items; and accessibility of education & Health institutions in villages for resident Households.

5: Social Impact Assessment

5.1 Defining Social Impact Framework and Approaches

The company's Social Impact framework is largely based on the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement, 2013 (No. 30 of 2013) enforced through Ministry of Law and justice and subsequently related amendments. It also includes Extraordinary Part II – Section 3 subsection (ii) on 19th December 2013 through Ministry of Rural Development (Department of Land Resources). Besides, the social impact framework designed by understanding several real projects and was adapted in response to our own assessment and feedback taken from the project partners and community stake holders. Owing to current Mining Lease Area (MLA) incorporating 9 villages (and similar number of villages surrounding the MLA), it is difficult to reveal exactly every detail, but it has been used to plan complex resettlement projects in any future course of time.

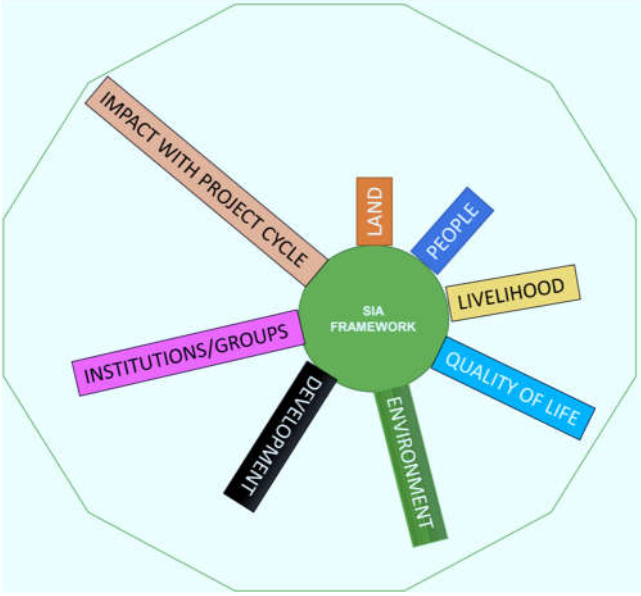
5.1a Defining SIA Framework

The Social Impact Framework as defined in Figure 1 represents a simple and basic conceptual model for highlighting the social issues that contribute to Social Impact Assessment Framework leading to people's well-being and that are impacted by large projects here in define as Jaganathpur-B coal block of Raniganj coal field area. It should be noted that the core of the Social Impact framework largely cantered along the people's well-being. Individuals are used as the primary unit of analysis in recognition of the fact that there is considerable inequality within households and communities, and that it is important to understand how some people are more vulnerable to project impacts than others. The Framework also acknowledges that individuals typically live within families and communities, and that there is co-dependence between these different social layers. Impacts at the community welfare can occur at local, national and even international levels. Changes to our local environment can have a possibility of direct and indirect impact on community well-being.

The Social Framework encompasses everything that needs to be considered in projects as per RFCTLARR of 2013 and incorporating subsequent thereafter. It also includes what people value about their current situation, their aspirations and expectations, the likely project impacts, project planning issues, and potential mitigation and enhancement measures. Since there are so many issues that need to be considered, which interconnect and overlap, and because they vary according to local contextual issues, our company have grouped them into eight key categories, described in detail below in Figure

5.1. These categories were derived from the hired experts' experiences and with several complex resettlement projects across India mentioned in fourth schedule RFCTLARR of 2013 (13) and Schedule 1 & 2 of The Coal Mines (special Provision), Act, 2015 (11).

Figure 5.1 Social Impact Assessment Framework



All these eight components of SIA framework evaluation also contribute to a greater extent of their information to be included in Rehabilitation and Resettlement programs arising out of the commercial activities of the development project. However, it is different matter that whether the R&R program is applicable due to displacement of the population or not because of the purchase of the barren land (inhabitant non fertile land). With the advent of any development project there would be impact issues related to environmental factors, on the resident population, group and community, that may or may not be affecting on their livelihood, that in turn affecting the infrastructure (Public amenities) of the region affecting their quality of life. Moreover, the cycle of the project (through various phases) also plays an important role owing to the explanation made for SIA framework. The elaborated version of the SIA framework is indicated in Figure 5.2.

The first important component is related with Land, where the development project is initiated. There are two issues which have to be explored one the land acquired with consent because of the submergence of land in the development project. Here the owner is entitled the market value of the land and the solatium associated with it. It also included the other public amenities and related infrastructure setup of the area with proper rehabilitation and resettlement plan for alternative site. While the other aspect is to purchase directly from the owner at market value provided that the land is barren and without habitant, to be utilized for the development project - as applied for the Jagannathpur-B coal block of Raniganj coal field area.

Figure 5.2. The Social Impact Assessment Framework for projects (elaborated version)

LAND	PEOPLE	LIVELIHOOD	QUALITY OF LIFE	ENVIORNMENT	DEVELOPMENT	INSTITUION/GROUPS	PROJECT CYCLE
-Type of land in Urban/Rural area -Market value & related factors -Factors affecting market value -**Direct Commercial Purchase of Land** **OR** -value of assets attached to land -Solatium -Subsistence -Provision of Housing -Land for Land -Compensation for Land -Transportation for displaced population -Temporary Rehabilitation Plan -Permanent Resettlement Plan	• Type of People -General -Other backward Caste -Scheduled Caste Scheduled Tribe • Capacity to work • Household strengths & vulnerabilities (children, elderly, disabled) • Education & skills • Gender divisions & women's empowerment • Aspirations, fears, expectations and anxieties • Leisure & recreation	Type of Work -Technical -Labour -Cultivator -Petty Business • Savings, loans & (micro)credit access • Stores of food, seeds, tools & households goods • Wage-based livelihoods: formal & informal employment & labour conditions • Land & water-based livelihood activities: cropping, sharecropping, livestock, fishing, hunting & gathering & legal small-scale mining • Enterprise-based livelihood activities: sale of goods & services, rental properties & tourism • Illegal activities: corruption, drug sales, illegal mining, fishing, sex-work, theft/crime, smuggling & poaching • Other livelihood supports: bartering, unpaid work, labour-sharing, caretaker, project compensation, remittances, pensions, dowries & gifts	-Type of housing -Water supply -Gutter connection -Power supply -Street light -Black Metal Approach Road -Internal road type -Water Tank -Control Ration Shop -ATM Machine -Commercial Bank -Agriculture Credit Bank - Community Hall -Panchayat Office -Primary School -Anganwadi Centre -Mobile/Telephone -Public/Private mode of Transportation -Facility of Pond/River/ Handpump -PHC/SC	•Natural resource assets (individual/common): forests, waterbodies, cropland & pasture, etc • Trends in land & resource use: deforestation, land degradation, land speculation & overfishing • Ecosystem services: crops, livestock, fish, wild foods, timber, freshwater, traditional medicines, biodiversity, genetic resources,.. • Tenure arrangements for land & common property • Competing land-use demands & elite capture • Impact on Physical Resources -Soil; Water; Air, water, land -common Property -natural resource for livelihood -Nuisance factors: noise, dust, vibration, blasting, flaring & light, traffic etc • Landscape aesthetics, natural features & place attachment	• **Local Economic Activities** -Formal & Informal local Industries -Access to Credit -Wages rates -Specific Livelihood activities women are involoved •**Land use and livelihood** -Agricultural and non-agricultural use -Quality of land – soil, water, trees etc. -Livestock - Formal and informal work & employment -Household division of labour and women's work -Migration -Household income levels -Livelihood preferences - Food security •**Village/Household Level** -Demographic Index -Social Index -Economic Index - Quality of Life index	•Social and cultural organisation •Administrative organisation •Political organisation •Civil society organisations and social movements -Women Groups -Youth Group -Cooperative Group	**(a) Pre-construction phase** (i) Interruption in the delivery of services (ii) Drop in productive investment (iii) Land speculation (iv) Stress of uncertainty **(b) Construction phase** (i) Displacement and relocation (ii) Influx of migrant construction workforce (iii) Health impacts on those who continue to live close to the construction site **(c) Operation phase** (i) Reduction in employment opportunities compared to the construction phase (ii) Economic benefits of the project (iii) Benefits on new infrastructure (iv) New patterns of social organisation **(d) De-commissioning phase** (i) Loss of economic opportunities (ii) Environmental degradation and its impact on livelihoods **(e) Direct and indirect impacts** (i) "Direct impacts" will include all impacts that are likely to be experienced by the affected families (i.e. Direct land and livelihood losers) (ii) "Indirect impacts" will include all impacts that may be experienced by those not directly affected by the acquisition of land but those living in the project area **(f) Differential impacts** (i) Impact on women, children, the elderly and the different abled (ii) Impacts identified through tools such as Gender Impact Assessment Checklists, and Vulnerability and Resilience Mapping **(g) Cumulative impacts** (i) Measurable and potential impacts of other projects in the area along with the identified impacts for the project in question. (ii) Impact on those not directly in the project area but based locally or even regionally

The second aspect is related to the type of the resident population (SC/ST/OBC/General etc) that includes disabled as well issues pertaining to Gender. This is very well connected to their livelihood as the third aspect and quality of life – the fourth aspect that is largely associated with their associated living condition. The livelihood largely explored owing to the nature of profession/employment prevalent in the area with their associated activities such as land and water based, wages related, enterprises based etc. While the quality of life largely explores with infrastructure and services associated at village and household level.

The fifth aspect is related with environment that largely focussed on natural resource assets and its impact due to advent of the development project. The impact is largely focussed land, water, air, etc. The sixth aspects are related to the existence of institutions and groups in the area which plays important role in the development of the area is the seventh aspects of SIA framework. The development is explored through local economic activities, land use and livelihood activities, explored at village and individual household level. It also includes grading of infrastructure and services to calculate social-demographic, quality of life and economic index as measure of yard stick for measuring the development issue in the area.

The last and the most crucial aspect of SIA framework is related to explore the impact in the various phases of the project cycle. This aspect is very crucial to understand the impact along with the progress of project execution at various stages as indicated in Figure 2. These all eight aspects help to develop Social Impact Management Plan that covers mitigation aspects in detail. The SIA framework data are enumerated using both primary and secondary information, that include both qualitative and quantitative information. Besides, data and information depicted in Environment Impact Assessment report are also incorporated for the analysis in SIA framework. It should be noted that SIA framework developed by our organization is subjected to the existing various law of our country and include subsequent changes related to it. Here we are looking in context to the commercial activities being under taken for excavation of in Amod (G-19 Extn.) mines.

5.2 Impact Assessment

According to International Association of Impact Evaluation "Social Impact Assessment includes the processes of analyzing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment. Further, it also brings more ecologically, socioculturally and economically sustainable and equitable environment. Impact assessment, therefore, promotes community development and empowerment, builds capacity, and develops social capital (social networks and trust). Thus, today the focus of concern of SIA is a proactive stance to development and better development outcomes, not just the identification or amelioration of negative or unintended outcomes. Assisting communities and other stakeholders to identify development goals, and ensuring that positive outcomes are maximised, can be more important than minimising harm from negative impacts".

Further, SIA is best understood as an umbrella or overarching framework that embodies the evaluation of all impacts on humans and on all the ways in which people and communities interact with their socio-cultural, economic and biophysical surroundings. SIA thus has strong links with a wide range of specialist sub-fields involved in the assessment of areas such as: aesthetic impacts (landscape analysis); archaeological and cultural heritage impacts (both tangible and non-tangible); community impacts; cultural impacts; demographic impacts; development impacts; economic and fiscal impacts; gender impacts; health; impacts on indigenous rights; infrastructural impacts, institutional impacts; leisure and tourism impacts; direct and indirect political impacts; poverty; psychological impacts; resource issues (access and ownership of resources); impacts on social and human capital; and other impacts on societies. As such, comprehensive SIA cannot normally be undertaken by a single person, but requires a team approach (as explained earlier).

Besides, SIA builds on local knowledge and utilizes participatory processes to analyze the concerns of interested and affected parties. It involves stakeholders in the assessment of social impacts, the analysis of alternatives, and monitoring of the planned intervention. The methodology of SIA can be applied to a wide range of planned interventions and can be undertaken on behalf of a wide range of actors, and not just within a regulatory framework. However, we have designed SIA framework based on The RFCTLARR (Compensation, RR, Development Plan) Rules 2015

Here we are looking in context to the commercial activities being under taken by Jagannathpur B coal mine mines. It explores the project aspects and activities there by studying their impact on physical factors (largely matching EIA report) and social impact explored largely on livelihood, displaced population, different groups, social & cultural aspect, public utilities and during project cycle as indicated in below Tables 5.1.

5.2a Physical Environment

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)	-During the rainy season there is a great possibility that run off water is assembled in the mining area making the routine operation difficult and could be a threat for the lives of the working employee	-Run-off water and mine water is led into settling ponds, then to water treatment plants; after treatment, some portion of water will be used for domestic mine use and the rest will be let into the natural drainage system. -The sewage from the pit head facility shall be treated in STP. The treated sewage will be used for non-potable purposes and greenbelt watering. -The processed wastewater will be passed through oil-water separator and subsequently through settling tank prior to reuse.
2	Deposition of pollutants emitted to air into the land or into water – air quality	-The major operations producing dust are drilling, blasting, hauling, loading, transporting and crushing. As a result, fugitive Emission are mainly caused particulate matter and gases including methane, Sulphur dioxide, oxides of nitrogen and carbon monoxide. -The vehicular traffic on haul roads has been identified as the most important cause of fugitive dust emissions and can contribute as much as 85% of the dust emitted from an opencast coal mine. -Water released from the mine site may result in the deposition of suspended solids. This will be deposited in the passage of underground mining site. As a result, the regular operation may get stuck.	-It is advisable to use dust extractors with drills and use suitably designed water sprays at the transfer points to suppress the dust. -Settlement of Suspended solids will be done in settlement tanks before discharging. -Deposition of dust on land and plants from air due to mining activities and transportation will be there which will be minimized through sprinkling. -It is advisable to plan for the development of green belts around the areas having mining and associated activities
3	Change in land use during regular operation	Land is used for inclines, shaft and other infrastructure like office buildings, CHP, workshops, WTP, STP stores, substation, stock Yard, Weigh	-Restoring the land to its pre-mining land use or to a use, that is consistent with thesurrounding land fabric. -Maintaining the long-term

		Bridge etc. The flat area in both external dumps and backfilled area will be able for plantations, whereas the sloping areas and areas with approach roads/safety berms will be re-graded for stabilization andgrasslands	stability of affected land to match with the community andcommercial needs the development such as parklands, flora & Fauna sanctuaries, and play- grounds with ecological, tourist and commercial values will be planned.
4	Impact on Natural Drainage System	-The main drainage of the area, Tumni Nala in the west and Ajay River is in the east of the block. There are many small & large ponds in the area, which are mostly used by the villagers for domestic purposes. -Only the groundwater seepage will form the source water for mining drainage. The water will be automatically drained to the sump in underground working at the lower most part of the mine.	-Adequate provision of pumping for draining out the seepage water from the sump will be provided and the working face will be kept dry. Care must be taken to protect the drainage bore hole from damage while blasting. Underground mine also does not involve any excavation, dumping or re-handling of wastes unlike in case of opencast mines. -Total waste/ reject (stone debris) generated through out the life of the mine has been estimated as about 0.32Mcum, which is produced during drainage of stone drifts for approach from one seam to another seam / inclines/ shafts
5	Impact on Ground Water	-Ground Water Quality: Mining operation and acid drainage can also affect groundwater. Older tailing ponds that were constructed without impermeable bases have generated acidic drainage that causes ground water contamination. Acidic water migrates into ground water and eventually lose its acidity and able to dissolve heavy metalpresent in rocks and contaminate ground water quality. -Lowering of water table: In the process of mining, when digging is undertaking below the water table, inflow of ground water occurs.	-it is suggested to place an impermeable barrier at the base of the tailing pond to prevent acidic drainage seepage. -It is suggested for the pumping of water for the inflow of the ground water

NOTE: Source of 3,4,& 5 is from EIA report of M/s PTPL, Kolkata by M/s Green C, Kolkata

(5.2b) Social Environment

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Tourism & Asthetic	-Shibpur Road at a distance of about 4.20 Km SE from project to connect Joydev Kenduli pilgrim area will be affected with the traffic movement of the coal mines However, suspended particles in the air is evident due to traffic movement	-Alternative arrangement for the movement of the traffic would be done during the peak/festival season Shibpur Road such that the incoming supply of the raw material and outgoing coal movement is not affected. Settlement of Suspended solids will be done in settlement tanks before discharging.
2	Areas occupied by sensitive man-made land uses	-The major man-made area occupied in the vicinity of 10 km are Temple: Durga Temple, Kendula 3.78 km SW Hospital: Jhanjra Area Hospital 10 km WNW School: Kalipur Primary School 7.5 km WNW College: Sanaka Medical college, Malandighi 9.6 km SSE Details of the sensitive manmade land uses is given as additional attachment	-The structure (Temple/ Hospital /School etc) of man-made land use pattern in the radial distance of 10 km would be an asset for the project in developing tourism site, facilitating the treatment for the workers and in providing education to the ward of the workers. However, whenever there is a demand for upscaling the facilities through designated Company's CER/EMP for Social & infrastructure development fund
3	Areas occupied by nature physical land uses	-The major natural area occupied in the vicinity of 10 km are village ponds; lakes, nallas, rivers, drainage etc will no longer have effect on the environment as the underground separates them with sufficient barrier	-The natural assets will have sufficient barrier in the underground mining points to desired natural assets points. -However, whenever there is a demand for upscaling the facilities through designated Company's CER/EMP for Social & infrastructure development fund
4	Culture and Social Cohesion	-With the advent of the Jagannathpur (B) coal mining, a lot of in migration will result. Jagannathpur (B) coal mining area comes Raniganj which is famous for illegal coal theft from the mining from coal mafias. It is expected that current mining also fall in the same trap. -Under the political structural setup, village panchayat specially for the mining villages will have greater power to make the project viable	-It is expected that near 1200 population will have in migration -Proper fortification from the dispatch units directly to the commuting vehicle with good inventory system connected to GIS is proposed -It is proposed to execute all area development with the support of local panchayat needs in coordination with them

5.2c Public Utilities

1	Social infrastructure	-Schools in the mining lease areas are either old and requires substantial repair work and in some villages the schools even don't exist. -Scarcity of drinking water is another major problem reported in the nearby villages	-The desired level of renovations in the schools will be done through designated Company's CER/EMP for Social & infrastructure development fund for Development program. -The company also plan for boring sweet water and thus as per the demand of nearby villages will share with the community
2	Physical infrastructure	-The village in the MLA and some villages adjacent to MLA does not have road accessibility and resident population largely commutes on kuccha road.	-Mining Plan had already proposed to build 9 km pucca road

5.2d Impacts at different stages of the project cycle

(d1) Pre-construction phase

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Interruption in the delivery of services	-Due to non-availability of the approach road, -Non-involvement of the local resident population for unskilled jobs	-MLA Plan had already proposed to build 9 km pucca road -One of the ccompany's policies is to give preference to local resident population
2	Drop in productive investment	-Low productivity indicates that resources are not utilizing their skills and competencies to their maximum potential which increases company's resourcing costs. -Lower work rate (or productivity) results in poor performance of employees which ultimately affects both quality of and quantity of deliverables. Poor productivitycauses delays in project timelines so as deliver of project on time	-Addressing the training needs as well increased employee engagement and improvement in morale that will eventually reduce employee burnout -Target based planning with resource efficient manpower will avoid the risk of drop in productive investment.
3	Land speculation owing to Land use pattern of Mining Lease Area (MLA) Plan	**-Total Mine Lease area is 856.68 ha.** Agriculture: 599.01 ha, Township: 15.05 ha, Water bodies: 70.09 ha, Roads: 3.34 ha. Grazing: 25.84 ha Barren:69.12 ha Community/Others: 15.60 -Govt. Non-Forest Agricultural 31.63 ha	-The company initiated the activities with the following -- Land use pattern: -Excavation Area: 0.0 ha -Top Soil Dump: 0.0 ha -External Dump: 0.0 ha -Safety Zone: 0.0 ha -Green Belt: 8.49 ha -Infrastructure areas: *24.14 ha -Other uses**: 442.85 ha -Undisturbed area: 381.20 ha

		Barren/other use 27.75 **Total 856.68 ha**	**Total: 856.68 ha** * 24.14 comprises of 1.03 ha UG entries + 0.20 Settling pond +22.91 Facilities **442.85 Ha area disturbed by subsidence
4	Stress of uncertainty	-Delay in the procurement of the manpower and material; tools and mandatory permission for operating mines -Any natural or a manmade calamity raises the stress for the situation in loss of materials and other halted business operations	-It is advisable for proper execution plan the manpower and material supplies the stress of uncertainty could be lowered -It is advisable to prepare a robust back-end plan so that the business operation is in continuations

(d2) Construction phase

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Displacement and relocation	-Since the project activities is underground and the Mining plan takes care without disturbing any natural features and human settlement (without any displacement) there is no proposal of R&R program.	-The company is in the process of purchasing the desired plots for mining operation on commercial basis. The details could be referred in chapter 3.
2	Vehicle and machine will generate noise	-Underground mechanized/ semi-mechanized mining method is proposed for the mining project. These are high noise generating machinery in the range of 60-100 dB (A). Fully mechanized machines like -Continuous Miners, Road headers and LHD machines are required for extraction. Noise and vibration will occur, the quantum of which is subject to strata under blasting. -Some noise is anticipated through heavy vehicular movement while bring the raw material and taking away the finished to the project site.	-Necessary mitigation like acoustic enclosures, housing of noise generating machineries in closed area/room, proper maintenance & lubrication should be done to control noise level. -Controlled blasting technique will be used as per the guide lines of DGMS. Plants & Machinery shall be provided with suitable devices to reduce the noise level and shall be maintained well within the statutory requirements. Thus, Anti-vibration pads are/will be provided wherever applicable. Regular maintenance lubrication is/will be done. Acoustic enclosure is/will provide to DG Set. -They should produce noise not more than 80 db(A). If the noise exceeds threshold limit of 80 db(A), earplugs shall be provided to the operator as per the guide lines of DGMS
3	Influx of migrant construction workforce	-Impact of the project during construction phase will be positive, as it will upgrade the	-Temporary employment generated during construction and commissioning of

		socio-economic status of local inhabitants by providing employment opportunities from nearby villages. This will increase direct / indirect employment opportunities and ancillary business development to some extent for the local population. -The manpower requirement for the proposed project is being expected to generate some permanent jobs and secondary jobs for the operation and maintenance of plant. It is estimated that influx of about 1000 semi-skilled & UNSKILLED and labour construction workforces from the surrounding villages will get livelihood	proposed project will have slight beneficial impacts on economic environment. -The company have framed the policy that all recruitments of non-technical (Temporary/ Permanent) should be made from the surrounding villages.
4	Health impacts on those who continue to live close to the construction site	-Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and water supplies Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases) -Mining and transportation activity will generate PM10 and PM2.5 in ambient air, which can affect health of vulnerable groups in nearby villages.	-The hazardous materials are engine oil, lube oil, transformer oil etc., which will be stored in leak proof drums located within fortified area. Hence, no contamination due to accidental rupture anticipated. -Proper hygienic condition will be maintained by sprinkling gabazine powder and chloroquine tablets in and around the Mine Lease Area in order to avoid incidence of any water-borne diseases. -However, with proper mitigation measures such as sprinkling of water, use of dust extractors, etc., the incremental ground level concentration will be kept low.
5	Construction activities at project sites	-The total ML area is 856.68 ha. The present land use of the lease area is mainly agricultural land with open scrubs and some vegetation cover. Core infrastructure like Mine office, stores, workshop, canteen, first aid center, Coal Handling Plant (CHP), Magazine etc. shall be constructed that may affect the land use pattern of the area and will disturb the Natural and Man-made habitat	-The total ML area is 856.68 (includes 8.49ha proposed for plantation and 24.14 ha area proposed for Infrastructure). The present land use of the lease area is mainly agricultural land with open scrubs and some vegetation cover. -Construction will be done in such selective piece of land in a way that it will have minimum effect on Physical and man-made features. Moreover, the total mining activity is underground (Mechanized/Semi –

			mechanized Bord & Pillar method).
6	Handling of Material, Storage, Leakage, use or spillage of hazardous materials	-There could be possibilities of spillage of hazardous materials during regular operations in the dyked mining area. -The waste produced from driving the main inclines and the shaft sinking and the waste produced during the roof ripping as well as from the cross-fault drifts will also lead to produce waste as by products. -Total waste/ reject generated throughout the life has been estimated as about 0.32M cum	-The hazardous materials are engine oil, transformer oil etc., which will be stored in leak proof drums in dyked area. Hence, no contamination anticipated. -To use the waste rock to construct the transportation (coal evacuation) roads; -To fill low lying areas elsewhere within ML for improving safety from water; -Any balance rock will be kept in reject stack on surface for which provision has been made. -Roof ripping and the cross-fault drifts waste produced will be usually disposed of below ground in goavs, low lying areas and available spaces along UG galleries while the rest will be taken out to surface by rope haulage, which is mainly meant for material transport from surface to underground workings and vice versa.

(d3) Operation phase

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Reduction in employment opportunities compared to the construction phase	-About 500 direct unskilled contractual labours will be dismissed after the construction and commissioning work at the mining site.	-It is expected to double - indirect employment. Or to accumulate unskilled work force in other similar mining area.
2	Economic benefits of the project	-Its is expected to produce 0.8 MTPA with unit rate of Rs. 2000 /ton. This coal will be used in in burning the furnance for producing steel in the factory.	-Coal to Shyam Steel Manufacturing Limited will be directly transported by road to EUP. -Coal to Orissa Metailiks Private Limited, Rashmi Cement limited will be transported to nearby UKHRA railway siding which is 19 KM away, by trucks, from where it will be transported by Rail to EUP.
3	Benefits on new infrastructure	-Facilities for long term housing of operational workers in the Mining Lease Areas	-The residential buildings and allied facilities of Jaganathpur–B Underground Coal Projects not visualized. Essential Quarters and Dormitory will be developed in 0.35ha area.

			-Only 0.03ha area is proposed as resting area for the employees and drivers. Essential Quarters and Dormitories will be develop for night shift employees
4	New patterns of social organisation	-The local village panchayat bodies will be largely involved in area development programs as well local in developing the public utilities in rural areas	-Adequate dialogue with the local bodies/ local population for development of water structures, strengthening of health and education services, Provide temporary employment generation opportunities to local people, especially in unskilled categories.
5	Employment Generation	-Temporary employment generated during construction and commissioning of proposed project will have slight beneficial impacts on economic environment. -Under the current project, it is estimated to generate employment of nearly 1956 individuals during Construction and Commissioning phase. -Additional indirect employment of around 1,000 persons is expected comprising of goods and service providers.	-The company should frame the policy that all recruitments of non-technical (Temporary/ Permanent) should be made from the surrounding villages. -The proposed project will generate employment for many peoples. Most of them in skilled and semi-skilled category will be coming from nearby villages.
6	Industrial Security & Safety	-Some health and safety hazards are anticipated to affect the persons employed in the project during construction, commissioning and in regular operation Phase (refer B3). -Major risks and uncertainties to the project viz., proximity to river, adjacent working, geo-mining disturbances, slope stability and remedial measures suggested -Besides, proposed overall slop of the quarry and OB dump, dump height, strata control, fire and spontaneous heating, gas leakage monitoring, danger from inflow of water, disaster management etc could be the major cause of accident	-All the risks and hazards will be identified through the principles of Hazard identification and Risk Assessment and Safety Management Plan will be prepared and implemented as per Reg.104 of CMR 2017. -The Mines Act 1952 and all the regulations and schedules of CMR 2017 relating to opencast and underground mining shall be adhered to and implemented in order to maintain day to day safety. -Appropriate safety zone margin around the Magazine will be kept as per the guidelines given in Schedule VIII of The Explosives Rules, 2008. -A Commitment from the Company Board that entire mining operation will be carried out as per the Statutory provision given under Mines Act 1952, Coal Mine Regulation 2017 and & specific permission will be required the company will

			approach the concerned authorities. The other safety measures as mentioned in the Mining plan (I) and related Acts (II) are mentioned in Annexure 15

(d4) De-commissioning phase

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Loss of economic opportunities	-The running business turn around and profitability will immediately be crashed out in the market toward liquidity of the company -The unemployment will be on rises as most of the employees would be restrain from working.	-The loss of the business could be compensated by converting the company reserves into share/debenture/joint venture in forthcoming companies. -The unemployment could be reduced by serving the employee three months prior notices by settling their allowance, salary and retirement benefits.
2	Environmental degradation and its impact on livelihoods	-Lead to after-use of the site created void, ruins and land excavated area as pit or large fill area, could have an impact on the environment -The MLA Could be affected by natural disasters (e.g., floods, earthquakes, landslides, cloudburst etc) causing environmental damage. -Raniganj area is coming under Moderate Earthquake Zone (ie Zone –III). -Being near a river, the flood durations and flood level may affect the aquifers. Many natural drains may pass over the lease area with chances of developing wetlands due to land undulations formed due to subsidence. Because of mining subsidence, the cumulative effect on terrain and landform mainly embodies terrain undulation, land use pattern and land cover change.	-The mine will be closed as per Mine Closure Plan. 393.92ha area will remain untouched. Settling Pond, Road, and Green Belt will be 0.20ha, 22.91ha and 8.49ha respectively. 1.03ha will remain as closed UG gate. -Most of the construction done in MLA would be earthquake proof. -Run-off water will be pumped out mine water will be led to settling ponds and after removal of Suspended Solids, a part will be utilized for domestic purpose, sprinkling, etc. and the excess will be discharged into natural drain. -The sewage from the pit head facilityshall be treated in STP. -The treated sewage will be used for non-potable purposes and greenbelt watering. Workshop wastewater will be passed through oil-water separator and subsequently through settling tank prior to reuse.
3	Long-term dismantling or decommissioning or restoration works	-Reclamation works will be done largely during the regular operations -Currently no dismantling or decommissioning or restoration works is proposed.	-Plantation will be carried out on both sides of the newly constructed road, around all the facilities area like mine infrastructure area, magazine building, shaft sites etc. -However, at the end of life of mine, all transportable Plant & Machinery, which have working

			life, will be removed from the leasehold and transferred to other mines of the company. All fixed equipment viz. Workshop P&M. HT transformers, Pumps etc. shall be transferred to other mines or auctioned off.
4	Inland, coastal, marine or underground waters	-The field visits shows that Ajay River Adjacent E Tumuni N, Inside PS Kunur N 4.2km WSW, Italhala N 7.8km WNW, Sal N 8.7km NE and Hingla N 3.8km N are present in the radial distance of 10 KM and may be affected during the regular operation.	-As per the Mining plan none of the physical features (River or nulla) on the ground will be affected as the mining activities will executed at a safe distance (25-50 meters) away from the said Physical features.

5.2e Direct and indirect impacts

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Direct Impact[14]	-Since there is no acquisition of the land in the villages belonging to the villagers, no displacement of families in the project area is projected -The livelihoods of the skilled (Rs.80000/ annum) and casual labours (Rs.60000/ annum) will gain boom in their income through employment in Jagannathpur Mining lease area	-Since there no displacement of the families, it is expected to have welfare of the families in the MLA through CER/EMP for Social & infrastructure development fund. -It is expected to recruit 60% each unskilled worker (Rs.24000/ month) to semi-skilled (Rs. 25000/ month) workers as well skilled (Rs.26000/month) in the specified scale from local villages coming in the radial distance of 10 km
2	Indirect Impact[15]	-There is great chance to develop local household ancillary which supplies local made, hand gloves, mask, sanitizer apron, employees uniform etc -Area development like automobiles spare part and repair shop, local Manpower contractor, Small petty shops etc will come in the vicinity of the mining area.	-It is suggested that such activities should be supported by the company's designated CER/EMP for Social & Infrastructure funds related to infrastructure and services. -The company should develop an inventory of such facilities so that annual maintenance of the desired service in MLA is outsource to these agencies to acquire their services as and when required

[14] "Direct impacts" will include all impacts that are likely to be experienced by the affected families (i.e. Direct land and livelihood losers)

[15] "Indirect impacts" will include all impacts that may be experienced by those not directly affected by the acquisition of land but those living in the project area

5.2f Differential impacts

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Impact on women, children, the elderly and the different abled	-The female literacy rate in the project area is only 30%. The participation of the female working for livelihood is very poor 1.6% in the project area -Only 49% of the children are reported going to Anganwadi centre in the normal setup.	-The company should promote female adult literacy program and Smart anganwadi centres with the help of designated funds of CER/EMP for Social & infrastructure development fund to infrastructure and services Soft work like gloves, apron, uniform making etc should be giving to Mahila Mandal groups from local villages.
2	Gender Impact Assessment	-There wide gap of female participation in the profession ie., the working population of female is very small. On an average 50% of the female population have better access to the household amenities -Only 2% of the women reported acting as head of village level samiti.	-The company should have the policy for gender equality by recruiting female members at various cadres. -It is proposed that with the designated funds of CER/EMP for Social & infrastructure development fund related to infrastructure and services and hence preference should be giving construction for toilet and bathroom under PPP model. -All local development programs in the villages should be run with local leader ship of resident women leaders.

5.2g Cumulative impacts

Sr	Project Activities/Aspects	Identified Impact	Suggested Mitigation Measures
1	Measurable and potential impacts of other projects in the area along with the identified impacts for the project in question	-There are many other industries and mines in 10 km radius. The nature and range of the pollutants from mines is mostly related to localized air pollution, pollution due to transportation and blasting	-Regular monitoring of the air monitoring at various mine sites would be done to control the air pollution with sound strategy that minimize the air pollutions in MLA as well in surrounding areas.
2	Development of Public Infrastructure	-Here transportation sector will boom as there would large vehicular movement. Besides widening of the road would require to reach the project site for the disposal of waste material. -From State highway to the project site, Restrictions on traffic movement hours which are staggered with respect to	-During Construction and in regular operation, heavy vehicles will be used to transport finished products from the project site, it is recommended that the road should wide enough for two-way movement with proper sign board and direction symbols.

		peak traffic hours. This mining has been established in the busy industrial belt and hence with its advent, there is great possibilities to develop potential commercial market (Grocery shops; small petty business; etc) in the nearby vicinity of the industries -There will be increase in real estate business to construction labour colonies as well as high rise building to carter the demand of incoming labour as well high skilled workers. New road, and rail traffic including new oraltered routes and stations, ports, airports duringconstruction and regular operation of the coal mines	-Separate entry and exist gate shall be provided and trained security guards shall be deployed to ensure proper management and movement of vehicles within premises -The industries should initially support to build some infrastructure like approach road to the / within the villages from its CER/EMP for Social & infrastructure development fund related to infrastructure and services such as upgrade the surrounding public amenities (like toilets; dispensary, creation hall etc) in consultation to the local village panchayat authorities such that a base is developed for the potential market. -The operation of mining block shall generate additional road and rail traffic for Transportation of coal. Nearly 6.5 km of new road will be constructed to connect the incline with the Duel more. The road is connecting the site with Shibpur Road. Shibpur Road is directly connected with the NH 60 which finally connects Ukhra Railway siding with the project site.

NOTE: Impact on those not directly in the project area but based locally or even regionally

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6: Analysis of Project Cost

6.1 Cost Description

The costing of Social Impact assessment largely based on Government authorities responsible for regulation of the mining sector; authorities responsible for regional development planning where mining is important; authorities with responsibilities for protection of environment, biodiversity, human rights and social justice; International finance institutes and donors supporting mining development (optional); Civil society organisations representing stakeholders and/or biodiversity (potentially) affected by mining activities; and Mining companies. Owing to the Indian context, The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Second Amendment) Bill, 2013 and its subsequent changes onward in 2013, 2015 etc and The Coal Mines (Special Provisions) act, 2015 no. 11 and subsequently, The Mineral law Amendment Ordinance, No: 1&2 of 2020 are applicable in the radial distance of 10 km for the Jagannathpur mines (B) of Paschim Bardhhaman district of West Bengal, owned by Power Plus Traders Pvt. Ltd.

The current Social Impact Assessment and Rehabilitation and Resettlement study criteria is largely based on format defined by the Extra Ordinary notifications in exercise of the power conferred by sub-section (3) of Section 1 of RFCTLA-RR Act 2013 (30), Published by Ministry of rural Development (Department of Land Resources), New Delhi Thursday December 19, 2013/ AGRAHAYANA 28,1935 – 5318 GI/2013. However, as described earlier in chapter 3 under Land resources, the rehabilitation and resettlement act are not applicable as there is no **displacement of the population** with the advent of the Jagannathpur (B) of Paschim Bardhhaman district of West Bengal. Thus, calculation of cost for acquired lands(s) from the community for the preparation of R&R mitigation and economic plan is not applicable, as by large the Land plots in mining lease area is commercial purchased.

The land is commercially purchased along with the fixed cost expenditure and other expenditure head made due to construction and purchase of material. The operative cost is defined separately with wages and salaries, tendering process, cost of increasing inflation, interest over capital loan and cost of executing the demand of Corporate Environment Responsibility (CER)/EMP for Social and infrastructure development. Below, the cost of project is first narrated first and later CER demand and its costing analysis were explained.

6.2 Investment in the Project

Jaganathpur B Coal block is a Underground mine. This is a coal block and the proposed mining life will be more than 60 years. The mine life may increase or decrease accordingly to the rate of production. The closure of mine involving technical aspects, environmental aspects, socio-political aspects and financial assurances for implementing post-closure activities will run for three years.

Table 6.1 Breakup of the Project Cost (INR)

Sr	Onsite Expenditure head	Cost in Cr (INR)
A	**Fixed Cost (GR Purchase & others)**	7.5
B	**Commercial Purchase of Land**	25.0
C	**Construction of Building**	
c1	Site office Building (Residential)	5.0
c2	Site office Building (Service))	15.0
	Total of C	**20 (5.7%)**
D	**Construction of Inclinds, Drift & Shaft:**	
d1	Two Inclinds 2 x 240m TRS	10.0
d2	Two Long Drift (1400 Mtrs x 2)	25.0
d3	Shaft 1 & 2	40.0
d4	Crossing of Fault by Drift (4000 Mtrs_ 250 Mtrs)	10.0
d5	Ajay River Bund	5.0
	Total of D	**90 (25.7%)**
E	**Plant & Machinery (Equipments)**	
e1	Panels Board & Pillers with LHD (375 TPD Each)	20.0
e2	CM Package (1500 TPD Each)	60.0
e3	Electricals	10.0
e4	Pumping	5.0
e5	Verticale Tranport	10.0
e6	Misclenous	5.0
e7	Other Palnt & Machinary (Conveyor + Haullage)	10.0
e8	Coal Handling Plant	15.0
e9	Power transmission line, Sub Station, DG Sets & Others	15.0
	Total of E	**150 (42.8%)**
F	**Other Project Expenditure**	
f1	Furniture Fittings & Computers	2.02
f2	Vehicles	1.0
f3	Prospecting & Boring	5.0
f4	Road & Culvers (11 km to Railway Sliding)	5.0
f5	Water Supply	5.0
f6	Sceintific Study	5.0
f7	Mining Plan Preparation, Designing, Consultancy etc	5.0
f8	Envrionment Cleareance	5.0
	Total of F	**33.02 (9.4%)**
	Total Cash Out Flow (A to F) (hard Cost)	**325.52 (100)**
G	**Pre operative Expenditure**	
g1	Wages, Salaries, Adm. Exp etc	10.0
g2	Tender document	0.2
g3	Increased inflation of Authorised Capital	5.0
g4	Interest during implementation (Interest on debenture)	5.0
g5	Impelenting CER Activities Budget	5.0
	Total of G (% from Grand total)	**25.2 (7.2%)***
	GRAND TOTAL	**350.72**

The total cost of the Jagannathpur (B) Coal Mine project for M/s Power Plus Project Pvt Ltd is estimated to be Rs.350.72 crores as indicated in table 6.1. From the total cost, the cost is pre operative expenditure is 7.2% and the remaining 92.8% is post operative. Among the post operative expenses, 5.7% expenditures are done as fixed cost, 25.7% as Construction of Inclinds, Drift & Shaft; 42.8% for Plant and Machinery and 9.2% as other project expenditure.

6.3 Mine Closure Cost

As per the guidelines of the MoC, the cost of the mine closure is to be computed based on the total project area involved in the project. The updated cost of the mine closure is estimated to be **Rs. 117.33 Crore**. The Break Up of the cost is given decipher in table 6.2

Table 6.2 Tentative cost of Mine Closure

Head	Activities	Unit	Volume of Work	Rate INR /unit	Total Cost in (Cr) INR
Progressive Closure	Water Quality management	LS			3.3
	Air Quality Management	LS			4.62
	Barbed wire fencing around dump	m	54937	1000	5.49
	Plantation over virgin area including Green Belt	Ha.	8.49	400000	0.34
	Manpower cost and supervision	LS			1.98
	Toe wall around the dump	m	537	1000	0.05
	Garland drain	m	13606	500	0.68
	Any other activity				
	i.Undergound Fire stopping	No.			73.75
	ii. Underground subsidence monitoring	LS			3.1
	Sub total (A)				93.32
Dismantling of Infrastructure. Disposal/ rehabilitation of mining machinery	Dismantling of workshop	LS			0.5
	Rehabilitation of dismantled facilities	LS			0.08
	Dismantling of pumps and pipes/other facilities	LS			0.6
	Dismantling of UG equipments	LS			0.5
	Dismantling of Powerline	LS			0.2
	Sub total (B)				1.88
Safety and security	Securing air shaft and installation of bore well pump	LS	2	2000000	0.4
	Securing of incline	LS	2	1000000	0.2
	Sub total (C)				0.6
Technical and biological reclamation of mined out land and OB dump	Expenditure of development of agriculture land		466.99	400000	18.68
	Sub-Total (D)				18.68
Post Closure Management and supervision	Power cost	LS			0.12
	Post mining water quality management	LS			0.14
	Post mining Air Quality management	LS			0.14
	Subsidence monitoring for 5 years				0.3
	Manpower cost and supervision	LS			0.6
	Sub total (E)				1.3
Others	Enterpreneurship development (vocational skill development, training for sustainable income of affected people	LS			0.45
	One time financial grant to societies/institutipns/organizations which is dependent upon the project	LS			0.5
	Provide jobs in other mining company				0
	Continuation of other services like running of schools etc	LS			0.6
	Sub total (F)				1.55
	Grand Total (A to F)				117.33

From the total, about 79.5% of the Mining closure fund will be utilized for the progressive closure, 16% for the technical and biological reclamation of mined out land and OB dump and rest 1.6% in dismantling infrastructure, 1.1 post closure management; 0.5% safety and security and 1.3% for other mining closure activities will be utilized.

6.4 Community Demand Analysis Development Program

Nevertheless, the other component of socio-economic status for calculation household poverty level and Socio-Economic index, with village level - Quality of Life and Economic index were calculated based on the primary survey among 820 sample households in sample 36 villages with all type of impact assessment. The samples details are narrated in chapter 2, while details of the survey enumeration and estimation for Social – Economic set up in project area is largely narrated in chapter 4 and impact assessment in chapter 5. The demand arises while doing primary survey for knowing the cost of socio-economic mitigation efforts for preparing Social Mitigation Plan, was based on the demand responses reported by 820 households' families individually and for area development for 36 sample villages. as indicated in table 6.3

The demand in the sample 36 villages were based on the responses received during the focus group discussion and these demands being largely reported, owing to the gravity of requirement for the development of the village area as indicated in Annexure 16a. About 30.2% of the villages reported their demand items to be vital; 29.5% report as essential; 28.2% desirable; 23.3% additional and 12.8% surplus items required for their village development.

Table 6.3 Demand of analysis of the items in households and villages

Sr	Major classification of Type of Demand	Priority of demand* (%) in sample 36 Villages					Average of Demand (%) of Village (N=36)	Total demand* (%) of HH (N=782)
		Vital	Essential	Desirable	Additional	Surplus		
1	Employment & Training	86	81	75	64	33	**67.8**	**32.3**
2	Road	44	44	42	33	19	**36.4**	**14.9**
3	Street Light	69	69	67	53	31	**57.8**	**9.2**
4	Health Mobile Van	53	53	50	39	19	**42.8**	**13.7**
5	Water for Drinking	25	25	25	19	6	**20.0**	**7.4**
6	Community Hall	44	44	42	33	22	**37.0**	**1.9**
7	Drainage	28	28	28	28	17	**25.8**	**6.7**
8	Water for Agriculture	17	17	14	11	11	**14.0**	**7.9**
9	School	11	11	11	11	6	**10.0**	**6.0**
10	Dustbin**	3	0.0	0.0	3	0	**1.2**	**0.0**
11	Pond Rennovation	6	6	6	3	3	**4.8**	**0.0**
12	Garden Development	3	3	3	3	0	**2.4**	**0.0**
13	Village Cemetary	3	3	3	3	0	**2.4**	**0.0**
	Average	**30.2**	**29.5**	**28.2**	**23.3**	**12.8**		

*** Based on analysis of multiple responses** **** Clean village – Green Village Program**
Note: Colour represent the gravity of requirement. For details refer Annexure 16a

Taking account of the items, nearly 67% of the villages reported to have local employment for their wards residing in the villages. Besides, requirement of the roads was very much in demand (36.4%) - to make village easily accessible. The street light was another major demand (57.8%) for the villages. Though the proportion of health sufferings were reported misrely owing to the present grim situation of the pandemic for COVID-19, but the demand for hospital and if this was not feasible, then the demand for mobile health van - Ambulance (42.8%) was very much reported.

Water logging was one of the major problems reported 25.8% of the villages and thus the demand to build drainage in the villages. Community hall was one of the demands (37%) reported to be built under PPP model to sustain social and cultural function and also to exercise fundamental rights like voting at village level, vaccination, village level gathering, distribution of resources as well as local village level Panchayat meetings. Demand of water for drinking (20%) and in doing agriculture activities (14%) was reported at majority in 34% of the villages. However, on an average, 19% of the villages demanded for construction and renovation activities was largely confined for school (10%); Ponds (4.8%), garden (2.4%) and village cemetery (2.4%). Even to make the village clean and green about 2% of the villages reported a better garbage collection system with the facility for domestic collection of waste with dustbin. A similar type of demand of items also came from household survey as indicated in Annexure 16b.

6.5 CSR efforts by promoters

The promoters[16] of M/s Power Plus Traders Pvt. Ltd have long history of doing activities under Corporate social responsibility. The Rashmi group largely focuses areas include health care, skill development, sustainable livelihood, infrastructure and environmental conservation under CSR, while the Shyam group conducts social development programs through Shyam Steel Foundation to make a positive contribution, especially to the special communities by supporting a range of socio-economic, educational and health initiatives by adopting a need profile analysis and implementing sustainable social development projects. Activities like development of the Children Park, blood donation camp, flood relief camp, distribution of school items, mobile health initiative, clean city initiative, relief camp for cyclone, food distribution for poor and initiating happiness day among children are some of the CSR initiatives undertaken by the promoters.

[16] M/s Rashmi Group and M/s Shyam Steel Manufacturer

6.6 Corporate Environment Responsibility/EMP for Social & Infrastructure Development

In context to Environment Clearance under the EIA notifications 2006 for extracting coal from underground mining in the Mining lease Area of 856.68 hector at Jagannathpur (B) coal field owned by M/s Power Plus Traders Pvt Ltd Calcutta with standard TOR No IA-J-11015/27/2021-IA-II(M) dated 2nd June 2021. Since the project is green field, a Need Assessment Study (NAS) under socio economic village and household survey was conducted survey The NAS is conducted based on Corporate Environment Responsibility (CER), office memorandum No F.No.22-65/2017-IA.III dated 30th Sept 2020 issued by Ministry of Environment, Forest and Climatic Change, New Delhi.

6.7 Social Management Plan

The social Management plan is based on CER/EMP for Social & infrastructure development allocated budget for social and economic development of the resident population in the villages falls in the radial distance from the Project site. The current project is new establishment for coal mining at Jagannathpur (b) coal mining area of M/s Power Plus Project Private Limited with the total cost of Rs. 350.78 Cr and hence it is being treated as Green Project. Owing to the demand in the Need Assessment Survey the total CER/EMP for Social & infrastructure development budget will be Rs.5.26 Cr, and further budget analysis as indicated in Table 6.4.

Table 6.4. CER/EMP Social & Infrastructure Budget classification for M/s Power Plus traders

Sr.	Budget Items Variables	Green Project (INR in Lakhs)
A	Total Cost of the Project	3507800000
B	CER/ EMP Social & Infrastructure development Budget	52600000
C	Per annum CER/EMP Social & Infrastructure development Budget budget*	10520000
D	Per village CER/EMP Social & Infrastructure development Budget budget**	1052000

*** The same amount to be utilized for each year till 5 consecutive years**

**** The same amount to be utilized in one village for each year for 10 villages in/near MLA.**

Owing to the commencement of the current project, the management of the company, decided to incur expenditure of CER/EMP Social & Infrastructure development budget for next 5 years. So the CER/EMP Social & Infrastructure development budget for one year comes around Rs. 10520000/year. This amount would be disbursed in development programs in the community residing in the 10 villages for the next 5 years. So the per annum CER/EMP for Social & Infrastructure Budget expenditure budget of one village comes around Rs.1052000/. The management decided to spend CER/EMP for Social & infrastructure budget in phase manner in the nearby villages of

Jagannathpur mining area. Based on the village level demand mentioned annexure 16c, the five years summary of the CER/EMP for Social and Infrastructure Development budget is indicated in table 6.5.

The five-year tentative planning of CER/EMP for Social & Infrastructure development budget suggest that 32% of the budget is spent for constructing 9 km metalled road in the villages, followed by 27% of the fund will be utilized for local recruitments and associated technical training under various cadre based on their qualification and experience. The health care mobile and promoting the concept of clean village and green village accounts 7% each. While village street lights, construction and renovation of schools and community hall and sweet drinking water in the village habitats accounts 4% each of the tentative budget over the years. While renovation of village pond and construction of village cemetery accounts 3% and construction of drainage, water facilities for agriculture fields and development village level children/community garden accounts 2% each of the allocated budget.

Table 6.5 Tentative CER/EMP for Social & Infrastructure Development Budget allocation for the demanded items in the village

Sr.	Budget head for the items demanded	Estimated Budget in Lakhs (INR)					Budget Total	Total in %
		2021-22	2022-23	2023-24	2024-25	2025-26		
1	**Employment &Training**	45.0	45.0	25.0	15.0	10.0	**140.0**	**27**
2	**Street Light (Solar&LED)**	0.0	5.0	5.0	5.0	5.0	**20.0**	**4**
3	**Mobile Health Van**	10.0	0.0	10.0	6.0	10.0	**36.0**	**7**
4	**Road (9 KM)**	35.0	35.0	35.0	35.0	30.0	**170.0**	**32**
5	**Community Hall**	0.0	0.0	0.0	10.0	10.0	**20.0**	**4**
6	**Drainage**	2.0	3.0	3.0	2.0	2.0	**12.0**	**2**
7	**Water for Drinking**	2.0	2.0	5.0	5.0	5.0	**19.0**	**4**
8	**Water for Agriculture**	2.0	2.0	2.0	2.0	2.0	**10.0**	**2**
9	**School**	5.0	3.0	5.0	5.0	5.0	**23.0**	**4**
10	**Pond Rennovation**	2.0	2.0	2.0	3.0	5.0	**14.0**	**3**
11	**Garden Development**	0.0	0.0	3.0	2.0	5.0	**10.0**	**2**
12	**Village Cemetary**	0.0	5.0	4.0	5.0	0.0	**14.0**	**3**
13	**Dustbin**	9.0	9.0	5.0	5.0	10.0	**38.0**	**7**
	Total	**112.0**	**111.0**	**104.0**	**100.0**	**99.0**	**526.0**	**100**
	Percentage	**21**	**21**	**20**	**19**	**19**	**100**	

Note: Each year there would be slight variation in the budget amount owing to the market value of the items used

: However the management reserves the right to alter the budget owing to the local demand and according to the requirement as per the need and time.

: Owing to the cost of the demanded items, it is with the management of the company to decide - whether the allocation of the Funds is done in five years or in one year or joint collaboration with other promoter companies or based on the need of the item - so that the cost of the demanded items is fulfilled.

: In phase one 10 MLA villages are selected viz., Amdahi; Jot Balram; Basudepur, Sundipur; Benopur; Mahidanga; Dandeshwar; Sasipur; Rajhat and Jagannathpur for implementing FY 2021-22. Any unused fund will be carried forward to the next financial year

: The management reserve the right to undertake community-based Need Assessment Survey (NAS) after every two years to understand the prevailing actual demands in the villages

Overall, the proponent planned to do CER/EMP for Social & Infrastructure Budget expenditure as per our national development programs where CER/EMP for Social & Infrastructure Budget expenditure is highest in developing rural infrastructure (46%); followed by rural employment and technical training (27%). Further, promoting the concept of clean and green village environment and making rural health care services accessible with Ambulance accounts 7% each, while rural irrigation accounts 6%; rural electrification and education sector 4% each. The entire CER/EMP for Social & Infrastructure Budget expenditure budget activities are confined in the development of rural areas coming in the vicinity of Mining lease area and also in the coming years will expand its services to other villages coming in the radial distance of 10 km from the MLA with the help of future allocated CSR budget.

The management even wish to include interventions for gender empowerment like giving the production of items like gloves, mask, sanitizer etc from the cooperative efforts of the women groups. The demand analysis of the budget will be timely revised over the years, depending upon of the need of the resident community

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7: Recommendations & Conclusions

The Social impact study conducted in relation to EIA and R&R, the following points are suggested below:

- The satellite data captured and analysed using GIS digital elevation model for doing the **slop analysis** to understand the flow of Strom water and related drainage pattern, it is suggested to make suitable drainage system to avoid logging of water in the centre of subsidence troughs as it would affect the surface topography. It will be also benefit to avert any colossal human losses due to generation of methane gas from underground coal with the interaction of inflow of storm water. Further, owing to the land use classification for the actual ground topography, it is suggested to erect embarkment with an elevation above HFL on the western side of the Ajay River.
- As per the CSIR-CIMFR and **the terrain analysis done using satellite data**, it is suggested that the predicted maximum compressive strain and tensile strain at the surface of 10.0 mm/m and 9.1 mm/m respectively would lead to development of cracks with crevices of 60 to 100 mm at the surface. The surface cracks formed during extraction should immediately be filled in with soil/mitti to prevent breathing of air and inflow of water to the underground workings.
- There is no evidence of displacement of any residential population among the plot purchased for doing the underground mining activities. Sufficient barrier from the human habitats or any physical features as observed in the Jagannathpur (B) mining lease area ruled out any possibility to include R & R mitigation plan. Even while doing land use and land cover analysis using satellite data, seven blocks, were identified for extraction of coal and by large to be done in block D and G. Further about 6.3% area demarcated to develop barriers between villages and physical features and only 1.6% of the land area marked as construction of building and village habitats and 1% represent as green area. Still the unused land areas are the highest (35.6%) that can be used as alternative/addition, to the plots from A to G where in future there is any possibilities of households' constructions.
  - Further, it was observed that Underground mining of Coal was also reported in similar setting coal mining area in Lachipur Colliery in Kajora and in Shyam Sunderpur Colliery in Ukhara village of Andal Sub Division of Durgapur. Since the land plots are commercially purchased from the community in the MLA for doing underground coal mining, the Rehabilitation and Resettlement program is not applicable.
- The total cost of the project is Rs.350.68 Cr, of which 93% of the budget is being reserved for the on-site operations and 7% is being reserved as

pre operative budget. The pre operative budget includes CER/ EMP for Social & Infrastructure budget which is around Rs.5.26 Cr. A tentative provision of separate budget has been for the mining closer activities, whose budget is estimated around Rs.117.33 Cr. The demand of the community varies from the time to time and also according to the need of the individual household families as well for their resident villages. It is suggested that the management of the PTPL should conduct regularly need assessment study from a NABET Certified Social Sector expert. Any deficient in CER/EMP for Social and Infrastructure development budget should be compensated with the 2% CSR allocated budget, so that the social charity and philanthropic activities are continued for poor and under privileged groups residing in the MLA and in surrounding villages. Equally, it should become a practice to conduct impact assessment of the CSR/CER/EMP related activities using 17 UN Sustainable Development Goal indicators.

- The proposed project and allied activities will provide direct & indirect job opportunities. Temporary employment generated during construction and commissioning of proposed project will have slight beneficial impacts on economic environment. The company have framed the policy that all recruitments of non-technical (Temporary/ Permanent) are to be made from the surrounding villages. It is expected to recruit 60% of unskilled and casual workers from the surrounding villages. Estimates were made for increase of their income level by three folds from the current average income of these work force.
- The role of any NGOs nor any local groups (Mahila/Youth) was reported active in the participation of any development community activities. However, it becomes apparent to support gender empowerment activities owing to the weak data reported on gender participation and gender equality. It is suggested to have at least 10% local recruitment for the casual work in the coal mining exploration reserved for female. Besides company efforts should also be made to promote green area with the help of women groups and also to take initiative for household-based activities for items required in the mines viz, mask, gloves, apron, uniform etc from the local Mahila groups under the cooperative efforts.
- Though the morbidity of the disease's sufferings .is under reported in the period of ongoing pandemic, but the focus group discussion done at the village level suggest to have high morbidity of diseases, Typhoid, Malaria, Gynological problems, upper respiratory tract infections, skin infections etc. Thus, community express acute need of treatment door step in the villages. It is suggested to start ambulance services to organize medical camps at villages level.

- School attendance is reasonably good as reported in the focus group discussion. However, in this era of pandemic, presently it was not reported in household survey because of lockdown. The villages in the mining area and near to the mining areas needs renovation and repair work reported by the respective panchayats of the villages. Besides, deficiency of items like school bags, books and note books, school fee etc. requires constant support of doing charity, especially for the wards coming from very poor family. Apart from such support, it also recommended to start scholarship scheme for the under privileged children in such villages.
- It is mandatory to implement all related right based, welfare based and sustainability approach to be adopted for the employees as well for the local resident community according to the prevailing laws of the country that ensure implementation of Social Safeguard policies on the behest of the current project. This also includes local villagers/sarpanch as a committee member of Disaster Management Plan because for any untoward incident/accidents, the local people will be an asset for rescue and relief operations.

Conclusions

Here, the Social Impact Assessment study resulted out with emergence of development of Jagannathpur (B) Coal mines block of Raniganj Coal field area District Paschim Bardhhaman, West Bengal under The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement: Land Acquisition, Rehabilitation and Resettlement Act, 2013, No 30 of 2013 (adding all subsequent changes in RFCTLA- R&R) and related coal mining laws and also for acquire EC against the TOR No: IA-J-11015/27/2021-IA-II(M) dated 2nd June 2021. There is no displacement of the population with forthcoming underground mining operation in the mining lease area at Jagannathpur coal mining, the mine plan has made provision of sufficient barrier and subsidence in the mining lease area, below and over the surface of the ground. The land plots are going to be commercial purchased by the proponent without hampering any natural and man-made features. Even the scientific studies using Satellite imagery with modern techniques of Remote sensing integrating with Geographical information system ruled out any possibilities for implementation of the Rehabilitation and Resettlement program. However, the company have made sufficient provision to uplift the poverty level of the resident community with various socio-economic development program through Corporate Environment Responsibility/Emp for Social and infrastructure funds and are committed to continue in future with mandatory allocated budget of 2% from the total profit under Corporate Social Responsibility.

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Draft EIA Report of Jagannathpur Coal Block Mine (B) for M/s Power Plus Trader Pvt .Ltd from Green C

Annexure 1. Construction of Ancillary Infrastructure on land

Sr	Particulars	Area in Hectors
1	Essential Quarters & Dormitory	0.35
2	Waste Dump Yard	1.80
3	Rescue Room	0.16
4	Adminstrative Building	0.24
5	MVTC	0.06
6	Canteen	0.04
7	Security	0.02
8	Creche	0.01
9	Workers Rest Room	0.03
10	Cycle Shed	0.03
11	Motor Cycle Parking	0.03
12	Car Parking	0.03
13	Driver's Rest Room	0.06
14	Truck Parking Area	0.28
15	Weigh Bridge	0.02
16	Dispatch office	0.01
17	Samplying Lab	0.01
18	Black Smith Shed	0.15
19	Turing Shop	0.07
20	Repair Shop	0.20
21	MTK	0.01
22	Lamp Room	0.04
23	Pit Head Bath	0.04
24	Road	3.91
25	Truck Loading Silo	0.52
26	Environment Lab	0.10
27	Pit head store	0.02
28	Nitrogen Plant Room	0.02
29	Clay Pill Shed	0.03
30	Open Public Addressing area /Dias	0.35
31	Supervisors Rest Room	0.01
32	Control Room	0.02
33	First Aid Room	0.02
34	Officers Rooms	0.25
35	Incline Area including Track line, Haulage shed, crusher house, conveyors	1.02
36	Diesal bunk	0.01
37	Coal Stock Yard	0.80
38	ETP	0.25
39	Water Treatment Plant	0.25
40	Settling pond	0.20
41	Main Store + Closed Sheds	0.44
42	Compressor air sheds	0.01
43	Material Stock Yard	0.45
44	DG set Area	0.20
45	Sub station	0.45
46	Fan House & Shaft 1	0.12
47	Magazine including offie & Safety Zone	1.74
48	Shaft No 2 with surrounding area	4.00
49	Road from Magazine to inclines	1.90
50	Coal transport from incline to eastern boundary of ML via shaft No 2	3.36
	Total Ancillary Facilities	**24.14**

Source: Mining Plan of Jagannathpur for PTPL, Calcutta

Annexure: 2 All infrastructure facilities proposed to be dismantled.

Sl. No.	Particulars	Area (Ha)
1	Essential Quarters & Dormitory	0.35
2	Waste Dump Yard	1.80
3	Rescue Room	0.16
4	Administrative Buildings	0.24
5	MVTC	0.06
6	Canteen	0.04
7	Security	0.02
8	Crèche	0.01
9	Workers Rest Room	0.03
10	Cycle shed	0.03
11	Motor cycle parking	0.03
12	Car parking	0.03
13	Driver's Rest room	0.06
14	Truck parking area	0.28
15	Weigh Bridge	0.02
16	Dispatch office	0.01
17	Sampling Lab	0.01
18	Black smith shed	0.15
19	Turning shop	0.07
20	Repair shop	0.20
21	MTK	0.01
22	Lamp room	0.04
23	Pit Head Bath	0.04
24	Road	3.91
25	Truck Loading Silo	0.52
26	ENV Lab	0.10
27	Pit Head Store	0.02
28	Nitrogen Plant Room	0.02
29	Clay Pill Shed	0.03
30	Open Public Addressing / Meeting area/ Dias	0.35
31	Supervisors rooms	0.01
32	Control room	0.02
33	First aid Room	0.02
34	Officers rooms	0.25
35	Incline area including Track line, Haulage shed, crusher house, conveyors	1.02
36	Diesel bunk	0.01
37	Coal stock yard	0.80
38	ETP	0.25
39	Water Treatment Plant	0.25
40	Settling pond	0.20
41	Main stores + closed sheds	0.44
42	Compressor air shed	0.01
43	Material stock yard	0.45
44	DG set area	0.20
45	Sub station	0.45
46	Fan House & shaft 1	0.12
47	Magazine including office & safety zone	1.74
48	Shaft No 2 with surrounding area	4.00
49	Road from magazine to inclines	1.90
50	Coal transport road from incline to eastern boundary of ML via shaft No 2	3.36
	Total Facilities	**24.14**

Source: Mining Plan Vol 1 of Jagannathpur for PPTPL, Calcutta

Annexure 3: Proposed Requirement of Electricity for electrical equipment's

Sr.	List of Electrical Equipment at Mining Site	No.	Unit power (KW)	Total power (KW)
1	LHD	8	65	520
2	Heavy duty main conveyors (80m Lift)	5	2X75	750
3	Coal drill with panels	20	2	40
4	Roof bolting machines	8	50	400
5	Endless haulage	6	60	360
6	Auxiliary fans 11 M3/ sec	20	37	740
7	Face pumps	20	20	400
8	Main pumps	10	200	2000
9	Continuous miner	2	620	1240
10	Shuttle cars	4	219	876
11	Roof bolter	4	112	448
12	Feeder breaker	2	200	400
13	Main fans	1	500	500
14	Conveyors in gates	6	75	450
15	Main trunk conveyor	6	300	1800
16	Pony Conveyor	9	37	333
17	Material haulage in main incline	2	150	300
18	Workshop	1	500	500
19	Face pumps	20	20	400
20	CHP	1	500	500
21	Office, VT, disp, etc.	1	500	500
22	Nitrogen plant	1	75	75
23	Compressor for compressed air	3	132	396
24	Diesel bunk	1	100	100
25	Water treatment plant	1	200	200
26	Road headers	2	400	800
27	1000mm conveyors	5	75	375
28	Auxiliary fans	4	90	360
29	Roof bolting machines	4	50	200
30	Face pumps screw pumps	4	20	80
31	Main pumps 75kw	6	75	450
32	Main Pumps	3	240	720
33	Chair lift man riding	4	75	300
34	Underground long hole drilling machines	2	150	300
35	Cable bolting machines	2	30	60
36	illumination	1	100	100
	Sub Total			**17573**
37	Additional 10% unforeseen requirement			01757
	Grand Total			**19330**

Source: Mining Plan Vol 1 of Jagannathpur for PPTPL, Calcutta

Annexure 4: Planning to hire Workforce under different Operation of Mine

Sr.	Particular	Nos.		Sr.	Particular	Nos.
A	**OPERATIONS**			**E**	**Reclamation & Environment**	**6**
1	CM Production	212		**F**	**EXECUTIVES**	
2	LHD Production	560		1	PROJECT OFFICER	1
3	Road header production	148		2	MANGERS	1
	Sub Total (A)	**920**		3	COLLIERY ENGINEER	1
B	**MAINTENANCE**			4	SAFETY OFFICER	1
1	CM MNTC	48		5	VENTILATION OFFICER	1
2	LHD MNTC	24		6	FIRST CLASS MANAGERS	4
3	ROAD HEADER MNTC	48		7	EXECUTIVE ENGINEER	8
4	CONVEYORS MNTC	52		8	ASST. MANAGER	18
5	PUMPING & DRAINAGE SYSTEM	48		9	ASST. ENGINEER	40
6	MAN RIDING SYSTEMS	69		10	CHIEF SURVEYOR	1
7	VENTILATION & SAFETY	102		11	WELFARE OFFICER	1
8	SURVEY DEPARTMENT	22		12	PERSONAL MANAGER	1
9	ROPE SPLICER DEPARTMENT	7		13	STORES OFFICER	1
	Sub Total (B)	**420**		14	PURCHASE OFFICE	1
C	**SUPERVISION**			15	MVTC INCHARGE	1
1	CM SUPERVISION	24			**Sub Total (F)**	**81**
2	ROAD HEADERS SUPERVISION	22			**Grand Total Surface**	**299**
3	LHD SUPERVISION	57			**Grand Total Underground**	**1551**
4	CONVEYORS SUPERVISION	8			**Total Man power**	**1850**
5	PUMPING AND DRAINAGE SYSTEM	2				
6	MAIN RIDING SYSTEM SUPERVISION	6				
7	VENTILATION & SAFETY SUPERVISION	6				
8	SURVEY DEPARTMENT SUPERVISION	4				
9	ROPE SPLICER DEPARTMENT SUPERVISION	1				
	Sub Total (C)	**130**				
D	**SURFACE**					
1	COMMUNICATION	7				
2	STORES	16				
3	LAMPROOM	9				
4	FAN AND OTHERS	4				
5	MAN WAY ATTANDANTS	4				
6	ACCOUNTS	9				
7	CANTEEN	12				
8	WORKSHOP	31				
9	PERSONNEL & WELFARE	6				
10	NITROGEN PLANT	6				
11	CHP	94				
12	SUBSTATION	12				
13	WATER TREATMENT PLANT	8				
14	EFFELUENT TREATMENT PLANT	8				
15	CIVIL & WATER SUPPLY	14				
16	OFFICE	11				
17	MVTC	8				
18	MAGAZINE	11				
19	WATCH & WARD	1				
20	CANTEEN	12				
21	MEDICAL & Sanitation	6				
22	TRANSPORT	4				
	Sub Total (D)	**293**				

Source: Mining Plan Vol 1 of Jagannathpur for PPTPL, Calcutta

Note: Includes both Permanent and Temporary Employees

Annexure 5: Simple Random Sampling Technique for Selecting Sample Villages in 10 Km Radial Distance

Sr No	DT Name	CD Block	Town/Village Code	Level	Name of villages	TRU	No_HH	TOT_P	Sample HH
	Villages in Mining Lease Area								
1	Paschim Barddhaman	Faridpur Durgapur	318741	VILLAGE	Amdahi	Rural	244	1138	25
2	Paschim Barddhaman	Faridpur Durgapur	318727	VILLAGE	Jot Balaram	Rural	199	918	20
3	Paschim Barddhaman	Kanksa	318782	VILLAGE	Basudebpur	Rural	321	1285	32
4	Paschim Barddhaman	Kanksa	318781	VILLAGE	Sundipur	Rural	69	312	7
5	Paschim Barddhaman	Kanksa	318783	VILLAGE	Benodpur	Rural	135	570	16
6	Paschim Barddhaman	Kanksa	318787	VILLAGE	Majhidanga	Rural	17	75	2
7	Paschim Barddhaman	Kanksa	318788	VILLAGE	Dandeshwar	Rural	195	897	20
8	Paschim Barddhaman	Kanksa	318785	VILLAGE	Sasipur	Rural	225	939	22
9	Paschim Barddhaman	Kanksa	318784	VILLAGE	Rajhat	Rural	147	642	15
						Group Total_1	**1552**		**159**
	Villages Besides Ajay River								
10	Paschim Barddhaman	Kanksa	318786	VILLAGE	Dubrajpur	Rural	72	342	8
11	Birbhum	Illambazar	317962	VILLAGE	Dakshin Ekdala	Rural	77	364	10
12	Paschim Barddhaman	Kanksa	318790	VILLAGE	Ranipur	Rural	0	0	0
13	Paschim Barddhaman	Kanksa	318780	VILLAGE	Talbahari	Rural	27	109	5
14	Birbhum	Illambazar	317963	VILLAGE	Billwamangal B	Rural	55	288	6
15	Birbhum	Illambazar	317961	VILLAGE	Shukdala	Rural	110	543	11
						Group Total_2	**341**	**6676**	**40**
	Villages in 10 Km radial distance								
16	Birbhum	Illambazar	317965	VILLAGE	Joydev Kenduli	Rural	793	3280	80
17	Birbhum	Dubrajpur	318228	VILLAGE	Kendula	Rural	750	3232	75
18	Birbhum	Illambazar	317964	VILLAGE	Tikarbeta	Rural	606	2552	60
19	Paschim Barddhaman	Faridpur Durgapur	318739	VILLAGE	Jamgara	Rural	499	2315	50
20	Paschim Barddhaman	Faridpur Durgapur	318742	VILLAGE	Jagannathpur	Rural	424	2034	42
21	Birbhum	Dubrajpur	318269	VILLAGE	Bodhgram	Rural	373	1705	37
22	Paschim Barddhaman	Kanksa	318779	VILLAGE	Kanchanpur	Rural	362	1627	36
23	Paschim Barddhaman	Faridpur Durgapur	318756	VILLAGE	Baragaria	Rural	293	1241	30
24	Paschim Barddhaman	Barabani	318580	VILLAGE	Shyamsundarpur	Rural	281	1444	30
25	Birbhum	Illambazar	317957	VILLAGE	Baranabagram	Rural	244	1008	25
26	Birbhum	Dubrajpur	318239	VILLAGE	Barari	Rural	206	913	20
27	Birbhum	Dubrajpur	318240	VILLAGE	Khoj Kamalpur	Rural	166	791	15
28	Paschim Barddhaman	Kanksa	318797	VILLAGE	Dihibeta	Rural	145	609	15
29	Paschim Barddhaman	Burdwan-II	320172	VILLAGE	Kalinagar	Rural	138	527	15
30	Paschim Barddhaman	Kanksa	318792	VILLAGE	Phuljhuri	Rural	129	608	15
31	Paschim Barddhaman	Kanksa	318791	VILLAGE	Thakuranibazar	Rural	127	609	15
32	Paschim Barddhaman	Faridpur Durgapur	318764	VILLAGE	Gopendanga	Rural	124	536	15
33	Paschim Barddhaman	Kanksa	318799	VILLAGE	Krishnapur	Rural	109	435	10
34	Birbhum	Illambazar	317960	VILLAGE	Chak Rasik	Rural	101	478	10
35	Birbhum	Illambazar	317959	VILLAGE	Chak Paran	Rural	89	424	10
36	Paschim Barddhaman	Kanksa	318789	VILLAGE	Bidbihar	Rural	46	206	5
						Group Total_3	**6005**	**26574**	**610**
						Grand Total	**7898**	**34996**	**809**

Annexure 6: Village Level Information Sheet

PTPL **DRHS**

Village level Information

(Information to be collected from Panchayat Authorities/School Teacher)

Instruction to Fill: Always encircle the number as ① and use additional page as required

Sr. No.			
	Survey Date:		**Schedule No:**
1.	**District:**		
2.	**Mouza:**		
3.	**Village:**		
4.	**Name of Respondent:**		
5.	**Type of Respondent:**	1.Pardhan: 3.Bhumi Sahayak 5. Others	2.Panchayat Member: 4. School Teacher:
6.	**Mobile No./Tele No. with STD Code:**		
7.	**Total Household (HH):**		
8.	**Total Population:**		
9.	**Total BPL Family:**		
10.	**Number of Hamlets in the village (Including the main village):**		
11.	**Location of Village:**	1.On main road: 2.On pucca link road:	3.On kuchha road: 3a)If kuchha road,distance to pucca link road kms.:
12.	**How far the FOREST is located from this Village in kms.:**		
13.	**Approximate percentage (%) of Household:**	1) Elecrified: 2) Having Fixed Telephone: 3) Cable/Disc TV Connection: 4) LPG Connection: 5) Two wheeler: 6) Four wheeler:	

Page No.-1

Village level Information

PTPL (Information to be collected from Panchayat Authorities/School Teacher) **DRHS**

Instruction to Fill: Always encircle the number as ① and use additional page as required

14.	**A1) Total Area of Village** (in sq. kms): ☐☐☐	**A2) Cultivable Land** (in sq. kms): ☐☐☐	**A3) Non Cultivable Land** (in sq. kms): ☐☐☐
15.	**B1)Total Cultivable Land** (in sq. kms): ☐☐☐	**B2) Irrigate Land** (in sq. kms): ☐☐☐	**B2) Non Irrigate Land** (in sq. kms): ☐☐☐
16.	**Main Crop in the Village:** ☐☐ **Secondary Crop in the Village:** ☐☐ ☐☐	1 Wheat 2 Bajra 3 Maize 4 Paddy 5 Jawar 6 Tobacco 7 Other (specify): _____	
17.	**Main Occupation of Villagers:** ☐☐ **Secondary Occupation of Villagers:** ☐☐ ☐☐	1 Cultivator 2 Agricultural labour 3 Unskilled Worker 4 Skilled Worker 5 Petty Business 6 Big Business 7 Professional 8 Service (class I-IV) 9 Craftman & Artisan 10 Casual Labour 11 Other (specify): _____	
18.	**Type of Drainage Facility Within the Village:** ☐☐	1 Closed 2 Open 3 No Facility	
19.	**Main Source of Drinking Water Facility:** ☐☐☐☐	1 Overhead tank through Tap Water 2 Open Well 3 Hand Pump/Boring 4 Purchased RO water bottle 5 Canal 6 Pond	
20.	**Whether Water Tank is in Operational status?** ☐☐	1 Yes in Operation 2 Yes, but not in operation 3 No If Yes, years of Operation ☐☐ years	
21.	**Number of emigrants (out Side India) from the Villages?**	☐☐	
22.	**Whether people in the village migrate for labor to city or other area?** ☐☐	1 Yes **2** No If Yes, What Percentage ☐☐	

Page No.-2

Village level Information

PTPL (Information to be collected from Panchayat Authorities/School Teacher) **DRHS**

Instruction to Fill: Always encircle the number as ① and use additional page as required

23.	Number of Woman Panchayat Members:	☐☐
24	Religious composition of the Village (In Terms of Numerical Size):	i. First Majority _____ Per Cent ☐☐ ii. Secound Majority _____ Per Cent ☐☐
25.	Major Caste in Village (In Terms of Numeric Size):	i. First Majority _____ Per Cent ☐☐ ii. Secound Majority _____ Per Cent ☐☐ iii. Third Majority _____ Per Cent ☐☐

26. Education Facility in the Village (In Terms of Numeric Size)

Facility	If Yes, Write number in Actual	If not available within the Village, distance in Kms. If available keep blank
i. Anganwadi	☐☐	☐☐
ii. Primary School	☐☐	☐☐
iii. Secondary School	☐☐	☐☐
iv. College	☐☐	☐☐

27. Other Facility in the Village (In Terms of Numeric Size)

Facility	If Yes, Write number in Actual	If not available within the Village, distance in Kms. If available keep blank
i. Panchayat Office	☐☐	☐☐
ii. Post Office	☐☐	☐☐
iii. Bus Stand	☐☐	☐☐
iv. Railway Station	☐☐	☐☐
v. Low fair Ration Shop	☐☐	☐☐
vi. Nearest National Bank	☐☐	☐☐
vii. Nearest Cooperative Bank	☐☐	☐☐
viii. Village Cemetery	☐☐	☐☐

Village level Information

PTPL (Information to be collected from Panchayat Authorities/School Teacher) **DRHS**

Instruction to Fill: Always encircle the number as ① and use additional page as required

28.	Accessibility of Facility		
Item	**Name**	**Aproximate Distance**	**Average time to reach(in Hours)**
i. Nearest Town			
ii. Nearest Market Centre/Place			
iii. Block HQ.			
iv. Revenue Inspector (RI) HQ			
v. District HQ			

29.	Community Individual/Organization	
Organization	**If Yes, Write number in actual**	**Membership (How Many)**
i. Youth Club		
ii. Women's group/ Mahila Mandal		
iii. Credit Union		
iv. Voluntary Organization		

30. Villagers by profession (in %) for working Population Only	1.Cultivators/Farmer:	2.Agriculture Labour:
	3.Casual Labour:	4. Petty Business:
		5. Services:
31. Villagers by Education (in %)	1.Below/under graduate	2. Graduate 3. Post Graduate
	4. Professional	5. Others_____

32. Cropping Pattern & approximate Production in MT	1) Main	2) 1st Secondary	3) 2nd Secondary
33. Manufacturing Commodities	1) Main	2) 2nd Secondary	3) 2nd Secondary

34. Types of Manufacturing Industries	1. Engineering 2. Chemical 3. Food Processing 4. Furniture 6. Minings 7. STP/ETP 8. Pharmaceutical 9. Textile 10. Others (Specify) _____

Page No.-4

Village level Information

PTPL (Information to be collected from Panchayat Authorities/School Teacher) DRHS

Instruction to Fill: Always encircle the number as ① and use additional page as required

35. Currently how many persons requires Technical jobs in your villages:	1. ITI Certificate ☐☐ 2.Diploma Holder ☐☐ 3. Graduate Engineeres ☐☐ 4. Labours ☐☐
36. Facilities Avaliable in the Villages	1. Govt/Pvt Anaganwadi 1. Yes 2. No 2. Govt/Pvt Primary School 1. Yes 2. No 3. Vocational Training Center (ITI) 1. Yes 2. No 4. Govt. PHC/SC 1. Yes 2. No 5. Major source of Drinking water: 1. Yes 2. No 6. If Yes Mention the Source: 1. Boring 2.Water Tank 3.Others_____ 7. Presence of river/Canal: 1. Yes 2. No 8. Total Sanitation Programe: 1. Yes 2. No 9. Presence of Telephone/Mobile: 1. Yes 2. No 10. Pub/Pvt mode of Transporation: 1. Yes 2. No 11. Approach Road: 1.Metalled 2.Cement 3. Kuchha 12. Presence of Commercial Banks: 1. Yes 2. No 13. Presence of Agriculture Credit Society: 1. Yes 2. No 14. Presene of Cooperative Bank: 1.Yes 2.No 15. Household Handicraft Units 1. Yes 2. No 16. Presence of Community Centre: 1. Yes 2. No 17. Presence of Self Help Groups: 1. Yes 2. No 18. Domestic Power supply: 1. Regular 2. Irregular 3. No 19. Agriculture Power Supply: 1. Regular 2. Irregular 3. No 20. Commecial/Industry Power Supply: 1. Regular 2. Irregular 3. No

Page No.-5

Village level Information

PTPL (Information to be collected from Panchayat Authorities/School Teacher) DRHS

Instruction to Fill: Always encircle the number as ① and use additional page as required

	21. ATM Machine	1. Yes	2. No
	22. Vegetable/Mandis Market	1. Yes	2. No
	23. Village Weekly Haat	1. Yes	2. No
	24. Presence of Tractor	1. Yes	2. No
	25. Presence of BullokCart	1. Yes	2. No
	26. Village Street Light	1. Yes	2. No
	27. Pond in Village	1. Yes	2. No
	28. Garden in Village	1. Yes	2. No

37. Ask Specific need of the Panachayt for the village under ESC? List the items?

Sr	List of items demanded	No/Dimensions	Vital	Essential	Desriable	Additional	Surplus
1							
2							
3							
4							
5							

(For Office Use Only)
(To be filled by Field and office editor)

Name of Investigator:_____ Interview Date | | | | | | | (d d m m y y)

No. of Visits:_____ Time started: _____ Time completed: _____

Annexure 7: Household Information Sheet

Strictly Confidential SIA_R&R_Socio-Economic Survey

Exploring Socio - Economic Impact Assessment

(HOUSEHOLD SCHEDULE)

PTPL **(Information to be collected from Head/Next Representative of the household)** **DRHS**

Instruction to Fill: Always encircle the number as ① and use additional page as required

Project ID No. of Data Schedule **PTPL/SIA-R&R** No of Data Schedule: ☐☐☐☐

A) Name of the District: i) Paschim Bardhaman ii) Birbhum ☐☐☐

B) Name of the CD Block: _____ ☐☐☐☐

C) Village Name: _____ ☐☐☐☐☐☐

D) Name and Head of Household: _____

E) Religion of Family: 1. Hindu 2. Muslim 3. Sikh 4. Christian 5. Other (Specify)_____ ☐

F) Caste of the Family: 1.Higher caste 2.OBC 3.SC 4.ST 5.Other (Specify)_____ ☐

G) Name of the Caste: _____ ☐☐

House No:_____ Lane No:_____ Name of Locality: _____

Mobile No/Tele No. with STD Code: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐

(For Office Use Only)
(To be filled by Field and office editor)

Name of Investigator: _____ Interview Date ☐☐☐☐☐☐
d d m m y y

Time started: _____ Time completed: _____

Interview Result (Final Visit) ☐ 1. Completed 2. Refused 3. Incomplete Schedule

4. Others:_____ ☐

Schedule Edited by: _____ Place: 1. Field 2. Office ☐☐

Remarks if any _____

Executing Agency

Power Plus Traders Private Limited

(A joint venture Orrisa Matelic Pvt. Ltd; Rashmi Cement Limited & Shyam Steel Mfg. Pvt. Ltd)

5th floor Constantia Building-B Wing, Rawdon St, Mullick Bazar, Taltala, Kolkata 700016 West Bengal

Hired Survey Agency

DRHS Consultancy Services

A/255 Darshnam Antica, Opp. HWT colony, Danteshwar Tarsali Ring Road, Danteshwar, Vadodara, Gujarat 390 004 INDIA

SECTION A: DEMOGRAPHIC DETAILS: **NOTE: FIRST NAME RECORDED SHOULD BE HEAD OF HOUSEHOLD (In the absence of Head of HH, answers should be obtained from Head Man/Women).**

Sr. No. (01)	Name of the household Member (02)	Relationship to Head of HH (03)	Sex: Male-1 Female-2 (04)	Age in completed years (05)	Marital Status CM1/ S2/ D3/ W4 NM5/ NG6 (06)	**Col 7 & 9:** Applicable only to 6 years and above			Working Status		Migratory for Livelihood (Yes 1 / No 2) (11)
						Can read and write Yes 1 No 2 (07)	Completed Education **(Col. 08 for all)** (08)	If aged 6-14, Currently going To school (Yes 1 / No 2) (09)	(10a)	(10b)	
01											
02											
03											
04											
05											
06											
07											
08											
09											
10											
11											
12											
13											
14											

NOTE: In case of children of the age less than a month, code 95 in column5. Similarly, if age 1-12 months, code 99 in column5 and if age is above one year, code age in actual years in col. 5

SECTION B: HOUSEHOLD AMENITIES AND QUALITY OF LIFE

1) Type of Family living in the house: 1. Joint 2. Nuclear ☐

2) Ownership of the residential house: 1. Owner occupied 2. Tenant 3. Others ☐

3) Type of household (Observed the House and fill) ☐

Type of Houses	Criteria for Wall	Criteria for Floor	Criteria for Roof
a. Hut	Trampoline/Plastic	Mud	Trampoline/Plastic/Leaves/Grass
b. Kuccha	Mud/Mat	Mud	Thatched/Cloth/Leaves/Grass
c. Semi Pucca	Bamboo/Tin	Mud	Asbestos/Bamboo/Wooden log
d. Pucca	Concrete	Tile/Concrete	Concrete

4) How many rooms are there in your household? (Including kitchen) _____ ☐

5) Do you have a separate bathroom? 1. Yes 2. No ☐

6) What is the type of bathroom where you or your household members take bath? ☐

1. Open 2. Partially closed 3. Completely closed

7) What kind of toilet facility does your household have? ☐

1. No facility/Defecate outside 2.Shared 3. Own

8) If Shared or own toilet, please ask about type of toilet? ☐

1. Soak pit 2. Septic tank 3. Modern Flush 4. Others_____

9) How often you clean (Soak pit/Septic tank/Flush system)? ☐

1. Never 2. Occasionally 3. Regularly

10) In case of Septic tank/Modern Flush system, ask whether they have sewage line? 1. Yes 2. No ☐

11) Do you have a separate room for kitchen? 1. Yes 2. No ☐

12) What is the main type of fuel used for cooking? ☐

1. Cow-dung 2. Agri.waste 3. Firewood 4. Coal/Charcoal 5. Kerosene 6. Bio-gas 7. LPG 8 Solar Cooker 9. Other (specify)

13) What is the main source of drinking water for your household? ☐

1. River/Canal 2. Ponds/Tanks 3. Well/Tube Well 4. Hand pump 5. Pipe water without overhead tank 6. Pipe water with overhead tank 7. Other (Specify) Water Tanker

14) At What distance it is located: _____Km.

(NOTE: Code: 00 if it is within house; 99 within 1 Km and rest in actual distance in Km)

15) What is the main source of water for (bathing/washing) domestic use for your household? ☐

1. River/Canal 2. Ponds/Tanks 3. Well/Tube Well 4. Hand pump 5. Pipe water without overhead tank 6. Pipe water with overhead tank 7. Other (Specify)_____

16) What is the main source of lighting in your household? ☐

1. Firewood 2. Oil lamp 3. Candles 4. Solar Lamp 5. Electricity

17) What kind of domestic animals do you have? 1. Don't have ☐ 2. Sheep ☐☐ 3. Goat ☐☐

4. Buffalo ☐☐ 5. Cow ☐☐ 6.Camel ☐☐ 7. Others _____ ☐☐

18) Does this household own any of the following? (Code 1 Yes 2. No)

1.Clock/Watch ☐	2.VCR/CD Player ☐	3.Car/Jeep ☐	4.Thresher ☐
5.Fan ☐	6.Sewing machine ☐	7.Telephone ☐	8.Bullock Cart ☐
9.Radio/Transistor ☐	10.Bicycle ☐	11.Refrigerat ☐	12.Water Pump ☐
13.Television ☐	14.Motor Cycle/Scoote ☐	15.Tractor ☐	16.Spraying machir ☐

SECTION C: DETAILS OF FAMILY INCOME

1) Does this household own any land? 1. Yes 2. No (Move to 3) ☐

2) If Yes, Give details of land holding Total ☐☐☐☐

a) Cultivable Land _____ (acres) ☐☐☐☐

b) Non_Cultivable Land _____ (acres) ☐☐☐☐

3) How many family members are working for earning livelihood? Ask about approximate annual income and check profession dependency on Forest (**Check the numbers of earning members from Section A: Demographic Profile**)

	Sr.No Family Member (a)	Primary		Secondary	
		Profession (b)	Annual Income (c)	Profession (d)	Annual Income (e)
☐	☐☐	☐☐	☐☐☐☐☐☐	☐☐	☐☐☐☐☐☐
☐	☐☐	☐☐	☐☐☐☐☐☐	☐☐	☐☐☐☐☐☐
☐	☐☐	☐☐	☐☐☐☐☐☐	☐☐	☐☐☐☐☐☐
☐	☐☐	☐☐	☐☐☐☐☐☐	☐☐	☐☐☐☐☐☐
☐	☐☐	☐☐	☐☐☐☐☐☐	☐☐	☐☐☐☐☐☐

P-4

4) In year how many months you/family members are migrating for doing your primary profession work? ☐

1. One month 2. Two Months 3. Three Months 4. Four to Six Months 5. Above Six Months

5) Does your family income have increased compared to last three years? 1.Yes (Move to 6) 2. No (Move to 7)

6) If Yes; How much? 1. Above Rs.10,000/- 2.Above Rs.25,000/- 3.Above Rs.50,000/- 4. Above Rs. 1 Lakh ☐

7) Have you/your family members taken monetary loan during last three years? 1.Yes (Move to 8) 2. No (Move to 9)

8) If Yes; How much? 1. Above Rs.10,000/- 2.Above Rs.25,000/- 3.Above Rs.50,000/- 4. Above Rs. 1 Lakh ☐

9) Then ask reason why do say that your family income has not increased since last three years? ☐☐☐

1. Unaware of Govt. Scheme 2. Earning members are less 3. Household expenditure is more
4. We did not get our share from Govt. 5.Becasue of middleman. 6. Others_____

SECTION D: FAMILY EXPENDITURE

1. Calculate the total Annual income of the family from Section 3 Sr. C in INR ☐☐☐☐☐☐☐
2. Calculate Monthly income by dividing total income Section 3 Sr. 3 in INR ☐☐☐☐☐☐☐
3. Ask the expenditure of the Family during last month under the following head:

Sr	Item of Expenditures in a Household	Amount in INR
3a	Rent or House Instalment	
3b	For Children education	
3c	For Purchase of Kitchen items (FMG) for food items (Vegetables, Non-Veg items, Masala, Edible Oil, cooking gas. Coal etc	
3d	For Purchase of Lifestyle items (FMG) for Bathroom & Dressing table items	
3e	Petrol Expenses	
3f	Electricity Bill	
3g	Other Miscellaneous items	
	Total	

SECTION E: EDUCATIONAL ATTAINMENT (Refer Section A: Demographic Details and ask these questions)

1. Where is your children's school located? ☐
   1. Within Village 2. At a distance of 2 km 3. Three to Five km 4. Five to Ten km 5. Above 5km ☐
2. Are all your Children attending School? 1. Yes (Move to 4) 2. No (Ask 3) ☐

P-5

3. Give Reasons for Children not Attending School

1. School is too far 2. Teachers are absent 3. Lack of Infrastructure 4. To increase more money

4. Can't afford the expense 5. Due to Custom & Traditions 6. Others_____

4. If yes whether the school / Anganwadi / Balwadi provides Mid-day meal. 1. Yes 2. No.

5. Does any school going children have been awarded Scholarship/Stipend? 1. Yes 2. No (move to Sr.7)

6. If Yes, Name the type of Scholarship/Stipend awarded: _____

7. Does any of your children went for technical training? 1. Yes 2. No. (Move to next Section)

8. If Yes ask type of techncial training he/she had undergone ?

1. ITI 2. Mechnical 3. Electronic 4. Electrical 5.Turnner 6. Health 7.Others (Specify)_____

9. In which Institution and where? 1. Name of the Place_____

2. Name of the Institution: _____

SECTION F: HEALTH ATTAINMENT

1. Where your health facility does is located?

1. Within Village 2. At a distance of 2 km 3. Three to Five km 4. Five to Ten km 5. Above 5km

2. During last one year do any family members visited health institutions and for what illness?

1. SC 2. PHC 3. Govt. Dispensary 4. CHC 5. Dis. Hospital 6. Private Hospital at taluka/Dist HQ

7. Private hospital at Metro city 8. Traditional Health 9. Others (specify)_____

3. For what type of Illness (From 2, Mention the Code of Health institutions visited on 1st row and illness from 2nd row onwards)

Code of Health institutions visited	Code of Health institutions visited	Code of Health institutions visited
Illness1	Illness1	Illness1
Illness2	Illness2	Illness2
Illness3	Illness3	Illness3

4. Why do you prefer GHF/Pvt. doctor? (Multiple responses are possible)

1. Services are nearby 2. More convenient 3. Treatment is more effective 4. Treatment is cheaper or free 5. Doctors are always available 6. Convenient timings 7. Required medicines are available 8. More faith in that doctor 9. Doctor pay personal attention/Courteous 10. Other (specify)_____

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SECTION G: GENDER EMPOWERMENT & GOVERNANCE

1. Does your family have birth registration certificates of your alive Children? 1. Yes 2.No ☐ 3.NA
2. Does your family has death certificates of the persons expired in your family (with in 6mth)? 1. Yes 2.No ☐ 3.NA
3. Does your family have BPL Card? 1. Yes 2.No ☐ 3.NA
4. Does your all family members above 18 years has voter ID card? 1. Yes 2.No ☐ 3.NA
5. Do all members in your family having voter id cards cast their vote? 1. Yes 2.No ☐ 3.NA
6. If No, Ask for Reasons: _____ ☐☐
7. Do your all family members above 18 years have employment Guarantee Card? 1. Yes 2.No ☐
8. Does any of your family members are in Village/Taluka/District Panchayat Samiti? 1. Yes 2.No ☐
9. If Yes, Ask at what level? 1. Village 2. Taluka 3. District ☐
10. Identify the sex of committee member? 1. Male or 2. Female? ☐
11. (If person Is female),does she face difficulty in executing her duties as Panchayat leader? 1. Yes 2.No ☐
12. If yes ask what type of difficulties: _____ ☐☐
13. Is any member of your family is in Village Level Organization? 1. Yes 2.No ☐
14. Identify the sex of committee member? 1. Male or 2. Female? ☐
15. Who in your family takes major decision of running household? ☐

    1. Only male/s of HH 2. Only Female/s of HH 3. Both

16. Is any NGO is working in your village? 1. Yes 2.No (Move 18) ☐
17. If Yes, Ask how do they provide help to you? ☐☐☐☐☐

1. Enhancing their Skill 2. Providing irrigation facilities 3. Providing Biogas 4. Providing technical training 5. Providing food 6. Providing employment 7. Others_____

18. Does Village/Taluka/District Panchayat is helpful to you and your family? 1. Yes 2. No ☐

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19. If yes in What Way ☐☐☐☐

1. In providing employment 2. Generating awareness about Govt. Schemes

3. 4. 5.

20. Do you think all development programs had reached to your village? 1. Yes 2. No ☐

21. As reasons in both cases? ☐☐☐☐

1._____

2._____

3._____

SECTION H: ABOUT MINING PROJECT in JAGANATHPUR (B)

1. Do you know that Coal Mining project is coming in your area? 1. Yes 2. No ☐

2. If Yes, Do you have any objection related to this Project? 1. Yes 2. No ☐

3. If Yes, Please mention what objection do you have?

1._____ 2._____

3._____ 4. _____

5._____ 6. _____

4. What are your expectations from the Coal mining project? ☐☐☐☐☐☐

1. Employment 2. Development Programs 3. Road 4. Water supply 5. School

6._____ 7. _____ 8._____

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Annexure 8: Details of the land Coordinate yet to be purchased w.r.t Figure 3.1 on page 42

Block A		Block B		Block C		Block D	
X	Y	X	Y	X	Y	X	Y
537393.164	2617274.597	538305.117	2616731.183	537958.275	2617348.510	538899.406	2616536.296
537703.340	2617441.813	538371.758	2616705.209	537927.150	2617388.910	538911.019	2616603.309
537743.697	2617376.335	538438.389	2616656.125	537956.475	2617443.694	538885.971	2616619.508
537809.350	2617249.336	538438.389	2616656.125	537933.428	2617522.508	538873.759	2616623.695
537852.940	2617186.470	538438.389	2616656.125	537955.084	2617561.564	538823.723	2616657.212
537866.105	2617133.886	538455.992	2616453.826	538212.512	2617575.808	538811.379	2616662.769
537883.938	2617067.500	538531.710	2616503.381	538214.866	2617533.274	538746.066	2616705.521
537876.137	2616995.517	538648.673	2616359.875	538205.153	2617458.235	538717.313	2616719.924
537842.286	2616951.124	538676.474	2616316.014	538191.263	2617422.137	538696.101	2616742.799
537690.266	2616820.127	538742.424	2616295.727	538151.858	2617389.719	538672.831	2616766.134
537511.455	2617030.076	538798.232	2616242.466	538052.022	2617310.392	538609.555	2616822.270
537461.680	2617094.683	538821.064	2616199.347	537958.275	2617348.510	538580.328	2616838.072
537460.893	2617158.456	538823.534	2616162.492			538552.819	2616871.474
537393.164	2617274.597	538822.555	2616126.698			538519.107	2616915.850
		538844.546	2616083.838			538454.839	2616976.253
		538810.627	2615973.568			538454.771	2617174.752
		538805.869	2615915.259			538447.866	2617252.812
		538818.558	2615839.166			538368.928	2617233.312
		538841.390	2615796.047			538347.884	2617266.324
		538874.365	2615785.904			538328.110	2617285.809
		538864.222	2615752.929			538297.287	2617297.186
		538799.793	2615628.366			538254.158	2617367.535
		538746.096	2615593.771			538245.765	2617413.302
		538514.685	2615860.446			538245.765	2617452.599
		538448.088	2615940.878			538232.862	2617577.054
		538469.923	2616009.436			538430.711	2617587.747
		538450.197	2616033.632			538498.447	2617591.567
		538452.666	2616040.998			538911.194	2617614.933
		538131.656	2616371.875			538940.924	2617616.616
		538201.831	2616489.205			539169.703	2617630.423
		538157.917	2616504.423			539323.186	2617635.424
		538188.655	2616660.978			539444.082	2617646.296
		538160.904	2616667.675			539531.859	2617606.321

Block E	
X	Y
540012.819	2617344.701
540312.477	2617402.275
540403.546	2617418.700
540390.455	2617520.590
540373.831	2617564.059
540334.319	2617583.394
540174.383	2617568.422
539988.501	2617542.814
539950.255	2617471.887
539953.732	2617435.967
539991.261	2617413.981
539996.598	2617368.425
540012.819	2617344.701

Block F	
X	Y
540863.098	2617727.911
540770.833	2617722.735
540746.727	2617680.336
540704.791	2617630.605
540641.237	2617557.265
540577.539	2617498.520
540499.342	2617435.100
540425.970	2617407.316
540407.491	2617345.743
540395.629	2617264.221
540389.083	2617169.753
540389.396	2617156.511
540393.818	2617150.702
540401.541	2617141.602
540408.303	2617138.229
540413.198	2617138.617
540418.280	2617139.608
540420.945	2617141.981
540423.021	2617148.497
540425.264	2617153.459
540427.003	2617155.119
540428.231	2617155.358
540431.715	2617154.183
540436.877	2617150.807
540459.611	2617135.622
540493.879	2617130.140
540496.058	2617128.872
540497.895	2617126.580
540501.403	2617123.140
540505.934	2617121.700
540509.837	2617121.220
540535.895	2617123.172
540562.778	2617125.005

Block G	
X	Y
541442.199	2616639.483
541416.400	2616674.367
541372.978	2616714.893
541349.200	2616740.456
541342.328	2616746.005
541350.532	2616748.838
541352.071	2616743.099
541355.103	2616738.413
541362.638	2616728.603
541370.689	2616721.261
541390.529	2616703.167
541416.752	2616679.252
541432.336	2616658.819
541441.120	2616647.302
541459.799	2616623.434
541461.062	2616606.659
541515.174	2616602.573
541589.248	2616596.514
541586.584	2616636.399
541617.471	2616735.004
541665.140	2616872.101
541353.435	2616766.666
541350.647	2616760.620
541350.539	2616754.360
541116.916	2616806.338
541303.403	2616879.043
541322.215	2616882.466
541359.807	2616874.043
541376.346	2616879.681
541357.902	2616944.273
541280.785	2617199.010
541312.161	2617252.680
541384.501	2617230.159

Annexure 9: Status of working population by education and profession in Sample villages

	Type of Profession reported in %					Education reported in %			
Village	Culti/ Farm	Agri Labour	Casual Labour	Petty Business	Service	Under Graduate	Graduate	Post Graduate	Professionals
Rajhat	18	25	51	5	1	93	5	2	0
Jot Balram	30	28	30	12	0	80	18	2	0
Amdahi	32	23	38	7	0	90	9	1	0
Dandeshwar	36	24	30	10	0	88	10	2	0
Benodpur	32	31	34	3	0	81	11	8	2
Sasipur	31	28	35	4	2	96	3	1	1
Basudebpur	39	27	30	2	2	91	7	2	1
Sundipur	70	12	13	5	0	90	6	4	2
Majhidanga	52	31	15	2	0	97	3	0	0
Average MLA Village	**38**	**25**	**31**	**6**	**1**	**90**	**8**	**2**	**1**
Kendula	35	25	31	8	1	100	0	0	0
Baragaria	50	20	15	10	5	85	10	5	2
Tikarbeta	30	20	40	6	4	70	20	10	0
Bodhgram	26	24	38	9	3	88	9	3	2
Barari	39	23	35	3	0	93	5	2	0
Khoj kamalpur	35	22	38	5	0	96	3	1	0
Billwamangal B	33	28	36	3	0	89	8	3	2
Dakshin Ekdal	69	15	15	1	0	90	7	3	1
Sukdhala	61	14	24	1	0	95	4	1	0
Chak Rasik	65	20	10	5	0	83	10	7	2
Chak Paran	65	20	10	5	0	83	10	7	3
Joydev Kunduli	55	10	20	10	5	85	12	3	2
Baranabagram	52	28	18	2	0	84	11	5	2
Average Birbhum Village	**47**	**21**	**25**	**5**	**1**	**88**	**8**	**4**	**1**
Bidbihar	15	35	45	4	1	90	8	2	0
Krishnapur	11	12	72	4	1	94	5	1	0
Dihibeta	36	24	31	8	1	98	2	0	0
Kalinagar	50	25	11	9	5	90	7	3	2
Phuljhuri	55	26	10	6	3	97	2	1	1
Thakuranibazar	32	16	44	4	4	95	4	1	0
Gopendanga	48	12	33	5	2	88	10	2	0
Jaganathpur	50	20	20	7	3	89	8	3	0
Jamgara	32	28	23	12	5	97	2	1	0
Talbahari	38	15	42	5	0	97	2	1	0
Ranipur	20	22	55	3	0	91	7	2	1
Kanchanpur	30	26	38	4	2	91	7	2	1
Dubrajpur	68	20	10	2	0	92	5	3	1
ShyamSundarpur	60	20	10	7	3	85	10	5	3
Average P. Bardhhaman Village	**39**	**22**	**32**	**6**	**2**	**92**	**6**	**2**	**1**
Overall Average	**42**	**22**	**29**	**5**	**1**	**90**	**7**	**3**	**1**

Annexure 10: Status of Migration in Sample villages

District	Village	Tot_HH_2021	Pop_2021	Tot_HH_2011	Pop_2011	HH_Diff	Pop_Diff	Migration
P.Bardhaman	Bidbihar	35	160	46	206	-11	-46	OUT
P.Bardhaman	Krishnapur	150	600	109	435	41	165	IN
P.Bardhaman	Rajhat	200	1150	147	642	53	508	IN
P.Bardhaman	Dihibeta	40	315	145	609	-105	-294	OUT
P.Bardhaman	Kalinagar	115	425	138	527	-23	-102	OUT
P.Bardhaman	Phuljhuri	150	756	129	608	21	148	IN
P.Bardhaman	Thakuranibazar	110	500	127	609	-17	-109	OUT
P.Bardhaman	Gopendanga	150	700	124	536	26	164	IN
Birbhum	Kendula	65	300	750	3232	-685	-2932	OUT
Birbhum	Baragaria	400	1700	293	1241	107	459	IN
P.Bardhaman	Jaganathpur	500	2134	424	2034	76	100	IN
Birbhum	Tikarbeta	700	3500	606	2552	94	948	IN
P.Bardhaman	Jamgara	550	2500	499	2315	51	185	IN
P.Bardhaman	Jot Balram	400	1600	199	918	201	682	IN
P.Bardhaman	Amdahi	330	1200	244	1138	86	62	IN
Birbhum	Bodhgram	300	1500	373	1705	-73	-205	OUT
P.Bardhaman	Dandeshwar	250	1150	195	897	55	253	IN
P.Bardhaman	Talbahari	18	90	27	109	-9	-19	OUT
P.Bardhaman	Ranipur	60	220	0	0	60	220	IN
P.Bardhaman	Benodpur	350	900	135	570	215	330	IN
Birbhum	Barari	100	450	206	913	-106	-463	OUT
Birbhum	Khoj kamalpur	450	1800	166	791	284	1009	IN
P.Bardhaman	Kanchanpur	250	1088	362	1627	-112	-539	OUT
P.Bardhaman	Sasipur	265	1000	225	939	40	61	IN
P.Bardhaman	Basudebpur	350	1400	321	1285	29	115	IN
Birbhum	Billwamangal B	150	450	55	288	95	162	IN
Birbhum	Dakshin Ekdal	80	386	77	364	3	22	IN
Birbhum	Sukdhala	150	683	110	543	40	140	IN
P.Bardhaman	Dubrajpur	130	520	72	342	58	178	IN
P.Bardhaman	Sundipur	87	380	69	312	18	68	IN
Birbhum	Chak Rasik	118	480	101	478	17	2	IN
Birbhum	Chak Paran	130	486	89	424	41	62	IN
Birbhum	Joydev Kunduli	900	3400	793	3280	107	120	IN
P.Bardhaman	Majhidanga	16	58	17	75	-1	-17	OUT
Birbhum	Baranabagram	420	1050	244	1008	176	42	IN
P.Bardhaman	ShyamSundarpur	2000	7500	281	1444	1719	6056	IN

Source: District Census Handbook, 2011 for Birbhum and Paschim Barddhaman AND PTPL SIA Survey 2021.

Annexure 11: Calculation of Quality-of-Life Index

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	15 Vari=150	150	150
Sr	Village Name	Anganwadi	Govt. Primary School	Govt. Vocational Training Centre ITI	Govt. PHC & SC	Total Sanitaion Campaign	Metal Road	Commercial Bank	Community Centre	Tap Water Untreated	River & Canal	Telephone / Mobile	Public/Pvt mode of tranportation	Agricultural Credits Societies	Self - Help Groups	Electric Power Supply	Total Score (infrastructure + Services)	Total Score in %	Average Score
1	Bidbihar	10	0	0	0	0	0	0	0	10	0	10	0	0	10	10	50	33	3.3
2	Krishnapur	10	10	0	10	10	0	0	0	10	10	10	10	0	10	10	100	67	6.7
3	Rajhat	10	10	0	0	0	0	0	0	10	10	10	0	0	10	10	70	47	4.7
4	Dihibeta	0	0	0	0	0	0	0	0	10	10	10	0	0	10	10	50	33	3.3
5	Kalinagar	10	10	0	0	10	10	0	0	0	0	10	0	0	10	10	70	47	4.7
6	Phuljhuri	10	10	0	0	10	0	0	0	0	10	10	0	0	10	0	60	40	4.0
7	Thakuranibazar	10	10	0	10	10	0	0	0	10	10	10	0	0	10	10	90	60	6.0
8	Gopendanga	10	10	0	0	10	0	0	0	10	0	10	0	0	10	10	70	47	4.7
9	Kendula	10	10	0	0	10	0	0	0	10	10	10	3	0	10	10	83	55	5.5
10	Baragaria	10	10	0	0	0	10	0	0	10	0	10	0	0	10	0	60	40	4.0
11	Jaganathpur	10	10	0	0	10	0	0	0	10	10	10	0	0	10	10	80	53	5.3
12	Tikarbeta	10	10	0	10	10	3	0	0	10	10	10	0	0	10	10	93	62	6.2
13	Jamgara	10	10	0	0	10	0	0	0	10	10	10	0	0	10	10	80	53	5.3
14	Jot Balram	10	10	0	0	10	0	0	0	10	0	10	0	0	10	10	70	47	4.7
15	Amdahi	10	10	0	0	10	0	0	0	10	10	10	0	0	10	10	80	53	5.3
16	Bodhgram	10	10	0	10	10	0	0	10	10	10	10	0	0	10	10	100	67	6.7
17	Dandeshwar	10	0	0	0	10	0	0	0	10	0	10	0	0	10	10	60	40	4.0
18	Talbahari	10	0	0	0	10	0	0	0	10	10	10	0	0	10	10	70	47	4.7
19	Ranipur	10	10	0	0	10	0	0	0	0	10	10	10	0	10	10	80	53	5.3
20	Benodpur	10	0	0	0	10	0	0	0	0	0	10	0	0	10	0	40	27	2.7
21	Barari	10	10	0	0	10	0	0	0	10	10	10	0	0	10	10	80	53	5.3
22	Khoj kamalpur	10	0	0	0	10	0	0	10	10	10	10	0	0	10	10	80	53	5.3
23	Kanchanpur	10	10	0	0	10	0	0	0	10	0	10	10	0	10	10	80	53	5.3
24	Sasipur	10	10	0	0	10	0	0	0	10	10	10	0	0	10	10	80	53	5.3
25	Basudebpur	10	10	0	10	10	0	0	10	10	10	10	0	0	10	10	100	67	6.7
26	Billwamangal B	10	10	0	0	10	0	0	0	10	10	10	0	0	10	10	80	53	5.3
27	Dakshin Ekdal	10	10	0	0	0	0	0	0	10	10	10	0	0	10	10	70	47	4.7
28	Sukdhala	10	10	0	0	10	0	0	0	10	10	10	0	0	10	10	80	53	5.3
29	Dubrajpur	10	10	0	0	10	0	0	0	10	10	10	0	0	10	10	80	53	5.3
30	Sundipur	0	0	0	0	10	0	0	0	10	10	10	0	0	10	10	60	40	4.0
31	Chak Rasik	10	0	0	0	10	0	0	0	10	10	10	0	0	10	10	70	47	4.7
32	Chak Paran	10	0	0	0	10	0	0	0	10	10	10	0	0	10	10	70	47	4.7
33	Joydev Kunduli	10	10	0	10	10	0	0	10	10	10	10	10	10	10	10	120	80	8.0
34	Majhidanga	0	0	0	0	10	3	0	0	10	10	10	0	0	10	10	63	42	4.2
35	Baranabagram	10	10	0	0	10	0	0	0	10	10	10	0	0	10	10	80	53	5.3
36	ShyamSundarpur	10	10	0	10	10	0	0	10	10	10	10	0	10	10	10	110	73	7.3

Continuing Annexure 11

Sr	Village Name	8 Var=80 Total Score of Infrastructure out of 80	80 Total Score in %	80 Average Score of Infrastructure out of 80	7 Var=70 Total Score for Services out of 70	70 Total Score in %	70 Average Score for Services out of 70	70:30 Average Weighted Score point Infra+Services
1	Bidbihar	10	12.5	1.3	40	57.1	5.7	2.6
2	Krishnapur	40	50	5.0	60	85.7	8.6	6.1
3	Rajhat	20	25	2.5	50	71.4	7.1	3.9
4	Dihibeta	0	0	0.0	50	71.4	7.1	2.1
5	Kalinagar	40	50	5.0	30	42.9	4.3	4.8
6	Phuljhuri	30	37.5	3.8	30	42.9	4.3	3.9
7	Thakuranibazar	40	50	5.0	50	71.4	7.1	5.6
8	Gopendanga	30	37.5	3.8	40	57.1	5.7	4.3
9	Kendula	30	37.5	3.8	53	75.7	7.6	4.9
10	Baragaria	30	37.5	3.8	30	42.9	4.3	3.9
11	Jaganathpur	30	37.5	3.8	50	71.4	7.1	4.8
12	Tikarbeta	43	53.75	5.4	50	71.4	7.1	5.9
13	Jamgara	30	37.5	3.8	50	71.4	7.1	4.8
14	Jot Balram	30	37.5	3.8	40	57.1	5.7	4.3
15	Amdahi	30	37.5	3.8	50	71.4	7.1	4.8
16	Bodhgram	50	62.5	6.3	50	71.4	7.1	6.5
17	Dandeshwar	20	25	2.5	40	57.1	5.7	3.5
18	Talbahari	20	25	2.5	50	71.4	7.1	3.9
19	Ranipur	30	37.5	3.8	50	71.4	7.1	4.8
20	Benodpur	20	25	2.5	20	28.6	2.9	2.6
21	Barari	30	37.5	3.8	50	71.4	7.1	4.8
22	Khoj kamalpur	30	37.5	3.8	50	71.4	7.1	4.8
23	Kanchanpur	30	37.5	3.8	50	71.4	7.1	4.8
24	Sasipur	30	37.5	3.8	50	71.4	7.1	4.8
25	Basudebpur	50	62.5	6.3	50	71.4	7.1	6.5
26	Billwamangal B	30	37.5	3.8	50	71.4	7.1	4.8
27	Dakshin Ekdal	20	25	2.5	50	71.4	7.1	3.9
28	Sukdhala	30	37.5	3.8	50	71.4	7.1	4.8
29	Dubrajpur	30	37.5	3.8	50	71.4	7.1	4.8
30	Sundipur	10	12.5	1.3	50	71.4	7.1	3.0
31	Chak Rasik	20	25	2.5	50	71.4	7.1	3.9
32	Chak Paran	20	25	2.5	50	71.4	7.1	3.9
33	Joydev Kunduli	50	62.5	6.3	70	100.0	10.0	7.4
34	Majhidanga	13	16.25	1.6	50	71.4	7.1	3.3
35	Baranabagram	30	37.5	3.8	50	71.4	7.1	4.8
36	ShyamSundarpur	50	62.5	6.3	60	85.7	8.6	6.9

Annexure 12: Calculation of Economic Index

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sr.	Village/ Town	ommercial ank (Status (1)/NA(2))	TM (Status (1)/NA(2))	ooperative ank (Status (1)/NA(2))	gricultural redit ocieties tatus (1)/NA(2))	andis egular arket (Status (1)/NA(2))	eekly aat (Status (1)/NA(2))	gricultural ommodities irst)	of Working opulation as ultivtor/Farmer by rofession	of Working opulation as Agriculture Labour by Profession	of Working opulation as asual abour by ofession	of Working opulation as Petty Business by profession	of Working opulation as ervice class y professioin	anufacturers ommodities	andicrafts ommodities	tatus of ond	et Area own (in ectares)
1	dbihar	0	0	0	0	0	0	10	2	3	4	1	1	0	0	10	10
2	rishnapur	0	0	0	0	0	0	10	1	1	7	1	1	0	10	0	10
3	ajhat	0	0	0	0	0	0	10	2	2	5	1	1	0	10	10	0
4	ihibeta	0	0	0	0	0	0	10	4	2	3	1	1	0	10	10	10
5	alinagar	0	0	0	0	0	0	10	5	2	1	1	1	0	0	10	10
6	huljhuri	0	0	0	0	0	0	10	5	2	1	1	1	0	0	10	10
7	hakuranibazar	0	0	0	0	0	0	10	3	2	4	1	1	0	10	10	10
8	opendanga	0	0	0	0	0	0	10	5	1	3	1	1	0	0	10	10
9	endula	0	0	0	0	0	0	10	3	2	3	1	1	0	10	10	0
10	aragaria	0	0	0	0	0	0	10	5	2	1	1	1	0	0	10	0
11	aganathpur	0	0	0	0	0	0	10	5	2	2	1	1	0	0	10	0
12	karbeta	0	0	0	0	0	0	10	3	2	4	1	1	0	0	10	0
13	amgara	0	0	0	0	0	0	10	3	3	2	1	1	0	0	10	5
14	ot Balram	0	0	0	0	0	0	10	3	3	3	1	1	0	10	10	10
15	mdahi	0	0	0	0	0	0	10	3	2	4	1	1	0	10	10	0
16	odhgram	0	0	0	0	0	10	10	3	2	4	1	1	0	0	0	4
17	andeshwar	0	0	0	0	0	0	10	4	2	3	1	1	0	0	10	10
18	albahari	0	0	0	0	0	0	10	4	2	4	1	1	0	0	0	10
19	anipur	0	0	0	0	0	0	10	2	2	5	1	1	0	0	0	10
20	enodpur	0	0	0	0	0	0	10	3	3	3	1	1	0	0	10	10
21	arari	0	0	0	0	0	0	10	4	2	3	1	1	0	10	10	4
22	hoj kamalpur	0	0	0	0	0	0	10	3	2	4	1	1	0	0	10	10
23	anchanpur	0	0	0	0	0	0	10	3	3	4	1	1	0	0	10	10
24	asipur	0	0	0	0	0	0	10	3	3	3	1	1	0	10	10	10
25	asudebpur	0	0	0	0	0	0	10	4	3	3	1	1	0	10	10	10
26	llwamangal B	0	0	0	0	0	0	10	3	3	4	1	1	0	10	10	10
27	akshin Ekdal	0	0	0	0	0	0	10	7	2	1	1	1	0	10	10	10
28	ukdhala	0	0	0	0	0	0	10	6	1	2	1	1	0	0	10	10
29	ubrajpur	0	0	0	0	0	0	10	7	2	1	1	1	0	0	0	10
30	undipur	0	0	0	0	0	0	10	7	1	1	1	1	0	0	0	10
31	hak Rasik	0	0	0	0	0	0	10	6	2	1	1	1	0	0	10	10
32	hak Paran	0	0	0	0	0	0	10	6	2	1	1	1	0	0	10	10
33	ydev Kunduli	0	10	10	10	10	10	10	5	1	1	1	1	0	10	10	0
34	ajhidanga	0	0	0	0	0	0	10	5	3	1	1	1	0	0	10	10
35	aranabagram	0	0	0	0	0	0	10	5	3	2	1	1	0	10	10	10
36	hyamSundarpur	0	0	0	10	10	10	10	6	2	1	1	1	0	10	10	10

Continuing Annexure 12

								Total Score from 21 variables			1 Direct Economic Activities from 13 Varaibles			2 Indirect Economic Activities from 8 Varaibles			
	0	17	18	19	20	21	22	from 21 Variables	220		from 12 Variables	120		from 10 Variables	100		
Sr.	**Village/ Town**	Public Distribution System (PDS) Shop	Tractors (Status A(1)/NA(2))	Carts Drivens by Animals	Black Topped (pucca) Road	Power Supply For Agriculture Use	Power Supply For Commercial Use	Total Score from 220	Percentage of Score	Average Score	Total Score from 120	Percentage of Score	Average Score	Total Score from 100	Percentage of Score	Average Score	**Average Weighted Score point (1+2)**
1	Bidbihar	10	10	10	0	0	0	71	32	3	21	18	2	50	50	5	**2.7**
2	Krishnapur	10	10	10	0	10	0	81	37	4	21	18	2	60	60	6	**3.0**
3	Rajhat	0	10	10	0	0	0	61	28	3	21	18	2	40	40	4	**2.4**
4	Dihibeta	0	10	10	0	0	0	71	32	3	21	18	2	50	50	5	**2.7**
5	Kalinagar	0	10	10	10	0	0	70	32	3	20	17	2	50	50	5	**2.7**
6	Phuljhuri	0	10	10	0	0	0	60	27	3	20	17	2	40	40	4	**2.4**
7	Thakuranibazar	10	10	10	0	0	0	81	37	4	21	18	2	60	60	6	**3.0**
8	Gopendanga	0	10	0	0	0	0	51	23	2	21	18	2	30	30	3	**2.1**
9	Kendula	0	0	10	0	0	0	50	23	2	20	17	2	30	30	3	**2.1**
10	Baragaria	0	10	10	10	0	0	60	27	3	20	17	2	40	40	4	**2.4**
11	Jaganathpur	0	10	0	0	0	0	41	19	2	21	18	2	20	20	2	**1.8**
12	Tikarbeta	0	10	10	0	0	0	51	23	2	21	18	2	30	30	3	**2.1**
13	Jamgara	10	10	0	0	0	0	55	25	3	20	17	2	35	35	4	**2.2**
14	Jot Balram	0	10	10	0	10	0	81	37	4	21	18	2	60	60	6	**3.0**
15	Amdahi	10	10	0	0	0	0	61	28	3	21	18	2	40	40	4	**2.4**
16	Bodhgram	10	10	0	0	10	10	75	34	3	31	26	3	44	44	4	**3.1**
17	Dandeshwar	0	10	0	0	0	0	51	23	2	21	18	2	30	30	3	**2.1**
18	Talbahari	0	10	0	0	10	0	52	24	2	22	18	2	30	30	3	**2.2**
19	Ranipur	0	0	0	0	0	0	31	14	1	21	18	2	10	10	1	**1.5**
20	Benodpur	0	0	0	0	0	0	41	19	2	21	18	2	20	20	2	**1.8**
21	Barari	0	0	10	0	0	0	55	25	3	21	18	2	34	34	3	**2.2**
22	Khoj kamalpur	0	10	10	0	0	0	61	28	3	21	18	2	40	40	4	**2.4**
23	Kanchanpur	0	10	10	0	10	0	72	33	3	22	18	2	50	50	5	**2.8**
24	Sasipur	10	10	10	0	0	0	81	37	4	21	18	2	60	60	6	**3.0**
25	Basudebpur	0	10	10	0	0	0	72	33	3	22	18	2	50	50	5	**2.8**
26	Billwamangal B	0	10	10	0	0	0	72	33	3	22	18	2	50	50	5	**2.8**
27	Dakshin Ekdal	0	10	10	0	0	0	72	33	3	22	18	2	50	50	5	**2.8**
28	Sukdhala	0	0	10	0	0	0	51	23	2	21	18	2	30	30	3	**2.1**
29	Dubrajpur	0	10	0	0	0	0	42	19	2	22	18	2	20	20	2	**1.9**
30	Sundipur	0	10	0	0	0	0	41	19	2	21	18	2	20	20	2	**1.8**
31	Chak Rasik	0	10	10	0	0	0	61	28	3	21	18	2	40	40	4	**2.4**
32	Chak Paran	0	10	10	0	0	0	61	28	3	21	18	2	40	40	4	**2.4**
33	Joydev Kunduli	0	10	0	0	0	0	99	45	5	69	58	6	30	30	3	**4.9**
34	Majhidanga	0	10	10	0	0	0	61	28	3	21	18	2	40	40	4	**2.4**
35	Baranabagram	10	10	10	0	0	0	82	37	4	22	18	2	60	60	6	**3.1**
36	ShyamSundarpur	0	10	10	0	0	0	101	46	5	51	43	4	50	50	5	**4.5**

Annexure 13 Family income by profession in type of households

HH Phyical Type	Profession Groups	Income Group (INR) Percentage & Total based on Multiple Responses									Total Multiple Responses	Group Percentage
		Below 12000	12001-24000	24001-36000	36001-48000	48001-60000	60001-100000	100001-250000	250001-500000	500001 Plus		
Hut	Cultivators	0	0	0	1	2	3	0	0	0	6	54.5
	Agri Labour	0	1	0	1	3	2	0	0	0	7	63.6
	Petty Business	0	0	0	0	1	0	0	0	0	1	9.1
	Skilled Workers	0	0	0	0	1	0	0	0	0	1	9.1
	Hut Total	**0**	**1**	**0**	**2**	**6**	**2**	**0**	**0**	**0**	**11**	**100**
Kuchha	Cultivators	0	2	8	9	5	5	6	0	0	35	15.7
	Agri Labour	2	1	70	27	15	23	16	4	0	158	70.9
	Unskilled workers	1	0	2	8	2	1	2	0	0	16	7.2
	Petty Business	0	0	3	1	1	2	0	0	0	7	3.1
	Big Business	0	0	0	0	0	0	2	0	0	2	0.9
	Skilled Workers	0	0	0	1	0	4	1	0	0	6	2.7
	Professionals	0	0	1	0	0	1	0	0	0	2	0.9
	Services (Class III & IV)	0	0	0	0	1	0	0	0	0	1	0.4
	Driver	0	0	0	0	2	0	4	0	0	6	2.7
	Casual Labourer	0	0	1	3	8	5	1	0	0	18	8.1
	Housewife	0	0	0	0	0	1	0	0	0	1	0.4
	Pension	2	0	0	1	0	0	0	0	0	3	1.3
	Kuchha Total	**5**	**3**	**84**	**48**	**32**	**33**	**17**	**1**	**0**	**223**	**100**
Semi Pucca	Cultivators	0	0	5	13	8	11	15	1	1	54	30.7
	Agri Labour	0	1	14	17	20	21	7	0	1	81	46.0
	Unskilled workers	0	0	1	5	8	8	4	0	1	27	15.3
	Petty Business	0	0	1	1	5	8	3	0	1	19	10.8
	Big Business	0	0	0	0	0	0	1	0	0	1	0.6
	Skilled Workers	0	0	0	1	0	2	0	0	0	3	1.7
	Professionals	0	0	5	0	0	0	1	0	0	6	3.4
	Services (Class III & IV)	0	0	0	0	1	1	0	0	0	2	1.1
	Driver	0	0	0	1	1	3	1	0	0	6	3.4
	Craftman & Artisan	0	0	0	0	0	1	0	0	0	1	0.6
	Casual Labourer	0	0	0	0	4	5	1	0	0	10	5.7
	Student	0	0	0	0	0	0	1	0	0	1	0.6
	Pension	0	1	0	0	0	0	0	0	0	1	0.6
	Semi Pucca Total	**0**	**2**	**26**	**35**	**43**	**48**	**19**	**1**	**2**	**176**	**100**
Pucca	Cultivators	1	0	8	8	22	71	92	9	10	221	53.9
	Agri Labour	0	3	23	14	12	43	34	3	1	133	32.4
	Unskilled workers	0	0	1	1	9	20	24	1	2	58	14.1
	Petty Business	0	0	0	0	7	23	34	1	2	67	16.3
	Big Business	0	0	0	0	1	2	5	0	3	11	2.7
	Skilled Workers	0	0	0	1	1	8	9	0	0	19	4.6
	Professionals	0	0	0	0	0	1	7	1	1	10	2.4
	Service (Class 1)	0	0	0	0	1	1	1	1	1	5	1.2
	Service (Class II)	0	0	0	0	0	1	0	0	0	1	0.2
	Services (Class III & IV)	0	0	0	0	0	0	3	2	0	5	1.2
	Driver	0	0	0	1	1	7	7	0	0	16	3.9
	Casual Labourer	0	0	1	2	4	9	4	0	0	20	4.9
	Housewife	0	0	0	0	0	1	1	0	0	2	0.5
	Pension	0	1	0	0	0	0	0	0	0	1	0.2
	Pucca Total	**1**	**3**	**33**	**25**	**55**	**150**	**120**	**9**	**14**	**410**	**100**

Annexure 14: Points allocation Criteria for calculating SE Index

Household facilities	Points
Family type:Nuclear	2
Joint	1
Ownership: Own	5
Tenant	3
Type of HH: Hut	1
Kuchha	2
Semi Pucca	3
Pucca	4
Numbers of Rooms	Actuals
Separate Bathroom: Yes	1
No	0
Type of Bathroom: Open	0
Partially closed	2
Own	4
Type of Toilet: No	0
Shared	2
Own	3
If Shared- Connected to: Soakpit	1
Sptic Tank	2
Modern Flush	3
Toilet with Sewage Line: Yes	1
No	0
Separate Kitchen: Yes	1
No	0
Main Source o Fuel: Cow Dung	1
Agri-Waste	2
Firewood	3
Coal/Charcoal	4
Kerosene	5
Bio-gas	6
LPG	7
Solar Cooker	8
Source of water*: River/Canal	1
Ponds/Tank	2
Wel/Tubewell	3
Handpump	4
Pipe water without overhead tank	5
Pipe water wit overhead tank	6

Households Items	Points
Land in Bhigas	Actuals
Household items:Clock/Watch	1
Radio/Transistor	2
Fan	3
Telephone	3
VCR/VCD player	4
Sewing Machine	5
Bicycle	6
Television	6
Refrigeration	7
Bullock Cart	7
Thresher	7
Water Pump	8
Motor cycle/Scooter	9
Car/Jeep	10
Tractor	10
Live stock: Sheep	2xNo
Goat	3xNo
Buffalo	4xNo
Cow	5xNo
Camel	6xNo
Education & Health Inst.:In Village	4
At a distance 2 Km	3
At distance of 3-5 Km	2
At distance of 5-10 Km	1
At distance of 5-10 Km	0
Total Household Income in (INR)	
Below 12000	1
12001-24000	2
24001-36000	3
36001-48000	4
48001-60000	5
60001-100000	6
100001-250000	7
250001-500000	8
Above 500001	9

Annexure 15 Safety Measures and related laws and regulations in MLA

(I) All types of industries face certain types of hazards which can disrupt normal activities abruptly and lead to disaster like fires, inundation, failure of machinery, explosion to name a few. Similarly, coal mines also have impending which need be investigated addressed, disaster management plan will be formulated with an aim of taking precautionary steps to avert disaster and also to take such action after the disaster which limits the damage

It should also include to the minimum the following points:

a) All the machineries to be deployed with safety equipment like fire extinguishers and regularly proper maintenance should be done.
b) Adequate safety pillars / barrier has been kept on both sides of the faults to keep the workings on either side safe.
c) Adequate (45m) safety barriers have been provided on both sides of the roads and only essential drivage (no depillaring) has been envisaged below the roads and their barriers.
d) No coal is proposed to be mined from under the villages to prevent any subsidence.
e) Standing order for withdrawal of persons in case of apprehended danger shall be framed and implemented.
f) Sufficient fire extinguishers will be installed at selected locations on surface like Electrical Sub-stations, work-shop, Garage, Diesel Depot, Stores etc. Besides, sufficient number of water hydrants with sufficient hose pipes will be made available in the surface for fire protection.
g) Restrict the stacking height of the coal to below 2 meters. Higher height may only be attempted for shorter interval of stacking.
h) In case, internal temperature is found to shoot above safe limits, the coal from the part of stack shall be immediately dug out and disposed safely. Flame proof/ Intrinsically safe equipment will be used underground.
i) Regular stone dusting will be done in underground workings.
j) All places will be well ventilated.
k) Only DGMS approved plant and machinery including lighting arrangements will be used in the underground
l) Regular checks will be carried out for any spontaneous heating.
m) No unauthorized entry as well as no fire causing items will be permitted.
n) In case any fire is detected underground, the fire will be quenched and area will be sealed, if necessary

o) Total 0.750 TPD of explosive will be required. For keeping a buffer stock of 3-4 weeks, 20tecapacity magazine will be required to store explosives, primers, detonators etc. The explosive magazine will be designed in such a manner that normal chances of fire inside the magazine is ruled out.

p) All surface openings to underground work sites will be backfilled and leveled to blend in with the surrounding topography, or will be concrete-capped.

q) All access roads will be condemned and a fence or embankment meeting regulatory standards will be built.

r) subsidence will occur in the area where full pillar extraction is done and allowed the roof to cave in. surface land above the depillared panels will be properly fenced off, all the cracks which are extended to surface will be properly filled by dozing and all other precautions will be taken as stipulated by DGMS.

s) For stability of surface structures beneath which in underground some pillars will be left for protection of the structures.

t) The left-over pillars in underground mine cannot be guaranteed for stability on long term. If any problem arises due to instability of pillars fencing will be built around the problematic area.

u) All the boreholes, exploration holes will be properly capped and sealed to prevent ingress of air into the underground workings to prevent fire due to left out coal and to prevent inadvertent water entering into the workings.

v) Only authorized personnel will be allowed to carry out abandonment and post-project monitoring activities.

w) No loose coal has been left on the ground to prevent accidental fire.

x) All the ~~boreholes~~, subsidence affected area, cuttings in the mining leasehold area shall be properly ~~sealed~~ fenced off so as to prevent access to these.

y) All the electrical/ mechanical equipment such as shaft, Incline, conveyor belt etc./ facilities shall be decommissioned suitably so as to prevent any accident.

z) The drainage pattern of the reclaimed area will be properly planned to divert the surface water flow during monsoon.

aa) Monitoring facilities have been established for monitoring the soil/ air/ water quality, effectiveness of reclamation measures etc. The provisions of Coal Mines Regulations/Rules/Circulars of DGMS would be strictly followed during mine closure operations. Safety training will be imparted to the employees for protection against land slide/ fall, moving equipment, precautions during blasting operations, unpprotection against accidental fire or electric shock etc.

bb) In case of any temporary discontinuance, security guards will be provided to prevent stray animals or persons entering the mine. Temporary fencing with notices will be put up.

(II)The other applicable Law and regulation to avert any accident and ensure safety are:

a) The Water (Prevention and Control of Pollution) Act, 1974. (Amended 1988)
b) The Water (Prevention and Control of Pollution) Rules, 1975.
c) The Water (Prevention and Control of Pollution) Cess Act, 1977. (Amended 1991)
d) The Water (Prevention and Control of Pollution) Cess Rules, 1978.
e) Air (Prevention and Control of Pollution) Act, 1981. (Amended 1987)
f) The Air (Prevention and Control of Pollution) Rules 1982-83.
g) The Environmental (Protection) Rules 1986. (Amended 2002)
h) The Environmental (Protection) Act, 1986.
i) Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2016.
j) Environmental (Protection) Rule Environmental Statement 1992-1993.
k) Environmental (Protection) Rule Environmental Standard 1993.
l) Environmental (Protection) Rule Environmental Clearance 1994
m)Environmental (Protection) Rules Environmental Standard 1996.
n) The Factories Act, 1948.
o) The Motor Vehicle Rules, 1989. Rules 115 (2)
p) Noise Pollution (Regulation & Control) Rules 2000.

Annexure 16a: Analysis of gravity of Demand for items in Area Development of villages in the project area

Sr.	Type of Demand	Employment					Road					Street Light					Mobile Van					Water for Drinking				
	Village Name	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	Baranabagram	1	1	1	1	1						1	1	1	1	1										
2	Chack Paran	1	1	1	1	1						1	1	1	1	1	1	1	1	1	1					
3	Chack Rasik	1	1	1	1	1						1	1	1	1	1										
4	Shukdala	1	1				1	1																		
5	Dakshin Ekdala	1	1	1	1		1	1	1	1		1	1	1	1		1	1	1	1						
6	Billwamangal B	1	1	1	1							1	1	1	1		1	1	1	1		1	1	1	1	
7	Tikarbeta											1	1	1			1	1	1							
8	Joydev Kanduli	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					
9	Kendula						1	1	1	1		1	1	1	1											
10	Barari	1	1	1								1	1	1												
11	Khoj Kamalpur	1	1	1	1	1						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	Bodhgram	1	1	1	1		1	1	1	1							1	1	1	1		1	1	1	1	
13	Shyamsundarpur	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					
14	Jot Balaram	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
15	Jamgara	1	1	1	1	1	1	1	1	1	1						1	1	1	1	1					
16	Amdahi						1	1	1	1		1	1	1	1											
17	Jagannathpur	1	1	1		1	1	1	1		1	1	1	1		1	1	1	1		1					
18	Baragaria	1	1	1	1							1	1	1	1											
19	Gopendanga	1	1	1	1							1	1	1	1		1	1	1	1						
20	Kanchanpur	1	1	1	1							1	1	1	1							1	1	1	1	
21	Talbahari	1	1	1	1	1						1	1	1	1	1						1	1	1	1	1
22	Sundipur	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
23	Basudebpur	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					
24	Benodpur	1	1									1	1				1	1								
25	Rajhat	1	1	1	1							1	1	1	1		1	1	1	1						
26	Sasipur	1	1	1			1	1	1													1	1	1		
27	Dubrajpur	1	1	1													1	1	1							
28	Majhidanga	1	1	1			1	1	1			1	1	1												
29	Dandeshwar	1	1	1	1																	1	1	1	1	
30	Bidbihar	1	1	1	1		1	1	1	1							1	1	1	1						
31	Ranipur																					1	1	1	1	
32	Thakurnibazar	1	1	1	1		1	1	1	1							1	1	1	1						
33	Phuljhuri	1	1	1	1							1	1	1	1		1	1	1	1						
34	Dihibeta	1																								
35	Krishnapur	1			1																					
36	Kalinagar											1	1	1			1	1	1			1	1	1		
	Total	31	29	27	23	12	16	16	15	12	7	25	25	24	19	11	19	19	18	14	7	9	9	9	7	2
	Percentage	86	81	75	64	33	44	44	42	33	19	69	69	67	53	31	53	53	50	39	19	25	25	25	19	6

Sr.	Type of Demand	Community Hall					Drainage					Water for Agriculture					Schools					Dust bin		Pond Rennovation					Garden Developmen				Village Cemetry			
	Village Name	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	4	1	2	3	4	5	1	2	3	4	1	2	3	4
1	Baranabagram	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																				
2	Chack Paran	1	1	1	1	1	1	1	1	1	1																									
3	Chack Rasik	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																				
4	Shukdala																																			
5	Dakshin Ekdala																																			
6	Billwamangal B																																			
7	Tikarbeta	1	1	1																																
8	Joydev Kanduli	1	1	1	1	1																														
9	Kendula						1	1	1	1														1	1	1	1								
10	Barari	1	1	1																																
11	Khoj Kamalpur																1	1	1	1	1															
12	Bodhgram																																			
13	Shyamsundarpur											1	1	1	1	1																				
14	Jot Balaram	1	1	1	1	1	1	1	1	1	1																									
15	Jamgara						1	1	1	1	1						1	1	1	1	1															
16	Amdahi	1	1	1	1																														1	1	1	1
17	Jagannathpur	1	1	1		1																		1	1	1		1								
18	Baragaria	1	1	1	1																								1	1	1	1				
19	Gopendanga	1	1	1	1																															
20	Kanchanpur	1	1	1	1																															
21	Talbahari	1	1	1	1	1																														
22	Sundipur						1	1	1	1	1	1	1	1	1	1																				
23	Basudebpur	1	1	1	1	1																														
24	Benodpur	1	1									1	1																							
25	Rajhat																1	1	1	1																
26	Sasipur																																			
27	Dubrajpur											1	1	1																						
28	Majhidanga																																			
29	Dandeshwar						1	1	1	1							1	1	1	1																
30	Bidbihar						1	1	1	1																										
31	Ranipur																																			
32	Thakurnibazar						1	1	1	1																										
33	Phuljhuri	1	1	1	1																															
34	Dihibeta																																			
35	Krishnapur																					1	1													
36	Kalinagar																																			
	Total	16	16	15	12	8	10	10	10	10	6	6	6	5	4	4	4	4	4	4	2	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1
	Percentage	44	44	42	33	22	28	28	28	28	17	17	17	14	11	11	11	11	11	11	6	3	3	6	6	6	3	3	3	3	3	3	3	3	3	3

Gravity of demand: Vital | Essentail | Desirable | Additional | Surplus

Annexure 16b Analysis of Demand in HH (N-782) of sample villages in project area

Sr.	Name of the Villages	Employ ment	Road	Technical Training	Street Light	Health Mobile Van	Drinking Water	Comm unity Hall	Drain age	Water supply for Agri-cultural	School
1	Baranabagram	3	2	2	2	1	0	0	0	0	1
2	Chack Paran	1	1	0	0	1	0	0	1	1	1
3	Chack Rasik	2	0	0	0	3	2	0	0	0	0
4	Shukdala	1	2	2	0	1	0	0	0	0	0
5	Dakshin Ekdala	1	1	0	0	0	0	0	0	1	2
6	Billwamangal B	3	2	0	1	1	0	0	0	0	0
7	Tikarbeta	7	9	7	4	6	2	0	4	4	2
8	Joydev Kanduli	12	3	2	0	3	2	2	1	1	3
9	Kendula	2	2	1	2	1	2	0	1	2	1
10	Barari	3	3	4	4	2	4	2	2	4	1
11	Khoj Kamalpur	2	2	1	1	1	3	1	1	1	0
12	Bodhgram	6	2	3	2	3	2	0	0	0	0
13	Shyamsundarpur	12	10	8	8	6	7	1	5	7	4
14	Jot Balaram	4	3	7	6	5	5	1	3	4	3
15	Jamgara	13	4	3	2	5	2	0	1	4	1
16	Amdahi	5	3	6	5	5	3	1	4	3	3
17	Jagannathpur	5	5	4	4	3	2	0	2	0	2
18	Baragaria	4	3	1	2	1	1	1	0	2	1
19	Gopendanga	1	2	1	2	2	0	1	0	1	0
20	Kanchanpur	4	1	0	1	2	1	0	1	0	0
21	Talbahari	3	1	0	1	1	1	0	0	2	0
22	Sundipur	3	5	4	2	1	0	0	0	0	0
23	Basudebpur	6	8	8	7	4	4	2	3	6	3
24	Benodpur	5	5	7	5	3	3	1	1	3	3
25	Rajhat	3	6	4	0	8	1	0	4	3	2
26	Sasipur	7	6	6	7	4	2	1	2	5	3
27	Dubrajpur	2	2	0	0	1	0	0	0	0	0
28	Majhidanga	1	1	2	0	1	0	0	0	0	0
29	Dandeshwar	7	3	7	4	6	2	1	2	3	0
30	Bidbihar	5	3	0	0	0	0	0	2	0	2
31	Ranipur	2	0	1	0	1	1	0	1	0	0
32	Thakurnibazar	2	2	1	0	4	1	0	2	1	1
33	Phuljhuri	3	4	1	0	5	1	0	3	2	3
34	Dihibeta	4	2	2	0	2	2	0	1	0	3
35	Krishnapur	2	1	0	0	1	0	0	2	0	1
36	Kalinagar	3	3	2	0	4	2	0	3	2	1
	Total (N=782)	**152**	**116**	**100**	**72**	**107**	**58**	**15**	**52**	**62**	**47**
	Percentage	**19.5**	**14.9**	**12.8**	**9.2**	**13.7**	**7.4**	**1.9**	**6.7**	**7.9**	**6.0**

Annexure 16c item wise demand description among 36 Sample Villages

Sr.	Village	Item 1	Item 2	Item 3	Item 4	Item 5
1	Bidbihar	Employment	Road	Drainage	HMobile Van	-
2	Krishnapur	Employment	-	-	Dustbin	-
3	Rajhat	Emploment	Road	street Ligh	HMobile Van	-
4	Dihibeta	Employment	-	-	-	-
5	Kalinagar	Water	street light	HMobile Van	-	-
6	Phuljhuri	Employment	street light	HMobile Van	Comm_hall	-
7	Thakuranibazar	Employment	Road	Drainage	HMobile Van	-
8	Gopendanga	Employment	street light	HMobile Van	Comm_hall	-
9	Kendula	Road	Street light	Drainage	Pond_Renn	-
10	Baragaria	Employment	Street light	Comm_hall	Garden	-
11	Jaganathpur	Employment	Road	street light	HMobile Van	Pond_Renn
12	Tikarbeta	Street light	Hmobile Van	Comm_hall	-	-
13	Jamgara	Employment	Road	Drainage	HMobile Van	H School
14	Jot Balram	Employment	Road	street Light	Drainage	Comm_hall
15	Amdahi	Street light	Road	Comm_hall	Samshan	-
16	Bodhgram	Employment	Drinking Water	Road	HMobile Van	-
17	Dandeshwar	Employment	Drinking Water	Drainage	P School	-
18	Talbahari	Employment	street light	Drinking	Comm_hall	-
19	Ranipur	Drinking	Solar light	-	-	-
20	Benodpur	Employment	street light	HMobile Van	Comm_hall	WSA
21	Barari	Employment	Street light	Comm_hall	-	-
22	Khoj kamalpur	Employment	Drinking Water	Street light	HMobile Van	P School
23	Kanchanpur	Employment	street light	Drinking	Comm_hall	
24	Sasipur	Employment	Road	Drinking	-	-
25	Basudebpur	Employment	Road	street light	HMobile Van	Comm_hall
26	Billwamangal B	Employment	Drinking Water	Street light	HMobile Van	-
27	Dakshin Ekdal	Employment	Road	Street light	HMobile Van	-
28	Sukdhala	Employment	Road	-	-	-
29	Dubrajpur	Employment	Hmobile Van	WSA	-	-
30	Sundipur	Employment	Road	Drainage	street light	WSA
31	Chak Rasik	Employment	Drainage	street light	WSA	Comm_hall
32	Chak Paran	Employment	HMobile Van	Drainage	street light	Comm_hall
33	Joydev Kunduli	Employment	Road	street light	HMobile Van	Comm_hall
34	Majhidanga	Employment	Road	street light	-	-
35	Baranabagram	Employment	Drainage	street light	WSA	Comm_hall
36	ShyamSundarpur	Employment	Road	street light	HMobile Van	WSA

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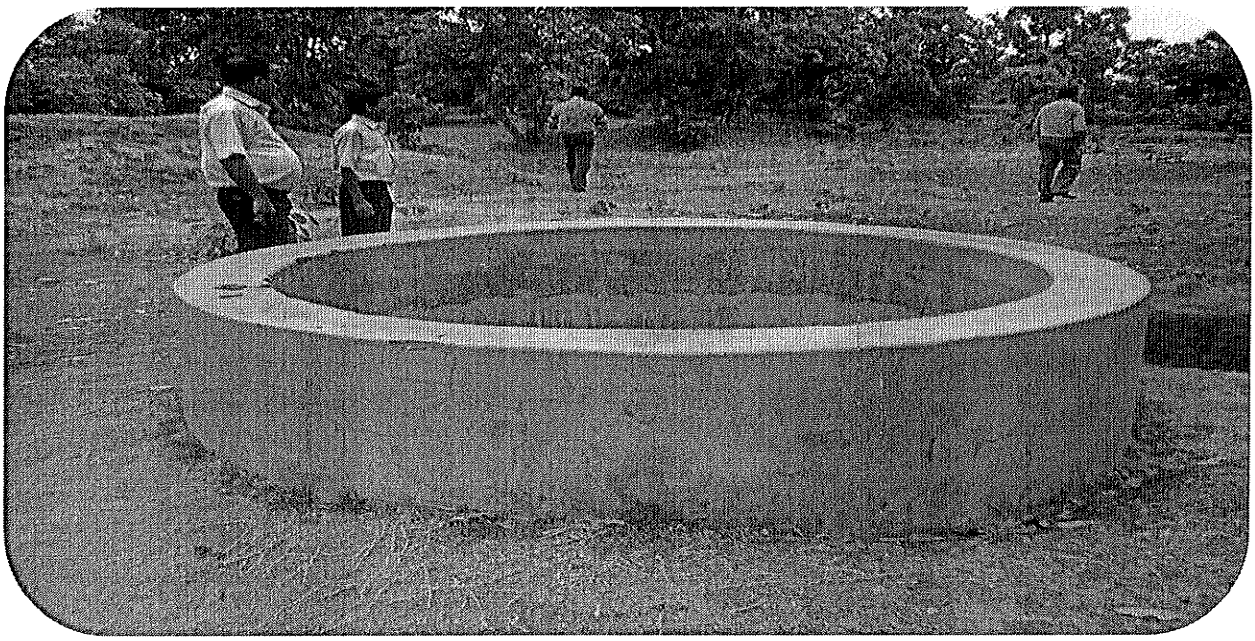
WEST BENGAL MINERAL DEVELOPMENT & TRADING CORPORATION LIMITED

REPORT ON

HYDRO-GEOLOGICAL STUDIES IN PROPOSED JAGANATHPUR "B" COAL BLOCK.



Prepared by:

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HYDROLOGICAL STUDY OF THE AREA

Water Resource of the Study Area

Information on water resources in the study area was collected. The water resources in the study area are mainly the Ajaoy River and its tributaries streams and groundwater. The main drainage of the area is controlled by the Ajaoy river which flows about 5 kms. north of the coalfield. There is no drainage within the block with seasonal surface flow and is a regular source of drinking water for this area. Apart from surface water, ground water potential is also very good. The parameter of prime importance for water quality study were selected under physical, chemical inorganic, chemical organic, nutrient and heavy metal groups as per prescribed limits and standards.

Hydrogeology of the Study Area

Owing to the rolling nature of topography and broad water divides, it is likely that the alluvial tracts are the zones of water seepage and percolation, while the elevated areas would help to constitute major run-off. Any realistic assessment of ground water condition would have to establish the basement configuration vis-à-vis deep alluvial valley tract presently occupied by the Ajaoy River which flows to the north maintaining a distance of about 5 km. from the north of Jagnnathpur block A. The GSI in course of their sub-surface investigation around the year 1956-58 reported artesian water gushing out of the boreholes. These outflow might have continued for a short spell of time only, since none of the boreholes drilled during detailed exploration encountered artesian water condition. In general, the static water level is shallow.

Ground Water Availability in West Bengal

At present the ground water being exploited mainly through open dug wells. The wells are 10-15 m deep below ground in fissured formations, so as to yield less than 5 m^3/h. The yield from bore wells in fissured formations varies from 2 to 36 m^3/h. The yield of tube wells constructed in sandstone up to 200 m depth varies from less than 50 to 150 m^3/h. The yield is low in the Raniganj and Barakar sandstones of Asansol-Raniganj area of Burdwan district of West Bengal. The alluvial deposits occurring in lower River Basin of West Bengal vary is thickness from 50 to more than 300m. The yields prospect of tube wells constructed to depths of 60 to 150 m below ground level ranges from 100-180 m3/h. In the eastern, central and southern parts of the command area (Burdwan-Memari-Kalna-Jamalpur sector of Burdwan and Chanditala and Amta blocks of Howrah district) profilic ground water resources are available in aquifers of 50-80 m thickness. Tube wells constructed up to depth of 120-150 m yield

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about 200 m3/h of water. Large scale ground water withdrawal through deep tube wells (heavy as well as low duty) have gained momentum in the lower most reaches of the Damodar basin. Ground water availability in West Bengal is presented below:

Table 1: Ground Water Resources in West Bengal

District	Utilizable G.W resources for Irrigation (MCM/yr)	Nat Annual ground water draft (MCM/yr)	Ground water balance (MCM/yr)	Status of ground water development (%)
Bankura	108.04	42.48	65.56	39.32
Burdwan	2269.45	444.52	1824.93	19.59
Hoogly	907.61	224.15	683.46	23.20
Howrah	142.37	26.77	115.60	18.80
Purulia	134.18	15.87	118.37	11.83

Hydrogeology of the Area

Introduction

Hydro-geological regime of a geometric region is mostly controlled by three major aspects, namely (i) Topography, (ii) Geology and (iii) Climate, besides the ground water and associated phenomena which are

- Mode of occurrence and movement of water,
- The direction and velocity of water flow,
- The rate and magnitude of fluid potential fluctuation,
- The quantity of water present in the formations i.e. conduit and storage Functions of aquifers,
- The recharge-discharge process,
- The infiltration phenomena,
- The relation/interaction of surface and ground water,
- The type and change of chemical quality of waters in space and time, etc.

Ground water conditions/regime: -

Water levels observed in dug wells in the area indicate that the ground water depth varies during summer between 4.0 m. to 6.0 m. and 2.5 to 4.0 m during monsoon. Fluid potential fluctuation between the two extreme climates is around 2.5 m.

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Recharge to the aquifer is mostly through precipitation, which is around 1380 mm per annum and is around 20 % of the annual rainfall due to loose strata. Detail of rainfall data as recorded during 33 months commencing from January 1986, are as follows:

a) Average number of total rainy days in a year 70

b) Maximum rainfall recorded on a single day 170.00 mm

c) Average rainfall in a year 1380.00 mm

d) Average rainfall on a rainy day during monsoon 53.00 mm

Ground water in entire region is potable with pH ranging between 7 to 7.5 and total dissolved solids (TDS) between 240 to 300 mg/liter.

Assessment of Capacity

The following assumptions have been made to arrive at the pumping requirement of the mine. Maximum rainfall in a single day during monsoon is 170 mm. Catchments area is considered as the maximum open recharge area. Seepage through, 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 hrs pumping per day.25 % reserve pumping capacity is kept as standby.

Water Table Behavior in the Area

The common sources water use for domestic and irrigation in the core and buffer 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.

Water levels in pre and post monsoon were observed in dug wells in the area indicate that the ground water depth varies during summer between 5.0 m. to 6.0 m. Average depth of water level rises up to 2.5 to 4.0 m in monsoon when it is minimum. These details, were collected from 50 wells.

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Ground Water Potential of the Study Area

The major source of the water in the region is south-west monsoon during summer and very small contribution from the north-east during the winter season. In the study area ground water is withdrawn usually by means of open dug wells and small diameter hand operated tube wells. The tube wells are most often deeper (20m - 40m) than the dug wells and tap the fractures below the weathered mantle. As the area is being located in the hot-tropical belt, the temperature regime is very high, the daily maximum ranging from 30.0^{0}C to over 40.0^{0}C. Due to excessive heat, the loss of moisture through evaporation is considerably high. During the wet monsoon seasons, the net evaporation is less than the precipitation, resulting in a surplus water which is lost either through surface runoff or being part of the subsurface storage. The surface runoff and subsurface storage of water depends upon various factors including the amount of rainfall, topography of the area, land use pattern, soil type, slope, physiographic, drainage pattern and hydrogeomorphology of the catchment/sub-catchment. The present study area is undulating with small hillocks and vegetative cover. Water collected on the hill slopes and valley areas either gets collected in low lying area and is thus ultimately absorbed in the top soil cover and become part of the ground water flow according the slope to form seasonal streams/nallas.

Average rainfall of the area is 1380 mm, out of which 36% is lost as the surface runoff, 44% is lost through evapotranspiration and only 20% is enter into the subsoil and recharge the aquifer.

(i) Computation of Total Annual replenishable Recharge (TARR)

(a) By Ground Water Table Fluctuation Method

The average water fluctuation in study area is 2.50 m.

Specific Yield = P*Rg/Hw*(P-Rs)

Where P is the annual Rainfall, Rg is the annual groundwater runoff, Rs is the annual surface runoff and Hw is the water table fluctuation

= 1380*351.2/2500*(1380-632)

= 0.0145

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TARR (million m^3/year = **Sub-watershed Area*** average water table fluctuation * Specific Yield

= **6630000m^2***2.50*0.0145

= 24033000 m^3.year

= 24.033 million /m^3

(b) By rainfall infiltration factor method (RIF)

= Area* average rainfall*infiltration

= 6630000 m^2*1.380m*0.20

= 18.29 million/m^3/

(c) Average TARR = 21.16 million / m^3

(ii) Annual draft excluding estimated draft through mine discharge:

The major source of the water in the region is small ponds and ground water. Ground water is withdrawal usually by means of open dug wells and small diameter hand operated tube wells. There is no irrigation facility by well 9Because of canal network) in the area only so the domestic withdrawal is the major water draft and water withdrawal from other sources is negligible. The total population in the sub-watershed area of 66.3 km^2 is around 9248, and the domestic withdrawal of water has been computed by considering 65 L per dey per head of water consumption. The total annual domestic water withdrawal for the wub-watershed becomes.

Population *consumption *days

= (9248*65*365)/1000m^3

= 0.219 million / m^3

(iii) Estimated draft through mine Discharge:

The total daily discharge from the mines will be around **4800 m^3/day**

Total annual draft through mine discharge = 4800 X 365 = 1.75 million / m^3

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(iv) Net ground water availability

= Average TARR –Domestic draft

= 21.16– 0.219 million m^3/ year

= 20.941 million m^3/year

(v) Stage of ground water developemtn (in %)

= 8.2 %

Summary of the Water Potential Estimation

a) Range of water table (m bgl)	
Pre-Monsoon	
• Buffer Zone	4.7
Post-Monsoon	
• Buffer Zone	3.2
b) Total annual replenishable recharge (million m^3/year)	
• By ground water table fluctuation method (million m^3/year)	24.03
• By rainfall infiltration factor method (million m^3/year)	18.29
• Average TARR (million m^3/year)	21.16
c) Annual draft excluding estimated draft through mine discharge (million m^3/year)	0.219
d) Estimated draft through mine discharge (million m^3/year)	1.75
e) Net annual ground water availability (million m^3/year)	20.94
f) Stage of ground water development in %	**8.2**

(vi) Radius of Influence (RO)

$Q = K*(h_o^2-hw^2)/ \ln (r_o/r_w)$

Where Q is discharge in m^3 / day, K is the hydraulic conductivity (m/day), ho is the thickness of the aquifer, h_w is pumping depth and r_w is the radius of the discharging well.

Q = 4800 m^3/day, h_w = 25.

The obtained ho is 35m and the average K is 2 m/day, r_w = 15m.

$R_o = r_w \exp \{K/Q*(h_o2-h_w^2)\}$

R_o = 510 M

Radius if influence = 510 m.

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Hydraulic Characteristics

Aquifer Parameters

To determine the aquifer characteristic within the area, total 7 pumping tests were conducted. Aquifer parameters like specific capacity 'C', coefficient of transmissibility 'T', coefficient of permeability 'K' and specific yield 'S' has been computed using field data in conjunction with certain logical assumptions. An attempt has also been made to compute safe distance between two wells and aquifer discharge. The basic data of pumping tests along with the computed values of various parameters are given in **Table 2.** It may also be mentioned here that some wells could sustain longer pumping duration and the recuperation data was taken as the basis of computation of aquifer parameters.

Details of pump tests at two sites within the lease area are listed in **Table 3..** From the results following conclusions have been derived:

a) The tube well data reveal that the area is having higher draw down with low yield
b) The transmissibility and field permeability are very low.

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Table 2: Details of pump test and computed values of aquifer parameters

s.n.	Village	Aquifer	TD in m	SWL in m	Saturated thickness H in m	Area of Well (A) sq.m.	DD in m	Discharge in m^3/min	Pumping time in min t	Specific capacity m^3/min/ mC	Transmissibility (m^2/day)T	Permeability (m/day) K	Safe distance between two wells (m) 2R from FD	Specific yield S
1	Srikrisnapur	Alluvium	11.15	7.17	3.98	6.15	2.24	0.126	180	0.0564	62.12	15.6	38	0.047
2	Binodpur		9.16	5.6	3.56	1.77	2.26	0.076	150	0.0335	75.69	21.08	38	0.047
3	Sibpur		21	14.9	6.1	6.15	3.36	0.111	160	0.033	184.21	30.19	36	0.124
4	Rajhat		6.6	2.73	3.87	8.04	2.56	0.248	180	0.0968	161.35	26.89	42	0.117
5	shyampur		8.48	1.8	6.68	6.15	4	0.101	60	0.0252	176.02	26.35	38	0.044
6	Jaganatpur		8	0.7	7.3	6.15	2.9	0.068	40	0.0234	237.63	32.55	36	0.04
7	Jamgara		7	2.21	4.79	6.15	3.29	0.027	60	0.0082	139.27	29.8	38	0.035
							Average value	**0.108**		**0.0395**	**148.04**	**26.07**	**38**	**0.065**

H : *Thickness of saturated aquifer (m)*
SWL : *Static water level (m)*
TD : *Total depth (m)*
A : *Area of wells (m2)*
DD : *Drawdown (m)*
C : *Sp. Capacity (m^3/min/m)*
Q : *Discharge (C*DD)*

T : *Transmissibility (m^2/day)*
K : *Permeability (m/day)*
2R : *Safe distance between two wells (m)*
FD : *Safe distance computed from field data*
t : *Pumping duration (min)*
R : *Radius of influence of pumping (m)*
S : *Specific yield (Fraction)*

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Table 3: Details of pump test and computed values of aquifer parameters

s.n.	Location	Aquifer	Dia (mm)	T.D. in m	S.W.L. in m	Area of Well (A) sq.m.	DD in m	Discharge in m^3/min Q	Pumping time in min t	Specific capacity m^3/min/ m	Transmissibility (m^2/day)T	Permeability (m/day) K	Radius of Influence (m)	Specific yield S
1	Ukhra	Alluvium	200	96	6.65	0.628	43.72	0.79	300	0.0255	45.34	1.47	57	0.0573
2	Srikrishnapur	Alluvium	270	152.74	10	0.847	17.1	1.31	300	0.0459	61.77	1.08	33	0.0985

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Specific Capacity 'C'

The specific capacity of the unconfined aquifer is an indication of its water yielding property. The specific capacity and the same have been computed by applying Slitcher's equation.

C = 2.303 A/t log (S1/S2)

C = Specific Capacity (m^3/min/m) A = Area of well

t = Time since pumping stopped (min) S1 = Maximum draw down (m)

S2 = Residual draw down (m)

Value of (S1/S2) corresponding to time is obtained from (S1/S2) vs. time plot. The specific capacity value is observed from 0.082 m^2/min/m to 0.234 m^2/min/m. Average value of specific capacity is 0.0696 m^2/min/m.

Coefficient of Transmissibility 'T'

The team 'Transmissibility is defined as the rate of water flow through a vertical section of an aquifer whose height is the thickness of the aquifer and whose width is one foot. When the hydraulic is 1.00. Transmissibility represents the water transmitting capacity of a unit width of the entire thickness of the aquifers.

The coefficient of transmissibility and storage are especially important because they defined the hydraulic characteristics of water bearing formation. The coefficient of transmissibility indicate how much water will move through the formation and the coefficient of storage indicate how much can be removed by pumping or draining.

Coefficient of transmissibility 'T' is computed by Thesis equation.

$T = 2.303Q/4\Pi\triangle S$

T = Coefficient of transmissibility (m^2/day) Q = Discharge (m^3/day)

$\triangle S$ = Residual draw down over one log cycle

The transmissibility value ranges from 62.12 m2/day to 237.63 m2/day in which indicate poor performance of alluvium aquifer due to predominant clay. Average value of transmissibility is 148.04.

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Field Permeability 'K'

Permeability is defined as the capacity of a porous medium for transmitting water. Movement of water from one point to another point in the material takes place whenever a difference in pressure or head occurs between two points. Permeability depends upon grain size of sand of aquifer and hydraulic gradient. It is computed by using the following equation.

$K = T/H$

K = Coefficient of permeability (m/day)
T = Coefficient of Transmissibility (m^2/day)
H = Saturated zone thickness of aquifer (m)

The computed values of permeability for alluvial aquifer are ranging from 15.60 m/day to 32.55 m/day. Average value of permeability is 26.07 m/day.

Specific Yield 'S'

Specific Yield is defined as the volume of water released from storage per unit surface by gravity. The part of the water that is not removed by gravity drainage is held against the force of gravity by molecular attraction and capacity action. The quantity that a unit volume retains when subjects to gravity drainage is called its specific retention. Both yield and specific retention are expressed as decimal fraction or percentage. Specific yield plus specific retention equals to porosity.

Specific Yield 'S' of the aquifer has been computed by 'Ramsey' formula applying following equation.

$S = 4Tt/R^2$

S = Specific Yield
T = Co-efficient of Transmissibility (m2/day)
t = Pumping duration (min)
R = Safe distance constant 25.68

The specific yield for alluvial aquifers is 3.5% to 12.40%. average value of specific yield is 6.49%.

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Safe Distance

When water is pumped from a well the quantity discharged initially is derived from aquifer storage immediately surrounding the well. As pumping continues more water must be derived from storage at greater and greater distance from the well. This means that the circular shaped cone of depression must expand so that water can move from greater distance towards well.

For individual pumping test data, safe distance between two wells is compared by using Theim's formula.

$$2R = 2 * \sqrt{\frac{2.25\ K\ H\ t\ /\ S}{\text{Log}^{-1}\ 2\ \Pi\ Ks(2H-s)/Q}}$$

2R = Sate distance (m)
H = Saturated thickness in m
S = Specific Yield (fraction)
Q = Discharge in Cubic m/hrs
K = Permeability 9m/hrs)
t = Time of pumping in hrs
s = Draw down at cone boundary in m(Assume to be 0.01 m)

The safe distance between two wells in alluvial aquifer is worked out to be 36 to 42m. The aquifer are not homogeneous hence their parameters are also not having any type of consistency.

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INTERIM HYDROGEOLOGICAL REPORT FOR EIA/EMP

FOR

Jaganathpur Coal Mine

PROJECT PROPONENT

Powerplus Traders Private limited

PREPARED BY

Nawal Kishor Prasad

Accredited Groundwater Professional CGWA

On the behalf of

SRUSHTI SEVA PRIVATE LIMITED

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FEBRUARY 2022

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1.0 INTRODUCTION

Jaganathpur-B Coal Mine is located in the Paschim Bardhaman District of West Bengal **(Figure-1.1**). M/s. Power Plus Traders Pvt. Ltd. (PPTPL) has entrusted to carry out Hydrogeological investigation to M/s Srushti Seva Pvt. Ltd., Nagpur vide Work Order No. PPTPL/SSPL/0001/21-22, dated 16-06-2021.

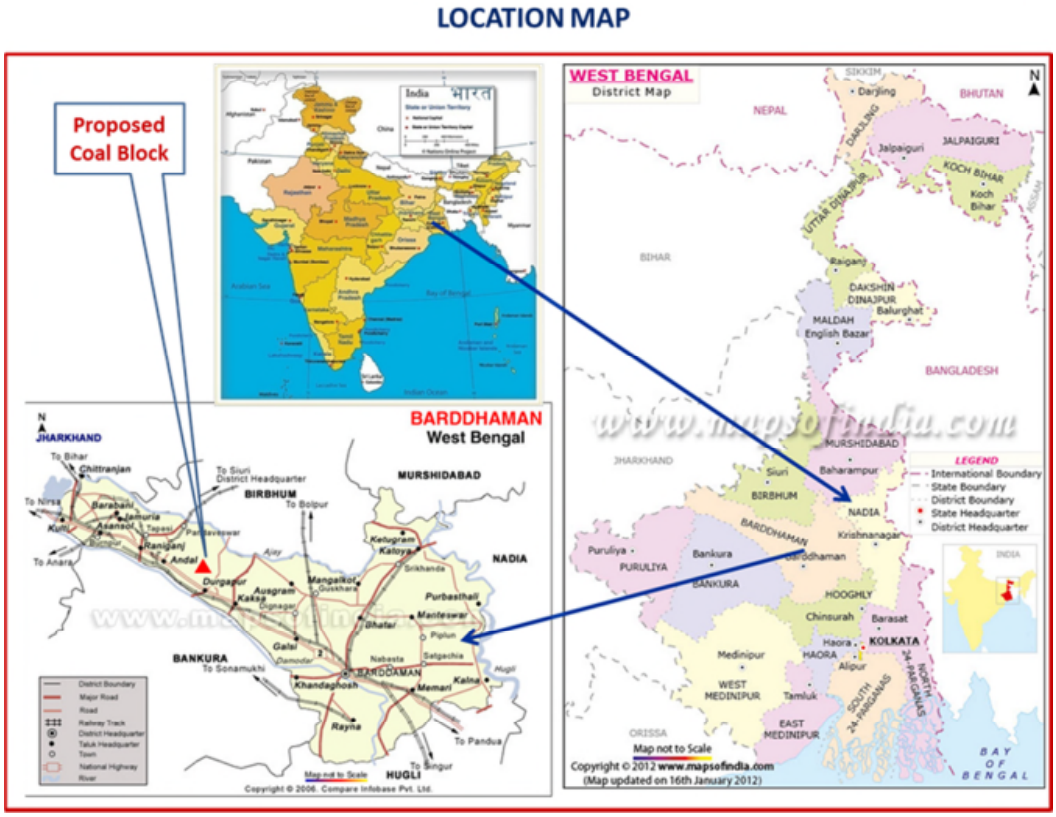


Figure 1.1: Location Map

1.1 LOCATION

The Jaganathpur-B Coal Mine is located in the eastern part of the Raniganj Coalfield and covers an area of 8.70 sq.km. It is defined by the latitudes 23^{o} 38' 34.2" - 23^{o} 40' 53.63", and longitudes 87^{o} 22' 03.62" - 87^{o} 34' 55.92" and is included in the Toposheet No. 73 M/6 of Survey of India. Location on Toposheet **(figure 1.2).**

The area can be approached by road and is well connected through metal road with Durgapur city which is only 20 km away. The 10 km buffer zone id marked on toposheet and placed at Plate II.

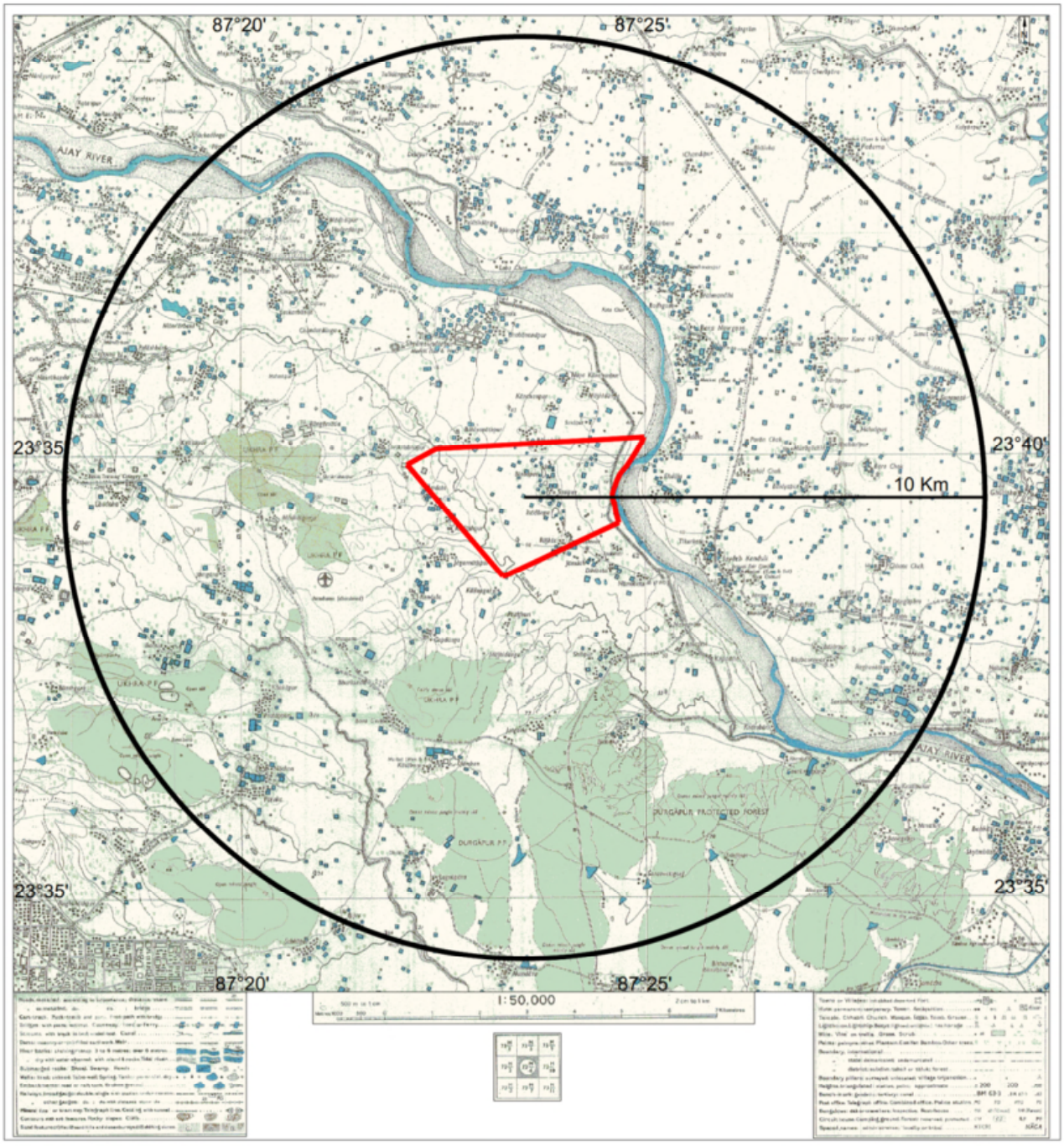


Figure 1.2- Location on toposheet

1.2 TOPOGRAPHY

The mine area exhibits a gentle undulating topography with surface elevation from maximum 66 m above msl in north-west part to minimum <56 m above msl in south and eastern part. The surface elevation of pumping well & observation well will be in range of 60-61 m amsl. The topography of 10 km buffer zone is also examined. In this process the Digital Elevation Model (DEM) of 10 km buffer zone is prepared by using arc GIS tool and placed in **figure 1.3.** In buffer zone the maximum elevation is reported 117 m amsl in the north western and western most part whereas minimum elevation is 33 m amsl in the south eastern side of buffer zone.

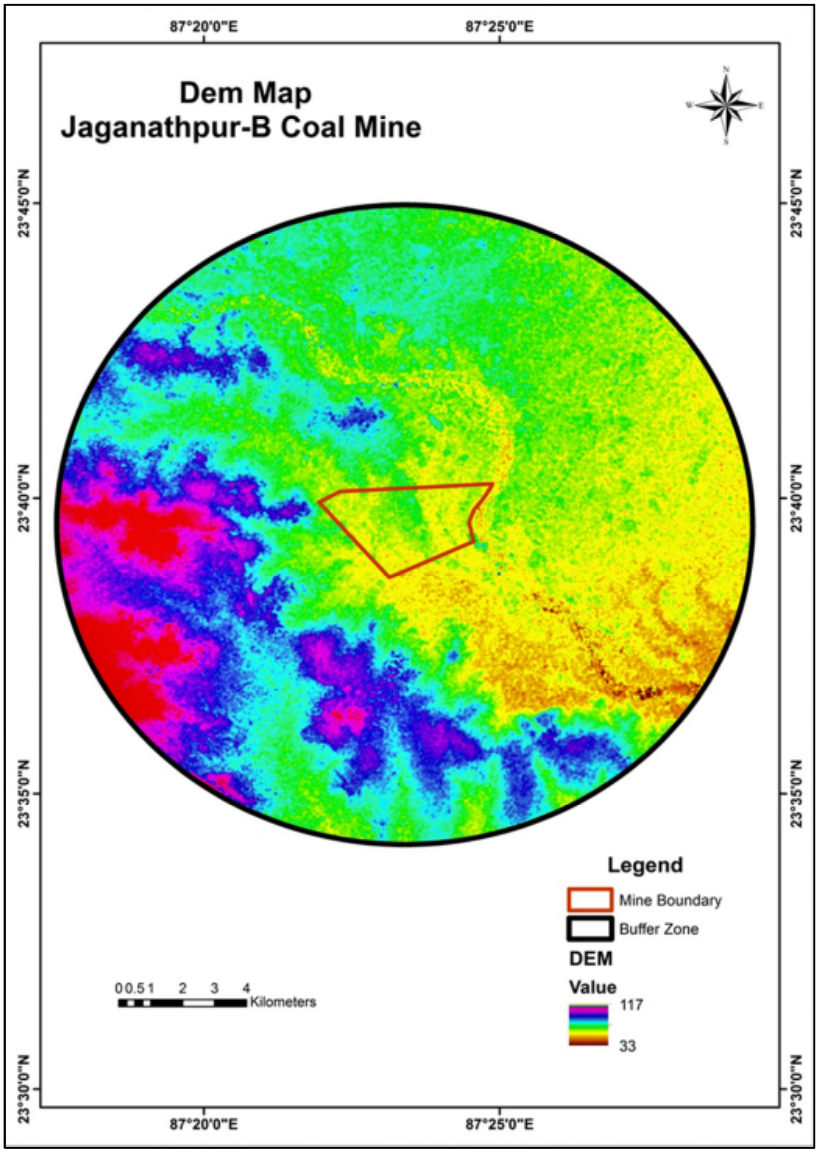


Figure 1.3 Digital Elevation Model (DEM Map)

1.3 DRAINAGE

The major part of the block is covered by alluvium. The land is mainly occupied as cultivation land, Ponds and Scattered Villages. The mine area is drained by Tumunl Nala The area west of Ajay River is a part of Tumuni watershed and whereas area east of Ajay River is part of Hingla and Sal sub watershed. Ajay River which ultimately contributes to lower Ganga basin. The western part of the buffer zone comes under Damodar watershed

1.4 PREVIOUS WORK AND OBSERVATION

Hydrogeological study and pumping tests have been carried out by CIMFR but the aquifer parameters are not recorded in the Project Report at a Glance of Jaganathpur-B Coal Mine. The GSI during 1956-58 periods carried out sub-surface investigation and reported artesian condition whereby groundwater is gushing out of the borehole. These outflow have continued for short spell of time only. Thereafter none of the boreholes drilled under detailed exploration have encountered artesian flow. However, in general shallow water level is reported.

2.0 HYDROMETEOROLOGY

2.1 RAINFALL

2.1.1 Normal rainfall in the study area: The annual normal rainfall has been considered for Durgapur IMD station. As per IMD record the month wise average normal rainfall based on recent 50 years is given in **Table-2.1** and depicted in **Figure-2.1**

Table-2.1

Normal rainfall in Durgapur station

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
14.4	17.5	12.7	27.5	54.5	259.9	290.2	292.6	246.3	121.4	1.9	0.3	1339.2

(Source- Climate of West Bengal IMD)

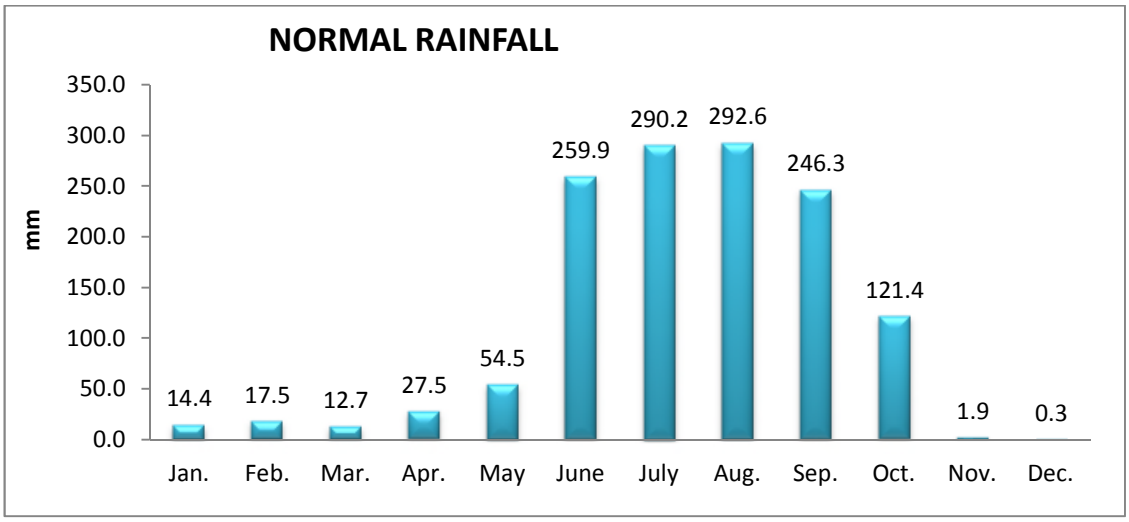


Figure-2.1 Normal rainfall

2.1.2 Extreme Rainfall*:* Extreme rainfall occurring in the area has been worked out by analyzing daily rainfall data of Durgapur station of the study area. Analysis has been published by IMD and the subsequent available data were also analyzed and the extreme rainfall occurring in the study area is tabulated in **Table-2.2.**

Table -2.2
Annual extreme rainfall & heaviest rainfall in 24 hours

Station (Catchment)	Heaviest rainfall in 24 hours	
	Amount mm	Date
Durgapur	387.7	27.09.1978

2.2 WIND SPEED:

Winds are generally light with some increase in wind force during the latter part of summer season and in the south west monsoon season.

Study reveals that maximum wind speed observed is 13.5 km/h in the month of May. The minimum wind speed recorded is 6.0 in the month of November, Wind speed generally increases from February to May and declines from June to November. Wind speed data has been collected and placed at **Table-2.3 & Figure-2.2**

Table-2.3
Normal wind speed (km/hr.)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Avg.
3.1	3.7	5.8	7.3	10.1	9.0	8.7	7.5	6.8	4.8	3.5	2.9	6.1

(Source-IMD)

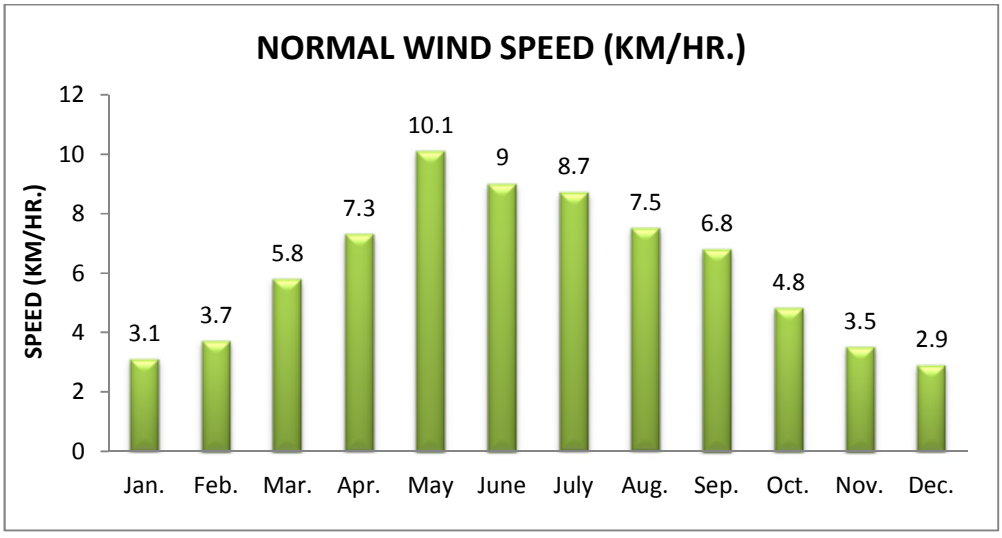


Figure-2.2 Normal wind speed

2.3 RELATIVE HUMIDITY

Mean data observation has been considered for calculation purposes. The normal of Relative humidity has been tabulated in **Table-2.4** and depicted in **Figure-2.3.** Relative humidity data are essential for estimation of evaporation and other climatological parameters.

Table -2.4

Normal Relative humidity

Time of Observation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
8.30 hr	63	61	63	70	71	76	82	84	81	74	67	63	71
17.30 hr	49	46	42	4	60	67	79	80	78	70	60	53	61

(Source-IMD)

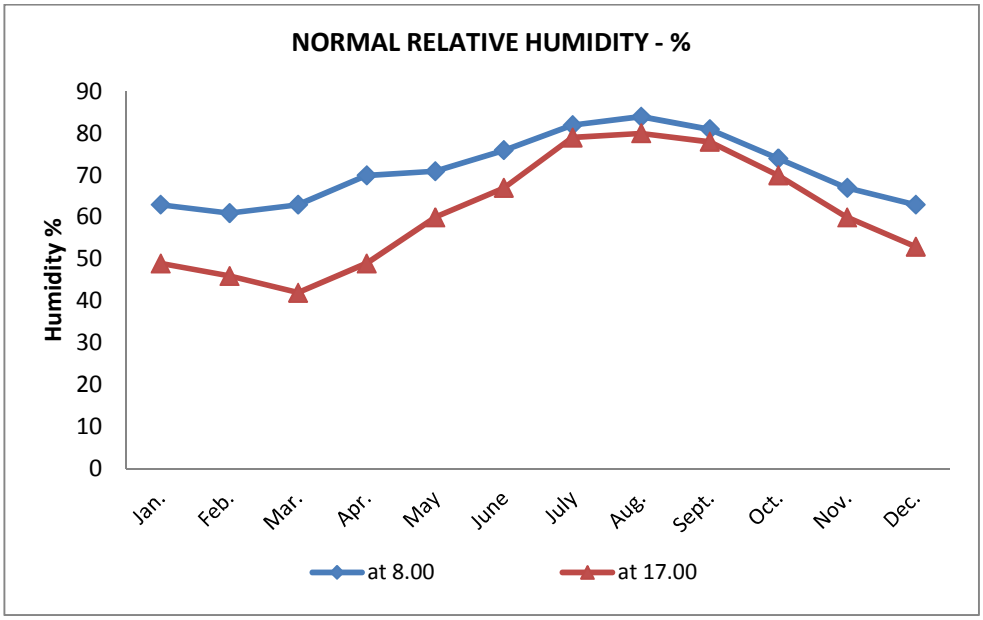


Figure-2.3 Normal Humidity

2.4 POTENTIAL EVAPOTRANSPIRATION (PE)

The potential Evapotranspiration (PE) data as calculated by IMD for Bardhaman district is given in Table-**2.5** and depicted in **Figure-2.4.**

Table-2.5
Potential Evapotranspiration (PE)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
71.8	89.6	146.6	177.5	202.9	146.2	129.1	124.5	115.1	117.9	86.9	67.3	1476.0

(Source-IMD)

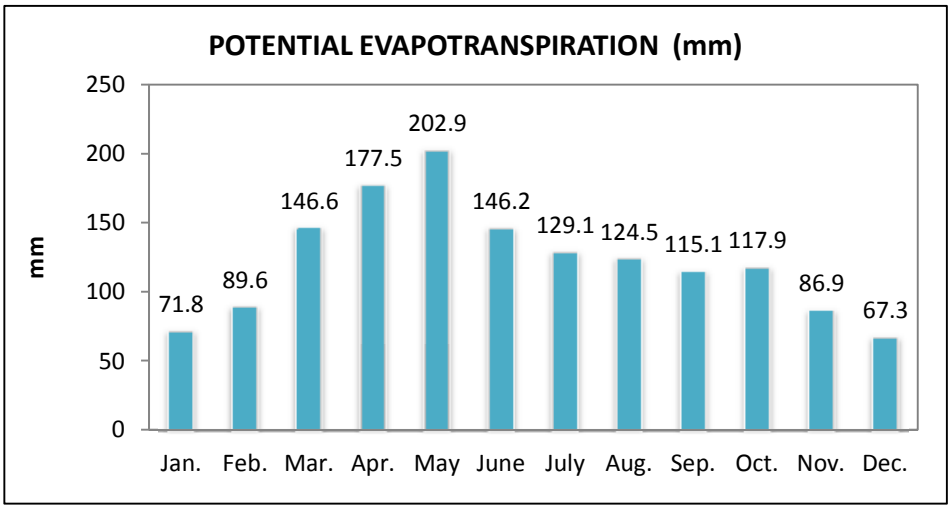


Figure-2.4 Potential evapotranspiration

2.5 CLIMATIC WATER BALANCE

The idea of climatic water balance was first put forth by Thornthwaite in 1944. Subsequently he developed water balance technique. Elements of climatic water balance for watershed located in and near the project area are computed.

2.5.1 Water Balance Techniques: The term "Water Balance" refers to the balance between the incoming water from precipitation and the outgoing water by evapotranspiration resulting in change of soil moisture and runoff. It is a climatic balance obtained by comparing the match of precipitation with evapotranspiration, yielding a number of moisture parameters like water surplus, water deficiency, soil moisture change and runoff. The basic relation governing the water balance concept is;

$$P = E \pm \Delta S + R_O$$

Where,

P = is precipitation in mm

E = is evapotranspiration in nun

ΔS = is change of soil moisture in mm

Ro = is runoff in mm

An important feature of the water balance concept is the recognition of the part played by soil in the exchange of moisture between the earth's surface and the atmosphere. Soil-acts as a medium for storing water (up to a limit) in times of excessive rainfall and releasing the same (in a restricted manner) at other times for purposes of evaporation and transpiration.

2.5.2 Parameters for computation: To work out the water balance, three parameters are required:

i. Evapotranspiration (ET) (water need),

ii. Precipitation (P) (water supply),

iii. Available water capacity (AWC).

Evapotranspiration is the water loss from the earth's surface to the atmosphere -the sum of evaporation loss from soil and water surface and transpiration losses from vegetation. Evapotranspiration depends to a certain extent on the supply of moisture from the soil which can be evaporated and utilized by plant for transpiration. The water loss taking place from extensive vegetation cover under the ideal condition of continuously adequate soil moisture is termed as potential evapotranspiration (PE).

The potential evapotranspiration i.e. (PE) is essentially determined by available energy and is for all practical purposes independent of vegetation, soil or precipitation. It is a theoretical moisture loss which applies to any place but is only attained in reality where there is no shortage of water moisture and where other requirements are met.

2.5.3 Estimation of Potential Evapotranspiration : There are various practical difficulties in measuring PE by Lysimeters and other devices. Consequently, PE is estimated by theoretical methods. Solar radiation, air temperature, wind and humidity are some of the chief factors that affect evaporation and transpiration. Monthly potential evapotranspiration has been placed in preceding chapter. The annual PE value is 1476 mm is taken form Table-5.

Monthly potential evapotranspiration does not show significant change from year to year. This is because, it is largely controlled by the input of solar energy of the month which remain constant from year to year. The contribution from the atmospheric drying power terms is much less compared to the radiation term. Thus, for all practical purposes, monthly potential evapotranspiration can be taken nearly constant for the entire area with a minor correction factor.

2.5.4 Precipitation: Rainfall plays the most important role in water balance concept. Rainfall data required for computation has been dealt in detail in preceding chapter. Normal rainfall for 1286.3 has been taken from **Table-2.1** for computation of climate water balance. The monsoon average rainfall is 111.6 mm.

2.5.5 Soil Moisture: During the period of excessive rainfall, the balance of water, i.e. left over after meeting the requirement of potential evapotranspiration, goes into soil to charge it. This process goes on till the soil attains field capacity. Any further addition of rain water would become water surplus that flows out of the region as surface runoff or sub-surface or underground drainage.

Available water capacity (available water at field capacity) depends on the type of soil and depth of the root zone of the crop coupled with forest cover. For determining the available water capacity the type of soil of the area is found out from the soil map and corresponding to the soil type and the cereal grain crops, the value of available water is taken from the standard table of IMD. In general, the silty loam type of soil is available having moderate deep rooted crops (corn, cotton, tobacco, cereal grains, pastures, surbs and close mature forest). The available water capacity of such soil, has been taken as 200 mm per meter (Thornthwaite and Mather 1957). During the period of deficient rainfall soil moisture is used for evapotranspiration purposes. As soil dries, the rate of evapotranspiration decreases. According to Thornthwaite, 1957, the release of moisture is according to an exponential function given by ;

$$S = AWC.\ \exp \frac{ACC(P-PE)}{AWC}$$

Where,

S	=	is the soil moisture remaining in the soil as storage
ACC(P-PE)	=	is the accumulated potential water loss (sum of negative P-PE value)
AWC	=	is available water capacity = 200 mm/meter

2.5.6 Water Balance Computation: As mentioned earlier, in the water balance computation, precipitation (P) is compared with potential evapotranspiration (PE). On a monthly basis, P-PE can be zero, positive or negative. When P-PE is positive, actual evapotranspiration (AE) is equal to potential evapotranspiration (PE), as evapotranspiration can proceed unhindered with no water shortage. Negative (P-PE) value means potential loss of moisture from the

soil. The actual loss of moisture from the soil will be at a potential rate or at a lesser rate as mentioned above. The actual evapotranspiration, in this case is equal to precipitation plus moisture actually lost from the soil.

The difference between potential evapotranspiration and actual evapotranspiration is water deficiency of the month after the soil has attained field capacity, the difference between precipitation and actual evapotranspiration which equal PE is the water surplus of the month. This surplus is the amount of water that is available for deep drainage as well as for runoff into streams, rivers and lakes. The part of this surplus only does actually runoff in the month. This has been taken as 50% of the surplus for the present study. The rest of the surplus is detained in the water shed and becomes runoff during subsequent period.

2.5.7 Water Balance: Using the method described in the above paragraph, the climatic water balance has been computed with the following information for the for normal rainfall an placed in **Table-6**.

1. Potential evapotranspiration (PE)
2. Rainfall (P)
3. P-PE
4. Accumulated potential water loss (accumulated negative value of P-PE) = ACC (P-PE)
5. Storage (S)
6. Storage change (ΔS)
7. Actual evapotranspiration (AE)
8. Water deficit (WD)
9. Water surplus (WS)
10. Runoff (R_0)

2.5.8 Discussion on climatic water balance : From the study of table and graph following important facts in respect of climatic water balance has emerged for study area.

Table2.-6

Climatic Water Balance of Jagannathpur-B, Coal Mine, Bardhaman W.B

Para-meter	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
PE	71.8	89.6	146.6	177.5	202.9	146.2	129.1	124.5	115.1	117.9	86.9	67.3	1476.0

P	14.4	17.5	12.7	27.5	54.5	259.9	290.2	292.6	246.3	121.4	1.9	0.3	1339.2
P-PE	-57.4	-72.1	-133.9	-150.0	-148.4	113.7	161.1	168.1	131.2	3.5	-85.0	-67.0	-136.8
ACC (P-PE)	-209.4	-281.5	-415.4	-565.4	-713.8	0	0	0	0	0	-85.0	-152	-2422.5
S	70.20	48.95	25.06	11.8	5.64	200	200	200	200	200	130.75	95.53	1387.93
ΔS	-25.33	-21.25	-23.89	-13.26	-6.16	194.36	0	0	0	0	-69.25	-35.22	194.36
AE	39.73	38.75	36.59	40.76	60.66	146.2	129.1	124.5	115.1	117.9	71.15	35.52	955.69
WD	32.07	50.85	110.01	136.74	142.24	0	0	0	0	0	15.75	31.78	519.44
WS	0	0	0	0	0	113.7	161.1	168.1	131.2	3.5	0	0	577.60
Ro	8.64	4.32	2.16	1.08	0.54	56.85	108.98	138.54	138.87	69.18	34.59	17.29	577.10

2.5.9 Water need of catchment (PE): The annual potential evapotranspiration is taken as water need. The annual water need for 1476 mm. The annual water need of the country is ranging from 200 mm to 2000 mm. Thus, it is observed that the need is moderately high. The minimum and maximum monthly water need is ranging from 67 mm to 203 mm for the months of December and May respectively at Kurra site.

2.5.10 Actual Evapotranspiration (AE): The actual evapotranspiration (AE) represent the amount of water loss actually taking place in the form of evaporation and transpiration. Monthly actual evapotranspiration is ranging from lowest value of 35.52 mm to highest value of 146.2 mm in the month of January and June respectively. The annual actual evapotranspiration for the normal being 956 mm. The annual actual evapotranspiration for all over India ranges from 100 mm to 1200 mm.

2.5.11 Water Deficiency (WD): The extent to which the actual evapotranspiration falls short of the potential evapotranspiration is measured as water deficiency. The annual water deficiency estimated 519 mm. The monthly water deficiency starts from Nov. to May .The highest is 142 mm in the month of May lowest water deficiency in the month of November is 15 mm. The annual water deficiency figures for all over India range from 50 mm to 1600 mm. In comparison to all India figures water deficiency figures are well within the limits.

2.5.12 Water Surplus (WS): Water surplus is the amount by which precipitation exceeds actual evapotranspiration, when soil is at field capacity. In this area the water surplus is for five

months viz. June, July, August September and October. Monthly water surplus start in the month of June (113.7 mm) to in the month of July (161 mm), August (168.7 mm), start declining in the month of September (131.5 mm) and in October (3.5 mm). The annual water surplus is 578 mm. The annual water surplus of the country ranges from 100 mm to 2000 mm. The water surplus is moderate and also well within the limit.

2.5.13 Runoff (Ro): Water surplus does not remain in the surface soil layer but goes off as surface runoff, deep percolation to water table or sub-surface flow. Information on the water surplus climatically determined from the water balance thus, provide a rough idea of stream flow which otherwise has to be obtained only from extensive stream gauging installation. Runoff is a monthly distribution of annual water surplus taking into account, as mentioned earlier, a 50% of the surplus water of the respective month goes actually as runoff in the subsequent month. The annual runoff is same as annual normal water surplus i.e. 581 mm. The monthly lean and peak runoff for normal rainfall is 0.052 mm to 135.50 mm in the month of May and Sepetember respectively.

2.5.14 Seasonal concentration of water surplus and deficiency: The striking features of the water surplus and water deficiency are indicative of seasonal concentration of the rainfall which result frequent flash floods in area. Many of the small streams and nalas in the study area experience flash floods during peak monsoon months. The water in smaller capacity reservoir surplus in the water shed is considered to be potential prospect for impounding of water for future use.

2.5.15 Water Balance Diagram: The match of monthly potential evapotranspiration, precipitation, actual evapotranspiration is graphically represented in **Figure-2.5**. The graph shows period and amount of water surplus water deficiency and soil moisture utilization. This graph brings out climatic peculiarity of study area and helps in quick assessment of its water potential.

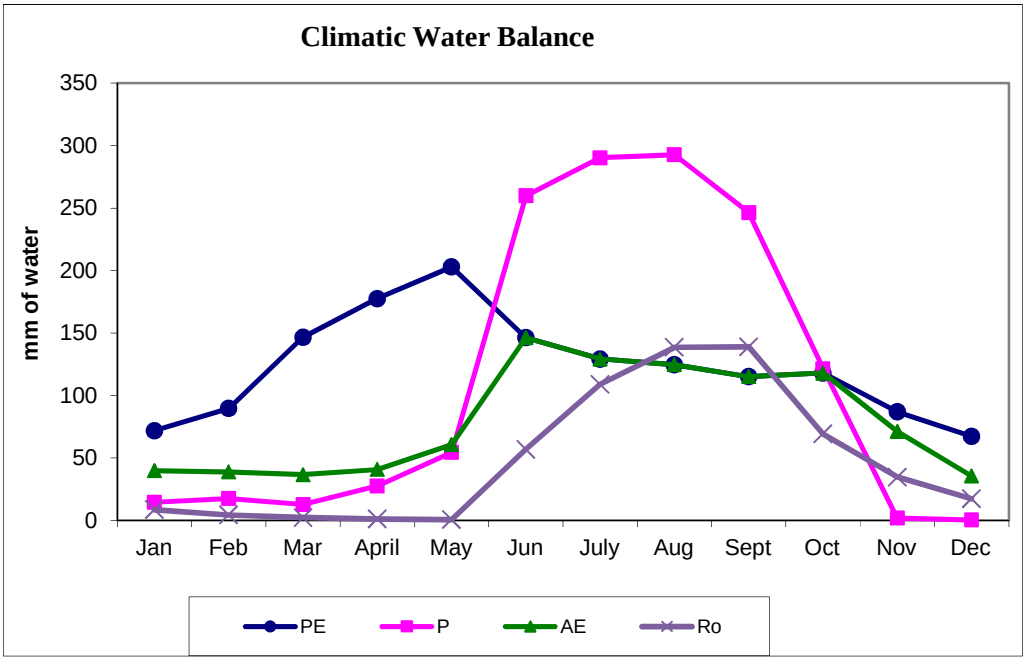


Figure-2.5 Climatic water balance

2.5.16 Water Balance Equation: Water balance equation is computed in accordance with the latest techniques using the earlier described water balance data (**Table-2.7**). The water balance equation is equal for normal rainfall (mm).

$$P = AE + R \pm \Delta S$$

1339 = 956 + 577 - 194

Table-2.7
Summarized Climatic Water Balance

(mm in rounded figure)

Year	PE	P	P-PE	ACCP-PE	S	ΔS	AE	WD	WS	Ro
Normal	1476	1339	-136	--2422	1387	194	957	519	577	577

3.0 GEOLOGY

3.1 REGIONAL GEOLOGY – Raniganj Coalfield

The Raniganj Coalfield occupies an area of 1550 sq.km and typically exposes a complete succession of Lower Gondwana sediments (**Table -3.1).** It is bound in the north, west and south by the Archean Metamorphic except in the east where the boundary is not clear as it is covered by alluvium and Tertiary sediments. In the east of Raniganj River the Raniganj Formation crops out and attains nearly 1050 m thickness and extends over a major part of the Raniganj Basin. Geological map of Raniganj Coalfield is given in **Plate III.**

Table- 3.1
General Stratigraphic Sequence of the Raniganj Coalfield

Stratigraphic Units	Lithology
Recent	Alluvium/Soil, Very fine grained to medium grained loose sand, clayey at places.
Sub-recent & quaternary	Laterite and lateritic gravel, clays etc.
Unconformity	
Tertiary	Sticky clay with quartz grains, claystone, semi consolidated fine to medium grained sandstone etc
Unconformity	
Intrusives (dykes and sills)	Dolerite and Mica-Peridotite
Supra-panchets	Red sandstone and clays
Unconformity	
Panchet formation	Greenish grey sandstones, Red clays and khaki green shales.
Raniganj formation	Micaceous sandstones, Shales and coal seams.
Barren measures	Dark grey/black shales with Clays and iron-stone bands
Raniganj formation	Feldspathic sandstones, shales and coal seams.
Talchir formation	Greenish sandstones, Olive green shales and Boulder bed.
Unconformity	
ARCHEANS	Gneisses, granites and Schist

Talchir is the oldest sedimentary formation to be exposed along the north-western margin of the basin. It lies unconformably over the Archean. The Raniganj, Barren Measures, Raniganj and Panchet Formations are exposed successively from north to south. In the basin the Raniganj

Formation crops out along the southern half in the east of Raniganj river and attains nearly 1050 m thickness (at the maximum) having a spread over a major part of the basin.

The Supra-Panchet, exposed in two patches in the south-west and south-central parts of the basin, rest unconformable over the Panchet. In the southeastern part of the area Tertiary formation rests over Gondwana with pronounced erosional unconformity and show a marked increase towards southeast. This part of the coalfield is covered predominantly by laterite and alluvium. Intrusions of dolerite and/or mica-peridotite in the form of thin sills and dykes have been observed.

Structurally, the typical half graben type Raniganj Coalfield is a broad east-west trending and westerly plunging synform. As per the available Bouger anomaly Map the southern sector of the block comprises three segments corresponding to three geological elements viz. Durgapur Depression, Andal High and Raniganj Depression. The rocks in the greater part of the area dip towards south. The dips usually vary between 5 to10°. In the basin two major sets of normal faults with approximate NE-SW and NW-SE trends are prominent.

3.2 GEOLOGY OF THE BLOCK

The block has a monotonous cover of alluvium/soil except some scattered patches of laterite distributed throughout the block. The geology of the block has been deciphered mainly on the basis of the subsurface data obtained by exploratory drilling The stratigraphic sequence in this part of the area and the thickness of the formations intersected in the boreholes are given in **Table – 3.2**.

Table-__ 3.2
Stratigraphic Sequence in Jaganathpur-B Mine, Raniganj Coalfield

Stratigraphic Units	Lithology (Maximum thickness)
RECENT / QUATERNARY	Alluvium and sandy soil Laterite, Lateritic Clay and nodules (104.00 m),
----------Unconformity ----------	
Tertiary Formation	Sticky clay with quartz grains, clay stone, semi consolidated fine to medium grained sandstone etc (120.00 m).
----------Unconformity----------	
Panchet formation	Greenish grey and brownish sandstones; shale and red clays (78.36 m).
Raniganj formation	Micaceous sandstones, grey to carbonaceous

	shale and coal (352.64 m).
Barren measures	Dark grey arenaceous and micaceous shale with clay, iron stone bands at places (149.09 m)

3.3 STRIKE & DIP

The general trend of the strata is almost E-W. However, there are local variations in the trend towards NE-SW. This is most pronounced in the north-western part of the block. The dip direction of the strata in this block varies widely as outlined below:

- North Sector :Dip varies between 3^{o} to N 155^{o} and 4^{o} to N205^{o}.
- Central and South Sector: Dip varies between 5^{o} t N 190^{o} and 3 deg. To N 110^{o}.
- Western Sector : dip varies between 4^{o} to N70^{o} and 8^{o} to N 150^{o}

3.4 INCROPS OF COAL SEAMS

The floor of the coals seams as well as the floor of the weathered mantle has been taken into consideration while interpreting the incrop of the coal seams. In the western part of the block only R-XI seams incrops in a small patch. Apart from this the top split of R-IX seams Incrops in the north-eastern part of the block. No other seam Incrops within the block.

3.5 FAULTS

As told earlier, in accordance with the regional trend, the block shows a complicated structural setup. 52 numbers of faults have been identified through 3D HRSS interpretation. These faults have been identified on the basis of seismic reflection. Throw and angle of the faults vary along the strike and dip of the fault planes.

The major fault (F4-F4), with southerly throw ranging from 300m-540m with almost east-west trend, traverses in the northern part of the block. This fault has separated out a small patch in the north-eastern part of the block. Along this fault the Raniganj formation in the upthrown side has come in juxtaposition with Panchet formation in the downthrown side. In the upthrown side of the fault i.e along the northern periphery of the block extensive mining activities are being carried out in Shyamsundarpur, Bankola and Tilaboni area at a much shallower depth.

Faults F1-F1 having NW-SE trend with, throw and angle 0m-240m and 45°-65° respectively traverses in the south central part of the block and suddenly changes its trend NNW-SSE and

dies out. F2-F2 also traverses in the similar trend almost across the block. Throw and angle of this fault vary from 28m-110m and 38°-55° respectively. These faults have divided the block into four sectors. Geological Map of Raniganj Coal Field is given in **Figure 3.1.**

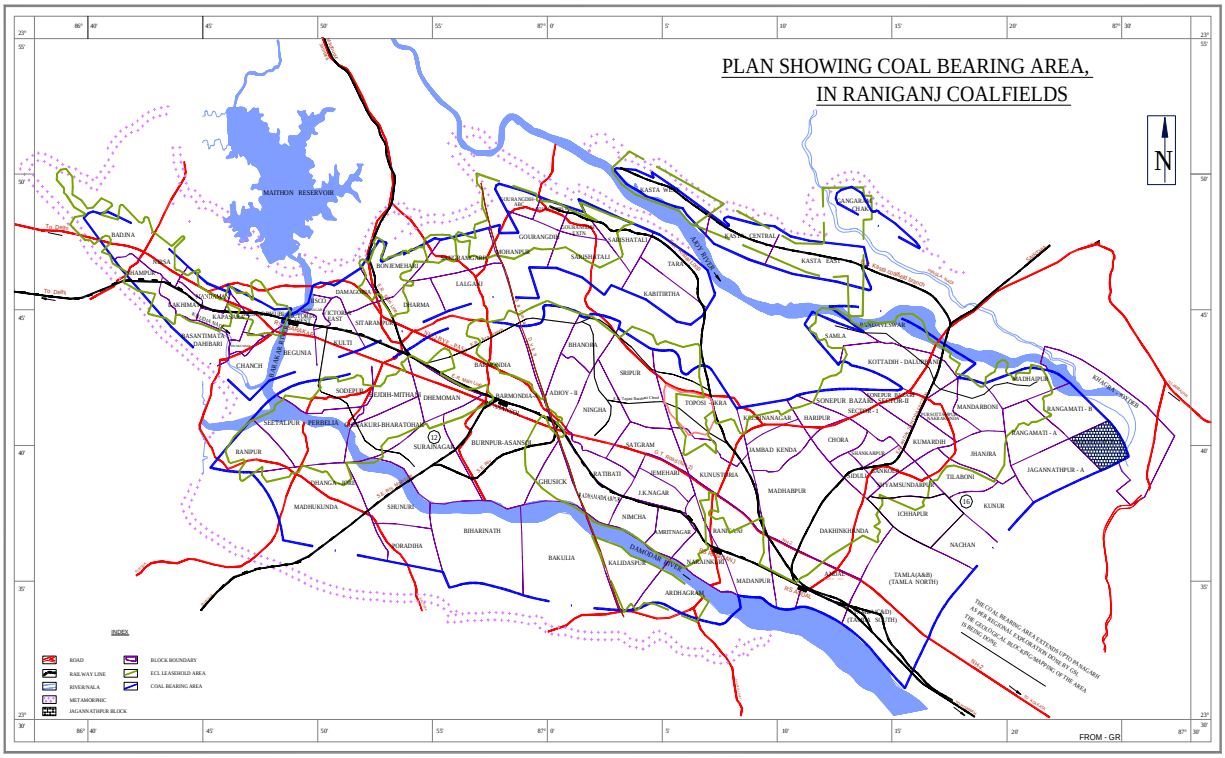


Figure 3.1: Raniganj Coal Field- Jaganathpur block

4.0 HYDROGEOLOGY

4.1 Depth to water level - Annual fluctuations – Recharge/discharge : The depth to water level below ground level depict the inequalities in the position of water table with respect to ground surface and are useful in delineating recharge/discharge area, dealing with drainage transpiration and opening of mine in which depth to water level is critical. The depth to water level data is given in **Table 4.1.**

The depth to water level in the block area varies from 1 m to 6 m below ground level in monsoon whereas in pre-monsoon varies from 2 to 10 m in general. The average annual fluctuation in the block is 4 m. In recharge area fluctuation is high. The deep water level normally observed in the recharge area. The recharge area is around watershed divide line in the eastern sector of the block.

4.2 Water table: The surface at which pore water pressure is equal to atmospheric pressure is called the water table. The atmosphere exerts the pressure on the water table through the interstices (void & fracture) in the zone of aeration as on the water column in the well.

In the present condition of pre-mining the water table is subdued replica of the land surface, reason being the primary control of topography. Positions of water table are also influenced by geologic control like structure and hydraulic conductivity of formation. The water table in the block is ranging between 100 m MSL to 45 m MSL. The Water Table map of pre monsoon is prepared and is given in **Figure 4.1**.

4.3 Movement of groundwater: The major flow of groundwater in the block is from northern periphery of boundary to the southern side of block. The general flow is towards local Nalla. The general direction of groundwater flow is NNE to SSW. The movement of groundwater is not in conformity with the dip of coal seam. The hydraulic gradient of groundwater is 1.88×10^{-3}.

4.4 Auto flow zone : Groundwater in confined aquifer, exerts an upward hydrostatic pressure on the confining layer, depending on the pressure of the groundwater, the water level in a well /bore well will rise above the top of the confined aquifer. Depending on the topographic consideration of ground surface the well become free flowing water well or auto flow well. Such condition noticed during coal exploration by G.S.I in southern side of coal block. This zone is called auto flow zone. During coal mining water may ooze from floor. This area is in discharge zone.

Sr No	Well Code No.	Village Name	Lattitude	Longitude	Type of Well	Dia	Depth	Water Level bgl in m. Pre-Monsoon	Water Table RL	Pre monsoon Water table
						(m.)	(m.)	(m.)		
Buffer zone										
1	W-1	Gaurbazar	23 41 23.23	87 22 30.33	DW	1.20	12.5	3.50	78	74.50
2	W-2	Gutulia	23 41 34.00	87 22 49.00	DW	1.1	13.5	3.4	74	70.60
3	W-3	Vbhavnandpur	23 41 26.00	87 23 08.00	DW	1.2	9.7	2.9	73	70.10
4	W-4	Baidyanathpur	23 40 19	87 22 32	DW	1.17	12	4.3	69	64.70
5	W-5	Shrikrishnapur	23 40 07.00	87 21 36.00	DW	1.2	11	2.2	71	68.80
6	W-6	Amdahi	23 39 33.00	87 22 20.00	DW	1.3	8	2	66	64.00
7	W-7	Kailashpur	23 39 20	87 22 28	DW	1	8	3	66	63.00
8	W-8	Jaganathpur	23 38 55	87 22 21	DW	1.2	9	2.5	64	61.50
9	W-9	Shrikrishnapur mazi pada	23 39 47	87 20 53	DW	1.1	9	3	80	77.00
10	W-10	Madhaiganj	23 39 21	87 20 08.00	DW	1.5	7	4	89	85.00
11	W-11	Tikarbeta	23 38 51	87 25 32	DW	2	7.6	6.8	65	58.20
12	W-12	Poranchak	23 39 55.53	87 25 59.86	DW	3	0		64	64.00
13	W-13	Chakrasik	23 40 12	87 26 01	DW	2.5	9.7	3.3	64	60.70
14	W-14	Joydeb	23 38 25.92	87 26 0.38	DW	2.5	10.7	3.4	62	58.60
15	W-15	Binodpur	23 39 49	87 23 36	DW	2.4	20	9.5	66	56.50
16	W-16	Madhaipur	23 42 15	87 21 05.00	DW	1.1	2.5	2.3	78	75.70
17	W-17	mamakuthi	23 42 15	87 20 24	DW	1	11.3	3.9	81	77.10
18	W-18	Panshivli	23 42 19	87 20 13	DW	1	13	3.9	80	76.10
19	W-19	Lashkarbandh	23 41 52	87 20 13	DW	1	13.2	2.4	75	72.60
20	W-20	Laudoha	23 39 45	87 18 14	DW	1.3	12.2	5.4	98	92.60
21	W-21	balujuri	23 40 40	87 19 14	DW	1.5	6	3.2	79	75.80
22	W-22	jhanjra	23 39 44	87 19 26	DW	1.8	5.2	2	93	91.00
23	W 23	malandighi	23 33 46.19	87 24 06.51	DW	1.6	9.2	3.7	69	65.30
24	W 24	Jatgoria	23 37 07 .04	87 23 26.37	DW	1.6	11	3.2	76	72.80
25	W-25	Sunmoni	23 40 2.81	87 28 12.20	DW	1	10.2	2.6	59	56.40
26	W-26	Khandogram	23 42 22.86	87 28 30.92	DW	1.3	9.8	2.6	62	59.40
27	W-27	Rengna	23 45 48.19	87 29 00.61	DW	1.7	8.6	3.2	65	61.80
28	W-28	Konda	23 42 52.72	87 18 19.23	DW	1.8	8.2	3.6	81	77.40
29	W-29	jhanjra	23 38 32.46	87 17 19.88	DW	2	12	3	100	97.00
30	W-30	Itapara	23 39 26.07	87 23 49.24	DW	2.2	8	2.2	62	59.80

Table 4.1: Well inventory data

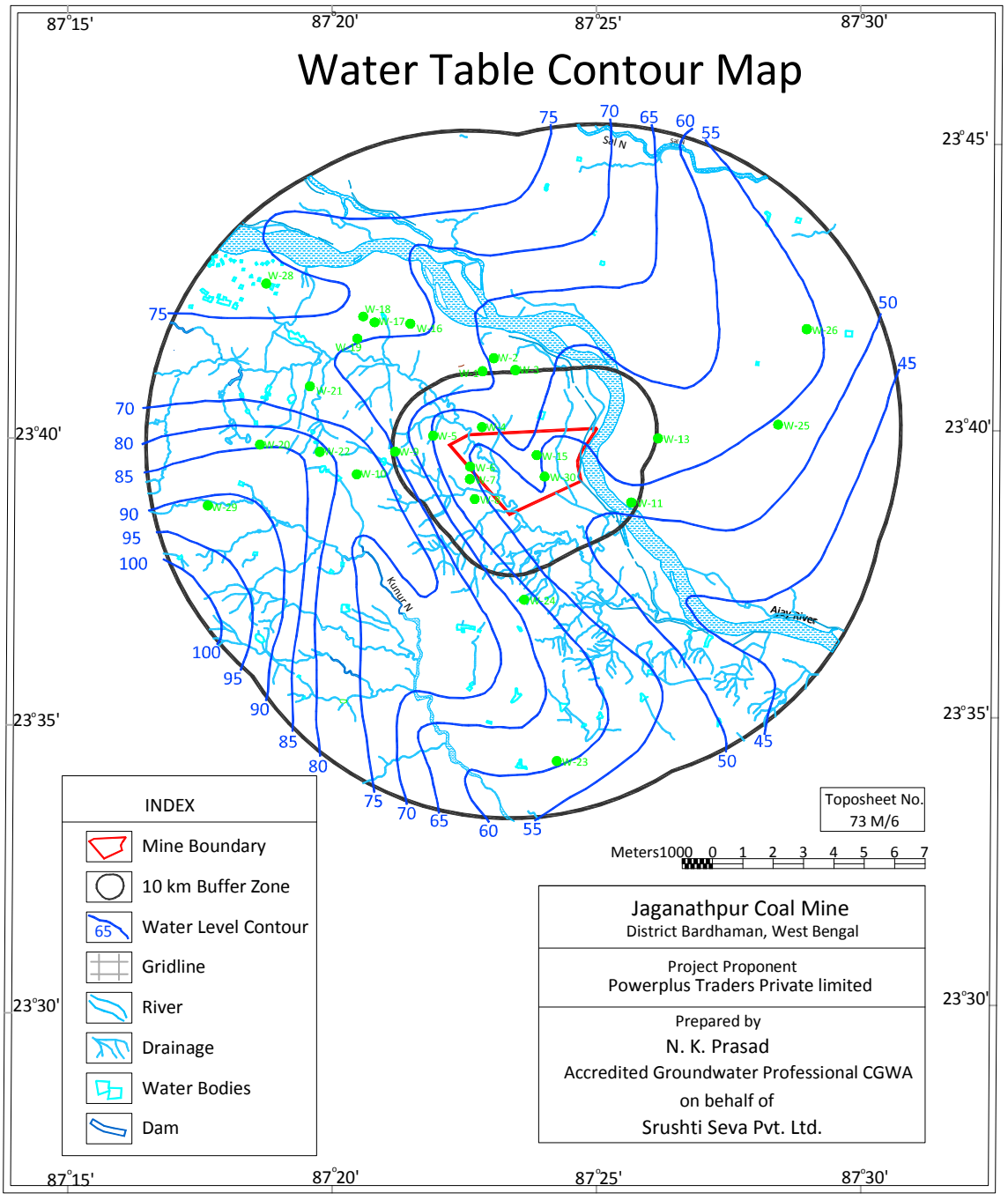


Figure 4.1: Water table Map

4.5 AQUIFER, AQUICLUDE SYSTEM

The cross section along inclined placed is given in **Figure 4.2** and is used for delineation of coal seams and partings constituting sandstone/ sandy shale. The top soil/ alluvium and partings are considered aquifer system in the mine.

Aquifer in the present contest is a natural zone below the surface that yields water in significant large amount to be important economically. The aquifer system in the mine constitutes both primary and secondary porosity In Jagannathpur coal block aquifer is non-indurated alluvium deposit, indurated sedimentary deposits of sandstone. Sandyshale and shalysand having double porosity duly fractured. The aquiclude consists of shale, carbshale and coal seam may act as impermeable bed to the extent of aquifuse. (**Table- 4.2**).

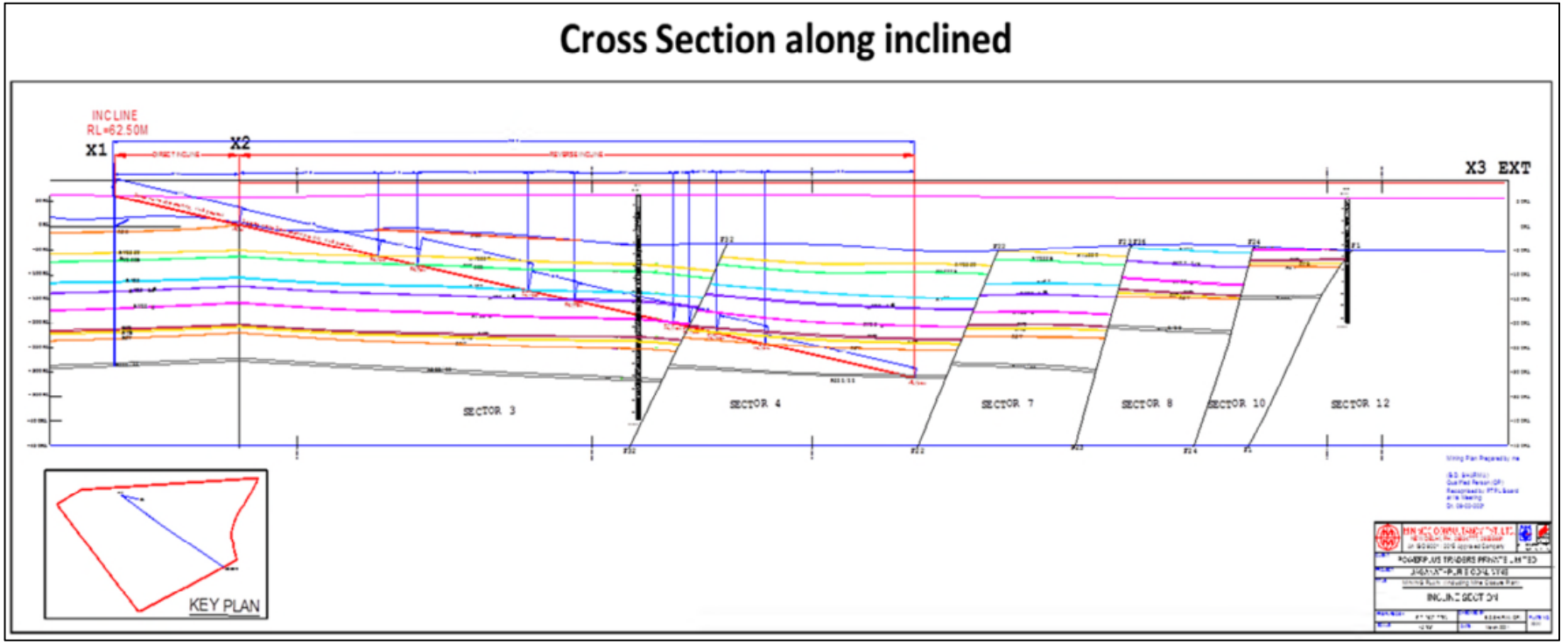


Figure 4.2: Cross Section

Table-4.2
Aquifer system

Sr. No.	Depth		Thickness	Aquifer	Aquiclude
	From	To			
1.	00.00	107.46	107.46	Aquifer 1	
2.	107.46	110.6	3.14		Aquiclude 1
3.	110.6	146.66	36.06	Aquifer 2	
4.	146.66	149.12	2.46		Aquiclude 2
5.	149.12	160.68	11.56	Aquifer 3	
6.	160.68	161.91	1.23		Aquiclude 3
7.	161.91	199.52	37.61	Aquifer 4	
8.	199.52	201.93	2.41		Aquiclude 4
9.	201.93	217.57	15.64	Aquifer 5	
10.	217.57	220	2.43		Aquiclude 5
11.	220	256.75	36.75	Aquifer 6	
12	256.75	258.29	1.54		Aquiclude 6
13	258.29	288.02	29.73	Aquifer 7	
14	288.02	290.9	2.88		Aquiclude 7
15	290.9	299.51	8.61	Aquifer 8	
16	299.51	301.62	2.11		Aquiclude 8
17	301.62	371.24	69.62	Aquifer 9	
18	371.24	377.35	6.11		Aquiclude 9

5.0 HYDROLOGY

5.1 Core zone resource evaluation (annual water balance–point value) : The annual water balance on unit area basis (point value) has been attempted in subsequent paragraph with special reference to underground mine area.

5.2 Surface water resource: The surface water resource evaluation of unit area basis has been done for pre-mining and post-mining condition. Accordingly, water balance in term of percentage of rainfall has also been arrived. The normal annual rainfall 1286 mm has been considered. Area considered is surbs cover with intercept loss in pre-mining condition and evaporation (E) losses in post-mining.

5.3 Runoff: The Damodar river discharge reflect the storm events of rainfall. So the flow is mainly spill over flow of local storage tank. Hence, flow data can be termed as runoff excluding groundwater runoff. However, an attempt has been made to compute the runoff by empirical relationship established for Model study of Indian coalfield.

A) Non Mining Pre-mining (Nm)

$R_{(Nm)}$ = P x 0.25

Where, $R_{(Nm)}$ = Runoff in Jagannathpur block in mm.

P = Precipitation 1286 mm

$R_{(Nm)}$ = 1286 x 0.25 = 322 mm

B) Post Underground Mining (Po)

$R_{(PO)}$ = P x 0.23

= 1286 x 0.23 = 296 mm

There will be reduction in runoff by 26 mm during post underground mining period.

5.4 Interception Losses/ Evaporation Losses (I/E): In Jagannathpur coal block some of the area is covered by surbs to the extent of more than 50% and accordingly all the precipitation does not falls directly on to the ground. A major part of precipitation is thus caught by the surbs vegetation. The volume of water intercepted is subsequently lost solely by evaporation and not by transpiration. This amount of water lost in a given area is extremely difficult to measure and depends on species, composition of vegetation and also storm characteristics. This loss is estimated to be around 25% of the annual rainfall in area. The same loss will be during post-mining as evaporation loss from pit water and plantation. So, the initial loss of precipitation due to interception /evaporation (I/E) in the Jagannathpur area is:

I/E =P * 0.25

= 1286 X 0.25 = 322 mm.

5.5 Change in Groundwater Storage (Δ Sg): Due to rainfall infiltration aquifers get recharged and this is reflected as rise in groundwater levels (head). The rise will recorded in the shallow dug wells. The estimated value will be 3800 mm. and specific yield of the aquifer is 0.03. During post underground mining period head value will be 6700 mm with increase specific yield will be 0.03. Hence, the change in groundwater storage is:

A. Pre-Mining Δ Sg = 3800 x 0.03 = 114 mm

B. Post Underground Mining Δ Sg_O = 4000 x 0.04 = 160 mm

In Post-Mining condition there will be scope of rise in groundwater recharge by 46 mm.

5.6 Evapotranspiration: Evapotranspiration losses, commonly termed as consumptive use has been calculated by using hydrological equation.

$$ET = P - R - I/E \pm \Delta Sg$$

Where, ET = Evapotranspiration in mm.

P = Precipitation in mm.

R = Runoff in mm

I/E = Interception / Evaporation losses in mm.

Δ Sg = Change in groundwater storage in mm.

A. **Pré-Mining** ET = 1286 – 322 – 322 – 150 = 492 mm

B. Post underground Mining ET = 1286 – 296 – 322 – 201 = 467 mm

Hence, the ET for Jagannathpur coal block will be 492 mm during pre-mining and post-mining period it will be 467 mm assuming the level of surbs cover restored by plantation**.**

5.7 Hydrologic Water Balance : Water balance exercise was carried out for Dhamar sub-basin at Jagannathpur coal block on unit area basis (point value**).** This is a quantitative statement of hydrologic water balance between total water gain and losses of the core zone over a period of time and can be expressed as:

A. Pre-Mining : P (1286) = R (322) + ET (492) + IE (322) + Δ Sg_N (150)

B. Post U/G Mining : P (1286) = R (296) + ET (467) + IE(322) + Δ Sg_O (201)

The total precipitation of Jagannathpur Block is thus expressed as percentages of hydrological parameters of pre-mining condition depicted in **Figure-5.1** and post underground mining condition depicted in **Figure-5.2** respectively. The values are shown in the **Table-5.1.**

Table-5.1

Hydrological parameters

Parameter	Pre-mining	Post-mining	Pre-mining	Post-mining
	Values in mm		Values in %	
ET	492	467	38	39
R	322	296	25	23
I	322	322	25	25
Sg	150	201	12	16
Total	**1286**	**1286**	**100**	**100**

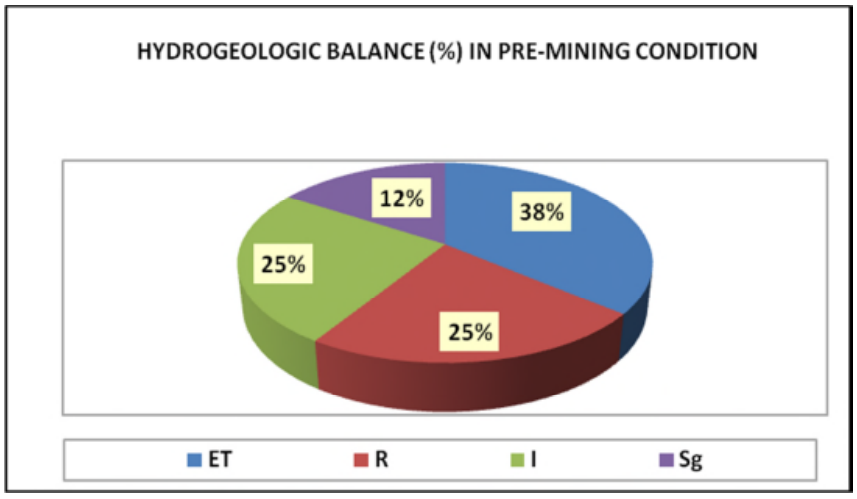


Figure-5.1: hydrological parameters of pre-mining

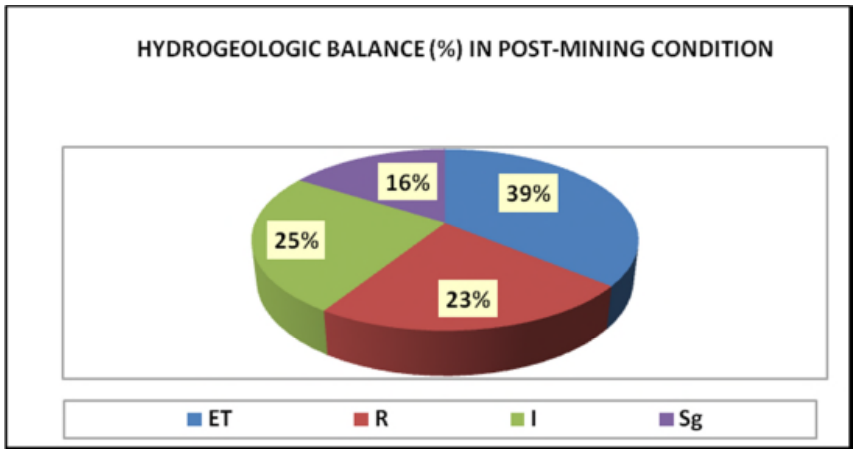


Figure-5.2: hydrological parameters of post-mining

5.8 Hydrologic Consequences

5.8.1 Mining Activity: As already discussed the mine area is drained by local Nalla and the streamlets. The streamlets are mostly 1st and 2nd orders of seasonal streams originating from the northern and southern side of the mine boundary. Local nalla passing though north, flowing east to west and finally towards south-western most tip of the mine.

The Tumani nadi flow from north to south direction and pass through the mining lease. Ajay river flows in the eastern part of the Mining lease Apart from these following activities are likely to occur in mining lease area;

1. The local nalla entering the block from northern and western direction and flowing north to south may lose some runoff during mining operation through further it will flow into Ajay river along its natural course.
2. The local nalla at the north of mine will be channelized into another nalla for mine and flow out of boundary.
3. During depillaring it is expected that area may not be affected by subsidence and may not from crack development in lease area due to deep seated mining.
4. It is anticipated that, situation of water logging or blockage of major stream will not occur due to mining during peak flow generation as water divide line in the eastern part of mine running north-south.
5. The loss in runoff during & post mining will be supplemented by mine pumping. Thus, the flow of Ajay River will be available for competing user rather it will be available during lean period also.

5.8.2 Peak Flow generation: The model study suggested that there may be three different quantum of rainfall may occur in a single day. Consequently peak runoff generation over mining area (8.70 km^2), in a single day under is estimated. The IMD data of Durgapur (W.B.) Station has been considered for the study and it may be recorded that maximum rainfall in 24 hours recorded on 29.09.1978 is 387.7 mm.

The total maximum surface water may be generated, over mine in core zone area (8.70 km^2) during extreme rainfall 387.7 mm in 24 hours, to the tune of 3.37 MCM in single day without

loss. The actual accumulation of water after due losses with runoff coefficient considered 23%. The annual yield will be 0.775 MCM

5.9 RAINFALL – RUNOFF MODEL

In the present study rainfall runoff model have been developed for the Jagannathpur Block based on model development under Indian coalfield study. The relationship in the model between rainfall and the resulting runoff is quite complex and is influenced by host of factors relating to catchment and climatic environment. The model developed for two specific conditions :

1) Rainfall-runoff in pre-mining condition.
2) Rainfall –runoff in post-mining conditions.
3) Change in status

The runoff generated over block area under normal rainfall is placed in **Table-5.2** and depicted in **Figure-5.3.**

Table-5.2
Rainfall-Runoff

Condition	Rainfall (m)	Area $m^2 \times 10^6$	Runoff factor	Runoff generation $m^3 \times 10^6$
Pre-mining	1.286	8.70	0.25	2.797
Post-mining	1.286	8.70	0.23	2.573
Loss				(-)0.224

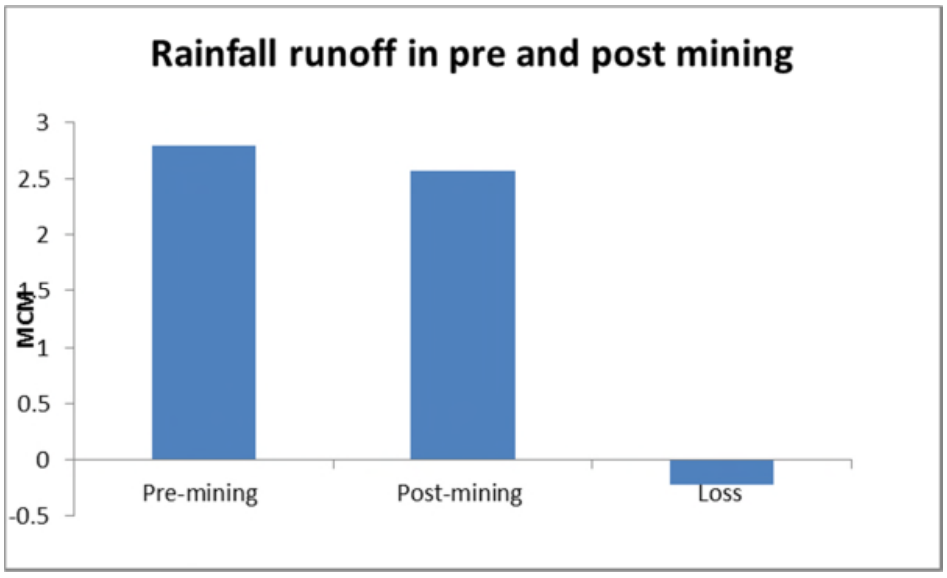


Figure-5.3: The runoff generated over block area under normal rainfall

The above model suggest a reduction in runoff generation in post underground mine period. This may be due to high infiltration capacity developed over underground mine area. This process is mainly due to underground void. Further it is resultant to disequilibrium and shattering of stratified formation. This phenomena is indicative of low overland flow and high interflow in underground mine area provided subsidence profile touches near to ground level. The reduction in surface runoff may be around 0.224 MCM/year.

5.10 RAINFALL-RECHARGE MODEL

Rainfall is the main source of recharge to aquifer system. The normal rainfall of Jagannathpur has been considered for development of model for mining block. The model developed under Indian coalfield study has been used to predict the occurrence of recharge in two conditions.

1) Pre-mining condition.
2) Post-mining conditions.
3) Change in status

The model depicts the changes in groundwater recharge due to underground mining. The normal gross recharge to mine block area is given in **Table-5.3** and depicted in **Figure-5.4.**

Table-12B
Rainfall-Recharge

Condition	Rainfall (m)	Area $m^2 \times 10^6$	Recharge factor	Annual recharge to block area $m^3 \times 10^6$
Pre-mining	1.286	8.70	0.10	1.12
Post-mining	1.286	8.70	0.14	1.57
Gain				0.45

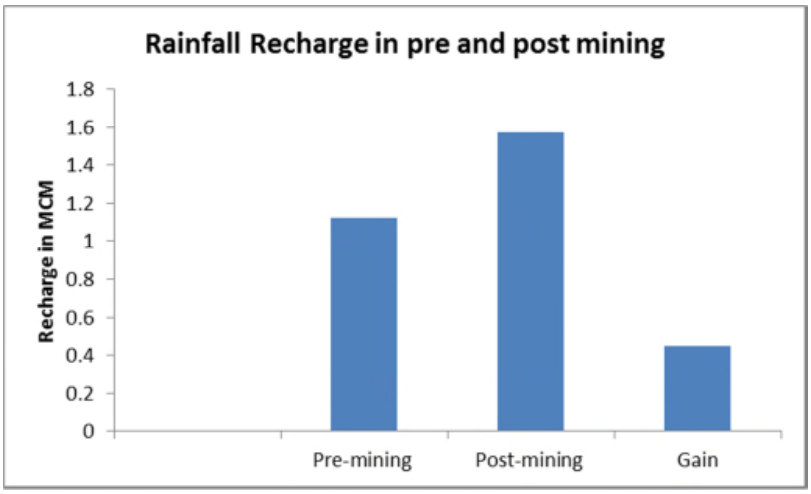


Figure-5.4: Rainfall recharge

The study of above table reveals that in the mining area there is induced recharge due to heavy withdrawal of water from the system and creations of high infiltration zone. Due to depillaring in underground mine, scattering of aquifer is main cause to increase infiltration capacity which in-turn induced additional recharge to the system. **Thus, due to underground mining in the area there will be addition recharge to the tune of 0.45 million cubic meter per year.**

5.11 AREA DRAINAGE

5.11.1 Core Zone: The coal block fall in watershed of Ajay river basin. It is observed that there are three micro watersheds in the area. All micro-watershed of the block is confluence into Ajay River.

5.11.2 Buffer Zone: The coal block fall in two watersheds which Damodar and Ajay River basin. It is observed that 75% area falls in the Ajay watershed and 25% falls in Damodar watershed. The watershed divide is passing through south to north in the eastern part of the block.

There is no modification of natural drainage diversion, and channeling of existing river/ water courses flowing through mining lease area and adjoining lease or project. There is no adverse impact of mining operation on the existing drainage system. This has been discussed in subsequent chapter under 'Impact of Deep Mining on Surface Water. The drainage map of Core and Buffer Zone is given in **Figure 5.5.**

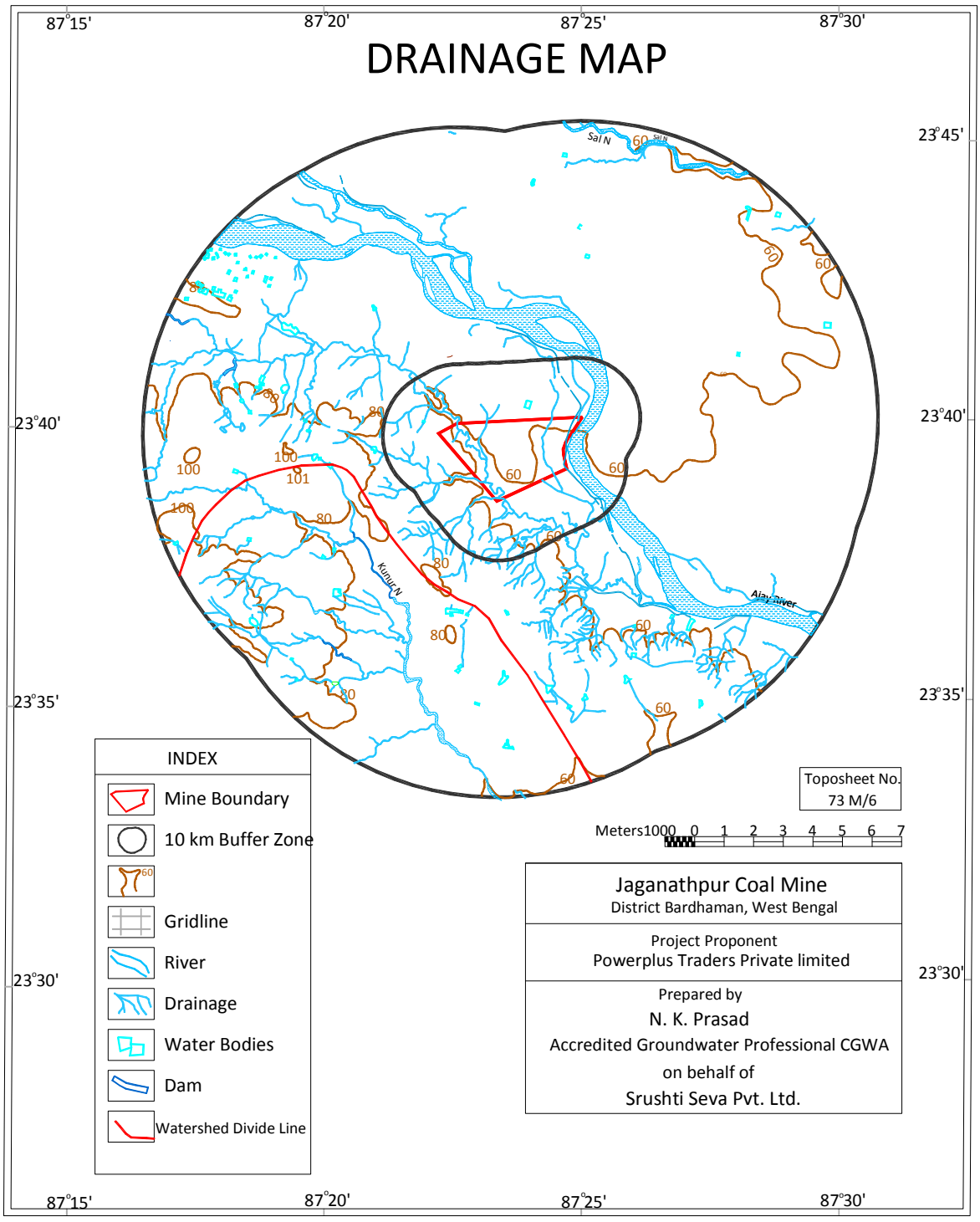


Figure 5.5: Drainage Map

6.0 Mine Pumping

6.1 Mine Pumping of Core Zone:

The mine seepage estimation will be done in details based on mine plan and pumping test data. The pumping test data for this mine is not available hence, approximate value of nearby mine has been considered for mine seepage estimation for EMP Report.

Mine seepage from inclined drivage-

Mine seepage is likely to occur during inclined drivage and is given in **Table 6.1** as first hand approximation.

Table 6.1: Mine seepage from inclined drivage

Length	Depth	Inclined Seepage
0-50	0-10	0
50-100	10-20	1180
100-150	20-30	2146
150-200	30-40	2897
200-250	40-50	3434
250-300	50-60	3756
300-350	60-70	3863

Mine seepage during shaft sinking-

Mine seepage during shaft sinking is given in **Table 6.2** as first hand approximation.

Table 6.2 : **Mine seepage during shaft sinking-**

Depth in m bgl	Shaft Seepage m^3/day
10	97
100	1249
200	2700
300	4100
400	5800

6.2 Mine Pumping of Buffer Zone:

The mine seepage in buffer zone area has been taken from report of Ministry of Coal June-2021, entitled "Status *report on mine water utilization*". The annual average mine water availability from the following nearby mines are given below.

Sr no.	Mine	Annual average mine water availability (LKL/year)	Daily average mine water availability (m^3/day)
1	Moira	1.59	435
2	Khandra	9.12	2498
3	Shankarpur	10.96	3002
4	Bankola	15.76	4317
5	Shyamsundarpur	20.50	5616
6	Tilaboni	6.57	1800
7	Kumardihi 'A'	10.70	2932
8	Nakrakonda-Kumardihi B	11.89	3257

***LKL/year = Lakh kilo litre per year**

7.0 Impact of Deep Mining

7.1 Concept

The proposed mining method for this block has been proposed is by longwall method in multi seam configuration. The average depth of the mine is 400 m which is considered to be deep underground mines. The impact of deep mining by using longwall, on surface water and ground water is based on the numerous research carried out by various worldwide authors and the practical impact observed in Raniganj Coalfield.

Underground mine openings can intercept and convey surface water and groundwater to the mine workings through the cracks and other geological structures. When mining is carried out below the water table, mine voids serve as low pressure sinks inducing groundwater to move the opening form the surrounding saturated rock. This results in dewatering of nearby rock units via drainage of fractures and water-bearing strata in contact with mine workings. There is also potential of impacts to the more remote water bearing units and surface water body, depending on the degree of Hydrologic communication. The extend and severity of the impact on the local surface water and ground water system, due to mining at depth depends on

- The depth of the mine
- The topographic configuration
- Hydrogeologic setting
- Hydrologic characteristics of the adjacent strata
- The amount an extent of mine subsidence
- Related change to rock mass governance the impact of underground mines.

The depth of the proposed mining is on an average 400 m down to 900 m.

The topographic configuration of the area is mostly flapped to undulating surface.

The hydrologic setting is occurrence of multiaquifer, semi-confined to confined with low hydraulic conductivity indicating poor mine drainage.

The hydrologic characteristics of the adjacent area indicate the occurrence of numbers of ponds and water body due to local subsidence of existing underground mines.

The subsidence in nearby mining area is exhibited on surface mostly due to mining at shallow depth, whereas the proposed mine is falling under the category of Deep Mines. So, it is expected that, the subsidence may not be severe in case of this proposed mine.

The related changes in the position of rock masses due to subsidence, may cause impact of underground coal mining on surface and underground water.

7.2.1 Potential Impact On Streams And Surface Water :

The study of area drainage system of the proposed mine inferred that there is no defined drainage system in the core area except 1st and 2nd order drainage. Under the circumstance the impact may be minimum.

The impact of underground mining on surface water can range from no noticeable impact to appreciable that diminution, ponding and local depression. The formation of subsidence induced cracks, surface depression may cause to leakage of surface water into underlying strata. In deep setting the impact tend to be minimal.

The studies conducted above long wall mines by researchers have provided insight into mining induced impact to a stream. They found that stream located above regional base level and also above panel at least three years old had normal flow. One important aspect of overburden movement related to high extraction mining's potential impacts to surface water is the formation of surface extension zone fracture. This near surface zone of increased Hydraulic Conductivity and Storativity can result in Shallow Aquifers and surface water impact even where overburden to seam ratio and considerable and there is no direct avenue for drainage to the mine. From the watershed prospective there appears to be relationship between groundwater interception by high extraction mining and base flow recharge to stream.

7.2.2 Potential Impact On Ground Water :

The severity of impact to groundwater source above high extraction workings depend on the distance of groundwater source above the mine working, topographic setting of the water supply, and the overburden litho logy. Typically ground water thin caved zone and all over part of the fracture zone will drain directly to the mine. Wells drawing water from this zone will generally be impacted. In the proposed mine the overburden is thick enough, zone of dilated fracture may developed above the fracture zone. Water level within this dilated zone typically drops during mining. The strata of this dilated zone are

deformed, but there is a no widespread development of vertical fractures. The groundwater within dilated zone does not usually drained to mine level although water level may drop due to increase storage. Hill and Price (1983) found that temporary water loss form water fracture zone and dilated zone may occur primarily due to increased fracture porosity, leading lowered water level and increase ground water storage at these levels. The majority researchers indicate that impact to sullied within the upper fracture zone and dilated zone are temporary. In fact the post mining water bearing capabilities of these units are often in hence due to large fracture apertures. The most extensive dewatering and least recovery for wells occur near the center of long walls panels, where subsidence fracturing is most severe. However, impact form near surface extension zone fractures attempt to be localized.

7.2.3 Discussion

The impact of deep long wall mining on surface water and ground water has been discussed above based on the views of various researchers. The rainfall runoff model study carried out for the period of pre-mining and post mining in respect of proposed mine indicate that there will be loss of runoff generation as surface water to the tune of 0.224 MCM/year. Similarly, the rainfall groundwater recharge model study have been done for pre and during mining period in respect of proposed mine indicates that there is a gain of additional recharge to the tune of 0.45 MCM/year. Thus, it can be concluded that the impact of deep mining is positive with reference to conservation of water resource of the area.

8.0 Rainwater Harvesting

8.1.1 Source of Rainwater for Groundwater Recharge:

Rainfall is only source of water for groundwater recharge. The surface runoff available in the mining area will be used for this propose. The total mine area is 8700000 m^2. The monsoon rainfall is 1.286 m. The coefficient of runoff is depending on type land under use in the range of 0.15 to 0.85. The quantity of rainwater available is 2320680 m^3. The estimation is given in **Table 8.1.**

Table 8.1: Source of Water – for Rainwater Harvesting

S. N.	Type of Land	Mine lease area	Monsoon rainfall	Rainfall runoff coefficient area	Available water for Rainwater Harvesting	Rainwater suitable for RWH
		m^2	m		$m^{3/}$year	
1.	Roof top	38800	1.286	0.85	42412	Yes
2	open area	8484600	1.286	0.20	2182239	Not suitable for RWH due dirt and surface pollutions
3	Road	91700	1.286	0.65	76652	
4	Green belt	84900	1.286	0.15	16377	
Total		8700000			2320680	

The total quantity of surface runoff available is 2320680 $m^{3/}$year. The runoff to the tune of 2278268 $m^{3/}$year is not suitable for rain water harvesting and same is discharge into local nalas for competing users. The balance of 42412 m^3/year is being utilized as rain water harvesting.

8.1.2 Proposed roof top recharge for new working:

The surface water available through roof top is to the tune of **42412** m^3/y. The effective quantity of total roof top rainwater will be utilized to the extent of 20% for Rainwater Harvesting only, which amount to **42412 m^3/y.**

Proposed RWH- 42412 m^3/y

8.1.3 Capacity of Intake Water in Recharge Well:

A recharge well may be defined as a well that admit water from the surface to fresh water aquifer. Recharge well is also known as disposal well or drain wells. A recharge wells flow is the reverse of a pumping well. If water is admitted into a well, a cone of recharge will be formed that is similar in shape but is the reverse of a cone of depression surrounding well. The equation for the curve can be derived in a similar manner to that for a pumping well. For confined or similar manner aquifer the water being recharged into a completely penetrating well at a rate Q_r, the approximate steady-state expression. (Ref - (D. K. Todd 3rd edition -2005 page 554). **(Figure 8.1)**

$$Q_r = \frac{\pi K (hw^2 - ho^2)}{L_n (ro/rw)}$$

Where, Q_r = Recharge Rate in m^3/d

K = Hydraulic Conductivity in m/d

hw = Depth of intake water level to bottom of unconfined Aquifer in m

ho = Depth of water table with reference to bottom of unconfined aquifer

ro/rw = Assumed value 200 as per above equation

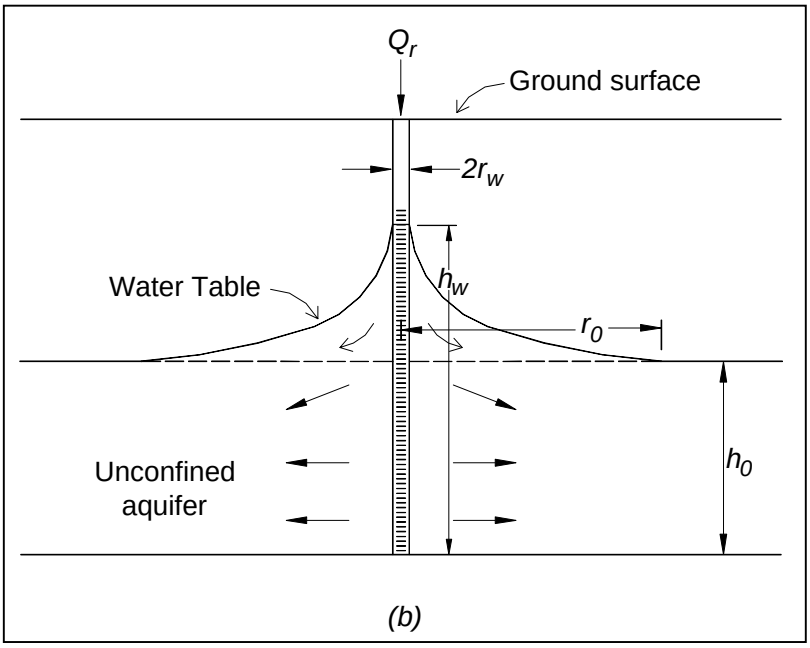


Figure 8.1: Steady-State Expression in Unconfined Aquifer

The recharge rate can be determined by substituting the required data in above equation:

Input data:-

K = 1.04 m/day (assumed in alluvium)

hw = 50 m

ho = 40 m

ro/rw = 200

π = 3.14 - (Universal Value)

$$Q_r = \frac{3.14 \text{ x } 1.04 \text{ x } (50^2 - 40^2)}{L_n\ (200)} = \frac{2939}{5.298}$$

$$Q_r = 554 \text{ m}^3/\text{day}$$

Thus, the recharge capacity of bore well will be 554 m^3/day in upper aquifer mostly alluvium.

Effective Recharge Capacity- 554 m^3/day

8.1.4 Schematic Diagram – Artificial Recharge:

The difficulty lies in the fact that pumping and recharging differ by simple change of flow direction. The schematic diagram of radial flow direction from recharging well penetrating unconfined aquifer is depicted at **Figure 8.2** for better understanding of artificial recharge. The notation in the diagram may be ignored for depicting value to obtain any result. The diagram may be used for illustration.

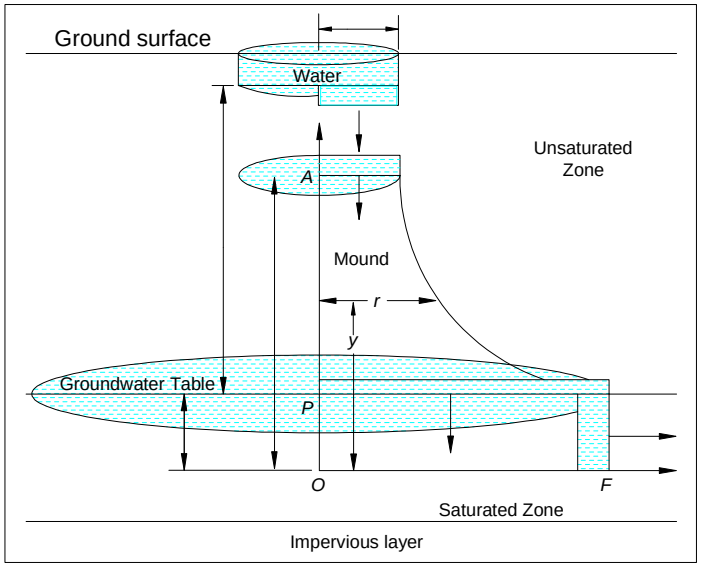


Figure 8.1: Schematic flow pattern under circular basin (J. C. Y. Guo-2001)

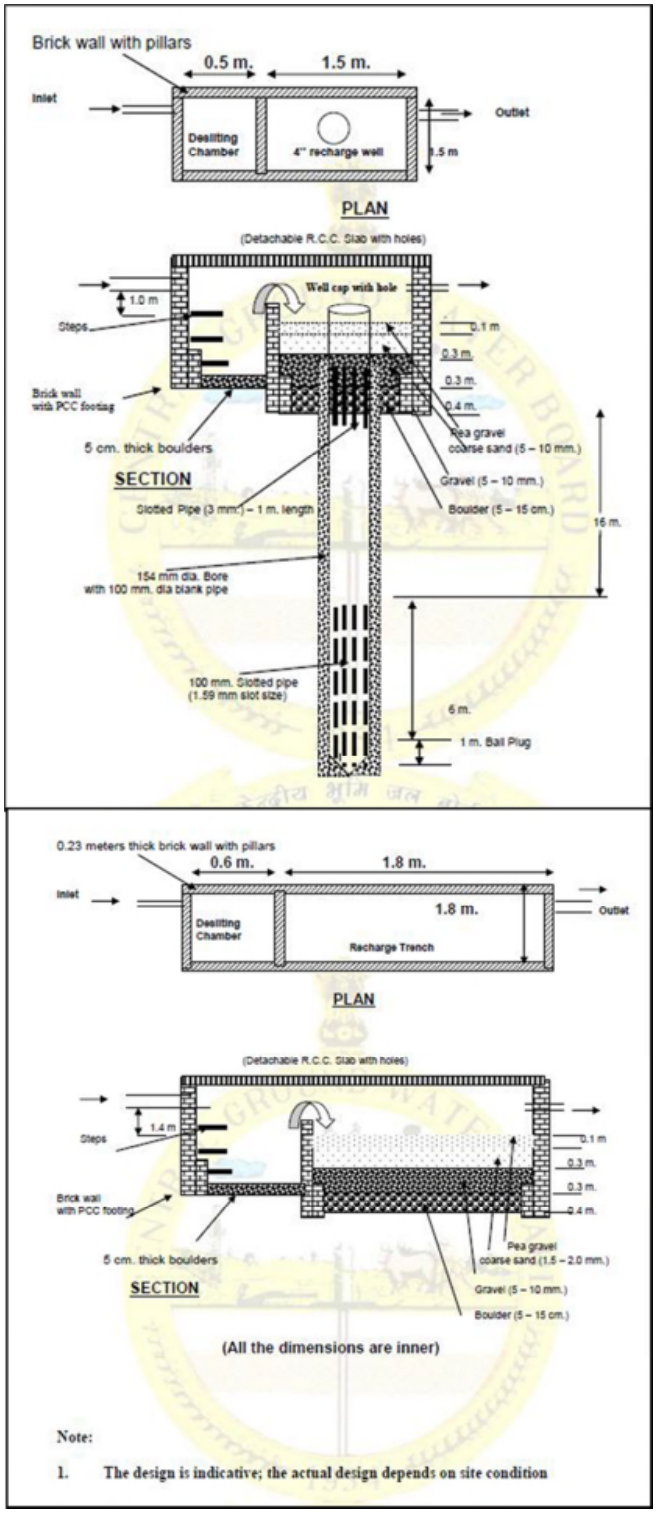
8.1.5 Proposed Rain Water Harvesting Structure:

The area most suitable for Rainwater harvesting in Coal Mine has been examined. The number and type of recharge structure required to store and recharge rainwater have been identified based on existing norms of CGWB and local conditions. The details are listed in **Table 8.2.**

Table 8.2: Proposed Rain Water Harvesting Structure

Effective roof toprunoff available for recharge m^3/year	Capacity for each recharge bore well in pit m^3/day	No. of rainy days	Estimated no. of RWH Structure	Recommended no. of RWH Structure
(A)	(B)	(C)	(A÷B:÷C)	
42412	554	15	5.10	6

Design of Roof top rainwater harvesting as per CGWA is given in **Figure 8.3.**



(Source-CGWA)

Figure 8.3: Roof Top Rainwater Harvesting