भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, पूर्वी झरिया क्षेत्र
पो.ओ.- भौरा, जिला - धनबाद (झारखण्ड)
पिन - ८२८३०२. दूरभाष - ०३२६-२३२००७७,
ईमेल- cgmej@bccl.gov.in
पंजीकृत कार्यालय: कोयला भवन, कोयला नगर, धनबाद-८२६००५, (झारखण्ड)
CIN: U10101JH1972GOI000918
दूरभाष-०३२६-२३२००७७/फैक्स:०३२६-२२३००५०, ईमेल- cos@bccl.gov.in

Bharat Coking Coal Limited
A MINI RATNA Co.
(A Subsidiary of Coal India Ltd)
Office of the General Manager, Eastern Jharia Area
P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302
Tel.:0326-2320077, Email-cgmej@bccl.gov.in
Regd.Off: Koyla Bhawan, Koyla Nagar, Dhanbad-825005,
CIN: U10101JH1972GOI000918,
Tel.:0326-2230190/FAX: 0326-2230050, Email – cos@bccl.gov.in

Ref. No.: BCCL/EJ/GM/Env./2019/686

Date: 30/05/2019
31

To,
The Director
Ministry of Environment, Forests and Climate Change
Regional office (ECZ)
Bungalow No. A-2, Shyamali Colony
Ranchi – 834002
Jharkhand

Sub.: Six monthly compliance report of the conditions of Environmental Clearance granted to Cluster X group of mines of BCCL for the period from October 2018 to March 2019.
(Ref.: EC Order No.- J-11015/380/2010-IA.II(M) dated 06.02.2013.)

Dear Sir,

Kindly find the enclosed here with the six monthly compliance report of the conditions of Environmental Clearance for the period from October 2018 to March 2019 in respect of Cluster X group of mines of BCCL.

Thanking You.

Encl.: Six monthly compliance report with annexure

Yours faithfully

31/5/19
General Manager
Eastern Jharia Area, BCCL
Cluster X

CC to:
1. Director, 1A Monitoring Cell, Paryavaran Bhawan, CGO Complex, New delhi-110003.
2. Dy. GM / HOD (Env.), BCCL, Koyla Bhawan, Dhanbad
3. AGM, E.J. Area, Bhowra, BCCL
4. Area Manager (Env.), E.J. Area
5. Master File

Scanned by CamScanner

ENVIRONMENTAL CLEARANCE COMPLIANCE OF CLUSTER-X

(GRANTED VIDE J-11015/380/2010-IA.II (M) Dated 06.02.2013)

(From October 2018 to March 2019)

Sl. No.	A. Specific Conditions by MOEF:	Compliance
I.	The maximum production from the opencast and underground section in the cluster shall not exceed beyond that for which environmental clearance has been granted for the cluster X as below:	The production from the cluster is within the limit for which environmental clearance has been granted. The year wise and colliery wise production is attached as Annexure – I.
II.	All the void /water bodies should be backfilled up to Ground level and no OB dump at the end of mining.	All the void is being backfilled as per EMP. The year wise data of backfilling and reclamation is given in Annexure – II.
III.	Extensive plantation should be provided on either side of Damodar River.	Extensive plantation is present along the Damodar river which is under cluster X. List of plant species present along the bank of Damodar river is attached as Annexure – III. In addition to this, Action has been taken for the plantation or eco-restoration work as per the Road Map prepared by Forest Research Institute (FRI), Dehradun. Annexure IV – Details of Plantation in EJ Area (Cluster X)
IV.	Details of impact of mining on Damodar River should be assessed and provided;	Detail study on Damodar River will be taken up by CMPDI. However, CMPDI is carrying out the Environment Monitoring which comprises of sampling and analysis of water from Damodar River (SW 21 & SW 22) under surface water analysis. Result of upstream and downstream samples showing no major changes in water quality of Damodar river (report enclosed as Annexure – V).
V.	Impact of mining on ground water of the area (Impact Zone) should be provided;	Ground water monitoring is being carried out by CMPDI and the ground water analysis report is enclosed as Annexure – VI.
VI.	A Garland drain should be provided and the drain water should not be discharged in to Damodar River;	Toe wall & retaining wall along the stabilized OB dump is present. OB dump is being stabilized through biological reclamation/ecological restoration technique which can be seen from Picture no. 1-5. No mine water is being discharged into Damodar river.
VII.	Excess water from mine after treatment should be supplied to the villagers;	An action plan for the utilization and treatment of surplus mine water has been prepared. In this regard 26 mines have

Scanned by CamScanner

		been identified for implementation of the Phase-I of the action Plan. However, at present, surplus mine water is being supplied to nearby villages / locality for domestic purpose (non drinking purpose). List of villages for supplied water is attached as Annexure – VII.
VIII.	Rejects of washery along with dry carbon slurry should be utilized in power plant and other recognized vendors;	Year wise produced dry carbon slurry is enclosed as Annexure – VIII.
IX.	There should be no discharge from the Washery (Slurry) in to the Damodar River. The entire washery water should be recycled;	All the washeries of BCCL are designed on Closed Circuit System to ensure no discharge from the washery premises.
X.	Damodar River should be protected by plantation on both sides;	Extensive plantation is present along the Damodar river which is under cluster X. List of plant species present along the bank of Damodar river is attached as Annexure – III. In addition to this, Action has been taken for the plantation or eco-restoration work as per the Road Map prepared by Forest Research Institute (FRI), Dehradun.
XI.	A herbal garden with medicinal plants be developed;	Kamini Kalyan Herbal Garden with 3.32 Ha. area has been taken up for 2016-17. Medicinal/ herbal plants have been planted as per FRI / BCCL Env. Dept. HQ guidelines. List of medicinal plants present in Kamini Kalyan herbal garden is enclosed as Annexure – IX.
XII.	A time schedule for filling of existing and abandoned quarries be done.	Existing & abandoned quarries are being filled as per approved progressive mine closure plan of the colliery. Time schedule as per approved mine closure plan is attached as Annexure – X.
XIII.	Of the total water bodies area of 286.54 ha in the post mining land use, consist of 243.97 ha of natural water bodies like Damodar river and no. of water ponds. Only 42.57 ha of mine voids were proposed to be converted to artificial water bodies for catering to domestic use of local villagers. Keeping in view the Damodar river in the vicinity, there should be no additional water bodies are created from mine.	Mine voids of 42.57 ha. will be converted to artificial water bodies at the end of mine i.e. at the post mining closure activities as per approved mining plan & mine closure plan. Mining Plan and Mine Closure Plan of Amalgamated Sudamdih Patherdih and Bhowra (South) mines has been approved in 348th BCCL Board meeting dated 29.01.2019 (copy enclosed as Annexure - XI).
XIV.	The measure identified in the environmental plan for cluster X groups of mine and the conditions given in this environmental clearance letter shall be	Master plan/Jharia Action Plan is dovetailed with environmental clearance conditions.

Scanned by CamScanner

	dovetailed to the implementation of the Jharia action plan.	
XV.	As there is no fire in cluster X but the measure should be adopted by proponent to control the spread of neighboring fire to the cluster X. The proponent shall prepare time series maps of the Jharia Coalfields through NRSA to monitor and prevent fire problems in the Jharia Coalfield by isothermal mapping/ imaging and monitoring temperatures of the coal seams (whether they are close to spontaneous ignition temperatures) and based on which, areas with potential fire problems shall be identified. Measures to prevent ingress of air (ventilation) in such areas, to prevent restart fresh/ spread fires in other areas including in mines of cluster XIV shall be undertaken.	Work has been awarded to NRSC (earlier NRSA) to monitor and prevent fire problems in the Jharia Coalfield and NRSC has submitted their final report. Fire affected area has been reduced from 9.00 Km^2 to 2.18 Km^2. For further dealing of fire and subsidence action has been taken and working as per the strategic plan of digging out of fiery coal followed by reclamation. A Global EOI was floated to control fire in Jharia Coalfield. None of the bidder qualified. Presently (i.e. in 2017) the Work Order for "Delineation of Surface Fire and associated land subsidence in Jharia Coal Field using satellite based remote sensing techniques" has already been awarded to NRSC under the MoU signed with NRSC. Measure to prevent ingress of air (ventilation) is being taken as specified in EMP and as per Jharia Master Plan. Further fire patches are under operation to dig out the fiery coal and combustible materials to save the coal from burning and to stop further spread of the fire. Once the fiery coal is dug-out/excavated there will be no more chance of re-starting of fresh/ spreading of fire into other areas. Annexure XII – Work Order awarded to NRSC regarding delineation of the surface coal fire.
XVI.	Underground mining should be taken up after completion of reclamation of Opencast mine area after 2 years.	It is being complied. Mining is being done as per the guidelines and approval/permission of Directorate General of Mines Safety (DGMS).
XVII.	No mining shall be undertaken where underground fires continue. Measure shall be taken to prevent/check such fire including in old OB dump.	It is being complied. Action is being taken to control, mine fires including old OB dump areas as specified in Jharia Master Plan and the mining is being done as per the guidelines and permissions of Directorate General of Mines Safety (DGMS).
XVIII.	A part of cluster X is under River Damodar. It was clarified that although the mine is underground, there is no coal underneath River Damodar, which would be mined. The Committee desired that the	CMPDI has prepared a report for design location and construction of 23 nos. of Piezometer covering all the 17 clusters of BCCL. Tender for establishing and

Scanned by CamScanner

	data of bore wells near River Damodar require to be monitored for permeability and seepage of water of River Damodar.	construction of a network of piezometric well system was done on 14.02.2019 and it is under process. However, a letter was sent to HQ for study of permeability and seepage of waster of Damodar river though CMPDIL. Same is attached as Annexure – XIII.
XIX.	The rejects of washeries in Cluster –X should be send to FBC based plant.	At present the Rejects generation is very low in operation of Sudamdih Washery as maximum portion is generated as middling. Rejects once significant in quantity will be checked for grade and auctioned to the users.
XX.	There shall be no external OB dumps. OB produce from the whole cluster will be 29.01 Mm3. OB from One Patch OCP mine shall be backfilled. At the end of the mining there shall be no void and the entire mined out area shall be re-vegetated. Areas where opencast mining was carried out and completed shall be reclaimed immediately thereafter.	Action is being taken as specified in EMP. O.B. removed from mine/ collieries are back filled in old/ abandoned quarry/voids. At the end of the mining, there shall not be voids and area will be re-vegetated and reclaimed with the proper eco-restoration techniques suggested by the experts available in BCCL and in external agencies i.e. FRI Dehradun, CEMDE Delhi. Year wise data of OB removal, backfilling & excavated area is being enclosed as Annexure – XIV.
XXI.	A detailed calendar plan of production with plan for OB dumping and backfilling (for OC mines) and reclamation and final mine closure plan for each mine of cluster- X shall be drawn up and implemented.	Calendar year plan of production and OB removal has been prepared for year 2018-19 & 2019-20. Mine closure plan as per the guidelines of Ministry of Coal have been prepared by Central Mine Planning and Design Institute (CMPDI) and it is being implemented. Annexure XV – Calendar Year plan of cluster X for year 2018-19 & 2019-20.
XXII.	The void in 5 ha area shall be converted into a water reservoir of a maximum depth of 15-20 m in post mining stage and shall be gently sloped and the upper benches of the reservoir shall be recognized with plantation and the periphery of the reservoir fenced. The abandoned pits and voids should be backfilled with OB and biologically reclaimed with plantation and or may be used for pisciculture	A part of the void will be converted into the water body as specified in EMP at post mining stage and plantation, sitting arrangement etc. will be provided around the periphery of the reservoir & will be developed as water recreational park.
XXIII.	Mining shall be carried out as per statuette from the streams/nalas flowing within the lease and maintaining a safe distance from the Nalas flowing along the lease boundary. A safety barrier of a	It is being followed. Action for construction of embankment has been taken as specified in EMP. Every year monsoon preparation programme is

Scanned by CamScanner

	minimum 60 m width shall be maintained along the nalas/water bodies. The small water bodies in OC shall be protected to the extent feasible and the embankment proposed along water body shall be strengthened with stone pitching.	carried out by colliery / mines before the onset of monsoon for protection of mines from rain water flow and to maintain a safe distance from nalas flowing or small water bodies protection in the lease boundary.
XXIV.	Active OB dumps near water bodies and rivers should be rehandled for backfilling abandoned mine voids. However, those which have been biologically reclaimed need not be disturbed.	No OB is being dumped near water bodies. The OB dumps created earlier already stabilized & further action has been taken for their eco-restoration work as per Road Map prepared by FRI, Dehradun.
XXV.	Thick green belt shall be developed along undisturbed areas, mine boundary and in mine reclamation. During post mining stage, a total of 47.63 ha area would be reclaimed by planting native species in consultation with the local DFO/Agriculture Department/institution with the relevant discipline. The density of the trees shall be around 2500 plants per ha.	Currently, dense plantation exists in Bhowra north, Bhowra South, Sudamdih, Patherdih and Amlabad Colliery. Several eco-restoration sites covering an area of 27.24 Ha have also been developed in consultations with institutes like FRI which was duly visited and appreciated by RO during his visit. Green belt is developed at available places and after the remaining area is decoaled, plantation will speed up in a time bound manner as per the EC conditions. Plantation work done in each calendar year is enclosed as Annexure – IV.
XXVI.	The road should be provided with avenue plantation on both side as trees act as sink of carbon and other pollutant.	Due to absence of permanent roads in the coalfield, avenue plantation couldn't be done but trees were planted near permanent structures to minimize the pollution. Approx. 50 plants were planted along both side of approach road of Bhowra north colliery as seen in Picture no. 6-7. DFO was requested through a letter regarding need based survey for plantation (Block plantation / gabion/ avenue plantation) under the leasehold area of Cluster X. Copy of the letter is enclosed Annexure – XVI.
XXVII.	Specific mitigative measures identified for the Jharia Coalfields in the Environmental Action Plan prepared for Dhanbad as a critically polluted area and relevant for Cluster –XIV shall be implemented.	Dhanbad Action Plan has been prepared in consultation with Jharkhand Pollution Control Board for entire BCCL. It is being implemented comprehensively for all the mines of BCCL. Some of the salient actions of this cluster are as under: 1. Construction of pucca road. 2. Construction of water reservoir for mine water utilization 3. Plantation.
XXVIII.	The locations of monitoring stations in the Jharia Coalfields should be finalized in consultation with	The locations of monitoring stations have been finalized in consultation with JSPCB.

Scanned by CamScanner

	the Jharkhand State Pollution Control Board. The Committee stated that smoke/dust emission vary from source to source (fuel wood, coal, fly ash from TPPs, silica from natural dust, etc) and a Source Apportionment Study should be got carried out for the entire Jharia Coalfields. Mineralogical composition study should be undertaken on the composition of the suspended particulate matter (PM10 and PM2.5) in Jharia Coalfields and also quantified. These studies would help ascertain source and extent of the air pollution, based on which appropriate mitigative measures could be taken.	The monitoring work of ambient environment quality is being carried out by Central Mine Planning & Design Institute Limited (CMPDIL) which is having CSIR laboratory recognized under the EP Rules. Work Order for the Project "Source Apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand" has been awarded to CSIR-National Environmental Engineering Research Institute (NEERI), Nagpur on 120.05.2018 and work has been started in September, 2018. Copy of the work order is enclosed as Annexure XVII.
XXIX.	No groundwater shall be used for the mining activities. Additional water required, if any, shall be met from mine water or by recycling/reuse of the water from the existing activities and from rainwater harvesting measures. The project authorities shall meet water requirement of nearby village(s) in case the village wells go dry to dewatering of mine.	It is being complied and mine water is being used for the industrial purpose like water sprinkling to suppress dust generation, etc. Further Mine water is also utilized for the community and irrigation purposes. Following action has been taken by the company: • Installation of Pressure filters for utilization of mine water. In cluster X, there is three nos. of Rapid Gravity Pressure Filter plant of total 1.72 MGD capacity, which is used for supply of water in nearby colonies, houses, quarters. Annexure XVIII – Details of water Filter plants in Cluster X. Report on Rain water harvesting and artificial recharge system in cluster X prepared by CMPDIL and attached as Annexure – XIX. Ponds & old quarries are being used for rain water harvesting & artificial recharge system in the area. Picture no. 8-13.
XXX.	Regular monitoring of groundwater level and quality of the study area shall be carried out by establishing a network of existing wells and construction of new peizometers. The monitoring for quantity shall be done four times a year in pre-monsoon (May), monsoon (August), post-monsoon (November) and winter (January) seasons and for quality including Arsenic and Fluoride during the month of May. Data thus collected shall be submitted to the Ministry of	Regular monitoring of Ground water quality is being carried out by CMPDIL. The Ground water Level and Quality report for Clusters of mines of BCCL (including Cluster X), have been submitted by CMPDIL & attached as Annexure VI. Annexure VI – Ground water level and Quality report. Establishment of new piezometers is

Scanned by CamScanner

	Environment & Forest and to the Central Pollution Control Board/SPCB quarterly within one month of monitoring. Rainwater harvesting measures shall be undertaken in case monitoring of water table indicates a declining trend.	under process. CMPDI has prepared a report for design location and construction of 23 Nos of Piezometer covering all the 17 clusters of BCCL. Tender for establishing and construction of a network of piezometer well system was done on 14.02.2019 and it is under process
XXXI.	Mine discharge water shall be treated to meet standards prescribed standards before discharge into natural water courses/agriculture. The quality of the water discharged shall be monitored at the outlet points and proper records maintained thereof and uploaded regularly on the company website.	Mine discharge water is being allowed to settle down in the mine sumps before disposal into storage reservoirs. The monitoring of water quality parameters is being done by CMPDIL and parameters are well within the prescribed limit provided by CPCB.
XXXII.	ETP shall also be provided for workshop, and CHP, if any. Effluents shall be treated to confirm to prescribe standards in case discharge into the natural water course.	There is no CHP in Cluster X. Letter regarding installation of Oil & Grease trap system at workshop has been sent to outsourced company & attached as Annexure – XX.
XXXIII.	Regular monitoring of subsidence movement on the surface over and around the working area and impact on natural drainage pattern, water bodies, vegetation, structure, roads, and surroundings shall be continued till movement ceases completely. In case of observation of any high rate of subsidence movement, appropriate effective corrective measures shall be taken to avoid loss of life and material. Cracks shall be effectively plugged with ballast and clayey soil/suitable material.	There is no subsidence movement over and around the working area of Cluster X mines as there is no depillaring operation going on in underground mines at present. Annexure – XXI is attached.
XXXIV.	Sufficient coal pillars shall be left unextracted around the air shaft (within the subsidence influence area) to protect from any damage from subsidence, if any.	Sufficient coal pillars have been left around air shafts as per the statutes and DGMS guidelines.
XXXV.	High root density tree species shall be selected and planted over areas likely to be affected by subsidence.	Identification of high root density Plant species and its plantation in subsidence prone area will be taken-up at the time of depillaring operations. Annexure XXII – List of High root density Plant species
XXXVI.	Depression due to subsidence resulting in water accumulating within the low lying areas shall be filled up or drained out by cutting drains.	It shall be complied, where ever applicable. However, a committee has been constituted for subsidence monitoring and surface mitigation measures under lease hold area of cluster X. Enclosed as Annexure – XXIII.
XXXVII.	Solid barriers shall be left below the roads falling within the blocks to avoid any damage to the roads.	It is being followed. Sufficient barriers are left for saving the surface installation and infra structures as per the statute and

Scanned by CamScanner

		DGMS guidelines.
XXXVIII.	No depillaring operation shall be carried out below the township/colony.	It is being followed.
XXXIX.	The Transportation Plan for conveyor-cum–rail for Cluster- X should be dovetailed with Jharia Action Plan. Road transportation of coal during Phase–I should be by mechanically covered trucks, which should be introduced at the earliest. The Plan for conveyor-cum–rail for Cluster-XIV should be dovetailed with Jharia Action Plan. The road transpiration of coal during phase–I should be by mechanically covered trucks.	Vehicles engaged in transportation are duly checked at Security Check-Post (CISF Check-Post) where security personnel also ensure proper covering of Trucks. No OEM is providing mechanically covered trucks. A communication in this regard has been made to Coal India Ltd for taking up with OEM. In absence of availability of approved OEM of mechanically covered trucks, BCCL is ensuring trucks are covered with tarpaulin through mandatory clause of covering in transportation contracts. The transport Plan for conveyor-cum-rail for Cluster X is to be implemented in the Phase II of the Jharia Master Plan. At present, Phase -1 is under implementation and after completion of Pre-implementation (1st & 2nd Yr.) and Phase 1 (3rd to 7th year) and Phase 2 (8th to 12th year). The plan shall be prepared after the completion of the above said phases to have conveyor-cum-rail transportation as informed by CMPDIL to whom the said work of preparation of Rail-cum-conveyor plan has been awarded (Annexure XXIV). During Phase- 1 & 2, covering of trucks by tarpaulin covers is being ensured. Picture no. 14-17 are attached.
XL.	A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport.	CMPDI is carrying out the study to analyze extent of reduction in pollution load every year by reducing road transport. Pollution load study report for Cluster X is awaited.
XLI.	R&R of 1670 nos of PAF's involved. They should be rehabilitated at cost of Rs 7087.75 Lakhs as per the approved Jharia Action Plan.	Implementation of master plan has already been started through Jharkhand Rehabilitation and Development Authority (JRDA), Dhanbad and 547 families (Non-BCCL) has been rehabilitated at well-established Jharia Vihar Township located at Belgoria.
XLII.	Details of transportation, CSR, R&R and implementation of environmental action plan for each of the 17 clusters should be brought out in a booklet for and submitted to Ministry.	A separate booklet comprising of CSR activities has been prepared and attached as annexure XXV (A). Annexure XXV (A) – Detail of CSR activity

Scanned by CamScanner

		of Cluster X.
XLIII.	A detailed CSR Action Plan shall be prepared for Cluster X group of mines. Specific activities shall be identified for CSR of Rs 20.25/annum @ of Rs 5/ton of coal production. As recurring expenditure. The 47.63 ha of area within Cluster XIV ML existing as waste land and not being acquired shall be put to productive use under CSR and developed with fruit bearing and other useful species for the local communities. Third party evaluation shall be got carried out regularly for the proper implementation of activities undertaken in the project area under CSR. Issue raised in the Public Hearing shall also be integrated with activities being taken up under CSR. The details of CSR undertaken along with budgetary provisions for the village-wise various activities and expenditure thereon shall be uploaded on the company website every year. The company must give priority to capacity building both within the company and to the local youth, who are motivated to carry out the work in future.	It being complied. BCCL is implementing CSR Activities. CSR action plan of BCCL including CSR budget and expenditure is enclosed as Annexure XXV (B). A separate CSR committee has been formed at Area level for cluster-X, who will look after the works being executed under CSR. A booklet comprising of CSR activities conducted by E.J. area has been prepared and attached as annexure XXV (A) – Detail of CSR activity of Cluster X.
XLIV.	For monitoring land use pattern and for post mining land use, a time series of land use maps, based on satellite imagery (on a scale of 1: 5000) of the core zone and buffer zone, from the start of the project until end of mine life shall be prepared once in 3 years (for any one particular season which is consistent in the time series), and the report submitted to MOEF and its Regional office at Bhubaneswar.	Presently a time series map of vegetation cover in the Jharia Coal Field is being carried out through CMPDI, Ranchi using satellite imagery for every 3 years. Time series of land use maps based on satellite imagery of the core zone and buffer zone is attached as Annexure – XXVI.
XLV.	A Final Mine Closure Plan along with details of Corpus Fund shall be submitted to the Ministry of Environment & Forests five year before mine closure for approval. Habitat Restoration Plan of the mine area shall be carried out using a mix of native species found in the original ecosystem, which were conserved in-situ and ex-situ in an identified area within the lease for reintroduction in the mine during mine reclamation and at the post mining stage for habitat restoration.	Mining Plan and Mine Closure Plan of Amalgamated Sudamdih Patherdih and Bhowra (South) mines has been approved in 348th BCCL Board meeting dated 29.01.2019 (copy enclosed as Annexure - XI).
XLVI.	A separate environmental management cell with suitable qualified personnel shall be set up under the control of a Senior Executive, who will report directly to the Head of the company for implementing environment policy and socioeconomic issues and the capacity building required in this regard.	A full-fledged Environment Department, headed by a HoD (Environment) along with a suitable qualified multidisciplinary team of executives which includes Environment, Mining, Excavation, Civil executives and technicians has been established in Headquarters. They are also trained in ecological restoration,

Scanned by CamScanner

		sustainable development, rainwater harvesting methods etc. At the project level, one Executive in each area has also been nominated as Project Nodal Officer (Environment) and is also entrusted with the responsibility of compliance and observance of the environmental acts/ laws including environment protection measures. The activities are monitored on regular basis at Area and at Head quarter levels. GM (Environment) at head quarter level, co-ordinates with all the Areas and reports to the Director (Technical) and in turn he reports to the CMD of the company. The team is multidisciplinary and very much motivated under the guidance of company's Director (Technical) and CMD. Further capacity building at both corporate and operating level is being done. Office Order of personnel along with designation looking after the environment management cell is attached as Annexure – XXVII.
XLVII.	Implementation of final mine closure plan for Cluster X, subject to obtaining prior approval of the DGMS in regard to mine safety issues	Final Mine Closure Plan has been prepared for each Mine in this cluster. Before implementation of final mine closure plan, prior permission from DGMS has been taken in regard to mine safety issues.
XLVIII.	Corporate Environment Responsibility: A. The Company shall have a well laid down Environment Policy approved by the Board of Directors. B. The Environment Policy shall prescribe for standard operating process/procedures to bring into focus any infringements/deviation/violation of the environmental or forest norms/conditions. C. The hierarchical system or Administrative Order of the company to deal with environmental issues and for ensuring compliance with the environmental clearance conditions shall be furnished. D. To have proper checks and balances, the company shall have a well laid down system of reporting of non-compliances/violations of	A well-defined Corporate Environment Policy has already been laid down and approved by the Board of Directors. This is also posted on BCCL website. Complied. A hierarchical system of the company to deal with environmental issues from corporate level to mine level already exists. Being complied.

Scanned by CamScanner

	environmental norms to the Board of Directors of the company and/or shareholders or stakeholders at large.	
B.	**General Conditions by MOEF:**	
I.	No change in mining technology and scope of working shall be made without prior approval of the Ministry of Environment and Forests.	Being complied.
II.	No change in the calendar plan of production for quantum of mineral coal shall be made	Being followed. Production is being done well within production capacity of this cluster as per EC.
III.	Four ambient air quality monitoring stations shall be established in the core zone as well as in the buffer zone for PM10, PM2.5, SO2 and NOx monitoring. Location of the stations shall be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board. Monitoring of heavy metals such as Hg, As, Ni, Cd, Cr, etc carried out at least once in six months.	The optimum location of monitoring stations in Jharia Coal Field finalized in consultation with the Jharkhand State Pollution Control Board. Ambient air quality is being regularly monitored by CMPDIL. Water Sprinkling in Mine Premises has been regularly done to reduce PM10 and PM2.5 level and at the same time Scheme for installation of Sprinklers at Coal Dumps, weighbridge taken up at HQ level. Picture no. 20-22. Annexure XXVIII – Environmental Monitoring Report for cluster X.
IV.	Data on ambient air quality (PM10, PM 2.5, SO2 and NOx) and heavy metals such as Hg, As, Ni, Cd, Cr and other monitoring data shall be regularly submitted to the Ministry including its Regional Office at Bhubaneswar and to the State Pollution Control Board and the Central Pollution Control Board once in six months. Random verification of samples through analysis from independent laboratories recognized under the EPA rules, 1986 shall be furnished as part of compliance report.	Ambient air quality data (PM10, PM2.5, SO2 and NOx) and other monitoring data have been regularly monitored and analyzed by CMPDIL and submitted the report, which is attached. Annexure XXVIII – Environmental Monitoring Report for cluster X.
V.	Adequate measures shall be taken for control of noise levels below 85 dBA in the work environment. Workers engaged in blasting and drilling operations, operation of HEMM, etc shall be provided with ear plugs/muffs.	It is being complied in mines and also the Noise levels are below the Ambient Noise Standard (Day time 75 dB & Night Time (70 dB for Industrial Area). However, ear muffs / ear plugs are provided to the workers engaged in blasting and drilling operations, HEMM operations etc.
VI.	Industrial wastewater (workshop and wastewater from the mine) shall be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19th May 1993 and 31st December 1993 or as amended from time to time before discharge. Oil and grease trap shall be installed before discharge of workshop effluents.	The optimum location of monitoring stations in Jharia Coal Field finalized in consultation with the Jharkhand State Pollution Control Board. Mine water & ground water quality is being regularly monitored by CMPDIL. Physico-Chemical characteristics of effluents are well within the prescribed

Scanned by CamScanner

		limit. Letter regarding installation of Oil & Grease trap system at workshop has been sent to outsourced company & attached as Annexure – XX.
VII.	Vehicular emissions shall be kept under control and regularly monitored. Vehicles used for transporting the mineral shall be covered with tarpaulins and optimally loaded.	Vehicular emissions are being under control and the Pollution under control certificate has been attached as Annexure – XXIX. All the vehicles used for coal transportation are covered with tarpaulins.
VIII.	Monitoring of environmental quality parameters shall be carried out through establishment of adequate number and type of pollution monitoring and analysis equipment in consultation with the State Pollution Control Board and data got analysed through a laboratory recognized under EPA Rules, 1986.	Monitoring of Environmental quality parameters have been regularly done by CMPDIL with proper analysis equipment.
IX.	Personnel working in dusty areas shall wear protective respiratory devices and they shall also be provided with adequate training and information on safety and health aspects.	It is being complied. All Personnel working in mines are provided with respiratory masks and safety eyeglass to protect the dust ingestion. List of persons who have been issued protective respiratory devices/ dust mask in the year 2016-2017& 2017-2018 is enclosed as Annexure – XXX. A separate full-fledged Human Resource Development Department is conducting regular training programme on these issues. Apart from this, Vocational Training Center exist in E.J. area (cluster X), which provides periodical training on the safety and occupational health issue to workers working in the mines.
X.	Occupational health surveillance programme of the workers shall be undertaken periodically to observe any contractions due to exposure to dust and to take corrective measures, if needed and records maintained thereof. The quality of environment due to outsourcing and the health and safety issues of the outsourced manpower should be addressed by the company while outsourcing.	Initial Medical Examination (IME) and Periodical Medical Examination (PME) of all the personnel are carried out as per the Statutes and Director General of Mines Safety (DGMS) guideline. Annexure XXXI – List of IME and PME of cluster X (EJ Area) for 2018-19. Certificate of the area medical officer is attached as Annexure XXXII showing no occupational disease has been detected in the Cluster X group of mines.
XI.	A separate environmental management cell with suitable qualified personnel shall be set up under the control of a Senior Executive, who will report directly to the Head of the company.	A full-fledged Environment Department, headed by a HoD (Environment) along with a suitable qualified multidisciplinary team of executives which includes Environment, Mining, Excavation, Civil executives and technicians has been

Scanned by CamScanner

		established in Headquarters. They are also trained in ecological restoration, sustainable development, rainwater harvesting methods etc. At the project level, one Executive in each area has also been nominated as Project Nodal Officer (Environment) and is also entrusted with the responsibility of compliance and observance of the environmental acts/ laws including environment protection measures. The activities are monitored on regular basis at Area and at Head quarter levels. GM (Environment) at head quarter level, co-ordinates with all the Areas and reports to the Director (Technical) and in turn he reports to the CMD of the company. The team is multidisciplinary and very much motivated under the guidance of company's Director (Technical) and CMD. Further capacity building at both corporate and operating level is being done. Office Order of personnel along with designation looking after the environment management cell is attached as Annexure – XXVII.
XII.	The funds earmarked for environmental protection measures shall be kept in separate account and shall not be diverted for other purpose. Year-wise expenditure shall be reported to this Ministry and its Regional Office at Bhubaneswar.	Year wise and item wise expenditure made on environment protection measures is enclosed as Annexure – XXXIII.
XIII.	The Project authorities shall advertise at least in two local newspapers widely circulated around the project, one of which shall be in the vernacular language of the locality concerned within seven days of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance letter is available with the State Pollution control Board and may also be seen at the website of the ministry of Environment & Forests at http://envfor.nic.in.	It has been complied. Advertisement in local newspaper has also been done. Enclosed as Annexure – XXXIV.
XIV.	A copy of the environmental clearance letter shall be marked to concern Panchayat/Zila Parishad, Municipal corporation or Urban local body and local NGO, if any, from whom any suggestion /representation has been received while processing the proposal. A copy of the clearance letter shall also be displayed on company's website.	A copy of EC letter sent to Municipal corporation / panchyat is enclosed as Annexure – XXXV.

Scanned by CamScanner

XV.	A copy of the environmental clearance letter shall be shall also be displayed on the website of the concerned State Pollution Control Board. The EC letter shall also be displayed at the Regional Office, District Industry Sector and Collector's Office/Tehsildar's Office for 30 days.	Complied.
XVI.	The clearance letter shall be uploaded on the company's website. The compliance status of the stipulated environmental clearance conditions shall also be uploaded by the project authorities on their website and updated at least once every six months so as to bring the same in public domain. The monitoring data of environmental quality parameter (air, water, noise and soil) and critical pollutant such as PM10, PM2.5, SO2 and NOx (ambient) and critical sectoral parameters shall also be displayed at the entrance of the project premises and mine office and in corporate office and on company's website.	Complied. The clearance letter has been uploaded on the BCCL website.
XVII.	The project proponent shall submit six monthly compliance reports on status of compliance of the stipulated environmental clearance conditions (both in hard copy and in e-mail) to the respective Regional Office of the Ministry, respective Zonal Offices of CPCB and the SPCB.	Being complied.
XVIII.	The Regional Office of this Ministry located at Bhubaneswar shall monitor compliance of the stipulated conditions. The Project authorities shall extend full cooperation to the office(s) of the Regional Office by furnishing the requisite data/ information/monitoring reports.	Project authority is ready to extend its full cooperation for any kind of visit and inspection conducted by Regional Office in connection with EC Conditions Compliance.
XIX.	The Environmental statement for each financial year ending 31 March in Form –V is mandated to be submitted by the project proponent for the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be uploaded on the company's website along with the status of compliance of EC conditions and shall be sent to the respective Regional Offices of the MoEF by E-mail.	Environmental Statement (Form-V) has been regularly submitted for each financial year to Jharkhand State Pollution Control Board. Annexure XXXVI – Environmental statement (Form-V) of projects/collieries of E.J. Area attached.
C.	**Other Conditions by MOEF:**	
i.	The Ministry or any other Competent Authority may stipulate any further condition(s) for environmental protection.	Agreed.
ii.	Failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract the provisions of the	Agreed.

Scanned by CamScanner

	Environment (Protection) Act, 1986.	
iii.	The above conditions will be enforced inter-alia, under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and the Public Liability Insurance Act, 1991 along with their amendments and Rules. The Proponent shall ensure to undertake and provide for the costs incurred for taking up remedial measures in case of soil contamination, contamination of groundwater and surface water, and occupational and other diseases due to the mining operations.	It is being complied.
iv.	The Environmental Clearance is subject to the outcome of the Writ Petition filed by M/S Bharat Coking Coal Limited (BCCL) in response to the closure orders issued by the Jharkhand State Pollution Control Board which is pending in the Jharkhand High Court.	Agreed.

30/5/19
Project Officer
Bhowra (North),
EJ Area

30/5/19
Project Officer
Bhowra (South),
EJ Area

30/5/19
Project Officer
ASP,
EJ Area

30/05/19
Area Manager (Env.)
EJ Area

31/5/19
Addl. General Manager
EJ Area, BCCL
Cluster X

31/5/19
General Manager
EJ Area, BCCL
Cluster X

Scanned by CamScanner

Annexure -

COAL PRODUCTION DATA (IN MT) OF CLUSTER X SINCE GRANT OF EC

Mine Name		EC Capacity (Peak)	2013-14		2014-15		2015-16		2016-17		2017-18	
			Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual
Amlabad UG	UG	0	0	0	0	0	0	0	0	0	0	0
Bhowra North	UG	0.143	0.054	0.024	0.030	0.032	0.040	0.028	0.040	0.023	0.026	0.012
	OC	0.546	0.282	0.143	0.160	0.010	0.105	0.028	0.000	0.000	0.000	0.000
Bhowra South	UG	0.377	0.054	0.037	0.045	0.032	0.030	0.025	0.030	0.022	0.024	0.010
	OC	0.51	0.218	0.185	0.225	0.110	0.145	0.28	0.320	0.413	0.424	0.458
Sudamdih Shaft	UG	0.241	0	0	0	0	0	0	0	0	0	0
Sudamdih Incline	UG	0.117	0.024	0.021	0.033	0.032	0.020	0.014	0	0	0	0
Patherdih	UG	0.07	0.018	0.014	0.017	0.008	0	0	0	0	0	0
	OCP	0.286	0.150	0.104	0	0.045	0.128	0.205	0.260	0.267	0.227	0.277
Total (Cluster X)		**2.289**	**0.800**	**0.528**	**0.510**	**0.269**	**0.468**	**0.580**	**0.650**	**0.725**	**0.700**	**0.757**

Annexure - II

UNIT WISE BACKFILLING DATA (IN Ha.) OF CLUSTER X

Mine Name	2013-14	2014-15	2015-16	2016-17	2017-18
Bhowra North – Mix	1.76	3.17	0.00	0.00	0.00
Bhowra South – Mix	4.10	6.50	6.50	5.24	5.24
Sudamdih Incline	0.00	0.00	0.00	0.00	0.00
Patherdih – Mix	1.93	0.96	0.60	0.58	0.51
Sudamdih Shaft	0.00	0.00	0.00	0.00	0.00
Amlabad UG	0.00	0.00	0.00	0.00	0.00

AREA OF ECOLOGICAL RESTORATION SITES / PLANTATION / BIOLOGICAL RECLAMATION (in Ha.)

Colliery / Mine Name	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Bhowra North	Nil	Nil	Nil	5.20	3.10	Nil
Bhowra South	Nil	4.78	Nil	Nil	Nil	4.50
Sudamdih Incline (UG)	Nil	0	Nil	Nil	Nil	Nil
Patherdih - OC Section	Nil	3.95	5.71	Nil	Nil	Nil
Sudamdih Shaft (UG)	Nil	Nil	Nil	Nil	Nil	Nil
Amlabad UG	Nil	Nil	Nil	Nil	Nil	Nil
Total (in Ha.)	Nil	**8.73**	**5.71**	**5.20**	**3.10**	**4.50**

Annexure -III

LIST OF PLANTS SPECIES ALONG RIVER DAMODAR

List of the plants species, which are found most commonly along the river Damodar, is given below:

S. No.	Botanical Name	Local Name	Hindi Name
1	*Acacia arabica*	Babul	Babul
2	*Adina cordifolia*	Karam	Karam
3	*Ailanthus excelsa*	Ghorkaranj/ Ghorkaram	Ghorkaranj/ Ghorkaram
4	*Alangium Lamarckii*	Dhela	Dhela
5	*Albizzia lebbek*	Siris	Siris
6	*Albizzia procera*	Safed Siris	Safed Siris
7	*Alstonia scholaris*	Chatni	Chatni
8	*Azadirachta indica*	Neem	Neem
9	*Bombax ceiba*	Semal	Semal
10	*Butea frondosa*	Palas	Palas
11	*Casearia tomentosa*	Beri	Beri
12	*Cassia fistula*	Dhanraj/Amaltas	Dhanraj/Amaltas
13	*Dalbergia sissoo*	Shisham	Shisham
14	*Eugenia jamb*	Jamun	Jamun
15	*Ficus religiosa*	Pipal	Pipal
16	*Lagerostroemia parviflora*	Sidha	Sidha
17	*Mitragyna parviflora*	Guri/Gurikaram	Guri/Gurikaram
18	*Terminalia arjuna*	Arjun	Arjun
19	*Phoenix acaulis*	Khejur	Khejur
20	*Ficus racemosa*	Gular	Gular
21	*Calotropis procera*	Calotropis	Calotropis
22	*Ricinus communis*	Castor	Castor

Detail of Plantation / Ecological Restoration of E.J. Area										
Area/ Colliery		Site Name	Area (Ha)	Taken up in	Plantation (Nos)					
					2014-15	2015-16	2016-17	2017-18	2018-19	**Total**
Bh (N)		Bh N / BLA OB site	5.20	2016-17	-	-	13000	2850		**15850**
		New BLA site	3.10	2017-18	-	-	-	4725		**4725**
Bh (S)		3 Pit OB site	4.78	2014-15	12189		1000	2200		**15389**
		Bhowra Chandan OB Site	4.50	2018-19	-	-	-	-	11500	**11500**
ASP Colliery	Patherdih Mix	COCP / Vrindavan Site	5.71	2015-16	-	6125	8150	3000		**17275**
		Kamini Kalyan Herbal garden	3.32	1980 (old)	375 (planted before 2014)	-	40	50		**465**
	Sudamdih	Mohalbani Site	3.95	2014-15	10874		1000	1200		**13074**
Amlabad		-	-	-	-	-	-	-	-	-
Total			**30.56**		**23063**	**6125**	**23190**	**14025**	**11500**	**78278**

STRICTLY RESTRICTED
FOR COMPANY USE ONLY RESTRICTED
The information given in this report is not to be communicated either directly or indirectly to the press or to any person not holding an official position in the CIL / GOVERNMENT.

ENVIRONMENTAL QUALITY REPORT OF BHARAT COKING COAL LIMITED, CLUSTER – X

(FOR THE Q.E. JUNE 2018)

E. C. no. J-11015/380/2010-IA.II (M) dated 06.02.2013

CMPDI
ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CLUSTER - X

(FOR THE Q.E. JUNE 2018)

CONTENTS

SL. NO.	CHAPTER	PARTICULARS
1.		EXECUTIVE SUMMARY
2.	CHAPTER - I	INTRODUCTION
3.	CHAPTER-II	AIR SAMPLING & ANALYSIS
	CHAPTER-III	WATER SAMPLING & ANALYSIS
4.	**Plates:**	
	Plate NO. - I	SURFACE PLAN SHOWING WATER MONITORING LOCATIONS

STRICTLY RESTRICTED
FOR COMPANY USE ONLY RESTRICTED
The information given in this report is not to be communicated either directly or indirectly to the press or to any person not holding an official position in the CIL / GOVERNMENT.

ENVIRONMENTAL QUALITY REPORT
OF
BHARAT COKING COAL LIMITED
CLUSTER – X

(FOR THE Q.E. JUNE 2018)

E. C. no. J-11015/380/2010-IA.II (M) dated 06.02.2013.

CMPDI

ISO 9001 Company

Regional Institute-II

Dhanbad, Jharkhand

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the environment around us. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. One of these major attributes is water.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by $23^0$37' N to $23^0$52' N latitudes and $86^0$09' E to $86^0$30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Water sampling stations

The Water sampling stations were selected for mine effluent water, drinking water supply, well/ Hand pump water & also surface water samples.

2.2 Ambient air sampling locations

The ambient air quality monitoring stations were selected to represent core, buffer zone area. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

3.0 Methodology of sampling and analysis

3.1 Water quality

Water samples were collected as per standard practice. Effluent samples were analyzed for 25 parameters on quarterly basis & for 27 parameters on half yearly basis. The drinking and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Asansol, West Bengal.

3.2 Heavy Metal in Ambient Air

Parameters chosen for assessment of Heavy metal in Ambient Air Quality were cadmium (Cd), Mercury (Hg), Arsenic (As), Chromium (Cr), Nickel (Ni), and Lead (Pb). Respirable Dust Samplers (RDS) & fine particulates for PM 2.5 sampler were used for sampling PM 10 & PM 2.5 respectively. These heavy metals are analyzed regularly on half yearly basis. The samples were analyzed in Environmental Laboratory of CMPDI, RI-II, Dhanbad

4.0 Results and interpretations

4.1 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, IS.10500/2012 (Drinking water) and IS: 2296 (Surface water), are with in permissible limits.

4.2 Heavy Metal in Ambient Air

The results of Heavy metal in Ambient Air Quality are presented in tabular form for each monitoring station. The concentration of heavy metals in ambient air is well within the permissible limit.

CHAPTER - I

INTRODUCTION

1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by Ministry of Environment, Forests and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal Limited (BCCL), a subsidiary company of Coal India Limited (CIL) is operating UG Mines and Opencast Mines in Jharia Coalfield (JCF). The Jharia Coalfield (JCF) having an area of 450 Sq.KM.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

1.1 The Cluster-X is in the Eastern part of the Jharia coalfield. It includes a group of 6 Mines (viz. Amlabad UG, Bhowra north, Bhowra South, Patherdih, Sudamdih Incline & Sudamdih Shaft. The Cluster – X is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – X are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by Damodar River.

1.2 The Cluster-X is designed to produce 1.762 MTPA (normative) and 2.289 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 1.762 MTPA (normative) and 2.289 MTPA (peak) capacity of coal production vide letter no. J-11015/380/2010-IA.II (M) dated 06th February, 2013.

In compliance of these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC & SPCB and other statutory authorities.

CHAPTER – II

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

(As per G.S.R. 742 (E) dt. 25th December, 2000)

2.2 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) Bhowrah North (A14): Industrial Area

The location of the sampling station is 23°41'37.00"N - 86°23'54.00"E.

ii) Sudamdih Washery (A15): Industrial Area

The location of the sampling station is 23°39'31.00"N - 86°25'48.00"E.

II. BUFFER ZONE Monitoring Location

i) Jeenagora (A13): Industrial Area

The location of the sampling station is 23°42'31.00"N - 86°26'38.00"E.

ii) Sitanala (A30): Industrial Area

This location of the sampling station is 23°41'15.00"N - 86°22'39.00"E, at the Amlabad Project office which is currently in-operational.

2.3 Results and interpretations

The results of Heavy metal in Ambient Air Quality are presented in tabular form for each monitoring station. The concentration of heavy metals in ambient air is well within the permissible limit.

AMBIENT AIR QUALITY DATA

Name of the Company: **Bharat Coking Coal Limited** Year : **2018-19.**
Name of the Cluster : **Cluster - X** PERIOD: **Q. E. JUNE- 2018.**
MONTH: JUNE 2018

Heavy Metal Analysis report of Ambient Air Quality

SAMPLE	Cadmium(Cd) (µg/m3)	Mercury(Hg) (µg/m3)	Arsenic(As) (ng/m3)	Chromium(Cr) (µg/m3)	Nickel (Ni) (ng/m3)	Lead (Pb) (µg/m3)
Jeenagora (A13)	<0.001	<0.001	<0.005	0.01	<0.01	<0.005
Bhowrah North (A14)	<0.001	<0.001	<0.005	0.01	<0.01	<0.005
Sudamdih Washery (A15)	<0.001	<0.001	<0.005	0.01	<0.01	0.005
Block II OCP (A4)	<0.001	<0.001	<0.005	0.03	<0.01	0.009

Analysed By
JSA/SA/SSA

Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(Mining/Environment)
RI-2, CMPDI, Dhanbad

CHAPTER – III

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. - I**)

I) Drinking Water quality at **Bhowrah North (DW10)**

ii) Surface Water quality at **U/S of Damodar River (SW21)**

iii) Surface Water quality at **D/S of Damodar River (SW22)**

iv) Mine Effluent quality **at Bhowrah North (MW10)**

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. Effluent samples were analyzed for 25 parameters on quarterly basis & for 27 parameters on half yearly basis. The drinking and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Asansol, West Bengal.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results show that most of the parameters are within the permissible limits.

WATER QUALITY

(SURFACE WATER- 17 PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2018-19.**

Name of the Cluster: **Cluster - X** Period: **Q.E. JUN 2018**

Stations: **Date of Sampling:**

1. Upstream in Damodar river SW-21 12/06/2018
2. Downstream in Damodar river SW-22 12/06/2018

Sl.No	Parameter	Sampling Stations				Detection Limit	IS:2296 – 1982 (Inland surface water) Class C	BIS Standard & Method
		SW-21	SW-22	3	4			
1	Arsenic (as As), mg/l, Max	<0.002	<0.002			0.002	0.2	IS 3025/37:1988 R : 2003, AAS-VGA
2	BOD (3 days 27°C), mg/l, Max	2.0	2.4			2.00	300	IS 3025 /44: 1993, R : 2003 3 day incubation at 27°C
3	Colour	Colourless	Colourless			Qualitative	300	Physical/Qualitative
4	Chlorides (as Cl), mg/l, Max	24	32			2.00	600	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03			0.001	1.5	IS 3025 /42 : 1992 R : 2009, AAS-Flame
6	Disolved Oxygen, min.	3.6	3.4			0.10	4	IS 3025/381989, R : 2003, Winkler Azide
7	Fluoride (as F) mg/l, Max	0.33	0.36			0.02	1.5	APHA, 22nd Edition SPADNS
8	Hexavalent Chromium, mg/l, Max	0.025	0.029			0.01	0.05	APHA, 22nd Edition, 1,5 - Diphenylcarbohydrazide
9	Iron (as Fe), mg/l, Max	<0.06	<0.06			0.06	50	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
10	Lead (as Pb), mg/l, Max	<0.005	<0.005			0.005	0.1	APHA, 22nd Edition AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	8.16	9.47			0.50	50	APHA, 22nd Edition, UV-Spectrphotometric
12	pH value	8.08	7.89			2.5	6.5-8.5	IS-3025/11:1983, R-1996, Electrometric
13	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.002	<0.002			0.002	5.0	APHA, 22nd Edition 4-Amino Antipyrine
14	Selenium (as Se), mg/l, Max	<0.002	<0.002			0.002	0.05	APHA, 22nd Edition AAS-GTA
15	Sulphate (as SO_4) mg/l, Max	84	98			2.00	400	APHA, 22nd Edition Turbidity
16	Total Dissolved Solids, mg/l, Max	590	602			25.00	1500	IS 3025 /16:1984 R : 2006, Gravimetric
17	Zinc (as Zn), mg/l, Max	<0.01	<0.01			0.01	5.0	IS 3025 /49 : 1994, R : 2009, AAS-Flame

All values are expressed in mg/lit unless specified.

Analysed By
JSA/SA/SSA

Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(Mining/Environment)
RI-2, CMPDI, Dhanbad

WATER QUALITY

(DRINKING WATER- 25 PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2018-19.**

Name of the Cluster: **Cluster - X** Period: **Q.E. JUNE 2018**

Stations: **Date of Sampling:**

1. Drinking Water from Bhowrah South DW-10 13.06.2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		DW-10	2	3			
1	Boron (as B), mg/l, Max	<0.2			0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	3			1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	62.3			1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	56			2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001			0.001	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.51			0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02			0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06			0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005			0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02			0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	18.4			0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable			Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.56			2.5	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001			0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002			0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	136			2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable			Qualitative	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	108			4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002			0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04			0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	424			25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	128			4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2			1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01			0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.005			0.005	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*All values are expressed in mg/lit unless specified.

Analysed By
JSA/SA/SSA

Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(Mining/Environment)
RI-2, CMPDI, Dhanbad

WATER QUALITY

(MINE EFFLUENT - 27 PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2018-19.**

Name of the Cluster: **Cluster - X** Period: **Q.E. JUNE 2018**

Stations: **Date of Sampling:**

1. Mine Water Discharge Bhowrah North MW-10 28/06/2018

Sl.No.	Parameter	Sampling Stations			Detection Limit	MOEF -SCH-VI STANDARDS Class 'A'	BIS Standard & Method
		MW-10	2	3			
1	Ammonical Nitrogen, mg/l, Max	0.08			0.02	50.0	IS 3025/34:1988, R : 2009, Nessler's
2	Arsenic (as As), mg/l, *Max*	<0.002			0.002	0.2	IS 3025/37:1988 R : 2003, AAS-VGA
3	B.O.D (3 days 27°C), mg/l, Max	<2			2.00	30.0	IS 3025 /44:1993,R:2003 3 day incubation at 27°C
4	Colour	colourless			Qualitative	Qualitative	Physical/Qualitative
5	COD, mg/l, Max	32			4.00	250.0	APHA, 22nd Edition, Closed Reflux, Titrimetric
6	Copper (as Cu), mg/l, *Max*	<0.03			0.03	3.0	IS 3025/42: 1992 R : 2009, AAS-Flame
7	Dissolved Phosphate, mg/l, Max	0.6			0.30	5.0	APHA, 22nd Edition Molybdovanadate
8	Fluoride (as F) mg/l, *Max*	0.70			0.02	2.0	APHA, 22nd Edition, SPADNS
9	Free Ammonia, mg/l, Max	<0.01			0.01	5.0	IS:3025/34:1988, Nesseler's
10	Hexavalent Chromium, mg/l, Max	0.042			0.01	0.1	APHA, 22nd Edition, Diphenylcarbohydrazide
11	Iron (as Fe), mg/l, *Max*	0.38			0.06	3.0	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
12	Lead (as Pb), mg/l, *Max*	<0.005			0.005	0.1	APHA, 22nd Edition, AAS-GTA
13	Manganese(as Mn), mg/l, Max	<0.02			0.02	2.0	IS-3025/59:2006, AAS-Flame
14	Nickel (as Ni), mg/l, *Max*	<0.005			0.005	3.0	IS-3025/54:2003, AAS-Flame
15	Nitrate Nitrogen, mg/l, *Max*	0.5			0.50	10.0	APHA, 22nd Edition, UV-Spectrphotometric
16	Oil & Grease, mg/l, Max	<2.0			2.00	10.0	IS 3025/39:1991, R : 2003, Partition Gravimetric
17	pH value	7.75			2.5	5.5 to 9.0	IS-3025/11:1983, R-1996, Electrometric
18	Phenolic compounds (as C_6H_5OH),mg/l, *Max*	<0.002			0.002	1.0	APHA, 22nd Edition 4-Amino Antipyrine
19	Selenium (as Se), mg/l, *Max*	<0.002			0.002	0.05	APHA, 22nd Edition, AAS-GTA
20	Sulphide (as SO_3), mg/l, Max	0.005			0.005	2.0	APHA, 22nd Edition Methylene Blue
21	Temperature (°C)	31.6			Shall not exceed 5^0 C above the receiving temp		IS-3025/09:1984, Thermometeric
22	Total Chromium (as Cr), mg/l, *Max*	<0.06			0.04	2.0	IS-3025/52:2003, AAS-Flame
23	Total Kjeldahl Nitrogen, mg/l, Max	1.0			1.00	100.0	IS:3025/34:1988, Nesseler's
24	Total Residual Chlorine, mg/l, Max	0.07			0.02	1.0	APHA, 22nd Edition, DPD
25	Total Suspended Solids, mg/l, Max	34			10.00	100.0	IS 3025/17:1984, R :1996, Gravimetric
26	Zinc (as Zn), mg/l, *Max*	<0.01			0.01	5.0	IS 3025 /49 : 1994, R : 2009, AAS-Flame
27	Odour	Agreeable			Agreeable	Qualitative	Is-3015/5:1983/R:2012/Qualitative

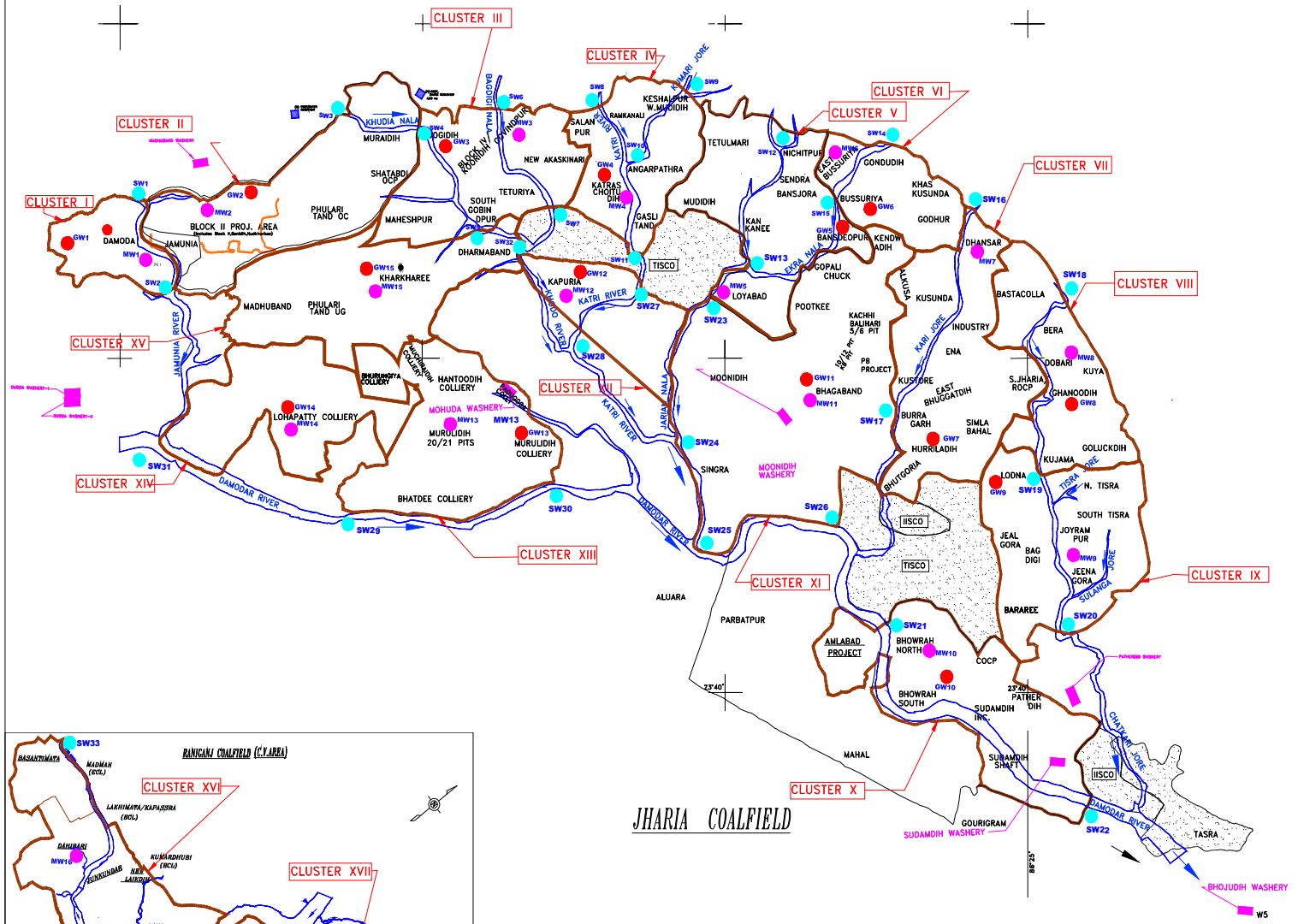
*All values are expressed in mg/lit unless specified.

Analysed By
JSA/SA/SSA

Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(Mining/Environment)
RI-2, CMPDI, Dhanbad

Water Sampling Locations in BCCL



INDEX

Cluster	Suface Water (U/S, D/S)	Name of River/ Nala / Jore	Mine/ Effluent Water	Sampling Location	Ground Water	Sampling Location
I	SW1, SW2	Jamunia River	MW1	Damoda Area	GW1	Ghutway Village
II	SW3, SW4	Khudia Nala	MW2	Block II OCP	GW2	Joyrampur Village
III	SW4, SW5, SW6, SW7	Khudia Nala, Bagdigi Nala	MW3	Govindpur Colliery	GW3	Jogidih Village
IV	SW8, SW11, SW9, SW10	Katri River Kumari Jore	MW4	Chotudih	GW4	Kankanee Village
V	SW12, SW13, SW15	Jarian Nala, Ekra Nala	MW5	Mudidih	GW5	Nichitpur
VI	SW14, SW15	Ekra Nala	MW6	East Bassuria UGP	GW6	Bansjora Borewell
VII	SW16, SW17	Kari Jore	MW7	Dhansar UGP	GW7	Hurriladih
VIII	SW18, SW19	Kashi Jore	MW8	Dobari UGP	GW8	Ghanudih
IX	SW19, SW20	Kashi Jore	MW9	Jeenagora	GW9	Lodna
X	SW21, SW22	Damodar River	MW10	Bhowrah North	GW10	Bhowrah South
XI	SW23, SW24, SW25, SW26	Jarian Nala, Damodar River	MW11	Bhagaband UGP	GW11	Bhagabandh
XII	SW27, SW28	Katri River	MW12	Kapuria	GW12	Kapuria
XIII	SW29, SW30	Damodar River	MW13	Murulidih (20/21)	GW13	Murilidih
XIV	SW31, SW29	Damodar River	MW14	Lohapatti	GW14	Lohapatti
XV	SW5, SW32	Khudia Nala	MW15	Kharkharee UGP	GW15	Kharkharee
XVI	SW33, SW34	Khudia River	MW16	Dahibari OCP	GW16	Patlabari Village
XVII	SW35, SW36	Barakar River	MW17	Damagoria Colliery	GW17	Chaptoria

STRICTLY RESTRICTED
FOR COMPANY USE ONLY

RESTRICTED

The information given in this report is not to be communicated either directly or indirectly to the press or to any person not holding an official position in the CIL/

GROUNDWATER LEVEL & QUALITY REPORT

FOR CLUSTER OF MINES, BCCL

(Assessment year – 2018-19)

[CLUSTER – I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XIII, XIV, XV & XVI of Mines, BCCL]

JHARIA COALFIELD AND RANIGANJ COALFIELD (PART)

For
(BHARAT COKING COAL LIMITED)

(A Subsidiary of Coal India Limited)

KOYLA BHAWAN (DHANBAD)

Prepared by

Hydrogeology Department

Exploration Division

CMPDI (HQ), Ranchi

MARCH – 2019

Job no-514218177

GROUNDWATER LEVEL & QUALITY REPORT

FOR CLUSTER OF MINES, BCCL

(Assessment year – 2018-19)

[CLUSTER – I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XIII, XIV, XV & XVI of Mines, BCCL]

JHARIA COALFIELD AND RANIGANJ COALFIELD (PART)

For

(BHARAT COKING COAL LIMITED)

(A Subsidiary of Coal India Limited)

KOYLA BHAWAN (DHANBAD)

Prepared by

Hydrogeology Department

Exploration Division

CMPDI (HQ), Ranchi

MARCH – 2019

JOB NO - 514218177

CONTENT

		Page No.
	DETAILS OF THE REPORT	1
1.0	Introduction	2 - 3
1.1	Climate, Temperature & Rainfall	2
1.2	Geomorphology	2
1.3	Drainage	3
2.0	Groundwater system	4 - 6
2.1	Geology of the area	4
2.2	Hydrogeology of the study area	5
2.3	Aquifer Description	5
2.4	Aquifer parameters	6
3.0	Groundwater level monitoring	7 - 24
3.1	Historical groundwater level	8
3.2	Groundwater level scenario (mining/non-mining)	9
3.3	Quarterly groundwater level, Cluster of mines	10
A	Monitoring of Ground Water Levels of Cluster-I	10
B.	Monitoring of Ground Water Levels of Cluster-II	11
C.	Monitoring of Ground Water Levels of Cluster-III	12
D.	Monitoring of Ground Water Levels of Cluster-IV	13
E.	Monitoring of Ground Water Levels of Cluster-V	14
F.	Monitoring of Ground Water Levels of Cluster-VI	15
G.	Monitoring of Ground Water Levels of Cluster-VII	16
H.	Monitoring of Ground Water Levels of Cluster-VIII	17
I.	Monitoring of Ground Water Levels of Cluster-IX	18
J.	Monitoring of Ground Water Levels of Cluster-X	19
K.	Monitoring of Ground Water Levels of Cluster-XI	20
L.	Monitoring of Ground Water Levels of Cluster-XIII	21
M.	Monitoring of Ground Water Levels of Cluster-XIV	22
N.	Monitoring of Ground Water Levels of Cluster-XV	23
O.	Monitoring of Ground Water Levels of Cluster-XVI	24
4.0	Ground water level scenario	25 – 26
5.0	Groundwater Quality	27 – 28
6.0	Stage of Groundwater Development	29 – 30
7.0	conservation measures & future strategy	31 – 32

Annexure-I:	Location of Hydrograph Stations	33
Annexure-IIA:	Details of Hydrograph Stations	34 - 35
Annexure-IIB:	Historical water level data	36 - 37
Annexure-III:	CGWB well Hydrographs	38 - 39
Annexure-IV:	Groundwater sample location details	40
Annexure-V (A-D):	Groundwater sample quality analysis	41 – 60
Annexure-VI:	Hydrographs of Cluster-I to XVI	61 – 75

Abbreviations 76

LIST OF TABLES

Table No	Description	Page No.
Table No – 1	Historical Groundwater Level	8
Table No – 2	Depth to water table	9
Table No – 3	Average hydraulic gradient	9
Table No – 4	GW level data Cluster wise	26
Table No – 5	Block wise Stage of GW Development	29
Table No – 6	Cluster wise GW Development scenario	30

LIST OF FIGURES

Nos.	Description
Figure No - 1	Groundwater monitoring station location map
Figure No - 2	Groundwater Quality sample location map
Figure No – 3	Proposed Piezometers location map
Figure No – 4	Water Table Contour Map: Pre-monsoon 2018

LIST OF ANNEXURES

Nos.	Description	Annexure No
1.	Location details of Monitoring stations	Annexure-I
2.	Details of Hydrograph Stations	Annexure-IIA
3.	Historical Water Level data	Annexure-IIB
4.	Hydrographs of CGWB observation stations	Annexure-III
5.	Groundwater sample location details	Annexure-IV
6.	Groundwater sample quality analysis	Annexure-V (A-D)
7.	Hydrographs of Cluster-I to XVI	Annexure-VI

DETAILS OF THE REPORT

Sl No.	ITEMS	INFORMATIONS
1	Geographical Area	Jharia Coalfield (JCF): 453 sq. km. Raniganj Coalfield (RCF part): 19.64 sq. km. (Cluster-XVI area only)
2	Major Physiographic Units	Dissected Pediplain with surface Reduced Level (RL) varies from 160 m to 220 m above mean sea level (AMSL) in JCF and 100 m to 140 m AMSL in RCF.
3	Drainage System	Damodar River is the master drainage flowing along western boundary of the JCF. Jamunia River, Khudia River, Katri River, Jarian Nala, Ekra Jore, Kari Jore, Kashi Jore, Chatkari Jore and their tributaries are flowing through the JCF area. Damodar River, Barakar River is the master drainage of the part of RCF area (CV Area).
4	Annual Rainfall	Jharkhand State – 1264.0 mm (2016) Dhanbad District - 1271.60 mm (2016) Normal Rainfall – 1296.30 mm (Source: Rainfall Statistics of India-2016, IMD, Ministry of Earth Sciences)
5	Geological Formations	Gondwana Formation (Talchir Formation, Barakar Formation, Barren Measure & Raniganj Formation)
6	Aquifer System	Top Unconfined/Phreatic Aquifer – average thickness 25 m Semi-confined to confined Aquifer – average thickness 50–200 m
7	Hydrogeological properties	Unconfined Aquifer (Damoda BJ Section & Block-III): Hydraulic Conductivity – upto 0.50 m/day Transmissivity – 10 - 42 m^2/day Semi-confined to confined Aquifer (Sitanala & Kumari Block): Hydraulic Conductivity – 0.0006-1.44 & 0.05-0.0027 m/day Transmissivity – 0.06 – 0.573 m^2/day
8	Groundwater Level Monitoring Network	Out of total 254 no of monitoring stations 64 nos located within core mining area and rest comes within Buffers zone. 60 Nos. of Groundwater monitoring well (Dug Wells) network is established by CMPDI to record groundwater level data in and around the Core Zone of JCF and 4 Nos. of Groundwater monitoring well (Dug Wells) in RCF (CV Area).
9	Groundwater Levels Below Ground Level (bgl)	JCF area: Pre-monsoon – 1.20 to 14.58 m (Avg. 5.55 m bgl) in '2018 Post-monsoon – 0.40 to 07.17 m (Avg. 2.83 m bgl) in '2018 RCF area (part): Pre-monsoon – 2.34 to 8.70 m (Avg. 4.35 m bgl) in '2018 Post-monsoon – 1.75 to 5.70 m (Avg. 2.75 m bgl) in '2018
10	Groundwater Quality	Potable (Annexure- IV)
11	Proposed Piezometers	New piezometers (23 nos.) have been proposed to monitor impact of coal mining on groundwater regime within the coalfield area (JCF & part of RCF) for maximum depth upto 290 m to monitor deeper aquifers.
12	Stage of Groundwater Development (CGWB)	Dhanbad District – 77% (GWRE-2013)

1.0 INTRODUCTION

1.1 CLIMATE, TEMPERATURE & RAINFALL

The Jharia Coalfield (JCF) and part of Raniganj Coalfield (RCF) area in Dhanbad District belongs to sub-humid tropical climatic region. The maximum temperature during summer shoots upto 45^{o} C and falls between 10^{o} C to 5^{o} C in winter. The maximum rainfall occurs during the period between June and September.

The annual rainfall in the Dhanbad District is 1271.60 mm (Rainfall Statistics of India-2016, IMD (Ministry of Earth Sciences), has been considered. The non-monsoon rainfall in the District is 93.60 mm (Winter-19.5 mm, Pre-monsoon-48.8 mm and Post-monsoon-25.3 mm) and the monsoon rainfall is 1178.10 mm of total annual rainfall. Monsoon Rainfall is around 92.65% of total annual rainfall in 2016 in Dhanbad District. Rainfall is the primary source of groundwater recharge. The normal rainfall of Jharkhand is 1296.30 mm (2015) as documented in MOSPI, Govt. of India.

1.2 GEOMORPHOLOGY

Northern part of the JCF area is covered with hills and thin forest. In general the altitude varies from 220 m AMSL in Barora area (Cluster-I) to 160 m above mean sea level (AMSL) in Sudamdih area (Cluster-X). Pediplains are developed over sedimentary rocks or Gondwana formation consisting of Sandstone, Shale, coal, etc. Dissected pediplains are developed over Gondwana formations found in Jharia, Baghmara, Katras areas etc. However, in RCF (part) areas the altitude varies from 100 m to 140 m AMSL (Cluster-XVI). The general slope of the topography is towards south, i.e. Damodar River.

1.3 DRAINAGE

The drainage pattern of the area is dendritic in nature. The drainage system of the area is the part of Damodar sub-basin. All the rivers that originate or flow through the coalfield area have an easterly or south easterly course and ultimately joins Damodar River, the master drainage.The drainage of the JCF is mainly controlled by Jamuniya River (5^{th} order), Khudia nala (3^{rd} order), Katri River (4^{th}) and Chatkari nala (3^{rd} order) flowing from north to south and joins Damodar River. Whereas, Barakar River and Khudia River are controlling the drainage pattern of RCF (part) and joins Damodar River in the south. Damodar River is the main drainage channel and flows from west to east along the southern boundary of JCF and RCF.

The drainage map of the JCF and part of RCF has been prepared on topographic map of scale 1:50,000 (**Figure No-1**). The watershed of all tributary rivers (Jamuniya River to Barakar River) falls within the north-western part of Damodar sub-basin which comes under Lower Ganga Basin.

Besides, a large number of ponds/tanks are distributed in and around JCF, out of which one prominent lake is located at Topchanchi in the north-west part. Two reservoirs, Maithon dam in Barakar River and Panchet dam in Damodar River near to Chanch Victoria Area of BCCL (part of RCF) are the main source of water supply to the nearby area. Jharia Water Board, Damodar Water Supply Scheme and Mineral Area Development Authority (MADA) are supplying water to the various coalfield area from Maithon dam, Damodar River, Jamunia River, Topchachi Lake, etc.

2.0 GROUNDWATER SYSTEM

2.1 GEOLOGY OF THE AREA

The Jharia Coalfield covers an area of 453 sq. km. located in Dhanbad District, Jharkhand. The non-coal bearing Talchir Formation is exposed in patches along the northern fringe of the Coalfield. The Barakar Formation which overlies the Talchir is covering the most part of the Jharia Coalfield and having an area of 218 sq. km. This is successively overlain by the non-coal bearing Barren Formation which is mainly exposed in the central part of the Coalfield. This, in turn, is overlain by the Raniganj formation (Coal Bearing horizon) in the south-western part of the Coalfield and covers an area of 54 sq. km.

Chanch-Victoria Area which is located in the western part of Raniganj Coalfield. The Raniganj coalfield represents the eastern most coal basin in the Damodar Valley Region and located in Burdwan District, West Bengal. The Coalfield is almost elliptical in shape and covers an area of about 1530 sq. km. out of which only 35 sq. km. comes under leasehold area of BCCL out of which 19.64 sq. km is the study area (Cluster-XVI only). The coal bearing formations of the area belongs to Barakar Formation of the Lower Gondwana.

2.2 HYDROGEOLOGY OF THE STUDY AREA

The permeable formations mainly composed of sandstone behave as aquifer units. The coal seam and shales developed in the area act as impermeable beds i.e. aquiclude. The aquifer materials of Gondwana Formation are constituted of fine to coarse grained sandstone having primary porosity of intergranular void space. The secondary porosity formed due to presence of faults, fracture, joints, etc. Sandstone of Gondwana formations in JCF and RCF are very hard, compact and cemented sandstone and forming less potential aquifer, particularly the deeper aquifer system. The secondary porosity along with primary porosity forms a conduit system making these formations good aquifers for movement and storage of ground water.

2.3 AQUIFER DISPOSITION

The aquifer system for shallow and deeper aquifer has been established through hydrogeological studies, exploration, surface and subsurface geophysical studies in the JCF and RCF (part) covering all geological formations. The aquifer can be divided into two zones – Un-confined/Phreatic (shallow) and Semi-confined to confined (deeper) aquifer.

PHREATIC/UN-CONFINED AQUIFER

The top aquifer occurred above the top most coal seam/shale bed is called un-confined or water table aquifer and it consists of relatively permeable formation such as weathered sandstone and loose soil. The thickness of the un-confined aquifer is varies from few meters to 50 m. This un-confined aquifer is more potential than deep seated semi-confined to confined aquifer.

SEMI-CONFINED TO CONFINED AQUIFER

The semi-confined to confined aquifer consisting of sandstone bed is sandwiched with coal seams/shale beds and multiple aquifer system developed due to presence of multiple numbers of coal seams/shale beds. With the presence of intercalated shale and carbonaceous shale beds and reduction in permeability with depth, the lower aquifers are poor in potential.

2.4 AQUIFER PARAMETERS

PHREATIC/UN-CONFINED AQUIFER – The wells are tested by CMPDI for determination of aquifer parameters in Damuda (BJ Section) and Block-III area of JCF. The hydraulic conductivity of the un-confined aquifer is 0.50 m/day as computed from pumping tests on the wells. The transmissivity of the unconfined aquifer ranges from 10.68 m^2 /day to 41.48 m^2 /day.

SEMI-CONFINED TO CONFINED AQUIFER – Below the un-confined aquifer, the sandstone partings in-between impervious layers of shale and coal seams is designated as semi-confined / confined aquifers. The sandstones in these aquifers are fine to coarse grained, hard and compact with very low porosity. Mostly groundwater occurs in the weak zones formed due to weathering, fracture, faults, which create the secondary porosity. The hydrogeological parameter has been determined by CMPDI in Sitanala Block by conducting aquifer performance test (APT). The hydraulic conductivity (K) of semi-confined aquifer in Barakar Formation ranges from 0.0006 m/day to 1.44 m/day. The hydrogeological parameter has also been determined at Kumari OCP Block in the central JCF by conducting aquifer performance test. The hydraulic conductivity (K) of semi-confined aquifer in Barakar Formation in this area ranges from 0.0027 m/day to 0.05 m/day.

Aquifer Type	Hydraulic Conductivity (m/day)	Transmissivity (m^2 /day)	Remarks
Unconfined	0.50	10.68 – 41.48	Site: Damuda (BJ Section) and Block-III area
Semi-confined	0.0006 – 1.44 (1) 0.0027 – 0.05 (2)	-	Site: (1): Sitanala Block (2): Kumari Block

3.0 GROUNDWATER LEVEL MONITORING

To collect the representative groundwater levels in the study area, CMPDI has established a monitoring network of total 254 monitoring stations out of which 64 located within core zone and rest comes within Buffer zone. 60 dug wells within JCF and 04 dug wells within RCF (part) area (Details of the Hydrograph stations & water level are given in **Annexure-I, IIA** & **IIB**) spread over the entire BCCL leasehold area, **Figure No-1**. Water level monitoring in 254 hydrograph stations has been done in pre-monsoon as well as in post monsoon whereas in 64 stations monitoring done in quarterly (March, May, August and November month of 2018) basis.

Depth to water level of the water table depict the inequalities in the position of water table with respect to ground surface and is useful in delineating recharge / discharge areas, planning of artificial recharge structure and shows the overall status of the groundwater level in the area. Historical groundwater level (GWL) of entire JCF and part of RCF with fluctuation, GWL of Non-mining / Mining areas and GWL of the Cluster of Mines of BCCL are shown in this report to assess the effect of Coal mining activity in the groundwater regime in and around the Coalfield area.

Mining is a dynamic phenomenon. The mining activity creates dis-equilibrium in environmental scenario of the area and disturbs the groundwater conditions/regime in particular. The impact on shallow water regime due to mining activity can be broadly viewed as under:

- Historical GWL with annual fluctuation over the years
- GWL scenario in Non-mining and Mining area (OC/UG mines)
- GWL scenario of Cluster of mines of BCCL

**Construction of piezometers within Jharia Coalfield and part of Raniganj Coalfield to monitor groundwater level of deeper aquifers is already in progress.*

3.1 HISTORICAL GROUNDWATER LEVEL

Historical GWL of JCF and part of RCF are given from 2005 to 2018 of CMPDI monitoring stations (total 66 stations within Coalfield area). Pre-monsoon and Post-monsoon GWL with Fluctuation has been mentioned below in the table.

Table No – 1: Historical Groundwater Level

Period		(Water level in metre below ground level)								
		Pre-Monsoon (April/May)			Post-Monsoon (Nov/Dec)			Fluctuation		
		From	To	Average	From	To	Average	From	To	Average
JCF	2005	0.07	19.08	6.29	0.84	12.13	3.20	0.12	12.45	3.21
	2007	0.40	19.27	5.66	0.35	8.21	2.87	0.02	16.15	2.96
	2008	0.45	18.35	5.42	0.35	14.20	3.62	0.03	9.22	2.45
	2010	0.85	14.47	5.24	0.10	15.88	4.48	0.02	5.55	1.54
	2012	1.27	18.68	5.58	0.15	7.80	2.72	0.08	13.45	2.96
	2013	0.70	19.20	5.65	0.45	8.35	2.77	0.29	15.88	3.17
	2014	0.70	16.28	4.92	0.75	14.98	3.27	0.25	10.15	2.17
	2015	1.38	17.20	6.00	0.45	14.58	3.92	0.28	7.62	2.15
	2016	0.78	16.73	5.64	0.30	12.43	3.19	0.23	6.35	2.88
	2017	0.67	16.28	5.61	0.15	6.97	2.41	0.10	12.10	3.25
	2018	1.20	14.58	5.55	0.40	7.17	2.83	0.20	9.45	2.68
RCF (part)	2008	5.02	10.50	7.59	2.85	4.90	3.71	1.82	6.60	3.87
	2010	2.20	8.85	4.74	2.78	9.58	4.63	0.68	1.10	0.89
	2011	3.57	8.02	4.98	2.50	6.21	3.75	0.55	1.90	1.23
	2012	3.10	7.34	4.59	1.55	7.00	3.66	0.05	2.78	0.94
	2013	1.70	9.87	6.54	2.90	8.85	4.71	1.02	5.54	2.84
	2014	3.27	6.48	4.57	2.13	3.03	2.63	0.54	3.45	1.94
	2015	3.38	9.52	5.33	2.68	8.20	5.11	1.06	1.32	1.81
	2016	3.61	10.65	6.24	0.90	6.50	3.18	1.63	4.40	3.06
	2017	1.93	5.80	3.25	1.63	3.78	2.47	1.63	3.78	0.78
	2018	2.34	8.70	4.35	1.75	5.70	2.75	0.41	2.55	1.59

3.2 GROUNDWATER LEVEL SCENARIO IN NON-MINING/MINING AREA

Depth to water level (DTW) range in different formations with respect of mining and non-mining areas is summarized in the Table No-2.

Table No – 2: Depth to water table

Formation	***Area***		***DTW (bgl, m)*** ***[Year-2018]***		***Average GWL (m)***	
			Pre-monsoon (Apr/May)	***Post-monsoon (Nov/Dec)***	***Pre-monsoon***	***Post-monsoon***
Sedimentary (Gondwana)	Non-mining		1.85-9.65	0.85-3.70	5.47	2.49
	Mining	OC	1.59-10.93	0.45-7.10	5.00	2.57
		UG	1.20-14.58	0.60-7.17	6.52	3.28
Metamorphics	Peripheral part of the Coalfield		0.75-13.68	0.45-8.00	7.12	3.90

The study revealed that water table is in shallow depth and there is no significant stress in the water table due to coal mining activity. Mining and Non-mining areas shows barely any difference in water table condition in the JCF and RCF (part) area. The average hydraulic gradient of the water table within mining and non-mining areas is given in Table No-3. There is no significant change in hydraulic gradient has been observed. Relatively steep gradient near active opencast mining areas w.r.t., Non-Mining, Underground mines and Metamorphics areas is observed.

Table No – 3: Average hydraulic gradient

Sl. No	***Formation***	***Area***		***Average hydraulic gradient***
1	Sedimentary (Gondwana)	Non-Mining		1.5×10^{-3} to 2.0×10^{-3}
2		Mining	OC	5.0×10^{-2} to 4.0×10^{-3}
3			UG	2.0×10^{-2} to 3.0×10^{-3}
4	Metamorphics	Peripheral part of the Coalfield		1.0×10^{-3} to 2.0×10^{-3}

3.3 QUARTERLY GROUNDWATER LEVEL, CLUATER OF MINES (BCCL)

3.3 A Monitoring of Ground Water Levels of Cluster-I

Cluster-I (Damuda Group of Mines) consisting of Damoda (BJ and Gutway section) UG, Damoda (Albion section) OCP, proposed Damoda (B.J.section) OCP and Closed Gutway OCP of Barora Area of BCCL. It is located in the extreme western part of JCF in Bokaro district of Jharkhand.

The present leasehold area of Cluster-I is 575 Ha. The Damoda block area is marked by more or less flat and gently undulating topography. The RL varies from 179 m to 208 m AMSL and the general slope of topography is towards east. Jamuniya River, Kari Jore, Podo Jore and its tributaries are controlling the drainage system of the area. The area comes under the watershed of Jamuniya River.

4 hydrograph stations (**B-15, B-21A, B51 and B-53**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April and August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	B-15	Bera Basti	1.56	1.85	0.75	0.85
2	B-21A	Dugdha	6.73	9.65	3.45	2.65
3	B-51	Taranga	3.00	5.02	2.25	2.42
4	B-53	Karmatanr	2.52	3.92	1.62	1.42
Average WL (bgl)			3.45	5.11	2.02	1.84

Ground Water Level (in bgl) varies from 1.56 to 6.73 m during February, 1.85 to 9.65 m during April, 0.75 to 3.45 m during August and 0.85 to 2.65 m during November within the Core Zone of Cluster-I area.

3.3 B Monitoring of Ground Water Levels of Cluster-II

Cluster-II consists of seven mines namely; Block-II mixed mine (OCP & UGP), Jamunia OCP, Shatabdi OCP, Muraidih mixed mine (OCP & UGP) and Phularitand OCP is under administrative control of Block-II Area and Barora Area of BCCL. It is located in the extreme western part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-II is 2025.71 Ha. The Damoda block area is marked by more or less flat and gently undulating topography. The RL varies from 176 m to 235 m AMSL. Jamuniya River, Khudia River and its tributaries are controlling the drainage system of the area. The area comes under the watershed of Jamuniya River and Khudia River.

5 hydrograph stations (**B-1, B-59, B-60, B-61A and B-62A**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	B-1	Muraidih	1.68	2.88	1.48	2.08
2	B-59	Khodovaly	1.38	5.47	0.90	1.10
3	B-60	Bahiyardih	8.21	13.68	3.13	4.23
4	B-61A	Kesargora	1.27	2.57	2.62	2.02
5	B-62A	Sadiyardih	5.87	8.27	4.00	4.78
Average WL (bgl)			3.68	6.57	2.43	2.84

Ground Water Level (in bgl) varies from 1.27 to 8.21 m during February, 2.57 to 13.68 m during April, 0.90 to 4.00 m during August and 1.10 to 4.78 m during November within the Core Zone of Cluster-II area.

3.3 C Monitoring of Ground Water Levels of Cluster-III

Cluster-III consists of nine mines namely, Jogidih UG, Maheshpur UG, South Govindpur UG, Teturiya UG, Govindpur UG, New Akashkinaree mixed mine (OC & UG) and Kooridih/Block-IV mixed mine (OC & UG) under the administrative control of Govindpur Area of BCCL. This Cluster of mines is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-III is 1420.0 Ha. The area is plain with gentle undulation with RL varies from 160 m to 208.80 m AMSL. The general slope of the area is towards south. Khudia River, Baghdihi Jore, Katri River and its tributaries are controlling the drainage system of the area. The area comes under the watershed of Khudia River.

5 hydrograph stations (**A-12, A-25, A-29, B-14 and B-60**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	A-12	Jamua	1.20	2.80	0.40	1.0
2	A-25	Sinidih	4.88	6.63	2.88	3.13
3	A-29	Dharmaband	3.25	6.45	2.86	2.10
4	B-14	Mathadih	1.69	3.64	1.22	2.84
5	B-60	Sonardih	8.21	13.68	3.13	4.23
Average WL (bgl)			3.85	6.64	2.12	2.64

Ground Water Level (in bgl) varies from 1.20 to 8.21 m during February, 2.73 to 13.68 m during April, 0.40 to 3.13 m during August and 1.0 to 4.23 m during November within the Core Zone of Cluster-III area.

3.3 D Monitoring of Ground Water Levels of Cluster-IV

Cluster-IV consists of six mines namely, Salanpur UG, Katras-Choitudih UG, Amalgamated Keshalpur & West Mudidih OC, Amalgamated Keshalpur & West Mudidih UG, Amalgamated Angarpathra & Ramkanali UG and closed Gaslitand UG of Katras Area of BCCL. It is located in the north-central part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-IV is 1123.79 Ha. The area has a general undulating topography, with an overall gentle south-westerly slope. The RL varies from 182 m to 216 m AMSL. Katri River, Kumari Jore and its tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Katri River.

4 hydrograph stations (**A-26, A28A, B-64 and B-65A**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	A-26	Malkhera	4.75	6.23	3.58	3.88
2	A28A	Lakarka	2.22	4.15	2.00	2.51
3	B-64	Keshalpur	1.42	2.15	0.55	1.85
4	B-65A	Jhinjipahari	4.18	10.03	2.10	2.40
Average WL (bgl)			3.14	5.64	2.16	2.66

Ground Water Level (in bgl) varies from 1.42 to 4.75 m during February, 2.15 to 10.03 m during April, 0.55 to 3.58 m during August and 1.85 to 3.88 m during November within the Core Zone of Cluster-IV area.

3.3 E Monitoring of Ground Water Levels of Cluster-V

Cluster-V consists of twelve mines namely; Tetulmari OC & UG mine, Mudidih OC & UG mine, Nichitpur OC, Sendra Bansjora OC & UG, Bansdeopur OCP (proposed) & UG, Kankanee OC & UG and closed Loyabad UG under the administrative control of Sijua Area of BCCL. This Cluster of mines is located in northern part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-V is 1957.08 Ha. The area has a general undulating topography, with an overall gentle south westerly slope. The RL varies from 210 m to 170 m AMSL. Jarian Nala, Nagri Jore, Ekra Jore and its tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Jarian Nala and Ekra Jore.

4 hydrograph stations (**A-3, A-16, A-27 and D-23**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	A-3	Sijua	0.77	1.27	0.37	0.47
2	A-16	Ekra	2.60	4.30	2.05	3.65
3	A-27	Tetulmari	1.90	2.90	1.49	1.00
4	D-23	Jogta	2.70	4.40	2.60	3.40
Average WL (bgl)			1.99	3.22	1.63	2.13

Ground Water Level (in bgl) varies from 0.77 to 2.70 m during February, 1.27 to 4.40 m during April, 0.37 to 2.60 m during August and 0.47 to 3.65 m during November within the Core Zone of Cluster-V area.

3.3 F Monitoring of Ground Water Levels of Cluster-VI

Cluster–VI consists of four coal mines; East Bassuriya OC, Bassuriya UG, Gondudih Khas-Kusunda OC, Godhur Mixed Mines (OC and UG) are under the administrative control of Kusunda Area of BCCL. This Cluster of mines is located in central part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-VI is 876.55 Ha. The area has a general undulating topography with general slope towards south. The RL varies from 180 m to 240 m AMSL. Ekra Jore, Kari Jore and their tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Ekra Jore and Kari Jore.

2 hydrograph stations (**D-25 and D-30**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	D-25	Godhur	0.50	2.60	0.60	2.40
2	D-30	Borkiboa	2.60	4.58	1.00	1.10
Average WL (bgl)			***1.55***	***3.59***	***0.80***	***1.75***

3.3 G Monitoring of Ground Water Levels of Cluster-VII

Cluster-VII consists of fourteen mines namely; Dhansar mixed mine, Kusunda OCP, Viswakarma OCP, Industry UG (closed), Alkusa UG, Ena OCP, S.Jharia/Rajapur OCP, Burragarh UG, Simlabahal UG, Hurriladih UG, Bhutgoria UG, Kustore UG (closed) and E.Bhuggatdih UG (closed) under the administrative control of Kusunda Area and Kustore Area of BCCL. This Cluster of mines is located in east central part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-VII is 2127.70 Ha. The area has a general undulating topography with general slope towards south. The RL varies from 172 m to 221 m above M.S.L. Kari Jore, Chatkari Jore and its tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Kari Jore and Chatkari Jore.

7 hydrograph stations (**D-3, D-4, D-33, D-34, D-47, D-55 and D-80**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	D-3	Dhansar	1.65	3.43	1.50	2.45
2	D-4	Jharia	1.21	1.91	0.91	1.56
3	D-33	Kustore	0.55	2.85	0.55	0.95
4	D-34	Kusunda	0.60	2.80	0.45	0.70
5	D-47	Parastanr	3.55	5.33	2.55	3.65
6	D-55	Hariladih	4.42	8.42	1.57	4.02
7	D-80	Bastacolla	4.35	9.35	3.28	4.20
Average WL (bgl)			2.33	4.87	1.54	2.50

Ground Water Level (in bgl) varies from 0.55 to 4.42 m during February, 1.91 to 9.35 m during April, 0.45 to 3.28 m during August and 0.70 to 4.20 m during November within the Core Zone of Cluster-VII area.

3.3 H Monitoring of Ground Water Levels of Cluster-VIII

Cluster-VIII consists of ten mines namely; Bastacolla mixed mines (OC & UG), Bera mixed mines (OC & UG), Dobari UG, Kuya mixed (OC & UG), proposed Goluckdih (NC) OC, Ghanoodih OC and Kujama OC under the administrative control of Bastacolla Area of BCCL. This Cluster of mines is located in eastern part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-VIII is 1200.41 Ha. The area has a general undulating topography with general slope towards south and south-west. The ground elevation in the area ranges from 175 m to 221 m AMSL. Chatkari Jore, Tisra Jore and its tributaries controlling the drainage pattern of the area. The area comes under the watershed of Chatkari Jore.

4 hydrograph stations (**D-8, D-43, D-49 and D-51**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	D-8	Alokdiha	3.20	5.65	1.65	1.85
2	D-43	Alagdih	3.05	7.15	2.90	3.45
3	D-49	Galucdih	1.98	3.45	1.45	2.45
4	D-51	Chankuiya	8.26	10.93	4.80	7.10
Average WL (bgl)			4.12	6.80	2.70	3.71

Ground Water Level (in bgl) varies from 1.98 to 8.26 m during February, 3.45 to 10.93 m during April, 1.45 to 4.80 m during August and 1.85 to 7.10 m during November within the Core Zone of Cluster-VIII area.

3.3 I Monitoring of Ground Water Levels of Cluster-IX

Cluster-IX consists of eight mines namely; North Tisra/South Tisra Expansion OCP, Lodna UG, Bagdigi UG, Bararee UG and Joyrampur UG and Jealgora UG (closed) are under the administrative control of Lodna Area of BCCL. This Cluster of mines is located in eastern part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-IX is 1942.12 Ha. The topography of the area is undulating with gentle slope towards south. The RL varies from 221 m to 188.44 m AMSL. Chatkari Jore, Tisra Jore, Sulunga Jore and its tributaries controlling the drainage pattern of the area. The area comes under the watershed of Chatkari Jore.

6 hydrograph stations (**D-5, D-7, D-39, D-40A, D-41 and D-74**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	D-5	Jiyalgora	5.80	7.80	4.39	5.30
2	D-7	Golden Pahari	5.15	7.53	2.23	2.83
3	D-39	Tilaboni	3.18	4.95	2.50	4.35
4	D-40A	Khapa Dhawra	1.70	2.10	1.10	1.40
5	D-41	Joyrampur	1.30	1.59	1.08	1.32
6	D-74	Bhulan Bararee	5.80	8.60	3.40	4.80
Average WL (bgl)			3.82	5.43	2.45	3.33

Ground Water Level (in bgl) varies from 1.30 to 5.80 m during February, 1.59 to 8.60 m during April, 1.08 to 4.39 m during August and 1.32 to 5.30 m during November within the Core Zone of Cluster-IX area.

3.3 J Monitoring of Ground Water Levels of Cluster-X

Cluster-X consists of ten coal mines and one coal Washery namely; Bhowrah North mixed mines (UG & OC), Bhowrah South mixed mines (UG, 3 Pit OCP, Chandan OCP), Patherdih Mixed mines (UG, Chandan OCP), Sudamdih incline UG mine, Sudamdih Shaft UG mine, Amlabad UG (Closed) and Sudamdih Coal Washery under the administrative control of Eastern Jharia Area of BCCL. This cluster of mines is located in the eastern part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-X is 2057.47 Ha. The area has an undulating topography with gentle slope towards south and south east. The RL varies from 185 m to 150.0 m AMSL. Gaurkuthi Nala and few seasonal streams are controlling the drainage pattern of the area. The area comes under the watershed of Damodar River.

4 hydrograph stations (**A-19, D-35, D-36 and D-77**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	A-19	Bhowrah	2.95	5.55	1.85	2.45
2	D-35	Patherdih	6.58	8.40	3.58	4.45
3	D-36	Sudamdih	1.00	1.20	0.45	0.60
4	D-77	Amlabad	3.63	6.30	4.00	5.20
Average WL (bgl)			3.54	5.36	2.47	3.18

Ground Water Level (in bgl) varies from 1.00 to 6.58 m during February, 1.20 to 8.40 m during April, 0.45 to 4.0 m during August and 0.60 to 5.20 m during November within the Core Zone of Cluster-X area.

3.3 K Monitoring of Ground Water Levels of Cluster-XI

Cluster–XI consists of eight coal mines and one coal Washery namely; Gopalichak UG Project, Kachi Balihari 10/12 Pit UG, Pootkee Balihari Project UG, Bhagaband UG, Kendwadih UG (closed), Pootkee UG (closed), Kachi Balihari 5/6 Pit UG (closed) are under the administrative control of Pootkee Balihari Area and Moonidih UG & Moonidih Washery are under the administrative control of Western Jharia Area of BCCL. This Cluster of mines is located in central part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-XI is 3527.58 Ha. The area has an undulating topography with gentle slope towards south. The RL varies from 201 m to 166 m AMSL. Katri River, Jarian Nala, Ekra Jore and Kari Jore are controlling the drainage of the area. The area comes under the watershed of Katri River and Kari Jore.

5 hydrograph stations (**A-17, A-18, A-20, A-32 and D-34**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water below (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	A-17	Kachi Balihari	2.07	3.34	1.64	2.84
2	A-18	Baghaband	0.89	1.24	1.34	0.99
3	A-20	Gorbudih	3.59	4.57	1.92	2.57
4	A-32	Baludih	0.60	2.80	0.45	0.70
Average GW (bgl)			2.26	3.20	1.64	2.16

Ground Water Level (in bgl) varies from 0.60 to 3.59 m during February, 1.24 to 4.57 m during April, 0.45 to 1.92 m during August and 0.70 to 2.84 m during November within the Core Zone of Cluster-XI area.

3.3 L Monitoring of Ground Water Levels of Cluster-XIII

Cluster-XIII consists of one operating mine i.e. Murulidih 20/21 pits UG mine and six abandoned mines (Bhurungiya Colliery, Muchraidih colliery, Hantoodih colliery, Padugora colliery, Murulidih colliery, Bhatdee colliery) of Western Jharia Area of BCCL. It is located in the south-western part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-XIII is 1898.62 Ha. The area has an undulating topography with gentle slope towards south-east. The maximum RL is 224 m AMSL in the north-western part of the area whereas the minimum RL is 179 m AMSL at southern part. The area comes under the watershed area of Jamunia River and Katri River.

6 hydrograph stations (**A-22, A-23, A-33, A-34, B-25 and B-48**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	A-22A	Nagdah Basti	1.70	3.35	1.10	1.30
2	A-23	Machhayara	8.92	11.15	6.46	7.17
3	A-33	Mahuda Washery	2.24	4.07	1.26	2.35
4	A-34	Mahuda Mosque	5.32	9.45	4.75	5.35
5	B-25	Mahuda More	3.68	5.90	2.90	3.70
6	B-48	Mahuda	3.55	7.33	2.95	3.97
Average GW (bgl)			4.24	6.88	3.24	3.97

Ground Water Level (in bgl) varies from 1.70 to 8.92 m during February, 3.35 to 11.15 m during April, 1.10 to 6.46 m during August and 2.35 to 7.17 m during November within the Core Zone of Cluster-XIII area.

3.3 M Monitoring of Ground Water Levels of Cluster-XIV

Cluster-XIV consists of two mines namely; Lohapatty UG and Lohapatty Opencast Patch (proposed). These are under the administrative control of Western Jharia of BCCL. This Cluster of mines is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-XIV is 1577.22 Ha. The topography of the area is undulating with slope towards south west. The maximum RL is 224 m in the north-eastern part whereas the minimum RL is 170 m above mean sea level on the south-western part of the area. Jamunia River and its tributaries are controlling the drainage of the area. The area comes under the watershed area of Jamunia River.

3 hydrograph stations (**B-23, B-24 and B-67**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	B-23	Lohapatti	3.04	6.64	1.74	2.14
2	B-24	Telmuchu	6.43	9.28	3.31	4.33
3	B-67	Simatanr	6.50	9.55	3.60	4.00
Average GW (bgl)			5.32	8.49	2.88	3.49

Ground Water Level (in bgl) varies from 3.04 to 6.50 m during February, 6.64 to 9.55 m during April, 1.74 to 3.60 m during August and 2.14 to 4.00 m during November within the Core Zone of Cluster-XIV area.

3.3 N Monitoring of Ground Water Levels of Cluster-XV

Cluster–XV consists of four coal mines; Kharkharee UG and Dharmaband UG are under the administrative control of Govindpur Area and Madhuband UG & Phularitand UG are under the administrative control of Barora Area of BCCL. This Cluster of mines is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-XV is 1696.55 Ha. The topography of the area is undulating with slope towards south west. The maximum RL is 235 m in the Kharkharee mine area whereas the minimum RL is 165 m AMSL on the eastern & western part of the Cluster. Jamunia River and Khudia River are controlling the drainage of the area. The area comes under the watershed area of both Jamunia River and Khudia River.

3 hydrograph stations (**A-24, B-32A and B-61A**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’18	Apr’18	Aug’18	Nov’18
1	A-24	Pipratanr	11.68	14.58	5.78	6.88
2	B-32A	Madhuband	3.23	6.75	2.80	3.90
3	B-61A	Kesargora	1.27	2.57	2.0	2.02
Average GW (bgl)			5.39	7.97	3.63	4.27

Ground Water Level (bgl) varies from 1.27 to 11.68 m during February, 2.57 to 14.58 m during April, 2.0 to 5.78 m during August and 2.02 to 6.88 m during November within the Core Zone of Cluster-XV area.

3.3 O Monitoring of Ground Water Levels of Cluster-XVI

Cluster-XVI consists of five mines namely, Dahibari-Basantimata OC, Basantimata UG, New Laikidih OC, Laikdih Deep UG and Chunch UG under the administrative control of Chanch-Victoria Area of BCCL. This cluster of mines is located in the western part of Raniganj Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-XVI is 1964.21 Ha. The topography of the area is undulating with slope towards south west. The area is plain with gently undulating with elevation varying from 100 m to 140 m AMSL. The general slope of the area is towards southeast. Barakar River and Khudia River are controlling the drainage of the area. The area comes under the watershed area of Barakar River.

4 hydrograph stations (**DB-22, DB-23, DB-24 and DB-25**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	DB-22	Dahibari, Niche Basti	1.98	2.34	1.35	1.93
2	DB-23	Dahibari OC	2.00	2.85	1.20	1.75
3	DB-24	Dahibari	8.70	8.25	4.43	5.70
4	DB-25	Palasya	3.23	3.93	1.41	1.63
Average GW Level			3.98	4.34	2.10	2.75

Ground Water Level (in bgl) varies from 1.98 to 8.70 m during February, 2.34 to 8.25 m during April, 1.20 to 4.43 m during August and 1.63 to 5.70 m during November within the Core Zone of Cluster-XVI area.

4.0 GROUNDWATER LEVEL SCENARIO

During the month of February'2018 the depth to water level (in bgl) within 15 nos Cluster of mines varies from 0.50 m to 11.68 m with an average varies from of 1.55 m to 5.39 m. During the month of April'2018 the depth to water level varies from 1.20 m to 14.58 m with an average varies from 3.12 m to 8.50 m. During the month of August'2018 the depth to water level varies from 0.80 m to 6.47 m with an average varies from 0.80 m to 3.73 m. During the month of November'2018 the depth to water level varies from 0.40 m to 7.17 m with an average varies from 1.75 m to 4.26 m. The summarized water level data of all clusters are given in **Table No – 4**.

Depth to water level (in bgl) values described that water level goes down to maximum 14.58 m during pre-monsoon'2018 and maximum upto 8.50 m during post-monsoon'2018. Un-confined aquifer is affected around 20 m to 30 m maximum close to active opencast mining areas, showing steep gradient towards mine void. Other than that, there is no mining effect in the water level within JCF area and RCF area (part). Historical water level data and hydrograph of permanent observation stations from CGWB shown in **Annexure–III**.

Monitoring groundwater (quantity & quality) to assess the present condition and resource has been done regularly in the coalfield areas. Well hydrographs (**Annexure–III and VI**) are prepared and studied to identify potentially adverse trends so that appropriate action can be taken to protect groundwater resource. According to the hydrograph trend analysis of CGWB monitoring wells and CMPDI observation wells, there are decline trends in both Pre and Post-monsoon GW level trends (max. upto 0.50 cm/year in Patherdih/D-35) but no significant decline trend (>1.0 m/year) of water level is noticed in any particular area for the last 10 years within the coalfield area. Regarding quality monitoring, the water sample location map (**Figure No–2**) with collection points details (dug wells) are given in **Annexure–IV** and Quality is given in **Annexure–V**.

Table No–4: Groundwater level data Cluster-wise

Sl. No.	Cluster of BCCL	No. of Monitoring Wells	Water level fluctuation Below ground level (Feb, Apr, Aug & Nov'18)	Formation
1	I	4 nos.	0.75 to 9.65 m	Barakar
2	II	5 nos.	0.90 to 13.68 m	Barakar
3	III	5 nos.	0.40 to 6.63 m	Barakar
4	IV	4 nos.	0.55 to 10.03 m	Barakar
5	V	4 nos.	0.37 to 4.40 m	Barakar
6	VI	2 nos.	0.50 to 4.58 m	Barakar
7	VII	7 nos.	0.45 to 9.35 m	Barakar
8	VIII	4 nos.	1.45 to 10.93 m	Barakar
9	IX	6 nos.	1.08 to 8.60 m	Barakar
10	X	4 nos.	0.45 to 8.40 m	Barakar
11	XI	5 nos.	1.0 to 3.65 m	Barakar & Barren Measure
12	XIII	6 nos.	1.10 to 11.15 m	Raniganj
13	XIV	3 nos.	1.74 to 9.55 m	Raniganj
14	XV	3 nos.	1.27 to 14.58 m	Barakar & Barren Measure
15	XVI	4 nos.	1.20 to 8.70 m	Barakar

5.0 GROUNDWATER QUALITY

The ground water sample of the study area (15 nos. of Cluster of mines, BCCL) have been collected from dug wells and analysed. Fifteen ground water samples (GW-1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15 & 16) were analysed quarterly (March, May, August and November'2018) at CMPDI, RI-II, Dhanbad. The water sampling details are given in **Annexure–IV** and Water sample locations are shown in **Figure No-2**. The water quality data are enclosed in **Annexure–VA, VB, VC and VD**.

The study of the variations in water quality parameters are described below:

During the month of March, May, August and December'2018:

The pH of the groundwater samples varies between 7.45 to 7.92 in March'18, 7.19 to 8.11 in May'18, 7.71 to 8.23 in August'18 and 7.14 to 8.24 in December'18. The pH is within the ISI limit of drinking water standard.

During the month of March, May, August and December'2018:

The mineral constituents dissolved in water constitute the dissolved solids. The total dissolve solids varies from 188 to 485 mg/l in March'18, from 286 to 566 in May'18, from 320 to 1060 in August'18 and from 132 to 830 in December'2018. The TDS values are above the IS 10500 standards of drinking water.

During the month of March, May, August and December'2018:

During the month of March'18 the alkalinity of the water samples varies from 64 to 132 mg/l and are within the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 30 to 46 mg/l and are within the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 68 to 196 mg/l and the value of total hardness in water samples are within the permissible limit (200 mg/l). The sulphate ranges between 08 to 96 mg/l and the value of sulphate in water sample are within the permissible limit (200 mg/l). The Iron, Copper, Manganese, Lead, Zinc and Chromium concentration in the water samples are found to be below the upper ISI limits for drinking water.

During the month of May'18 the alkalinity of the water samples varies from 70 to 188 mg/l and are within the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 29 to 58 mg/l and are within the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 132 to 326 mg/l and the value of total hardness in water samples are ***above*** the permissible limit (200 mg/l). The sulphate ranges between 65 to 180 mg/l and the value of sulphate in water sample are within the permissible limit (200 mg/l). The Iron, Copper, Manganese, Lead, Zinc and Chromium concentration in the water samples are found to be below the upper ISI limits for drinking water.

During the month of August'18 the alkalinity of the water samples varies from 45 to 152 mg/l and are within the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 30 to 194 mg/l and are above the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 130 to 740 mg/l and the value of total hardness in water samples are above the permissible limit (200 mg/l). The sulphate ranges between 34 to 228 mg/l and the value of sulphate in water sample are ***slightly above*** the permissible limit (200 mg/l). The Iron (***slightly above the limit***), Copper, Manganese, Lead, Zinc and Chromium concentration in the water samples are found to be below the upper ISI limits for drinking water.

During the month of December'18 the alkalinity of the water samples varies from 112 to 212 mg/l and are ***slightly above*** the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 12 to 28 mg/l and are within the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 286 to 602 mg/l and the value of total hardness in water samples are ***above*** the permissible limit (200 mg/l). The sulphate ranges between 48 to 84 mg/l and the value of sulphate in water sample are within the permissible limit (200 mg/l). The Iron, Manganese (***slightly above the limit***), Copper, Lead, Zinc and Chromium concentration in the water samples are found to be below the upper ISI limits for drinking water.

6.0 STAGE OF GROUNDWATER DEVELOPMENT

The groundwater is mainly utilized for domestic needs and for irrigation purposes. The groundwater abstraction is mainly through dug wells and bore wells. The stage of groundwater development in Dhanbad District is 77%. The highest stage of development is in Jharia Block (127.0%) & Dhanbad Block (107.50%) and lowest stage of development is in Baliapur Block (78.24%). The Gondwana sandstones in general, are known to constitute good aquifers at many places. However, the yield potential of the area adjoining to active mines in the coal belt is poor. The active mines often act as groundwater "sinks". In contrast, the water logged abandoned mines and pits act as potential sources of groundwater. As per the assessment done by Central Ground Water Board (CGWB), Patna in 2013, the Block wise data of Dhanbad District is given below:

Table No–5: Block-wise Stage of Groundwater development

Sl No.	Administrative Unit		Stage of GW Development	Category
	District	Block		
1	Bokaro	Bermo	156.30%	**Over- exploited**
2	Dhanbad	Baghmara	91.74%	Critical
3	Dhanbad	Baliapur	78.24%	Semi- Critical
4	Dhanbad	Dhanbad	107.50%	**Over- exploited**
5	Dhanbad	Jharia	127.0%	**Over- exploited**
6	Dhanbad	Topchachi	98.45%	Critical

- **Dynamic Groundwater Resource Assessment (as on 31st March, 2013), CGWB**

Table No–6: Cluster-wise Groundwater development scenario

Cluster/ Area	Adminis-trative Blocks/Stage Of GW Develo-Pment (SOD)	Total Water demand (Lakh cum/year)				Avg. GW level (bgl in m) 2018		GW level declining trend 2005-2018		Quantity Recharge/ future use (Lakh Cum/ Year)
		Mine Discharge (GW + Rainwater)	Surface Water Source	Total Use (Domestic + Industrial)	Excess Or other use	Pre-monsoon	Post-monsoon	Pre-monsoon	Post-monsoon	
Cluster-I	Bermo (SOD: Over-exploited)	9.56	NIL	7.42	2.14	5.11	1.84	YES	YES	NIL
Cluster-II	Baghmara (SOD: Critical)	170.17	Jamunia river	22.55	23.83	6.57	2.84	YES	NO	123.75
Cluster-III		58.18	NIL	2.58	12.65	6.64	2.64	NO	YES	42.95
Cluster-IV		68.84	MADA (Damodar river)	18.47	12.31	5.64	2.66	NO	NO	38.06
Cluster-V		127.29	MADA	77.92	31.02	3.22	2.13	YES	YES	18.35
Cluster-VI	Dhanbad (SOD: Over-exploited)	3.86	MADA (Damodar river)	3.69	0.0	3.60	1.75	YES	YES	NIL (loss due to FF)
Cluster-VII		93.33	MADA	27.70	6.87	4.87	2.50	YES	NO	58.76
Cluster-VIII	Jharia (SOD: Over-exploited)	29.27	MADA	24.04	1.18	6.80	3.71	NO	NO	4.05
Cluster-IX		310.34	MADA	160.28	45.05	5.43	3.33	NO	NO	105.01
Cluster-X		59.38	Damodar river	11.47	0.0	5.36	3.18	YES	NO	47.91
Cluster-XI	Dhanbad (SOD: Over-exploited)	249.67	MADA & DVC	19.86	43.92	3.20	2.16	YES	YES	185.89
Cluster-XIII	Baghmara (SOD: Critical)	64.61	Damodar river	10.09	9.86	6.88	3.97	YES	YES	44.66
Cluster-XIV		NA	NA	NA	NA	8.49	3.49	NO	NO	NA
Cluster-XV		5.11	Jamunia river	0.0	5.11	7.97	4.27	NO	YES	0.0
Cluster-XVI	Nirsa (SOD:Safe)	29.78	DVC (Barakar river)	14.60	6.57	4.34	2.75	NO	NO	8.61

7.0 CONSERVATION MEASURES & FUTURE STRATEGY

- BCCL has installed 25 Pressure Filter Plant of total capacity of 4.16 MGD to meet drinking water requirement nearby the area. At present 63 Water Treatment Plants are operational having capacity of 16.16 MGD within Jharia Coalfield area. Further installation of 28 more Pressure Filter Plants with the capacity of 5.84 MGD are in progress.

- BCCL participated in development of low cost technology for drinking water in a CSIR project along with CIMFR, Dhanbad and a pilot plant of 4000 Liters/hour is functional at PB Project site of BCCL. Similar plant has been proposed at other sites of BCCL.

- A scheme entitled 'Scheme for multi-purpose utilization of surplus mine water of Barora Area, Block II and Govindpur Area of BCCL' was prepared with a view to harness the excess water discharge to take care of the persistence problem of water scarcity in the nearby villages. In the scheme, two water reservoirs of capacity 27 MG and 17 MG have been proposed in the non-coal bearing area for storage of 3250 GPM and 2000 GPM surplus mine water which will be fed through pipe line by mine discharge at mines of Barora, Block-II and Govindpur Area.

- Roof-top rainwater harvesting (RWH) will be taken up in the project area using the administrative buildings. 138 no. of quarters having roof-top area of about 14950 sq. m. is already prepared to harvest rainwater and around 13150 cum/annum of water is going to be recharged the nearby groundwater system through RWH structures. Proposal already made to facilitate this kind of RWH structure at suitable locations i.e. Lodna Area, Kusunda Area (Jawahar Nagar, Matkuria, Coal Board Colony), Sijua Area (Nichitpur and Tetulmari Colony) within Jharia Coalfield to augment groundwater recharge.

- After cessation of mining, with plenty rainfall and abundant ground water recharge, the water levels will recoup and attain normalcy. Thus, the impact of mining on groundwater system may be considered as a temporary

phenomenon. The abandoned mine workings (UG) behave as water pool and improves the resources availability in the coalfield area.

- Utilization of treated mine water discharge by both industry and local people in the mine influence area. The excess mine water can be used to recharge groundwater system through connecting pipeline to abandoned dug wells. Utilization of mine water for irrigation use will also enhance the ground water recharge potential through artificial recharge in the area.

- Increase vegetative cover by plantation in the mine area under land amelioration measures. This will contain the surface run-off and increase the groundwater recharge.

- Creation of awareness among workers and local peoples about Rain water harvesting and artificial recharge will be given priority. This aspect is usually covered during the Environmental Week celebrated every year (5 to 12 June).

- Monitoring of water quality of mine water discharge, local River/nala and domestic water source (dug well/hand pump wells) will be continued under routine monitoring (February, May, August & November).

Annexure – I

Location of Hydrograph Stations (Dug Wells)

Well No	Latitude	Longitude	Well No	Latitude	Longitude
A-3	23^{0}47'53.35" N	86^{0}19'55.14" E	**B-63**	Abandoned due to OCP	
A-12	23^{0}48'20.31" N	86^{0}16'51.64" E	**B-64**	23^{0}48'43.14" N	86^{0}18'44.25" E
A-16	23^{0}46'57.00" N	86^{0}21'38.57" E	**B-65A**	23^{0}48'53.65" N	86^{0}18'11.82" E
A-17	23^{0}45'09.44" N	86^{0}22'16.35" E	**B-67**	23^{0}43'30.70" N	86^{0}14'01.45" E
A-18	23^{0}44'37.65" N	86^{0}22'58.90" E	**D-3**	23^{0}46'46.31" N	86^{0}24'49.30" E
A-19	23^{0}41'12.86" N	86^{0}23'55.27" E	**D-4**	23^{0}44'29.37" N	86^{0}24'42.88" E
A-20	23^{0}44'56.64" N	86^{0}19'55.35" E	**D-5**	23^{0}42'20.05" N	86^{0}24'86.06" E
A-22	23^{0}43'06.65" N	86^{0}14'48.53" E	**D-7**	23^{0}43'12.08" N	86^{0}27'11.89" E
A-23	23^{0}45'06.38" N	86^{0}15'12.69" E	**D-8**	23^{0}44'06.13" N	86^{0}27'20.72" E
A-24	23^{0}45'20.44" N	86^{0}13'45.12" E	**D-23**	23^{0}47'20.89" N	86^{0}20'09.96" E
A-25	23^{0}47'06.20" N	86^{0}15'27.79" E	**D-25**	23^{0}47'03.28" N	86^{0}23'29.56" E
A-26	23^{0}46'49.24" N	86^{0}18'12.12" E	**D-30**	23^{0}48'36.10" N	86^{0}21'50.07" E
A-27	23^{0}48'42.55" N	86^{0}20'21.80" E	**D-33**	23^{0}45'34.62" N	86^{0}23'18.50" E
A-28A	23^{0}47'34.74" N	86^{0}18'04.18" E	**D-34**	23^{0}45'36.50" N	86^{0}23'02.45" E
A-29	23^{0}47'08.02" N	86^{0}16'02.72" E	**D-35**	23^{0}40'46.54" N	86^{0}25'46.33" E
A-32	23^{0}44'15.56" N	86^{0}20'43.80" E	**D-36**	23^{0}40'19.26" N	86^{0}25'18.98" E
A-33	23^{0}44'32.58" N	86^{0}16'58.28" E	**D-39**	23^{0}43'28.50" N	86^{0}26'0.10" E
A-34	23^{0}42'58.63" N	86^{0}15'19.31" E	**D-40A**	23^{0}43'20.18" N	86^{0}25'45.70" E
B-1	23^{0}48'48.06" N	86^{0}14'16.87" E	**D-41**	23^{0}42'40.00" N	86^{0}26'17.20" E
B-14	23^{0}48'00.81" N	86^{0}16'25.88" E	**D-43***	NA	NA
B-15	23^{0}46'06.92" N	86^{0}08'59.30" E	**D-47**	23^{0}45'20.59" N	86^{0}24'34.86" E
B-21A	23^{0}45'10.50" N	86^{0}09'36.38" E	**D-49**	23^{0}44'08.96" N	86^{0}26'32.71" E
B-23	23^{0}44'13.05" N	86^{0}11'46.56" E	**D-51**	23^{0}44'20.86" N	86^{0}27'11.37" E
B-24	23^{0}44'26.80" N	86^{0}13'09.38" E	**D-55**	23^{0}43'58.37" N	86^{0}24'07.45" E
B-25	23^{0}44'44.98" N	86^{0}13'57.80" E	**D-74**	23^{0}41'33.66" N	86^{0}25'06.10" E
B-32A	23^{0}45'49.18" N	86^{0}13'03.64" E	**D-77**	23^{0}41'00.74" N	86^{0}22'25.55" E
B-48	23^{03}4'35.09" N	86^{0}16'38.30" E	**D-80**	23^{0}46'09.46" N	86^{0}24'33.08" E
B-51	23^{0}47'40.20" N	86^{0}09'11.90" E	**DB-22**	23^{0}43'38.81" N	86^{0}45'09.00" E
B-53	23^{0}45'55.25" N	86^{0}09'35.44" E	**DB-23**	23^{0}43'44.24" N	86^{0}45'06.39" E
B-53A	-	-	**DB-24**	23^{0}43'53.00" N	86^{0}45'03.88" E
B-59	23^{0}47'59.87" N	86^{0}13'37.97" E	**DB-25**	23^{0}44'10.75" N	86^{0}44'35.84" E
B-60	23^{0}48'7.87" N	86^{0}15'37.12" E			
B-61A	23^{0}45'59.85" N	86^{0}11'40.80" E			
B-62A	23^{0}45'44.15" N	86^{0}11'27.80" E			

Annexure – IIA

Details of Hydrograph Stations (Dug Wells)

Well No	Location	M.P. (agl) in m	Well Dia in m	Well Depth (m bmp)	R.L. (G.L) (m)	Formation	Owner	Utility
A-3	Sijua	0.53	3.00	5.20	203	Barakar	Govt.	Domestic
A-12	Jamua	0.80	1.90	3.30	202	Barakar	Govt.	Domestic
A-16	Ekra, Kalali More	0.45	3.10	6.50	205	Barakar	Govt.	Domestic
A-17	Kachi Balihari	0.56	1.60	5.30	182	Barakar	Govt.	Domestic
A-18	Bhagabandh	0.61	1.45	3.37	182	Barakar	Govt.	Domestic
A-19	Bhaura	0.54	3.15	11.65	162	Barakar	Govt.	Domestic
A-20	Gorbhudih	0.43	3.30	8.30	181	BM	Govt.	Domestic
A-22	Nagdah, Niche tola	0.00	1.40	9.50	171	Raniganj	Govt	Irrigation
A-23	Machhyara	0.43	1.85	12.40	203	Raniganj	Govt	Domestic
A-24	Pipra Tanr	0.22	1.80	19.55	208	Raniganj	Govt	Domestic
A-25	Sinidih	0.22	2.00	11.30	203	Barakar	Govt	Domestic
A-26	Pasitanr (Malkera)	0.32	1.80	9.65	198	Barakar	Govt	Domestic
A-27	Chandor	0.60	2.50	5.50	221	Barakar	Govt	Domestic
A-28A	Lakarka 6 no.	0.65	1.30	5.25	199	Barakar	BCCL	Domestic
A-29	Aambagan (Gobindpur)	0.10	2.60	9.15	186	Barakar	Govt	Domestic
A-32	Baludih	0.55	2.30	6.85	182	BM	Govt	Domestic
A-33	Mahuda	0.75	2.00	10.80	195	BM	BCCL	Domestic
A-34	Bhatdih	0.55	3.50	24.50	162	Raniganj	BCCL	Domestic
B-1	Muraidih	0.47	1.80	5.35	212	Talchir	Govt	Domestic
B-14	Mathadih	0.76	2.15	3.75	201	Barakar	Govt	Domestic
B-15	Bera Basti	0.55	1.60	2.50	221	Talchir	Dhanu Roy	Domestic
B-21A	Dugdha	0.55	2.10	10.35	220	Metamorphics	Govt	Domestic
B-23	Lohapati	0.26	3.60	10.85	204	Raniganj	Govt	Domestic
B-24	Telmuchu	0.67	4.35	10.83	207	Raniganj	Govt	Domestic
B-25	Mahuda More	0.10	2.45	8.45	205	Raniganj	Govt	Domestic
B-32A	Madhuband	0.80	4.30	8.60	205	Barakar	BCCL	Domestic
B-48	Mahuda	0.65	2.10	11.50	181	Raniganj	Mosque	Domestic
B-51	Taranga	0.00	2.50	5.75	215	Metamorphics	Bisun	Irrigation
B-53	Karmatanr	0.58	2.70	13.25	195	Barakar	Govt	Domestic
B-53A	Karmatanr-Damoda OCP							
B-59	Khodovaly	0.60	2.40	9.30	202	Barakar	BCCL	Domestic
B-60	Bahiyardih	0.77	3.00	15.60	196	Barakar	BCCL	Domestic
B-61A	Kesargora	0.48	2.00	11.20	201	Barakar	BCCL	Domestic
B-62A	Sadariyadih	0.15	3.10	9.50	188	Barakar	Govt	Domestic

Annexure – IIA

Details of Hydrograph Stations (Dug Wells)

Well No	Location	M.P. (agl) in m	Well Dia in m	Well Depth (m bmp)	R.L. (G.L) (m)	Formation	Owner	Utility
B-63	West Mudidih	0.60	1.70	3.35	196	Barakar	BCCL	Domestic
B-64	Keshalpur	0.65	1.10	3.40	195	Barakar	BCCL	Domestic
B-65A	Jhinjipahari	0.95	2.20	12.40	196	Barakar	Shiv Temple	Domestic
B-67	Simatanr	0.55	2.20	11.80	198	Raniganj	Govt	Domestic
D-3	Dhansar	0.60	1.70	8.70	217	Barakar	Govt	Domestic
D-4	Jharia	0.59	1.90	5.73	218	Barakar	Govt	Domestic
D-5	Jiyalgora	0.70	2.80	10.55	183	Barakar	Govt	Domestic
D-7	Golden Pahari	0.67	2.85	10.05	201	Barakar	BCCL	Domestic
D-8	Alokdiha	0.35	1.75	7.57	201	Metamorphics	BCCL	Domestic
D-23	Jogta (Sindra)	0.40	3.10	7.25	205	Barakar	BCCL	Domestic
D-25	Godhar More	0.60	2.75	5.60	219	Barakar	Govt	Domestic
D-30	Borkiboa	0.70	2.00	5.60	221	Talchir	H.Kumbhakar	Domestic
D-33	Kustore-4	0.55	1.85	3.45	196	Barakar	BCCL	Domestic
D-34	Kusunda-7	0.60	1.50	3.45	201	Barakar	BCCL	Domestic
D-35	Patherdih	0.40	2.00	11.20	160	Barakar	BCCL	Domestic
D-36	Sudamdih	0.90	2.00	6.20	141	Barakar	BCCL	Domestic
D-39	Tilabani	0.85	2.00	5.90	178	Barakar	BCCL	Domestic
D-40A	Khapra Dhaora	0.55	1.95	3.70	180	Barakar	Panchayat	Domestic
D-41	Joyrampur	0.50	1.80	4.00	180	Barakar	BCCL	Domestic
D-43	Alagdih	0.45	2.20	8.90	200	Metamorphics	Govt	Domestic
D-47	Parastanr	0.45	3.20	23.80	206	Barakar	BCCL	Domestic
D-49	Goluckdih	0.55	1.80	6.15	192	Barakar	BCCL	Domestic
D-51	Chankuiya	0.55	3.70	11.90	197	Barakar	BCCL	Domestic
D-55	Hariladih	0.48	2.80	11.80	184	Barakar	Govt	Domestic
D-74	Bhulan Barari	0.10	1.60	12.80	173	Barakar	Govt	Domestic
D-77	Rohoniatanr	0.40	3.15	6.70	156	Barakar	Govt	Domestic
D-80	Bastacolla	0.70	2.50	24.95	219	Barakar	Govt	Domestic
DB-22	Nichebasti	0.67	2.40	10.65	121	Barakar	Govt	Domestic
DB-23	Dahibari OC	0.70	2.30	8.00	-	Barakar	BCCL	Domestic
DB-24	Dahibari	0.60	3.60	13.70	125	Barakar	BCCL	Domestic
DB-25	Palasya	0.37	1.55	5.25	127	Barakar	Govt	Domestic

MP: Measuring Point **R.L.: Reduced Level** **W.L.: Water Level m: Meter**

Abn.: Abandoned **b.g.l.: Below Ground Level** **a.g.l.: Above Ground Level**

G.L.: Ground Level **bmp: Below Measuring Point** **BM: Barren Measure**

Annexure – IIB

Historical Water Level data of Hydrograph Stations

Well No	Water level below ground level (bgl) in meters														
	May, 11	May, 12	Nov, 12	May, 13	Nov, 13	May, 14	Nov, 14	May, 15	Nov, 15	May, 16	Nov, 16	May, 17	Nov, 17	May, 18	Nov, 18
A-3	4.77	4.25	1.87	4.47	4.45	4.67	2.37	3.70	3.42	4.87	0.47	0.67	0.77	1.27	0.47
A-12	2.80	2.80	1.30	3.00	1.17	2.45	1.4	3.00	2.68	2.50	0.70	2.55	0.85	2.80	1.0
A-16	5.80	3.53	1.60	3.80	3.35	5.5	2.9	5.55	4.17	5.85	3.15	3.65	2.20	4.30	3.65
A-17	2.24	2.52	2.34	2.32	1.54	2.19	1.91	3.79	2.64	2.44	2.69	2.44	2.24	3.34	2.84
A-18	2.49	2.59	0.90	2.87	0.91	1.76	1.19	2.84	1.29	1.14	0.89	1.29	0.99	1.24	0.99
A19		9.61	2.46	7.46	4.46	3.00	2.75	3.05	2.75	7.81	4.11	6.37	2.45	5.55	2.45
A-20	7.87	7.17	1.57	6.47	0.67	3.97	2.55	4.59	2.93	7.49	3.50	4.27	1.77	4.57	2.57
A22A		1.90	1.05	1.79	1.00	1.50	2.0	3.20	1.96	3.25	1.75	4.27	1.77	3.35	1.30
A-23	11.92	9.87	4.75	10.57	5.82	8.76	6.82	11.3	9.37	11.87	8.13	6.40	1.50	11.15	7.17
A-24	18.28	18.68	5.23	16.01	3.25	16.28	14.98	17.2	14.5	16.62	12.43	11.87	6.97	14.58	6.88
A-25	6.83	10.23	4.43	10.23	2.98	7.03	5.28	7.78	5.85	7.43	4.58	6.38	2.88	6.63	3.13
A-26	9.18	8.76	4.28	7.56	4.28	7.71	4.58	7.73	3.18	8.93	4.48	5.28	2.53	6.23	3.88
A-27	3.00	2.13	1.10	1.62	1.25	1.63	1.55	4.40	3.95	4.85	1.80	2.90	1.25	2.90	1.0
A28A	3.90	2.90	2.45	3.35	2.45	3.29	1.91	4.35	3.60	3.35	1.47	4.30	1.55	4.15	2.51
A-29	5.50	9.30	1.42	6.95	1.67	3.3	2.35	4.55	4.60	5.92	6.96	4.40	1.30	6.45	2.10
A-32	2.30	2.19	1.10	2.45	1.95	3.15	2.45	4.41	2.13	4.75	2.10	3.15	1.55	2.80	0.70
A-33	3.07	5.25	1.25	4.13	1.80	4.08	1.57	4.91	1.97	5.75	2.60	6.45	1.55	4.07	2.35
A-34	2.90	6.95	2.90	6.21	2.50	4.45	4.45	8.40	4.81	4.75	4.45	12.45	4.45	5.90	3.70
B-1	1.78	2.08	1.73	1.53	1.83	2.43	1.81	3.28	2.75	3.58	1.93	2.33	0.85	2.88	2.08
B-14	2.49	1.34	1.42	1.74	1.45	3.24	4.44	2.94	2.29	2.44	0.47	2.94	1.84	3.64	2.84
B-15	1.37	1.27	0.45	1.20	0.55	0.95	1.45	1.50	0.45	1.85	0.55	4.85	0.15	1.85	0.85
B21A	7.60	9.00	5.05	8.01	4.95	9.54	3.7	7.37	4.65	5.55	4.50	8.85	5.65	9.65	2.65
B-23	9.14	3.71	1.74	5.27	1.39	6.57	2.74	7.86	4.29	6.81	2.41	7.74	2.14	6.64	2.14
B-24	10.33	-	3.09	8.88	2.83	9.40	2.21	10.0	5.78	10.63	4.28	10.03	4.03	9.28	4.33
B-25	8.35	8.35	2.60	7.08	2.15	5.82	5.15	6.88	-	7.05	1.70	6.70	1.40	5.90	3.70
B32A	7.80	7.75	3.22	6.25	2.68	8.33	2.05	7.55	3.32	6.95	3.07	6.95	2.80	6.75	3.90
B-48	5.75	5.43	3.85	4.69	3.20	6.38	4.35	7.90	5.42	9.35	4.60	7.70	4.15	7.33	3.97
B-51	3.95	3.60	2.05	3.35	2.49	2.09	1.98	4.65	3.40	4.90	3.18	4.98	2.55	5.02	2.42
B-53	1.67	6.97	1.42	4.15	1.12	3.39	-	5.58	2.82	4.70	1.45	4.02	1.92	3.92	1.42
B-59	8.25	6.90	0.60	7.56	0.30	2.65	1.0	4.12	1.60	4.40	0.50	5.40	0.60	5.47	1.10
B-60	11.44	10.18	5.13	11.29	5.23	9.82	4.59	9.21	5.28	10.33	5.03	13.23	3.18	13.68	4.23
B61A	10.72	5.42	2.40	8.17	2.02	6.93	3.57	6.15	4.52	6.58	3.87	2.57	0.82	2.57	2.02
B62A	8.85	7.85	4.90	7.73	4.63	8.83	5.85	9.10	5.21	9.30	4.95	8.15	4.35	8.27	4.78

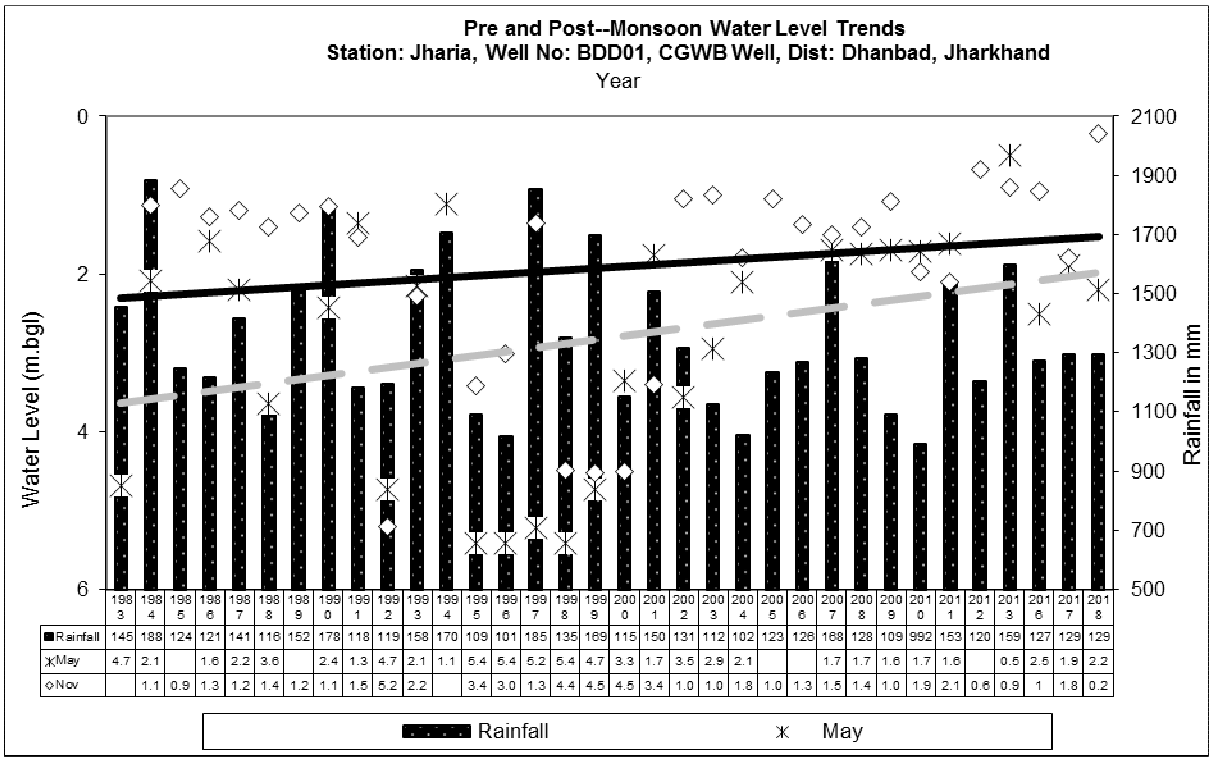
Annexure – IIB

Historical Water Level data of Hydrograph Stations

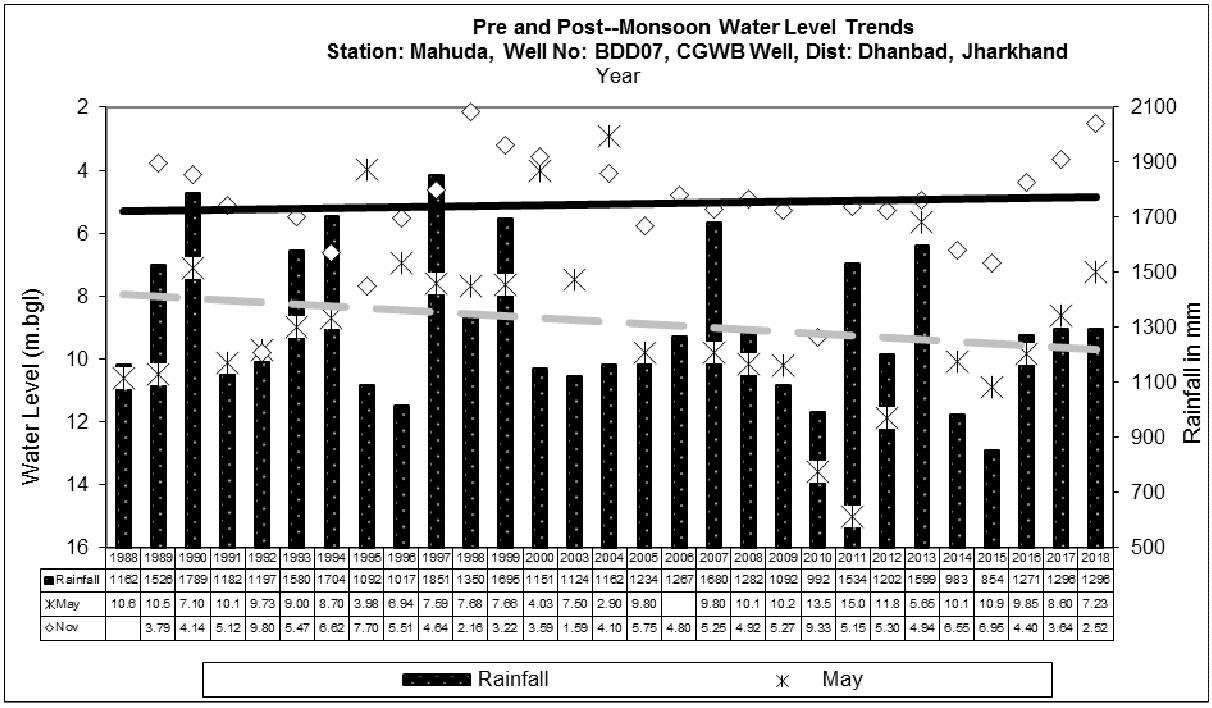
Well No	Water level below ground level (bgl) in meters														
	May, 11	May, 12	Nov, 12	May, 13	Nov, 13	May, 14	Nov, 14	May, 15	Nov, 15	May, 16	Nov, 16	May, 17	Nov, 17	May, 18	Nov, 18
B-64	0.85	1.05	1.00	1.35	0.85	0.7	1.15	1.38	0.95	2.35	0.55	1.25	0.85	2.15	1.85
B65A	9.65	11.45	1.73	10.11	1.82	10.45	2.4	7.82	5.87	7.15	2.68	9.05	1.25	10.03	2.40
B-67	11.25	8.55	6.50	9.73	5.31	9.80	3.72	9.23	5.53	9.53	4.30	10.00	2.15	9.55	4.0
D-3	2.55	2.93	1.80	3.45	1.68	2.54	2.11	4.25	2.25	2.35	1.90	2.15	2.30	3.43	2.45
D-4	1.51	1.94	0.91	2.41	0.98	1.23	0.91	2.41	1.27	1.21	1.36	1.21	1.46	1.91	1.56
D-5	9.05	9.50	6.45	9.32	4.59	9.0	7.8	9.37	8.33	9.40	6.40	7.90	5.20	7.80	5.30
D-7	9.33	6.08	5.83	7.19	4.63	5.28	5.53	8.25	5.61	7.53	4.03	7.33	2.88	7.53	2.83
D-8	7.75	6.15	3.75	6.65	2.85	7.73	-	6.24	4.38	8.00	3.43	5.15	1.85	5.65	1.85
D-23	6.80	6.00	3.30	6.60	1.20	6.38	2.4	6.55	3.48	5.70	1.63	2.80	2.98	4.40	3.40
D-25	4.70	5.20	3.65	4.26	3.45	4.42	2.9	4.48	2.45	2.40	1.90	2.40	1.20	2.60	2.40
D-30	5.10	3.88	1.80	4.38	3.08	4.17	3.3	4.55	3.15	4.45	3.20	4.40	1.25	4.58	1.10
D-33	0.95	2.85	0.35	1.80	0.45	1.72	0.35	2.25	1.10	2.50	1.95	0.75	0.75	2.85	0.95
D-34	2.85	2.35	2.50	2.50	2.13	2.80	0.30	2.55	1.45	2.30	0.30	0.80	0.55	2.80	0.45
D-35	8.20	8.05	5.55	7.70	4.10	6.94	6.15	9.80	7.90	9.52	6.45	8.80	3.60	8.40	4.45
D-36	1.95	1.55	0.15	1.28	0.80	1.82	0.75	1.66	1.13	0.78	0.95	1.30	0.70	1.20	0.60
D-39	5.05	5.05	3.65	3.98	2.50	5.03	2.25	5.00	2.61	2.18	2.65	6.17	4.75	4.95	4.35
D40A	1.95	2.45	1.70		2.25	2.35	2.45	3.07	2.45	1.40	0.85	1.45	1.35	2.10	1.40
D-41	1.55	1.50	1.50	1.72	1.35	3.20	1.35	2.65	2.32	1.30	1.52	1.40	1.20	1.59	1.32
D-43	7.65	7.05	4.00	6.23	4.05	6.0	4.75	6.61	5.05	8.20	3.35	7.50	3.60	7.15	3.45
D-47	4.35	1.95	2.12	2.60	2.97	8.0	2.37	9.60	3.60	3.18	2.95	3.15	2.85	5.33	2.55
D-49	1.55	1.60	1.65	1.30	1.45	2.51	1.65	3.55	2.35	2.45	1.72	2.70	2.05	3.45	2.45
D-51	10.85	10.00	7.85	8.94	8.35	9.60	9.05	10.48	9.15	11.15	6.45	10.45	5.43	10.93	7.10
D-55	5.97	1.93	1.82	3.90	1.45	1.95	2.07	6.15	1.57	2.52	3.62	6.42	2.37	8.42	1.57
D-74	4.05	4.95	3.60	4.55	3.41	5.0	4.0	10.05	7.20	7.73	5.00	9.25	3.85	8.60	4.80
D-77	6.30	6.50	4.75	4.79	5.10	6.23	6.0	6.44	5.60	4.60	2.90	6.50	4.90	6.30	5.20
D-80	17.45	14.20	3.35	15.25	3.32	13.3	3.15	10.97	3.35	6.55	4.15	8.65	3.70	9.35	4.20
RCF (part)		May, 12	Nov, 12	May, 13	Nov, 13	May, 14	Nov, 14	May, 15	Nov, 15	May, 16	Nov, 16	May, 17	Nov, 17	May, 18	Nov, 18
DB22		2.43	2.38	8.18	2.64	6.48	3.03	4.59	3.53	5.38	3.33	1.93	1.63	2.34	1.93
DB23		2.90	2.33	5.05	3.10	3.95	2.13	3.38	6.04	5.30	0.90	2.05	1.90	2.85	1.75
DB24		-	-	-	8.25	-	8.45	9.52	8.20	10.65	6.50	5.80	3.78	8.25	5.70
DB25		3.96	1.18	1.33	2.53	3.27	2.73	3.83	2.68	3.61	1.98	3.23	2.58	3.93	1.63

Annexure – III

HYDROGRAPHS OF CGWB PERMANENT OBSERVATION STATIONS



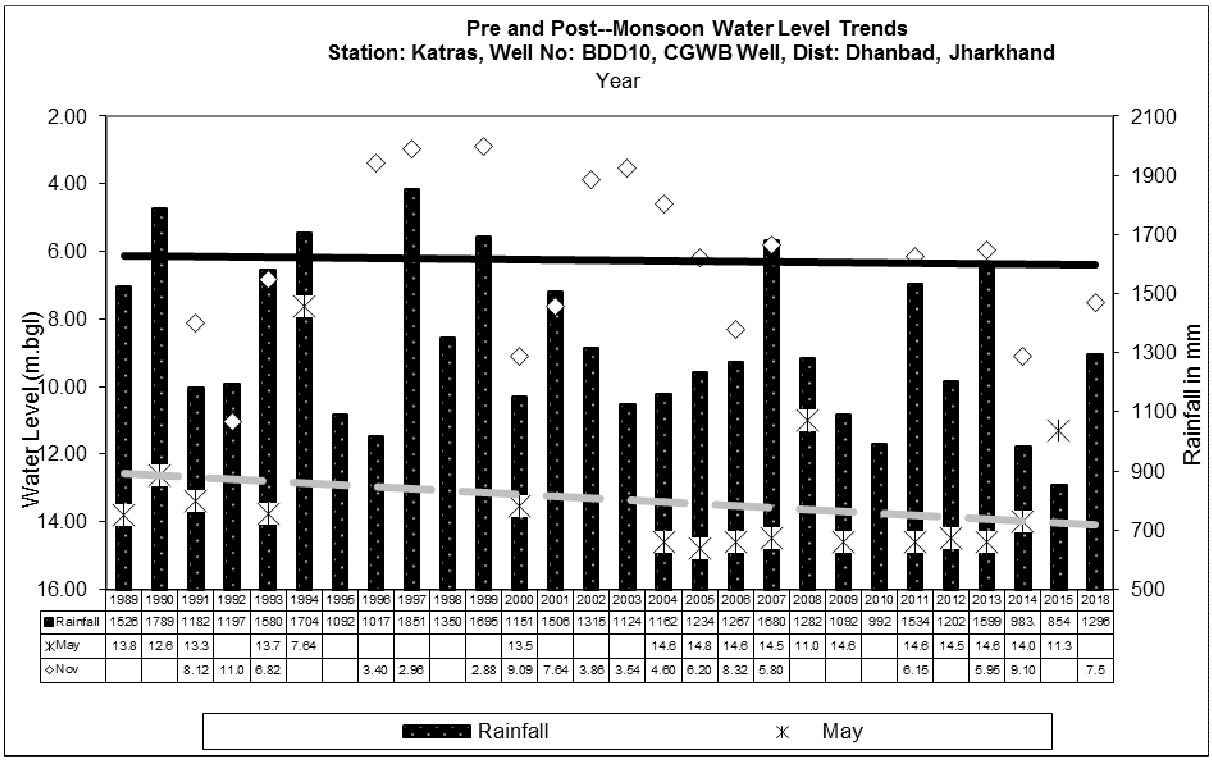
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	145	188	124	121	141	116	152	178	118	119	158	170	109	101	185	135	189	115	150	131	112	102	123	126	168	128	109	992	153	120	159	127	129	129		
May	4.7	2.1		1.6	2.2	3.6		2.4	1.3	4.7	2.1	1.1	5.4	5.4	5.2	5.4	4.7	3.3	1.7	3.5	2.9	2.1			1.7	1.7	1.6	1.7	1.6		0.5	2.5	1.9	2.2		
Nov		1.1	0.9	1.3	1.2	1.4	1.2	1.1	1.5	5.2	2.2		3.4	3.0	1.3	4.4	4.5	4.5	3.4	1.0	1.0	1.8	1.0	1.3	1.5	1.4	1.0	1.9	2.1	0.6	0.9	1	1.8	0.2		



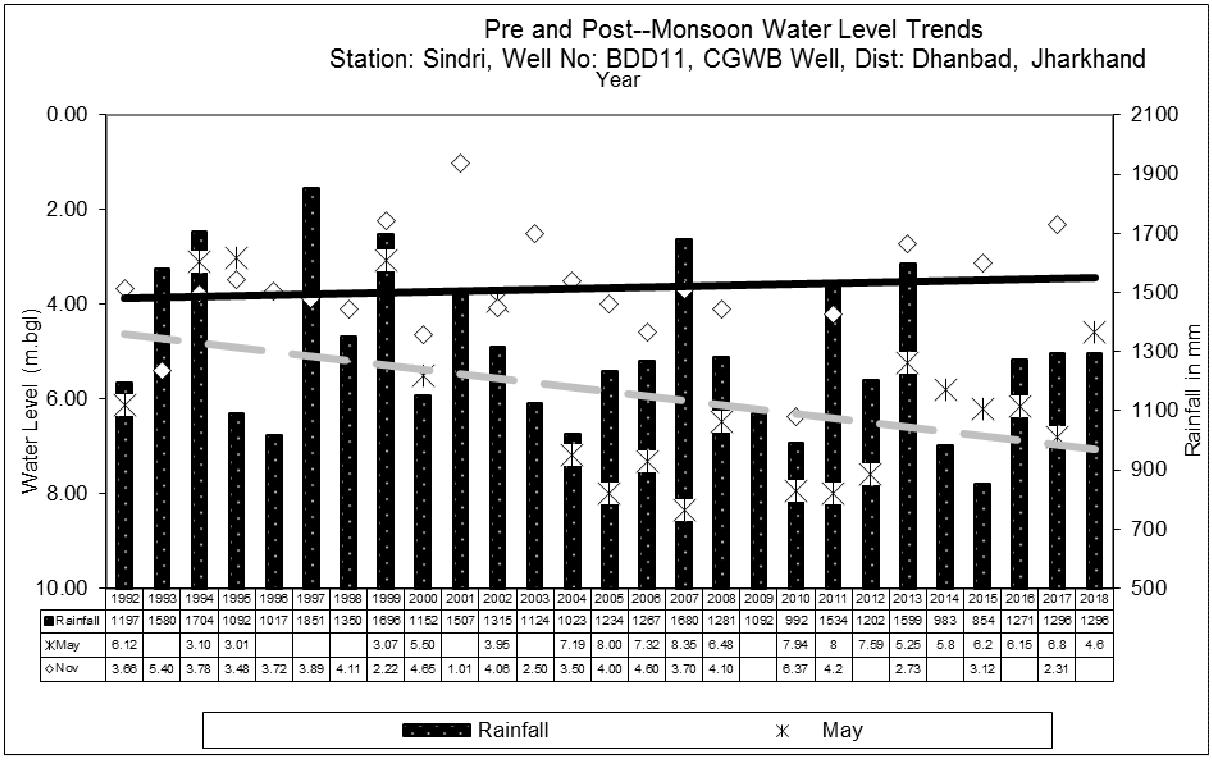
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1162	1526	1789	1182	1197	1580	1704	1092	1017	1851	1350	1695	1151	1124	1162	1234	1267	1680	1282	1092	992	1534	1202	1599	983	854	1271	1296	1296
May	10.8	10.5	7.10	10.1	9.73	9.00	8.70	8.98	6.94	7.59	7.68	7.66	4.03	7.50	2.90	9.80		9.80	10.1	10.2	13.5	15.0	11.8	5.66	10.1	10.9	9.85	8.60	7.23
Nov		3.79	4.14	5.12	9.80	5.47	6.62	7.70	5.51	4.64	2.16	3.22	3.59	1.59	4.10	5.75	4.80	5.25	4.92	5.27	9.33	5.15	5.30	4.94	6.55	6.95	4.40	3.64	2.52

Annexure – III

HYDROGRAPHS OF CGWB PERMANENT OBSERVATION STATIONS



	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2018
Rainfall	1526	1789	1182	1197	1580	1704	1092	1017	1851	1350	1695	1151	1508	1315	1124	1162	1234	1267	1680	1282	1092	992	1534	1202	1599	983.	854	1296
May	13.8	12.6	13.3		13.7	7.64						13.5				14.6	14.8	14.6	14.5	11.0	14.6		14.6	14.5	14.8	14.0	11.3	
Nov			8.12	11.6	6.82			3.40	2.96		2.88	9.09	7.64	3.86	3.54	4.60	6.20	8.32	5.80				6.15		5.95	9.10		7.5



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1197	1580	1704	1092	1017	1851	1350	1696	1152	1507	1315	1124	1023	1234	1267	1680	1281	1092	992	1534	1202	1599	983.	854	1271	1296	1296
May	6.12		3.10	3.01				3.07	5.50		3.95		7.19	8.00	7.32	8.35	6.48		7.94	8	7.59	5.25	5.8	6.2	6.15	6.8	4.6
Nov	3.66	5.40	3.78	3.48	3.72	3.89	4.11	2.22	4.65	1.01	4.08	2.50	3.50	4.00	4.60	3.70	4.10		6.37	4.2		2.73		3.12		2.31	

Annexure – IV

GROUNDWATER SAMPLE LOCATION DETAILS

Sampling month: March, May, August & December month of assessment year'2018

Sl No	Name of Cluster	Ground Water Sample	Dug well (CMPDI)	Location	Sampling Date			
					March'18	May'18	Aug'18	Dec'18
1	CLUSTER-I	GW-1	B-15	BERA VILLAGE	08.03.18	30.05.18	16.08.18	10.12.18
2	CLUSTER-II	GW-2	B-59	KHODOVALY VILLAGE	08.03.18	30.05.18	16.08.18	10.12.18
3	CLUSTER-III	GW-3	A-29	GOVINDPUR,AMBAGAN VILLAGE	08.03.18	30.05.18	16.08.18	10.12.18
4	CLUSTER-IV	GW-4	B-63	KESHALPUR, BATIGHAR	08.03.18	30.05.18	16.08.18	10.12.18
5	CLUSTER-V	GW-5	D-30	BORKIBOA VILLAGE	08.03.18	30.05.18	16.08.18	10.12.18
6	CLUSTER-VI	GW-6	D-25	GODHUR MORE	08.03.18	30.05.18	16.08.18	11.12.18
7	CLUSTER-VII	GW-7	D-80	DHANSAR MINE RESCUE STN.	07.03.18	31.05.18	17.08.18	11.12.18
8	CLUSTER-VIII	GW-8	D-49	NEAR GHANOODIH OC	07.03.18	31.05.18	17.08.18	11.12.18
9	CLUSTER-IX	GW-9	D-5	JEALGORA, NEAR P.O.	07.03.18	31.05.18	17.08.18	11.12.18
10	CLUSTER-X	GW-10	D-35	PATHERDIH RLY. COLONY	07.03.18	31.05.18	17.08.18	11.12.18
11	CLUSTER-XI	GW-11	A-32	MONNIDIH BAZAR	08.03.18	30.05.18	18.08.18	10.12.18
12	CLUSTER-XIII	GW-13	A-23	MACHHAYARA	08.03.18	30.05.18	18.08.18	10.12.18
13	CLUSTER-XIV	GW-14	B-23	LOHAPATTI VILLAGE	08.03.18	30.05.18	18.08.18	10.12.18
14	CLUSTER-XV	GW-15	B-32A	MADHUBAND VILLAGE	08.03.18	30.05.18	18.08.18	10.12.18
15	CLUSTER-XVI	GW-16	D-22	DAHIBARI,NICHE BASTI	07.03.18	31.05.18	17.08.18	11.12.18

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: March'2018

Stations: 1. Cluster-I (GW-1), Bera Village, Date: 08/03/2018
2. Cluster-II (GW-2), Khodovaly village, Date: 08/03/2018
3. Cluster-III (GW-3), Govindpur, Date: 08/03/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		1	2	3			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	02	03	4.0	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	34	44	30	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	28	34	52	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.43	0.26	0.38	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.12	0.08	0.18	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	6.20	15.20	8.9	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.63	7.45	7.92	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	65.0	82.0	75	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	76.0	84.0	78.0	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	301	442	393	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	156	188	172	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2.0	4.0	3.0	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV.**

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: March'2018

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 08/03/2018
5. Cluster-V (GW-5), Borkiboa village, Date: 08/03/2018
6. Cluster-VI (GW-6), Godhur, Date: 08/03/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	5	6			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	03	03	1.0	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	32	46	34	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	24	38	48	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.19	0.32	0.45	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.14	0.06	0.12	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	14.10	15.10	3.9	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.81	7.69	7.54	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	64.0	78.0	82	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	104	94.0	88.0	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	459	456	485	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	186	168	192	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	4.0	2.0	1.0	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: March'2018

Stations: 7. Cluster-VII (GW-7), Dhansar, Date: 07/03/2018
8. Cluster-VIII (GW-8), Ghanudih, Date: 07/03/2018
9. Cluster-IX (GW-9), Jealgora, Date: 07/03/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		7	8	9			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	04	02	4.0	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	42	36	30	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	34	38	52	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.33	0.28	0.16	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.06	0.06	0.08	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	6.70	2.60	12.40	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.49	7.88	7.67	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	8.0	58.0	46	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	98	72.0	86.0	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	396	272	224	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	182	168	96	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	3.0	2.0	2.0	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: March'2018

Stations: 10. Cluster-X (GW-10), Patherdih, Date: 07/03/2018
11. Cluster-XI (GW-11), Moonidih, Date: 08/03/2018
12. Cluster-XIII (GW-13), Machhayara, Date: 08/03/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		10	11	12			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	03	01	1.0	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	42	38	32	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	24	36	30	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.24	0.31	0.40	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.10	0.06	0.08	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	3.50	4.40	7.90	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.84	7.87	7.72	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	38.0	72.0	62	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	64	108	124	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	188	344	316	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	68	156	148	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	3.0	2.0	1.0	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: March'2018

Stations: 13. Cluster-XIV (GW-14), Lohapatti, Date: 08/03/2018
14. Cluster-XV (GW-15), Madhuband, Date: 08/03/2018
15. Cluster-XVI (GW-16), Dahibari, Date: 07/03/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		13	14	15			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	04	01	05	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	46	40	34	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	42	36	32	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.35	0.17	0.26	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.06	0.16	0.08	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	4.40	1.70	19.70	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.61	7.98	7.80	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	65.0	70.0	96	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	70	92	132	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	290	364	434	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	132	174	196	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2.0	1.0	1.0	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: May'2018

Stations: 1. Cluster-I (GW-1), Bera Village, Date: 30/05/2018
2. Cluster-II (GW-2), Khodovaly village, Date: 30/05/2018
3. Cluster-III (GW-3), Govindpur, Date: 30/05/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		1	2	3			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	05	04	05	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	35.2	57.6	44.8	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	36	44	102	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.37	0.14	0.94	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.02	0.03	0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.07	0.08	0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	7.1	18.30	11.7	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.54	7.19	7.82	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	81	178	90	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	144	104	96	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	312	566	404	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	164	236	196	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2.0	1.0	4.0	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV.**

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: May'2018

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 30/05/2018
5. Cluster-V (GW-5), Borkiboa village, Date: 30/05/2018
6. Cluster-VI (GW-6), Godhur, Date: 30/05/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	5	6			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	04	03	05	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	43.2	41.6	48	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	48	80	72	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.12	0.17	0.38	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.02	0.03	0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.06	0.08	0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	13.6	12.80	4.7	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.38	7.21	8.07	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	132	153	172	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_3),, mg/l, Max	108	92	172	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	470	454	490	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_3), mg/l, Max	188	180	196	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2.0	1.0	3.0	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: May'2018

Stations: 7. Cluster-VII (GW-7), Dhansar, Date: 31/05/2018
8. Cluster-VIII (GW-8), Ghanudih, Date: 31/05/2018
9. Cluster-IX (GW-9), Jealgora, Date: 31/05/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		7	8	9			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	05	04	04	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	41.6	46.4	33.6	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	78	34	46	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	0.003	0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.71	0.31	0.58	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.03	0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.19	0.11	0.08	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	8.3	3.7	16.3	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.45	7.92	7.76	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	147	176	107	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	116	112	104	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	418	478	334	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	176	184	152	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2.0	2.0	2.0	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: May'2018

Stations: 10. Cluster-X (GW-10), Patherdih, Date: 31/05/2018
11. Cluster-XI (GW-11), Moonidih, Date: 30/05/2018
12. Cluster-XIII (GW-13), Machhayara, Date: 30/05/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		10	11	12			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	02	03	03	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	28.8	48	49.6	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	66	44	68	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.64	0.03	0.72	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	0.03	0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.06	0.09	0.21	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	4.8	7.9	6.1	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.33	7.98	8.11	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	78	180	119	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	100	124	188	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	286	488	398	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	132	212	192	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	1.0	3.0	1.0	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: May'2018

Stations: 13. Cluster-XIV (GW-14), Lohapatti, Date: 30/05/2018
14. Cluster-XV (GW-15), Madhuband, Date: 30/05/2018
15. Cluster-XVI (GW-16), Dahibari, Date: 31/05/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		13	14	15			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	04	01	05	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	46	40	34	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	42	36	32	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.35	0.17	0.26	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	0.16	0.08	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	4.4	1.7	19.7	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.61	7.98	7.80	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	65	70	96	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	70	92	132	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	290	364	434	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	132	174	196	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2.0	1.0	3.0	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: August'2018

Stations: 1. Cluster-I (GW-1), Bera Village, Date: 16/08/2018
2. Cluster-II (GW-2), Khodovaly village, Date: 16/08/2018
3. Cluster-III (GW-3), Govindpur, Date: 16/08/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		1	2	3			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	12	1	16	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	43.2	40	52.8	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	24	26	20	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	0.02	0.03	0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.27	0.19	0.24	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.32	<0.06	0.18	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	0.02	0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	3.86	0.21	3.81	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.16	8.13	8.15	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	40	34	47	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	118	145	140	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	0.1	0.1	0.1	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	156	142	154	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	134	134	130	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2	1	2	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV.**

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: August'2018

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 16/08/2018
5. Cluster-V (GW-5), Borkiboa village, Date: 16/08/2018
6. Cluster-VI (GW-6), Godhur, Date: 16/08/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	5	6			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	3	4	4	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	40	177.6	59.2	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	24	104	30	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	0.02	0.02	0.02	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.22	0.53	0.15	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	0.01	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	0.01	0.009	0.008	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	0.40	4.83	7.50	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.12	7.73	8.07	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	40	228	85	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	152	95	105	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	0.1	0.1	0.2	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	144	830	204	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	130	740	192	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	1	<1	<1	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: August'2018

Stations: 7. Cluster-VII (GW-7), Dhansar, Date: 17/08/2018
8. Cluster-VIII (GW-8), Ghanudih, Date: 17/08/2018
9. Cluster-IX (GW-9), Jealgora, Date: 17/08/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		7	8	9			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	6	16	5	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	68.8	49.6	163.2	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	34	20	88	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	0.04	0.04	0.005	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.18	0.20	0.66	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.08	0.08	0.12	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	0.005	0.006	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	39.70	4.55	4.87	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.19	8.23	7.71	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	84	48	225	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	45	135	90	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	0.1	0.1	0.2	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	226	140	782	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	144	134	732	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	1	1	1	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.16	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: August'2018

Stations: 10. Cluster-X (GW-10), Patherdih, Date: 17/08/2018
11. Cluster-XI (GW-11), Moonidih, Date: 16/08/2018
12. Cluster-XIII (GW-13), Machhayara, Date: 16/08/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		10	11	12			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	5	3	3	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	49.6	30.4	187.2	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	58	28	96	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	0.005	0.005	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.31	0.24	0.58	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.08	0.12	0.12	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	0.02	0.01	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	7.07	0.90	4.88	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.02	8.15	7.88	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	225	93	39	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	102	147	95	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	0.2	0.1	0.1	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	220	132	792	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	202	126	722	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	<1	<1	1	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: August'2018

Stations: 13. Cluster-XIV (GW-14), Lohapatti, Date: 16/08/2018
14. Cluster-XV (GW-15), Madhuband, Date: 16/08/2018
15. Cluster-XVI (GW-16), Dahibari, Date: 17/08/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		13	14	15			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	7	3	4	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	51.2	193.6	115.2	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	46	98	64	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	0.02	0.02	0.005	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.32	0.61	0.44	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	0.08	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	5.74	5.16	43.57	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.78	8.05	8.06	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	81	226	144	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	107	102	112	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	0.04	0.1	0.1	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	210	776	552	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	200	710	584	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	1	<1	<1	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: December'2018

Stations: 1. Cluster-I (GW-1), Bera Village, Date: 10/12/2018
2. Cluster-II (GW-2), Khodovaly village, Date: 10/12/2018
3. Cluster-III (GW-3), Govindpur, Date: 10/12/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		1	2	3			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	3	2	4	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	24	12	16	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	28	20	22	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.28	0.16	0.62	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.47	0.11	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.38	0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	12.8	15.6	14.4	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.19	8.21	8.11	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	64	48	56	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	112	185	178	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	612	720	686	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	432	518	408	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	3	3	1	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.08	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV.**

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: December'2018

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 10/12/2018
5. Cluster-V (GW-5), Borkiboa village, Date: 10/12/2018
6. Cluster-VI (GW-6), Godhur, Date: 11/12/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	5	6			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	4	2	3	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	20	16	28	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	26	24	34	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.33	0.29	0.18	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.5	<0.06	0.47	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	0.009	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.08	<0.02	0.13	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	22.6	10.4	16.7	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.08	8.12	7.96	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	68	56	84	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	165	212	190	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	832	764	592	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	532	602	338	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	5	4	1	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: December'2018

Stations: 7. Cluster-VII (GW-7), Dhansar, Date: 11/12/2018
8. Cluster-VIII (GW-8), Ghanudih, Date: 11/12/2018
9. Cluster-IX (GW-9), Jealgora, Date: 11/12/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		7	8	9			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	1	1	4	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	12	16	12	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	36	26	24	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.18	0.25	0.17	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	17.8	14.4	20.8	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.67	8.05	7.46	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	56	78	62	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	176	192	201	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	938	664	704	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	528	420	386	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2	2	2	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: December'2018

Stations: 10. Cluster-X (GW-10), Patherdih, Date: 11/12/2018
11. Cluster-XI (GW-11), Moonidih, Date: 10/12/2018
12. Cluster-XIII (GW-13), Machhayara, Date: 10/12/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		10	11	12			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	3	3	2	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	12	24	16	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	32	26	34	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.26	0.44	0.19	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	0.11	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	12.7	18.1	19.6	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.01	8.17	8.19	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	61	57	65	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	148	169	188	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	556	804	728	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	286	536	444	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	1	3	4	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: December'2018

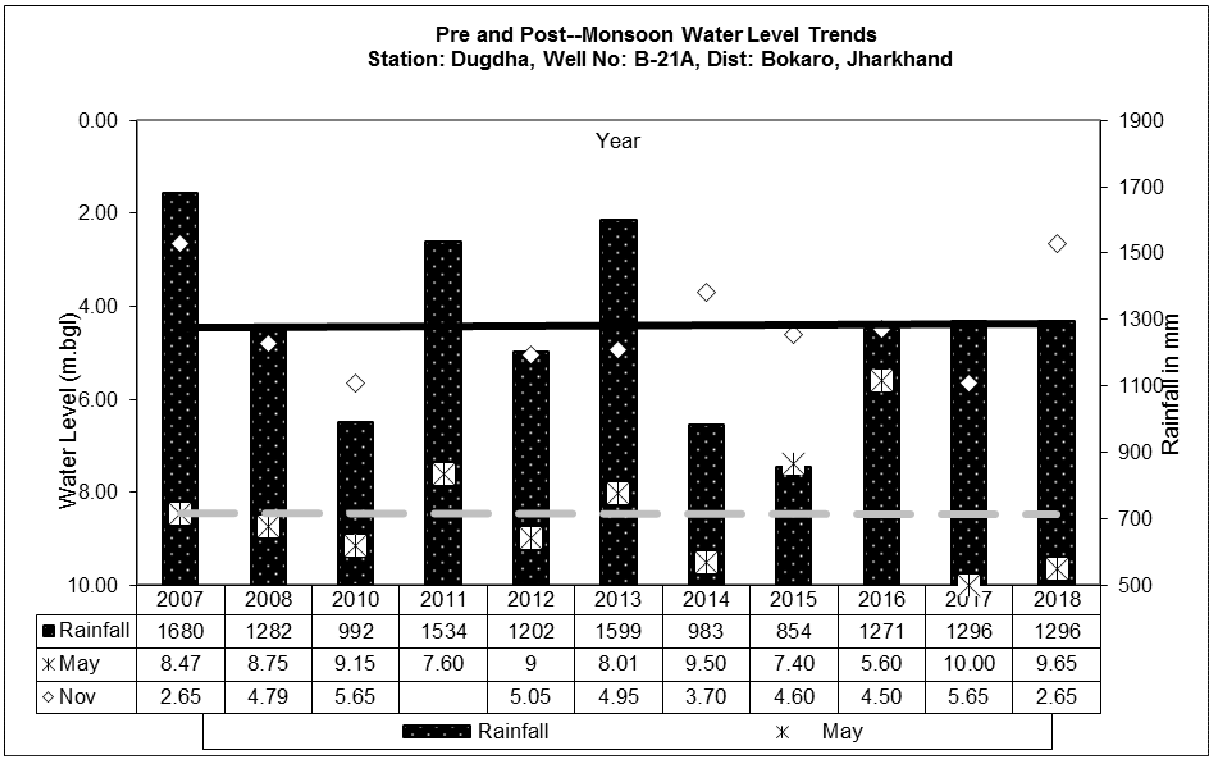
Stations: 13. Cluster-XIV (GW-14), Lohapatti, Date: 10/12/2018
14. Cluster-XV (GW-15), Madhuband, Date: 10/12/2018
15. Cluster-XVI (GW-16), Dahibari, Date: 11/12/2018

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		13	14	15			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	4	4	3	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	20	16	12	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	18	26	30	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.001	<0.001	<0.001	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.37	0.31	0.43	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.14	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.22	0.08	0.14	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	9.6	13.6	11.4	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.24	7.98	7.14	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	72	52	65	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	147	172	196	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	638	704	802	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	308	416	556	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2	1	4	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

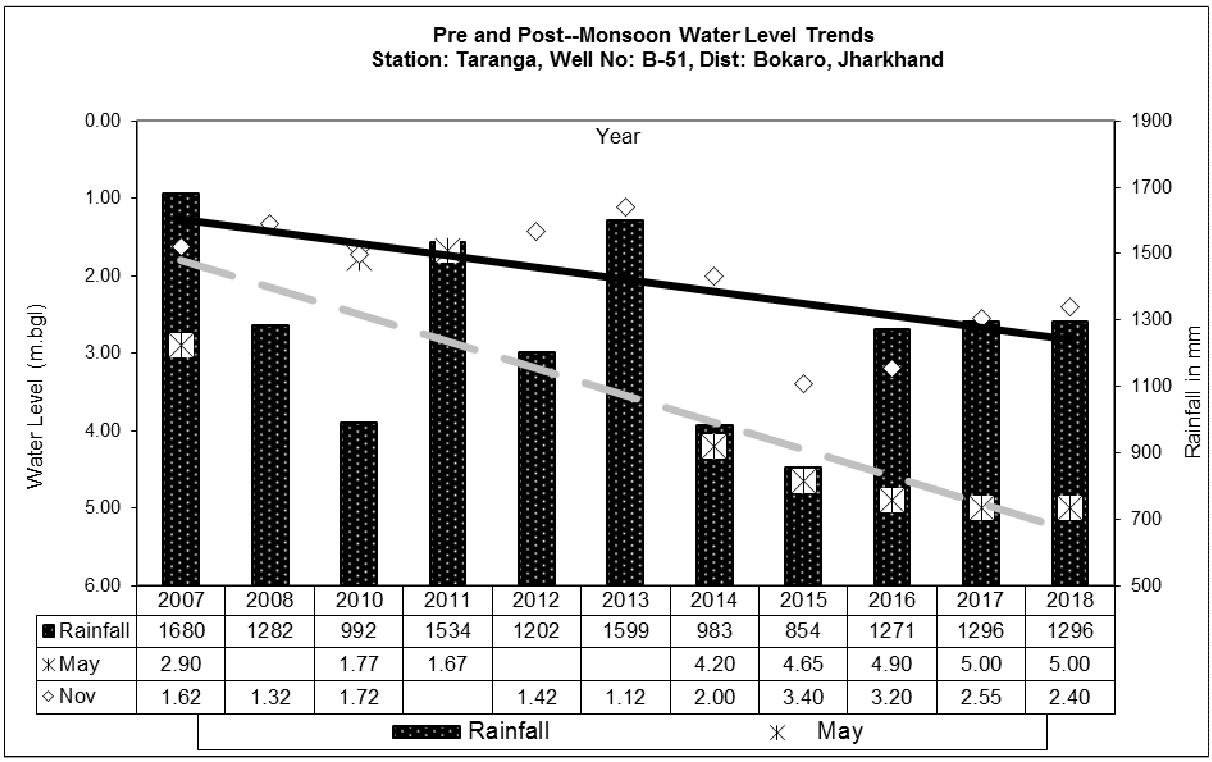
*Sampling location details and sampling date has been given in **Annexure-IV**.

Annexure – VI

HYDROGRAPHS OF CLUSTER-I



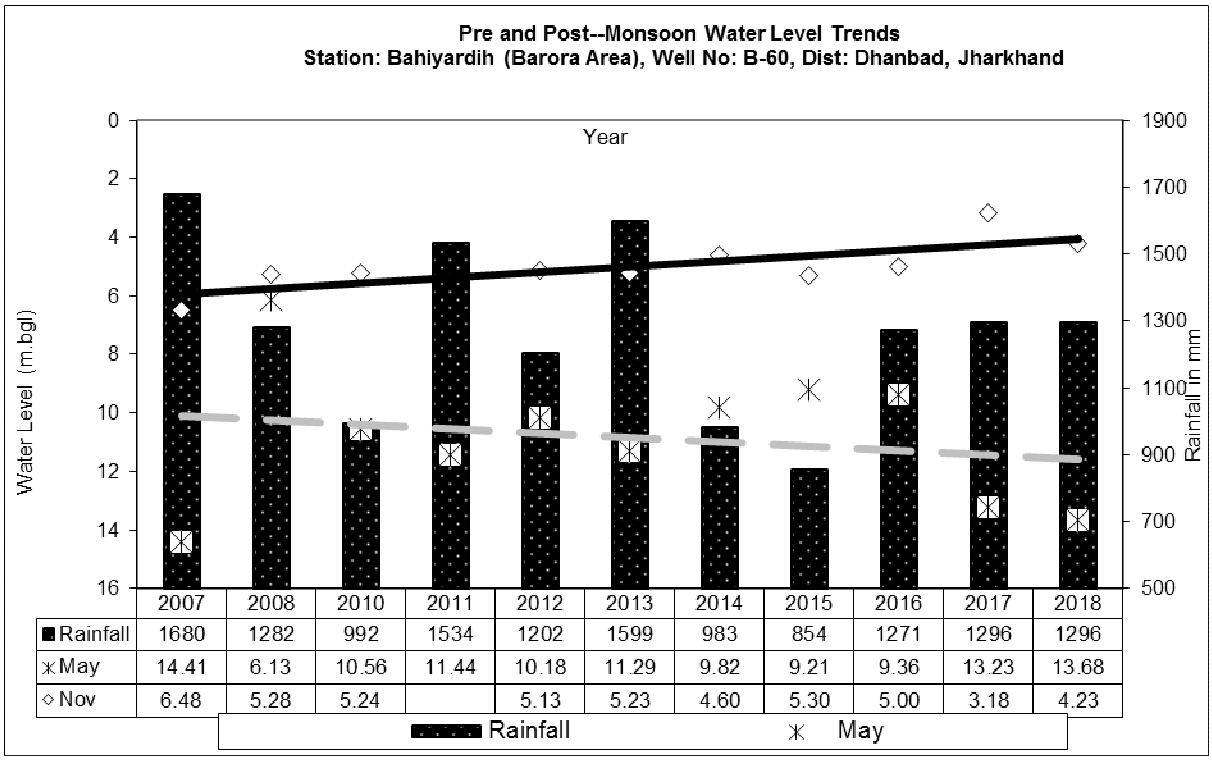
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	8.47	8.75	9.15	7.60	9	8.01	9.50	7.40	5.60	10.00	9.65
Nov	2.65	4.79	5.65		5.05	4.95	3.70	4.60	4.50	5.65	2.65



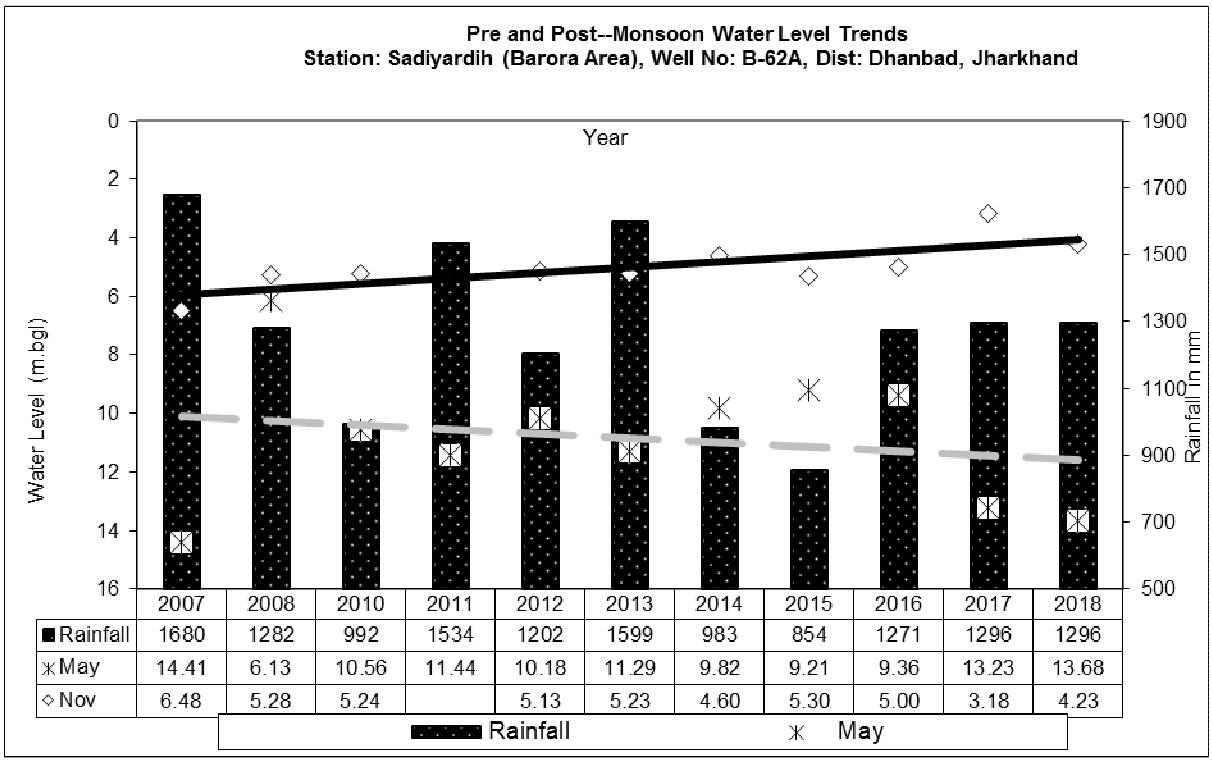
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	2.90		1.77	1.67			4.20	4.65	4.90	5.00	5.00
Nov	1.62	1.32	1.72		1.42	1.12	2.00	3.40	3.20	2.55	2.40

Annexure – VI

HYDROGRAPHS OF CLUSTER-II



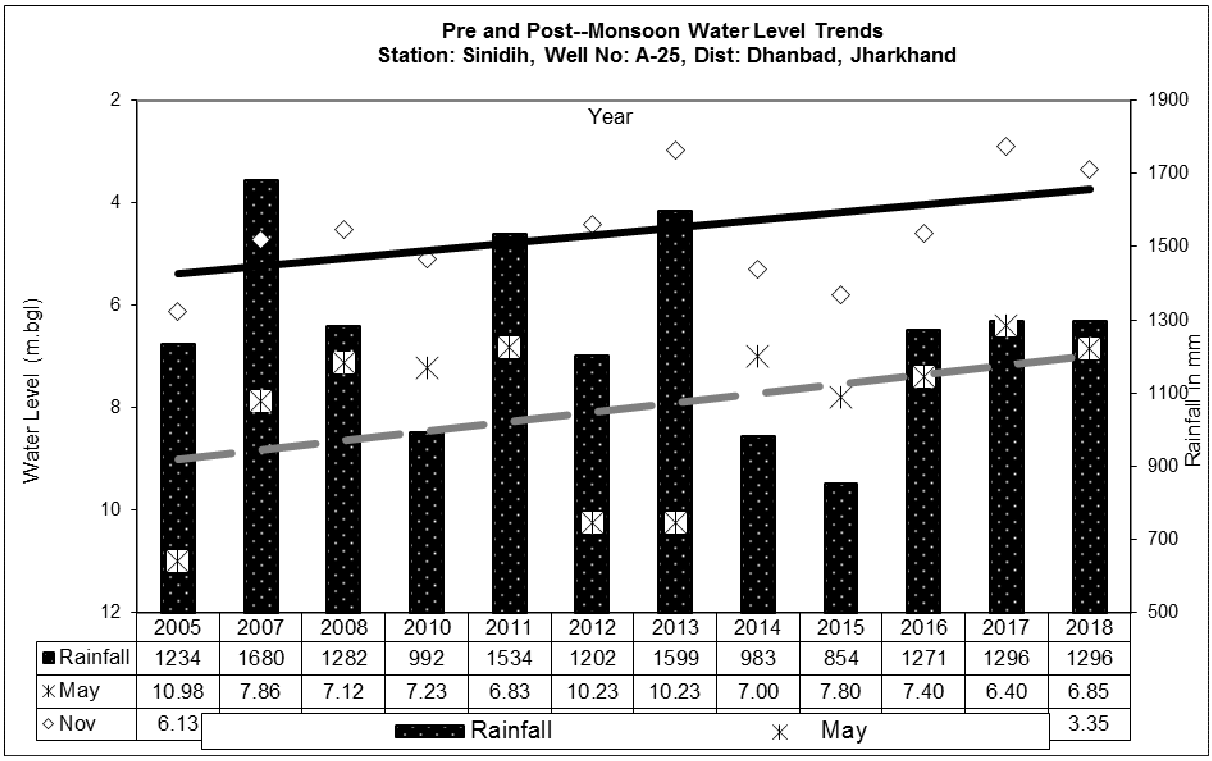
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	14.41	6.13	10.56	11.44	10.18	11.29	9.82	9.21	9.36	13.23	13.68
Nov	6.48	5.28	5.24		5.13	5.23	4.60	5.30	5.00	3.18	4.23



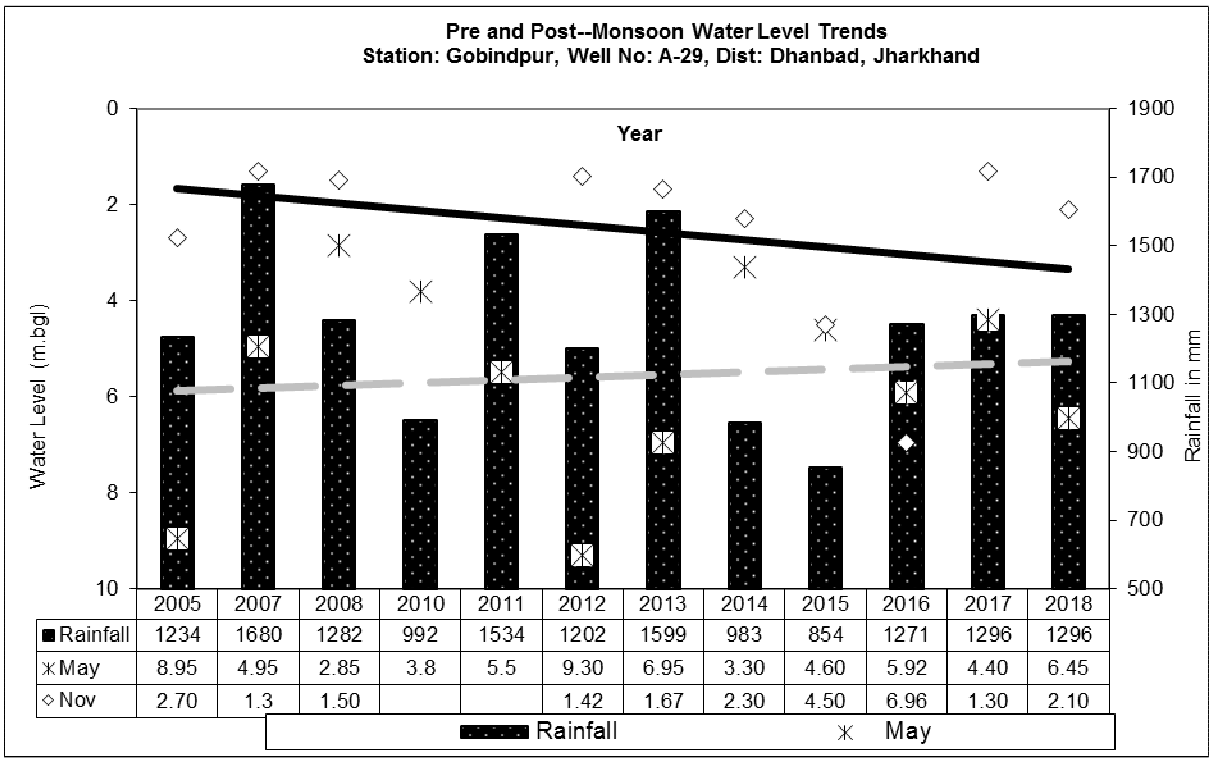
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	14.41	6.13	10.56	11.44	10.18	11.29	9.82	9.21	9.36	13.23	13.68
Nov	6.48	5.28	5.24		5.13	5.23	4.60	5.30	5.00	3.18	4.23

Annexure – VI

HYDROGRAPHS OF CLUSTER-III



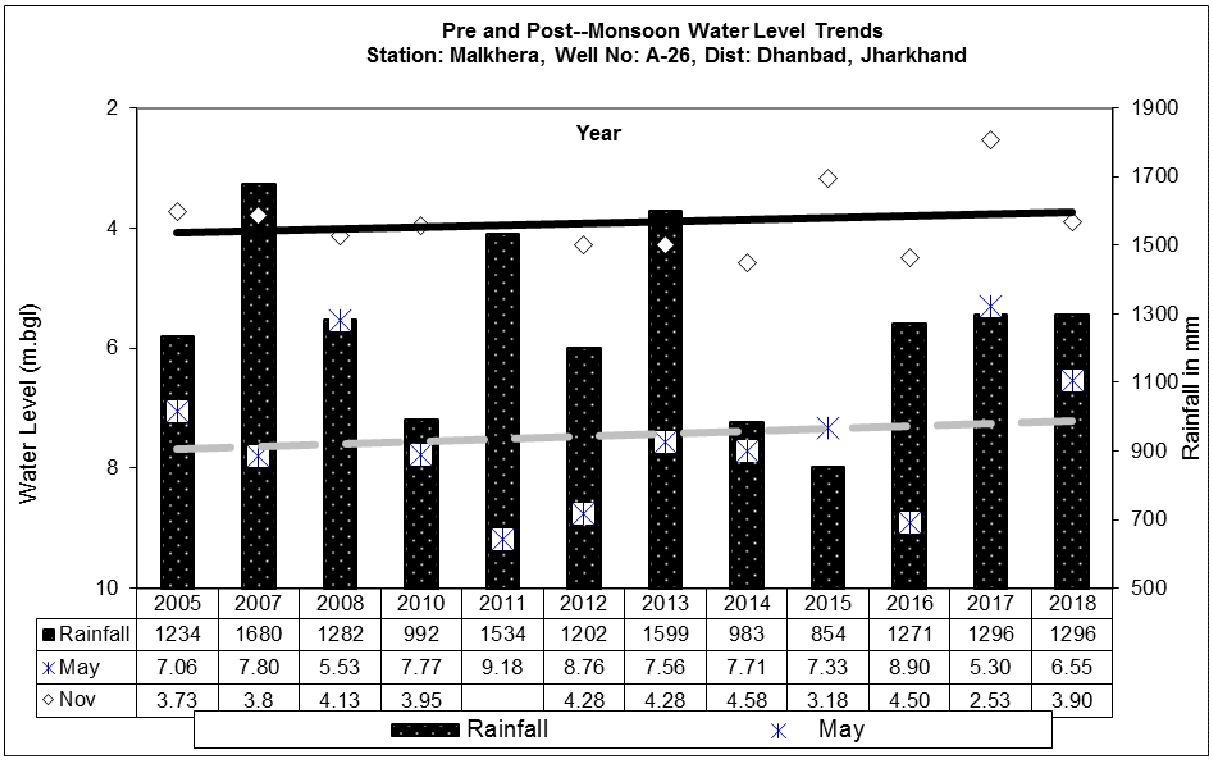
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	10.98	7.86	7.12	7.23	6.83	10.23	10.23	7.00	7.80	7.40	6.40	6.85
Nov	6.13											3.35



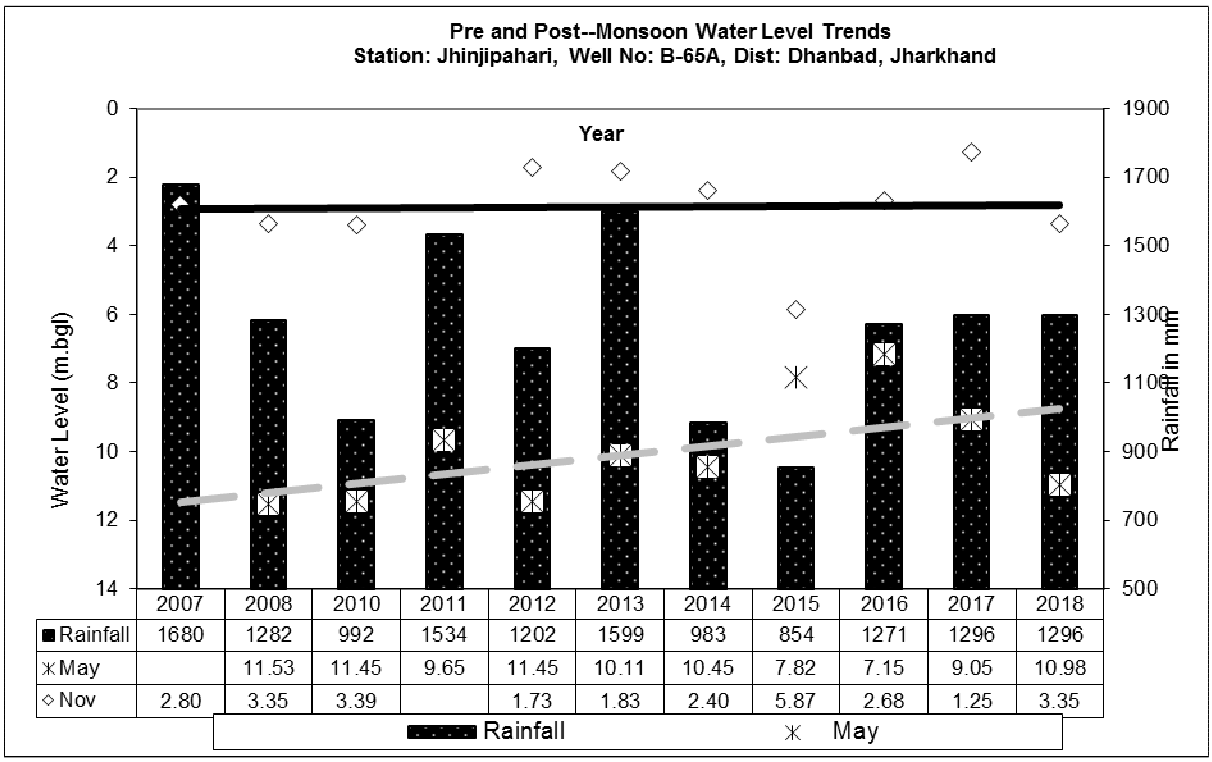
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	8.95	4.95	2.85	3.8	5.5	9.30	6.95	3.30	4.60	5.92	4.40	6.45
Nov	2.70	1.3	1.50			1.42	1.67	2.30	4.50	6.96	1.30	2.10

Annexure – VI

HYDROGRAPHS OF CLUSTER-IV



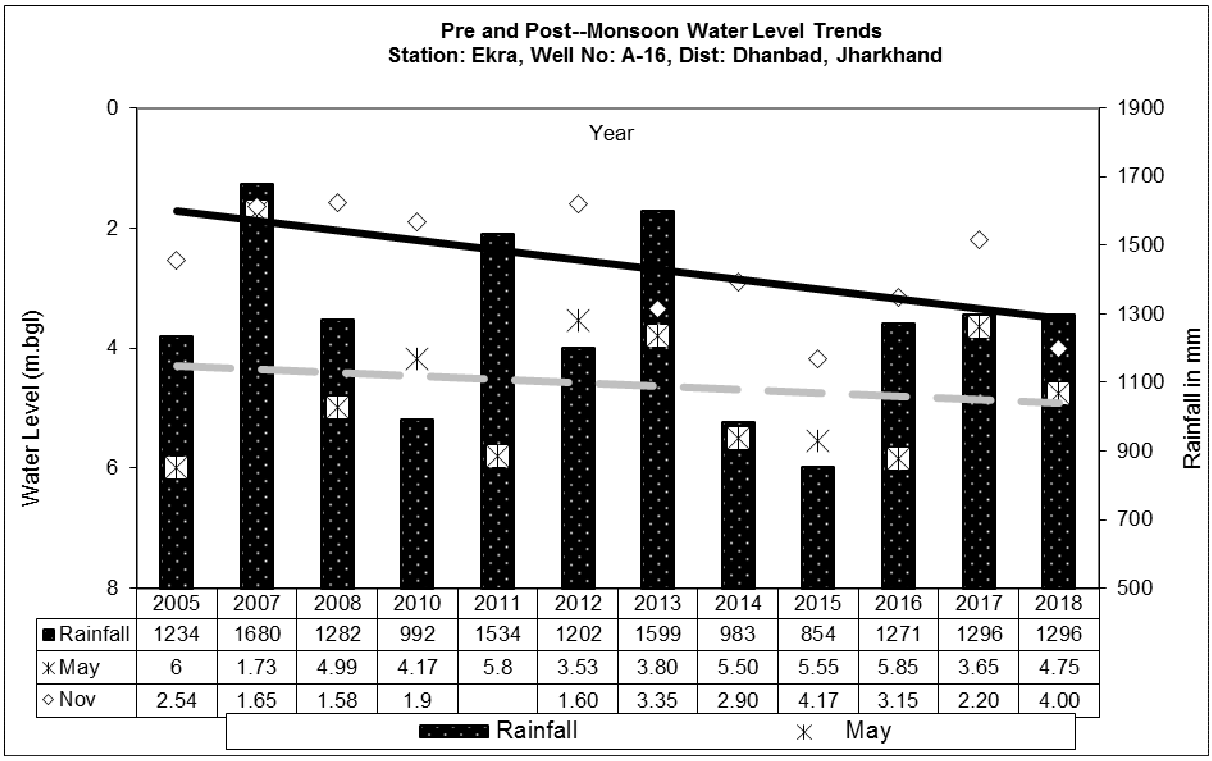
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	7.06	7.80	5.53	7.77	9.18	8.76	7.56	7.71	7.33	8.90	5.30	6.55
Nov	3.73	3.8	4.13	3.95		4.28	4.28	4.58	3.18	4.50	2.53	3.90



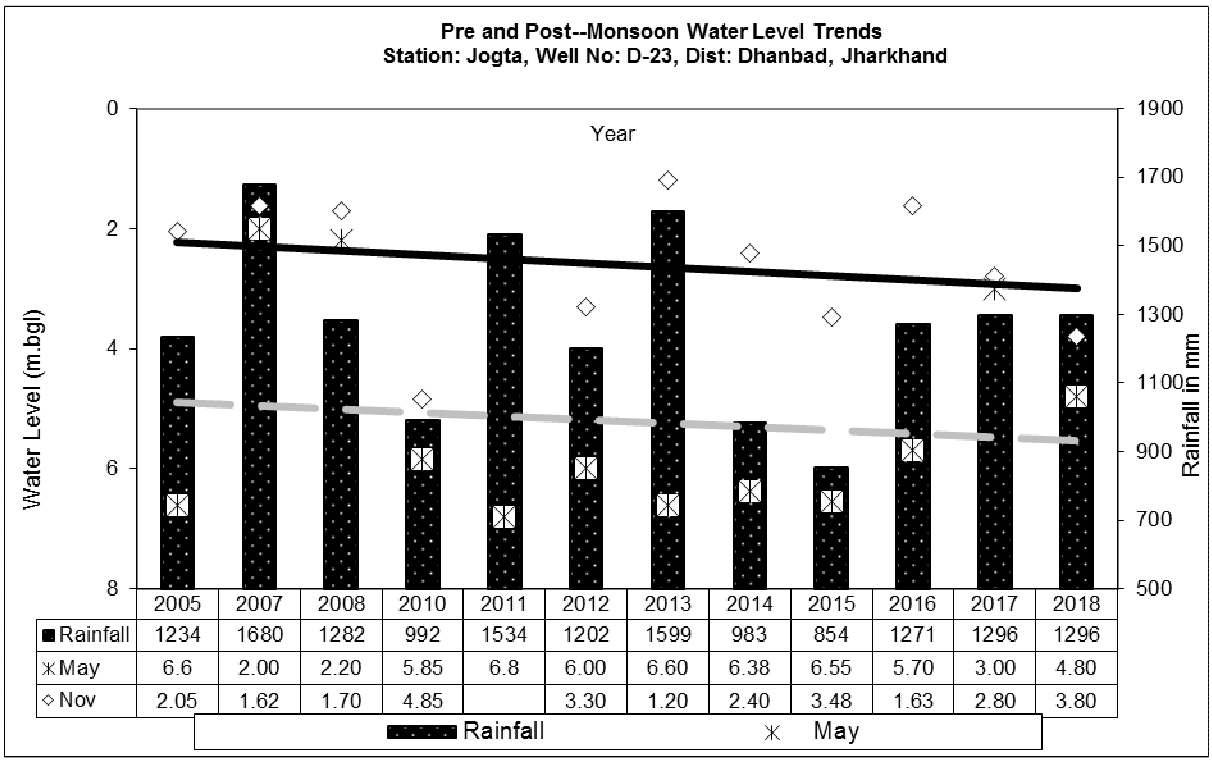
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May		11.53	11.45	9.65	11.45	10.11	10.45	7.82	7.15	9.05	10.98
Nov	2.80	3.35	3.39		1.73	1.83	2.40	5.87	2.68	1.25	3.35

Annexure – VI

HYDROGRAPHS OF CLUSTER-V



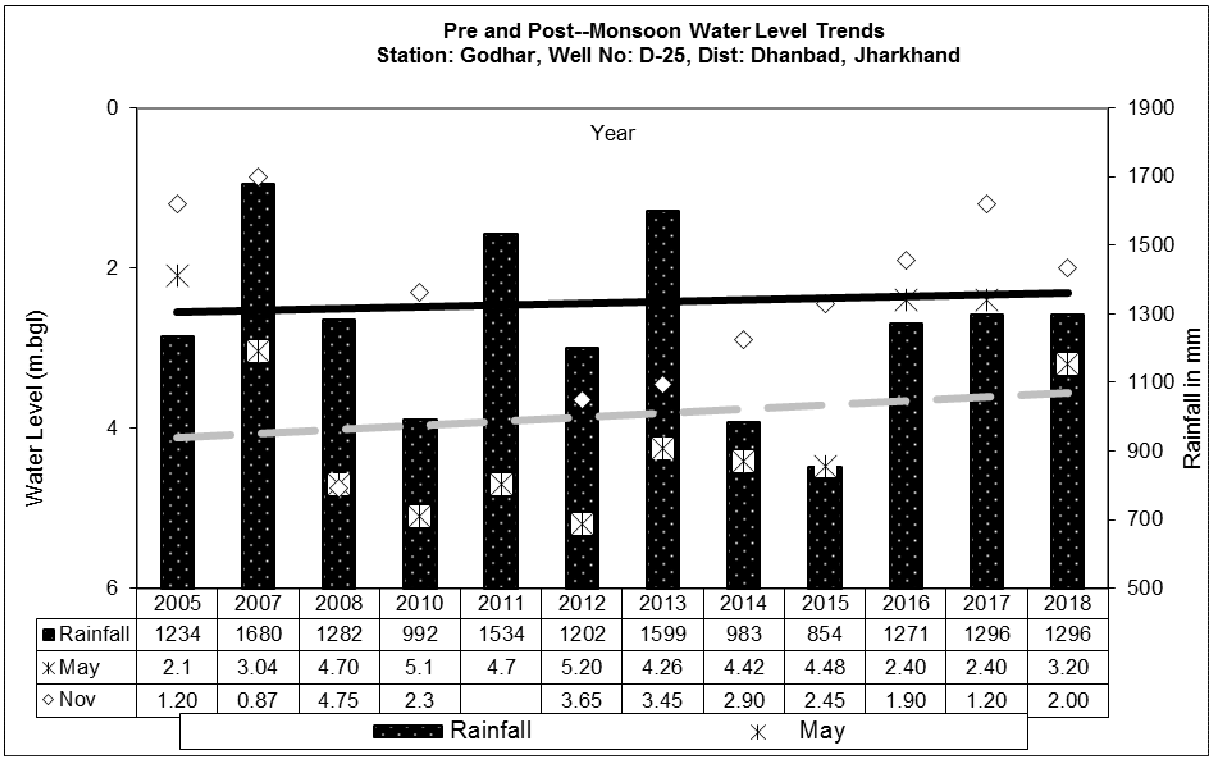
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	6	1.73	4.99	4.17	5.8	3.53	3.80	5.50	5.55	5.85	3.65	4.75
Nov	2.54	1.65	1.58	1.9		1.60	3.35	2.90	4.17	3.15	2.20	4.00



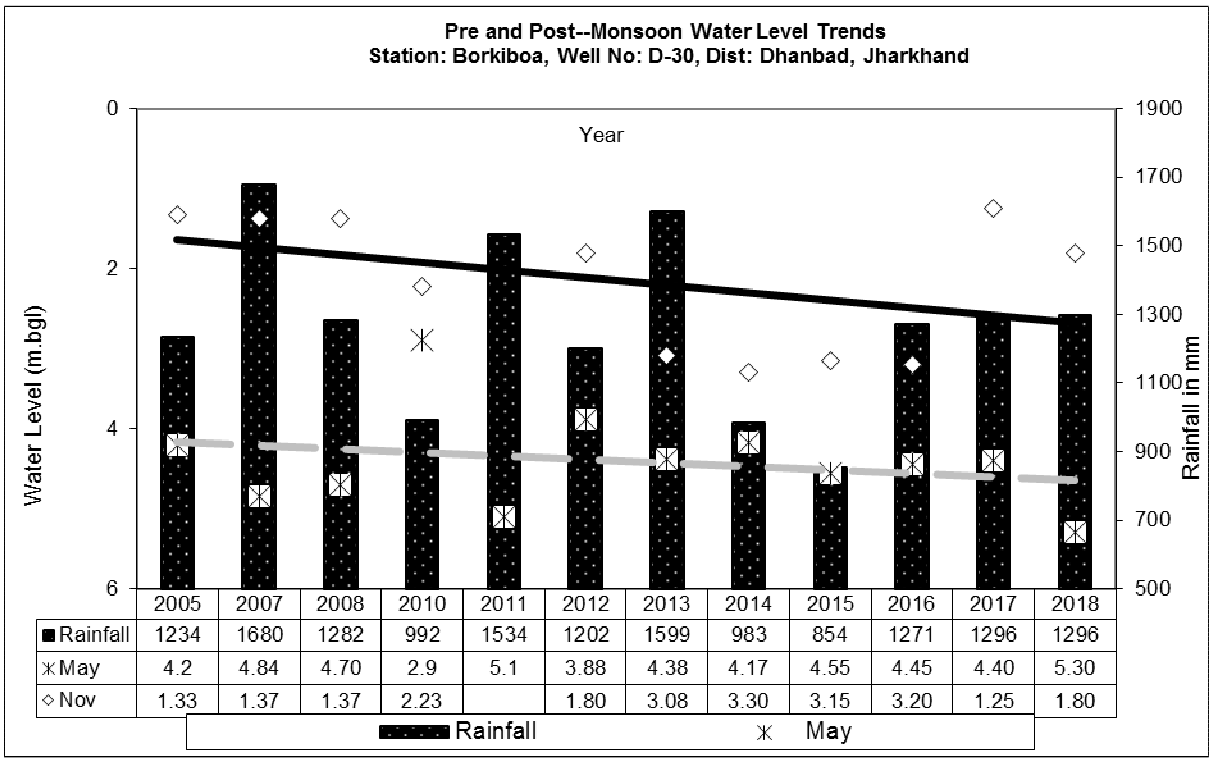
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	6.6	2.00	2.20	5.85	6.8	6.00	6.60	6.38	6.55	5.70	3.00	4.80
Nov	2.05	1.62	1.70	4.85		3.30	1.20	2.40	3.48	1.63	2.80	3.80

Annexure – VI

HYDROGRAPHS OF CLUSTER-VI



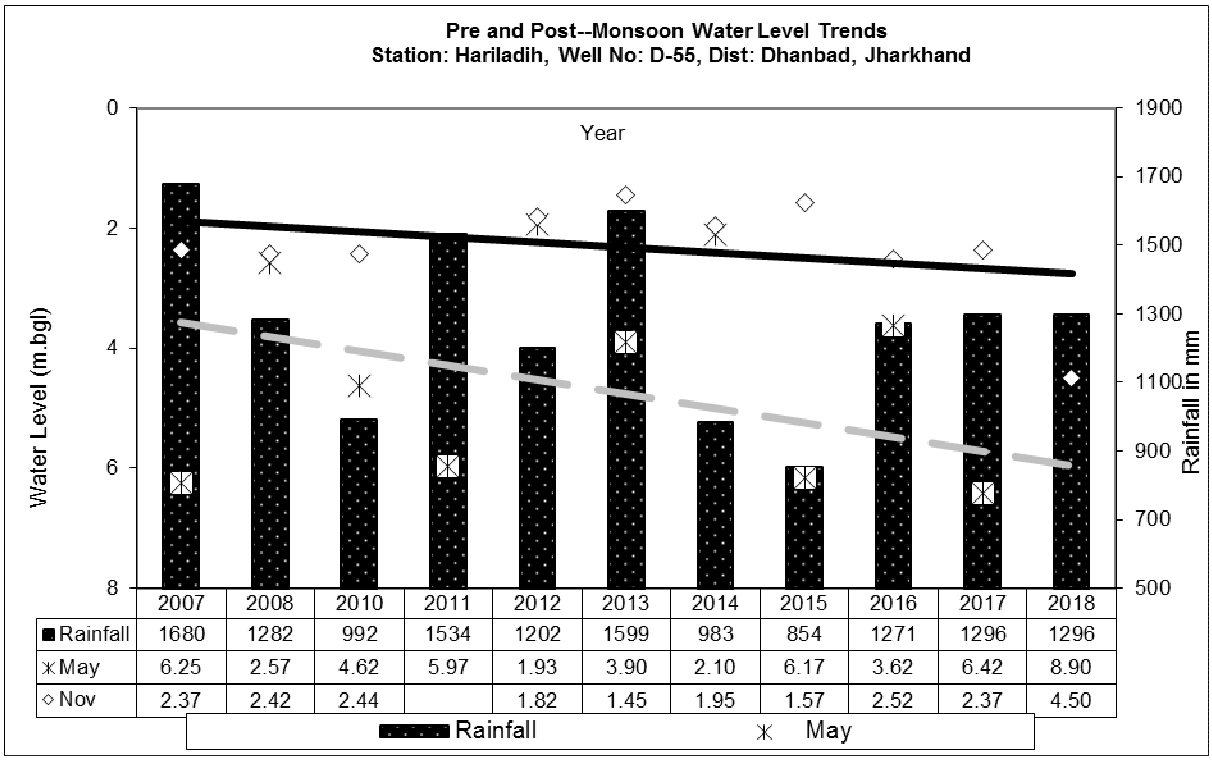
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	2.1	3.04	4.70	5.1	4.7	5.20	4.26	4.42	4.48	2.40	2.40	3.20
Nov	1.20	0.87	4.75	2.3		3.65	3.45	2.90	2.45	1.90	1.20	2.00



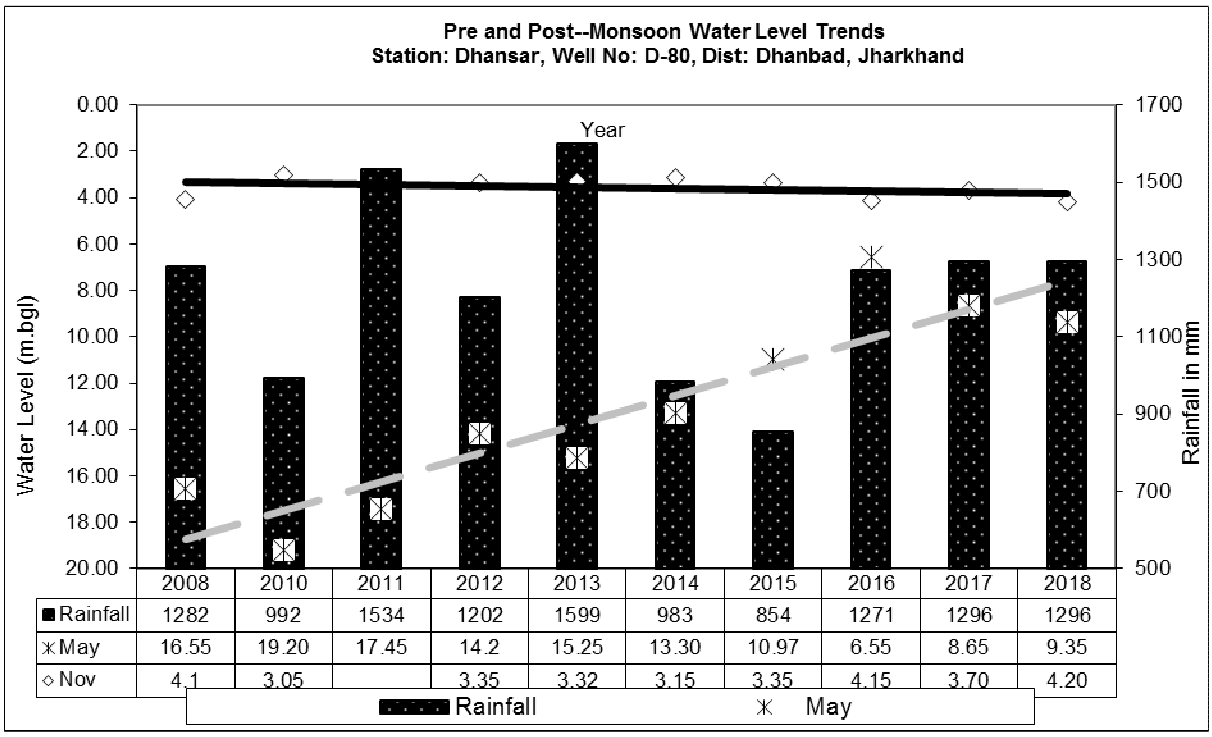
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	4.2	4.84	4.70	2.9	5.1	3.88	4.38	4.17	4.55	4.45	4.40	5.30
Nov	1.33	1.37	1.37	2.23		1.80	3.08	3.30	3.15	3.20	1.25	1.80

Annexure – VI

HYDROGRAPHS OF CLUSTER-VII



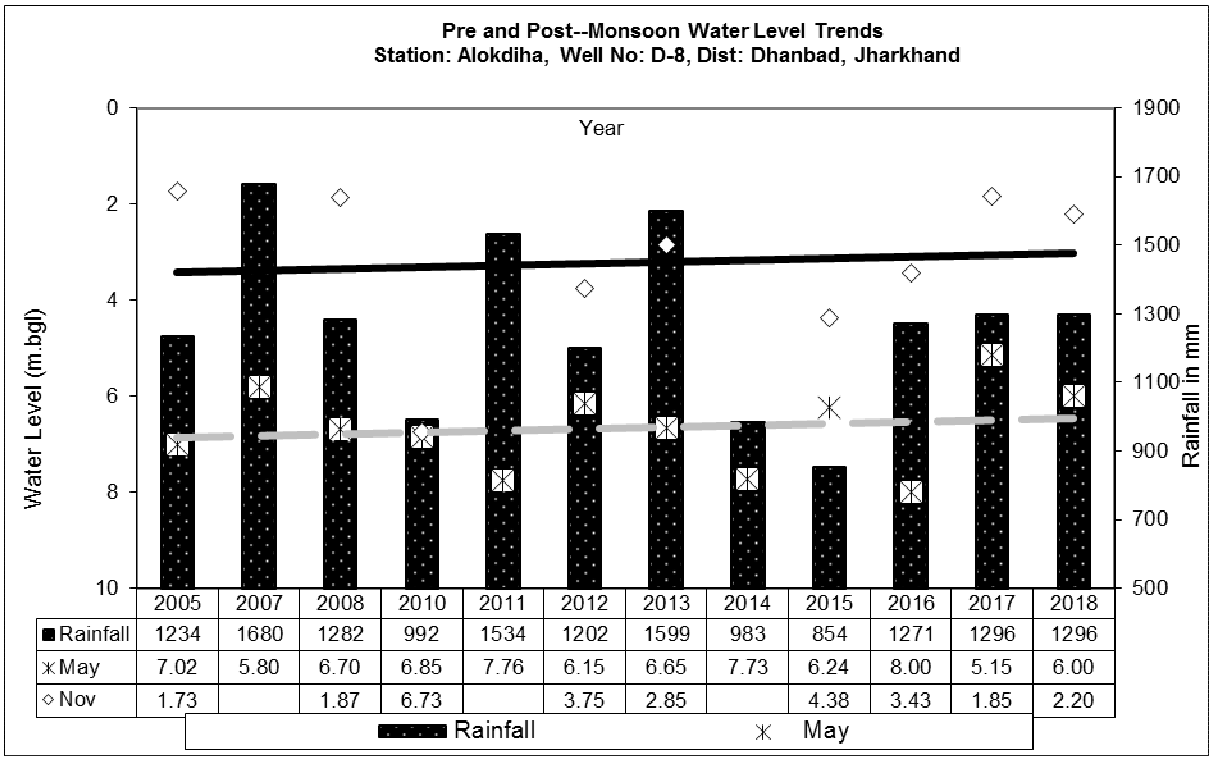
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	6.25	2.57	4.62	5.97	1.93	3.90	2.10	6.17	3.62	6.42	8.90
Nov	2.37	2.42	2.44		1.82	1.45	1.95	1.57	2.52	2.37	4.50



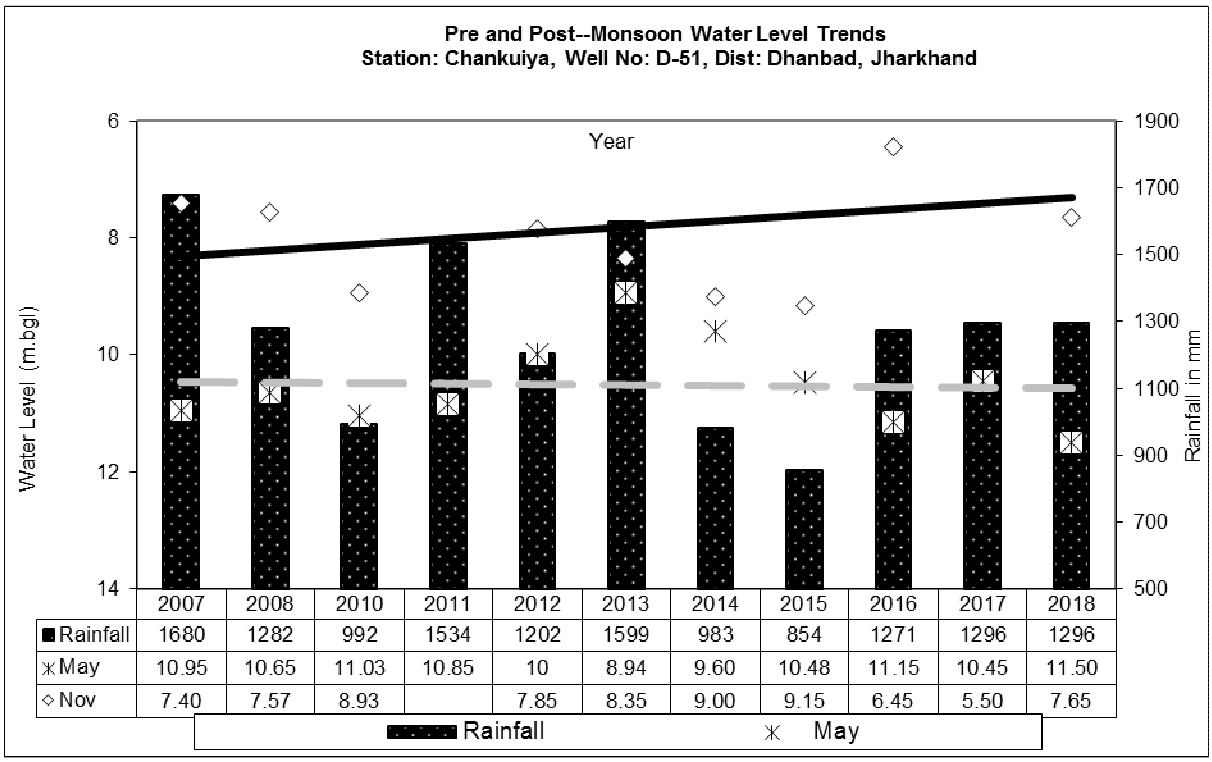
	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	16.55	19.20	17.45	14.2	15.25	13.30	10.97	6.55	8.65	9.35
Nov	4.1	3.05		3.35	3.32	3.15	3.35	4.15	3.70	4.20

Annexure – VI

HYDROGRAPHS OF CLUSTER-VIII



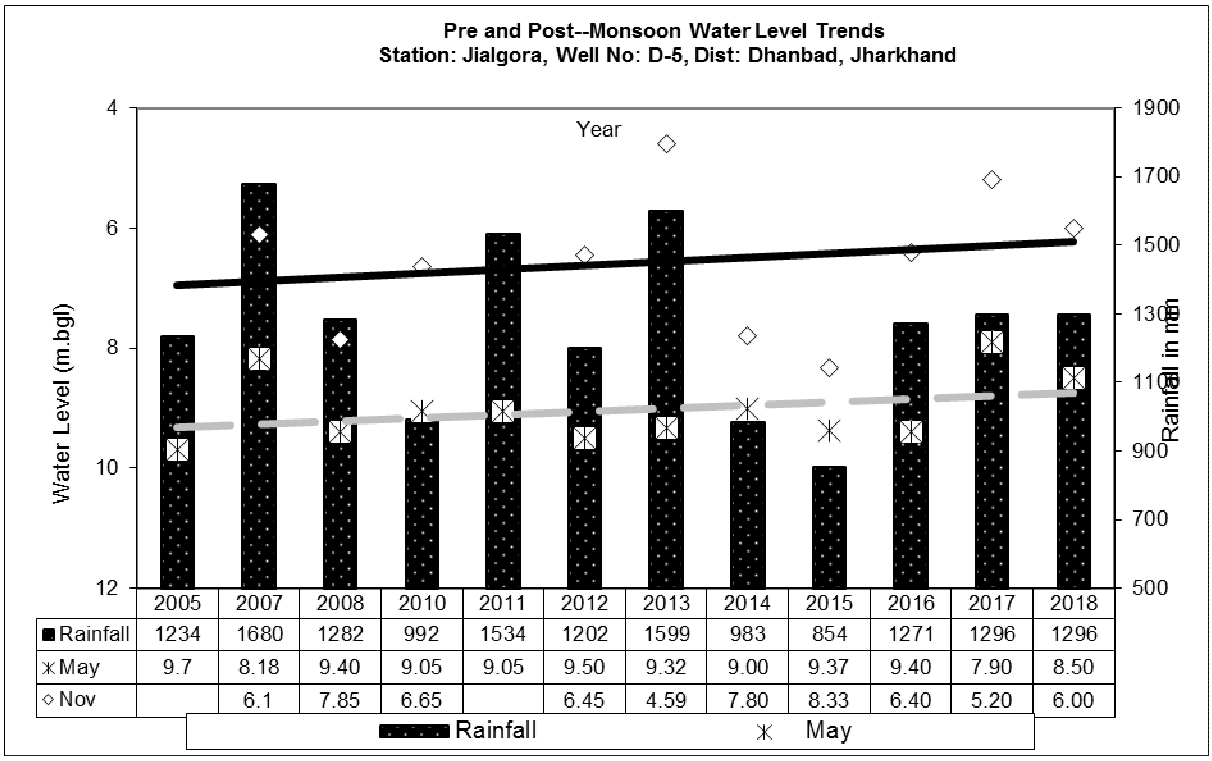
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	7.02	5.80	6.70	6.85	7.76	6.15	6.65	7.73	6.24	8.00	5.15	6.00
Nov	1.73		1.87	6.73		3.75	2.85		4.38	3.43	1.85	2.20



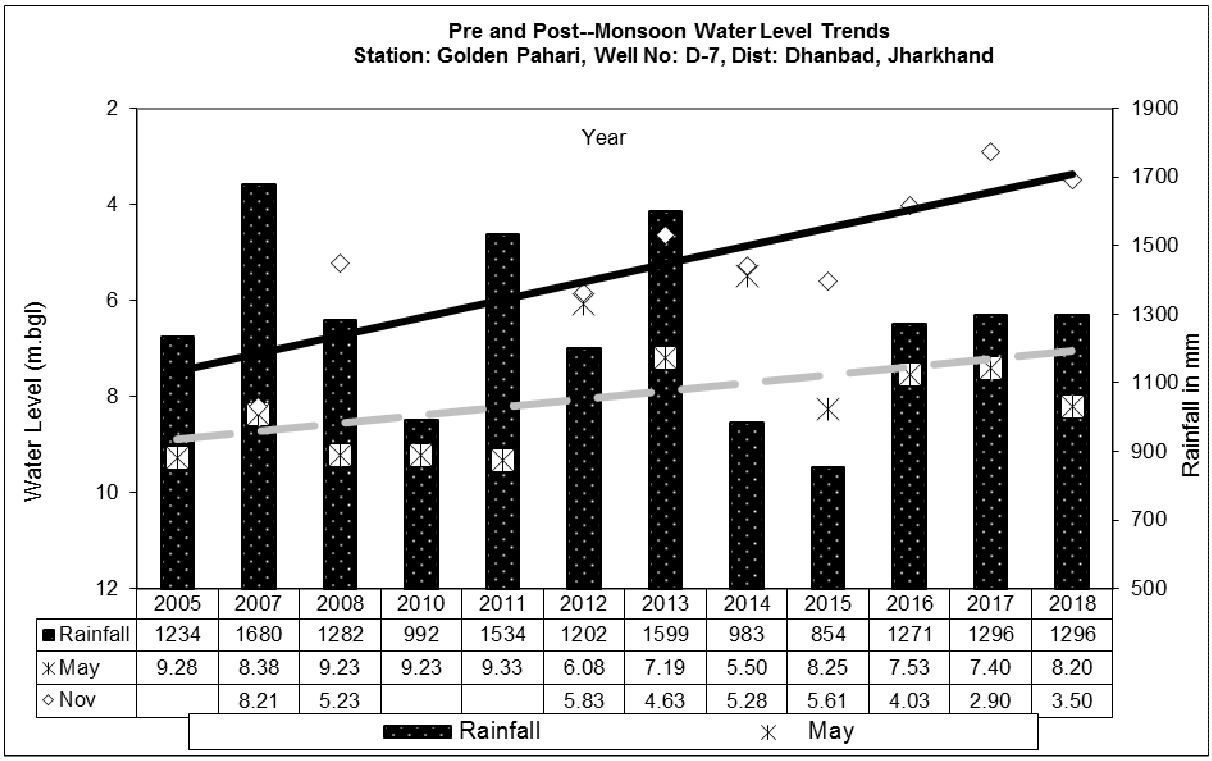
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	10.95	10.65	11.03	10.85	10	8.94	9.60	10.48	11.15	10.45	11.50
Nov	7.40	7.57	8.93		7.85	8.35	9.00	9.15	6.45	5.50	7.65

Annexure – VI

HYDROGRAPHS OF CLUSTER-IX



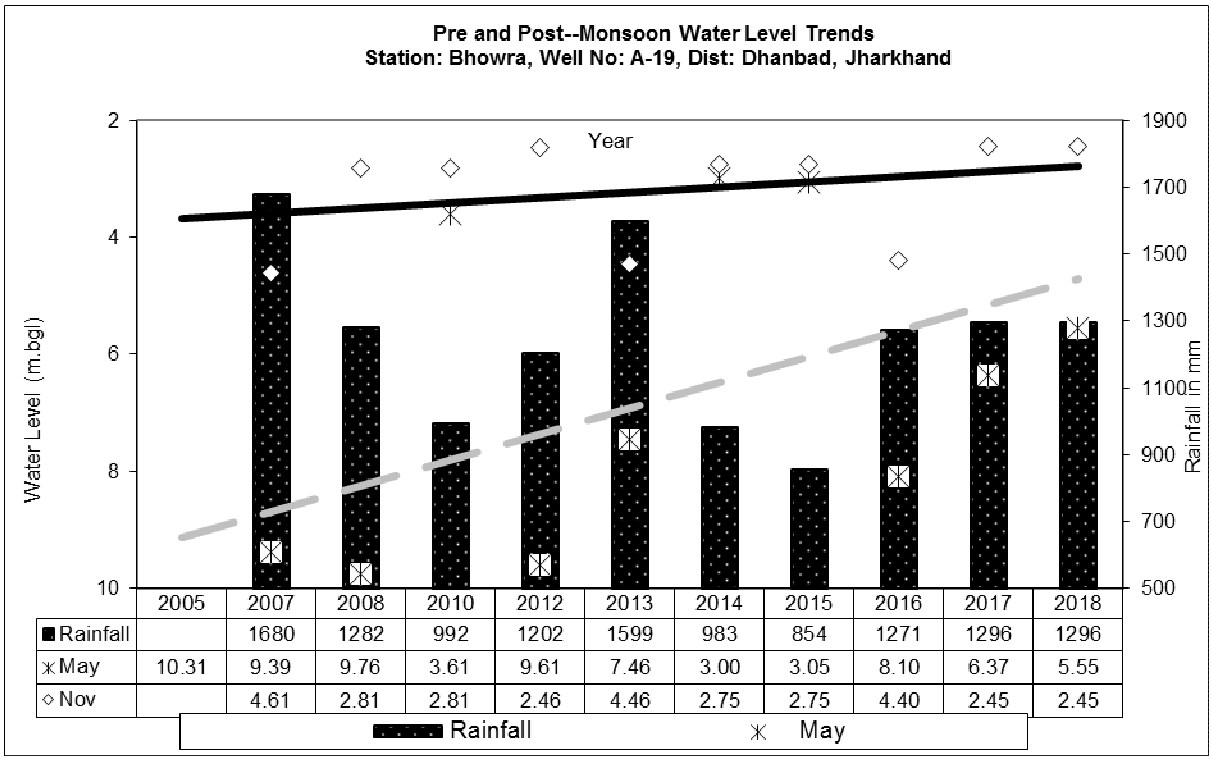
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	9.7	8.18	9.40	9.05	9.05	9.50	9.32	9.00	9.37	9.40	7.90	8.50
Nov		6.1	7.85	6.65		6.45	4.59	7.80	8.33	6.40	5.20	6.00



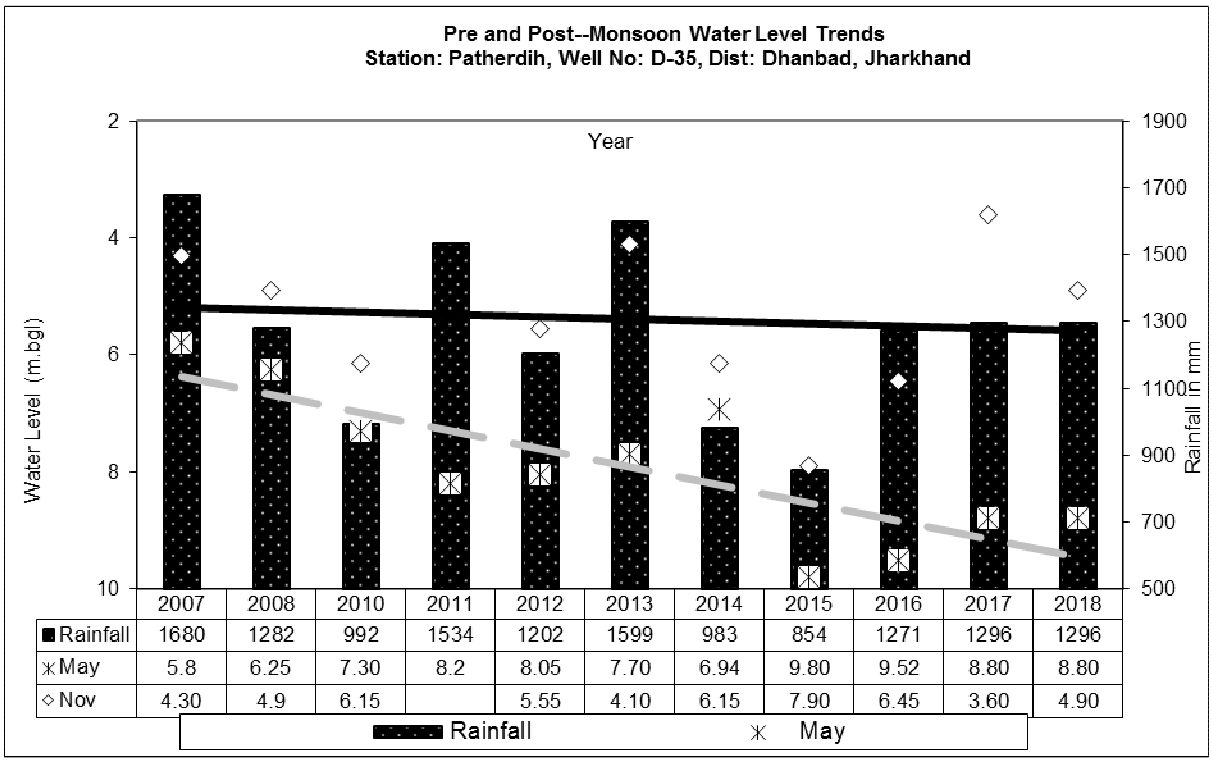
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	9.28	8.38	9.23	9.23	9.33	6.08	7.19	5.50	8.25	7.53	7.40	8.20
Nov		8.21	5.23			5.83	4.63	5.28	5.61	4.03	2.90	3.50

Annexure – VI

HYDROGRAPHS OF CLUSTER-X



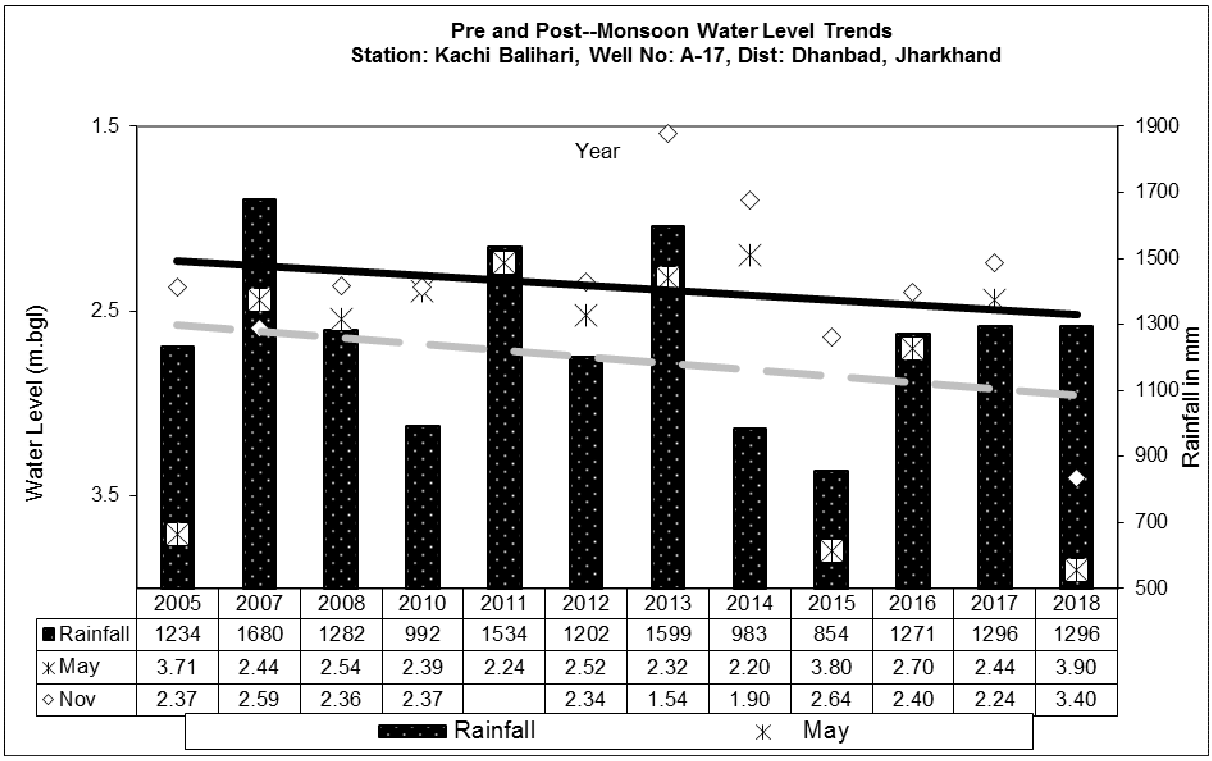
	2005	2007	2008	2010	2012	2013	2014	2015	2016	2017	2018
Rainfall		1680	1282	992	1202	1599	983	854	1271	1296	1296
May	10.31	9.39	9.76	3.61	9.61	7.46	3.00	3.05	8.10	6.37	5.55
Nov		4.61	2.81	2.81	2.46	4.46	2.75	2.75	4.40	2.45	2.45



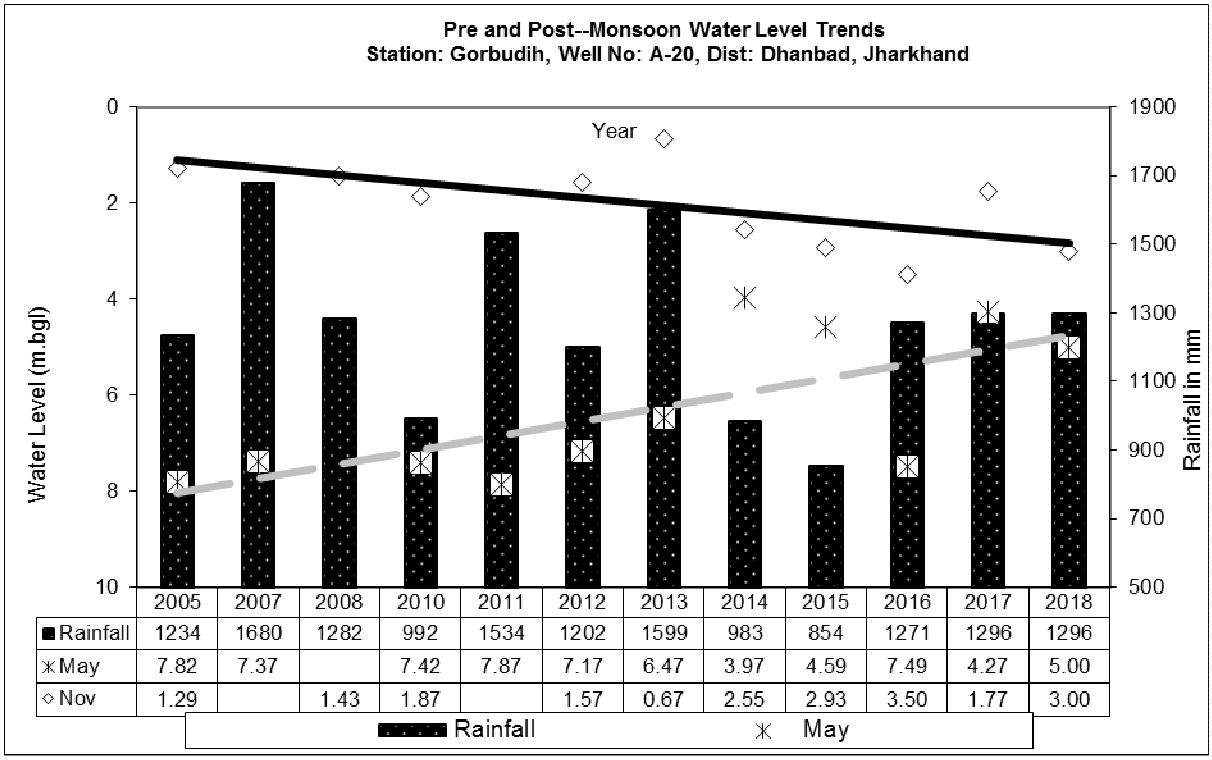
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	5.8	6.25	7.30	8.2	8.05	7.70	6.94	9.80	9.52	8.80	8.80
Nov	4.30	4.9	6.15		5.55	4.10	6.15	7.90	6.45	3.60	4.90

Annexure – VI

HYDROGRAPHS OF CLUSTER-XI



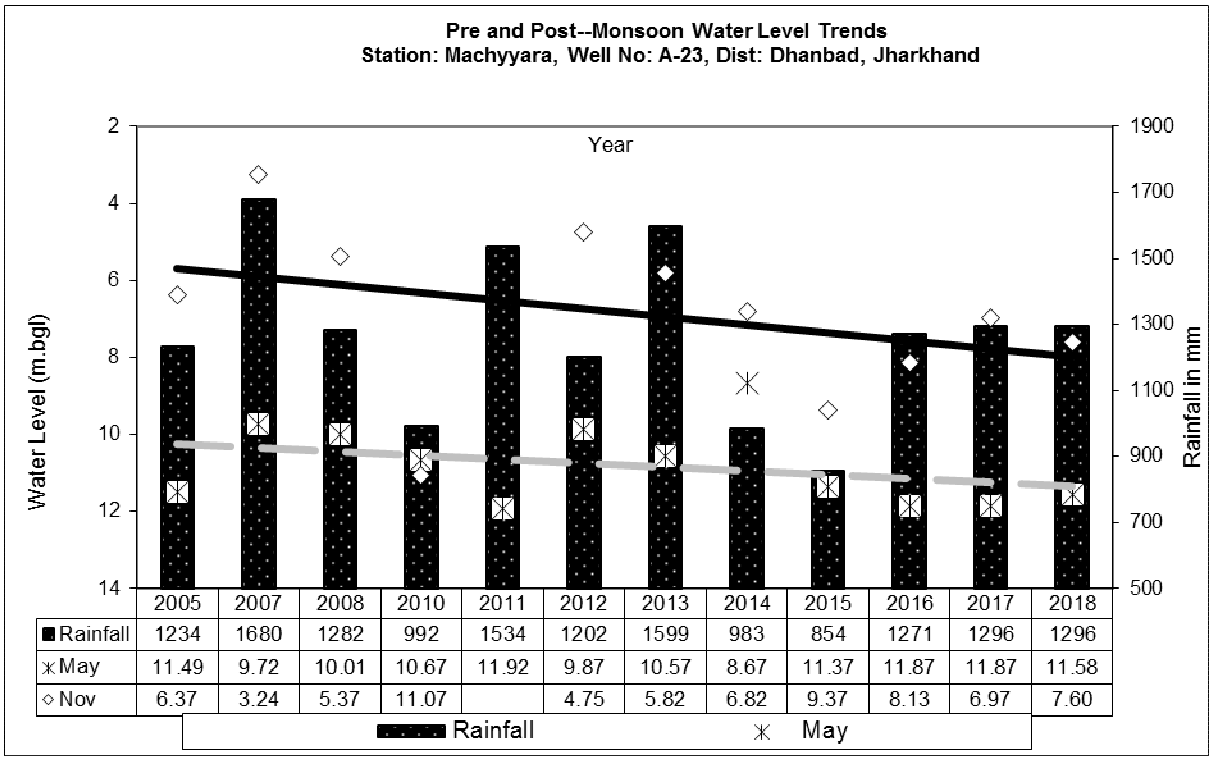
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	3.71	2.44	2.54	2.39	2.24	2.52	2.32	2.20	3.80	2.70	2.44	3.90
Nov	2.37	2.59	2.36	2.37		2.34	1.54	1.90	2.64	2.40	2.24	3.40



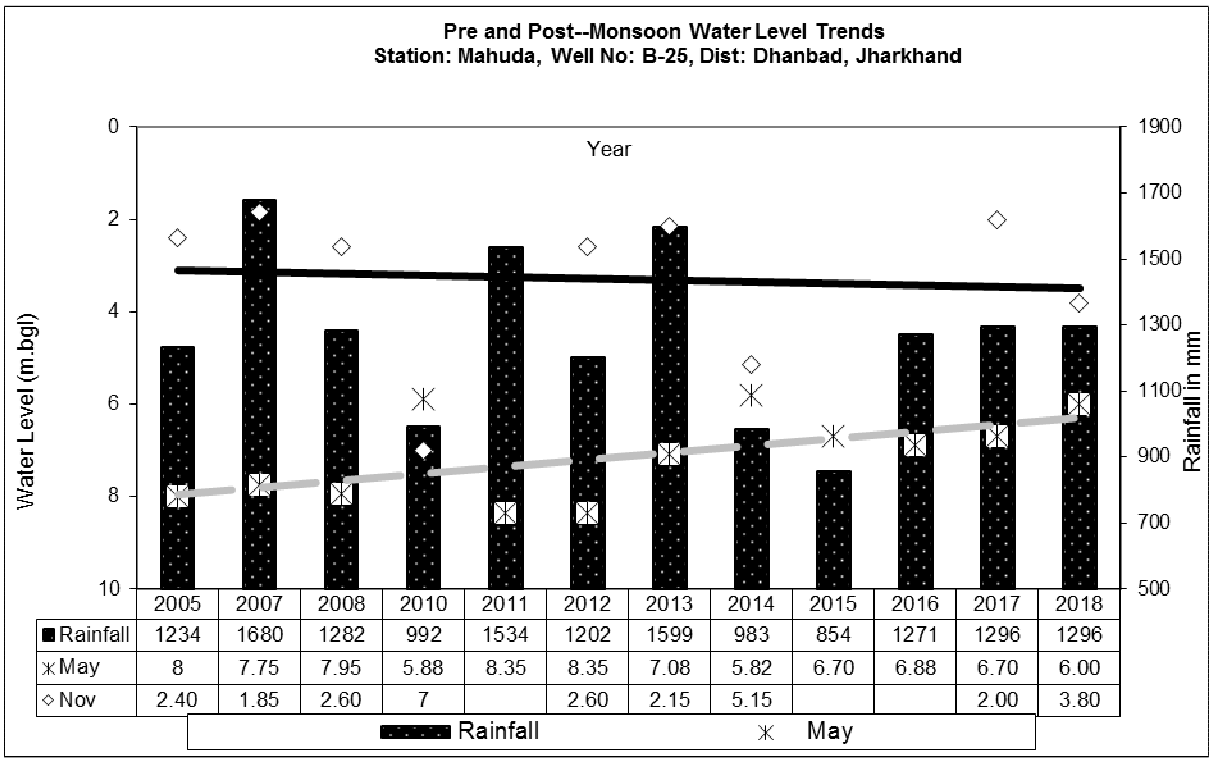
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	7.82	7.37		7.42	7.87	7.17	6.47	3.97	4.59	7.49	4.27	5.00
Nov	1.29		1.43	1.87		1.57	0.67	2.55	2.93	3.50	1.77	3.00

Annexure – VI

HYDROGRAPHS OF CLUSTER-XIII



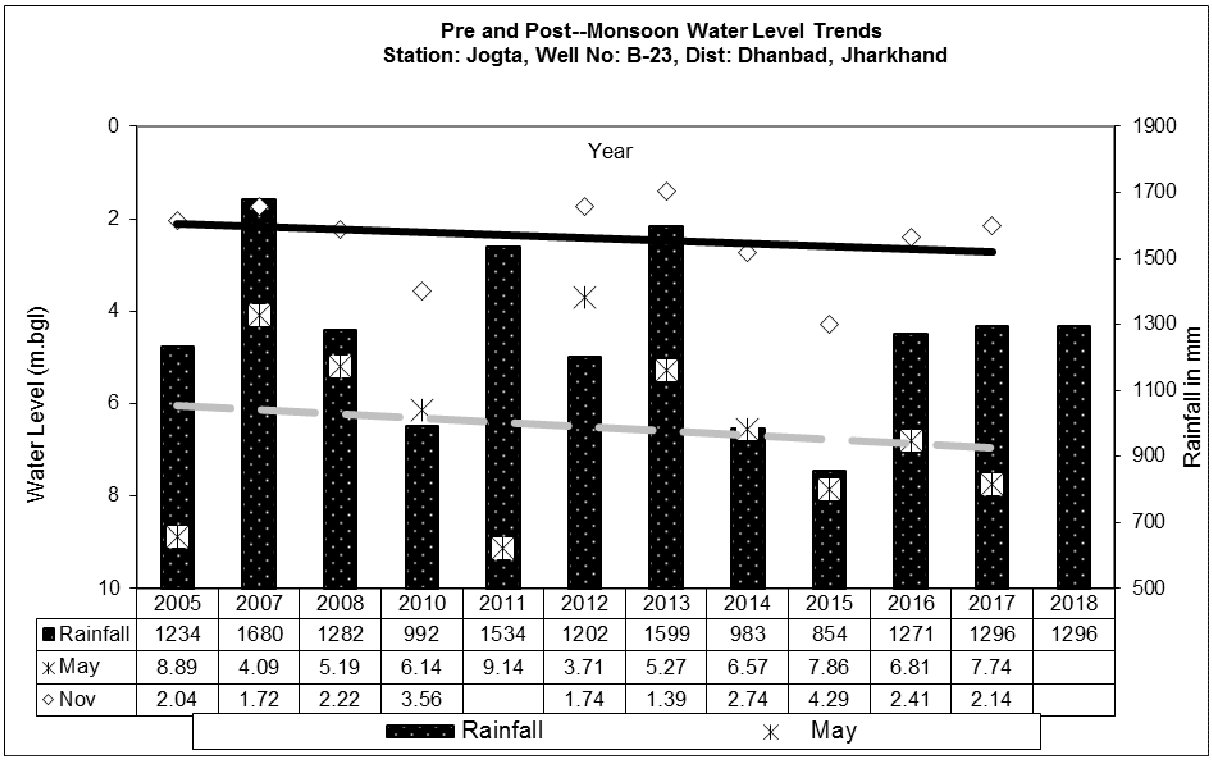
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	11.49	9.72	10.01	10.67	11.92	9.87	10.57	8.67	11.37	11.87	11.87	11.58
Nov	6.37	3.24	5.37	11.07		4.75	5.82	6.82	9.37	8.13	6.97	7.60



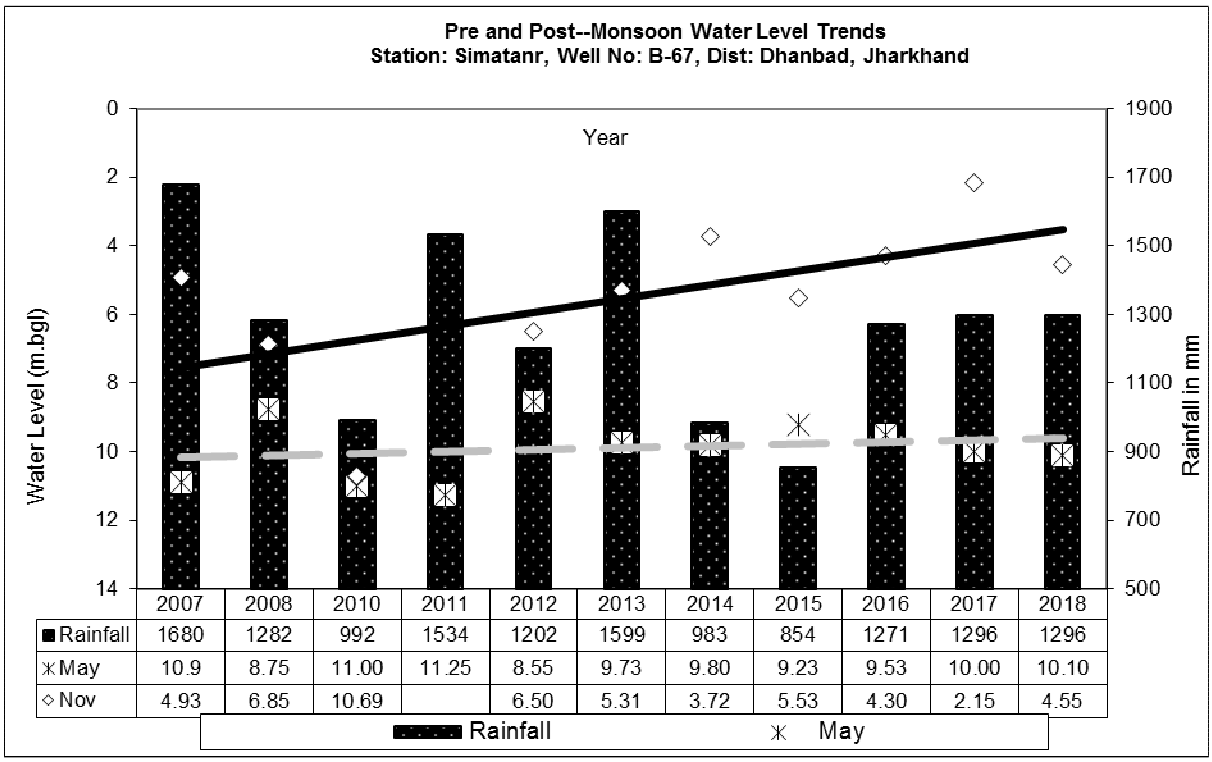
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	8	7.75	7.95	5.88	8.35	8.35	7.08	5.82	6.70	6.88	6.70	6.00
Nov	2.40	1.85	2.60	7		2.60	2.15	5.15			2.00	3.80

Annexure – VI

HYDROGRAPHS OF CLUSTER-XIV



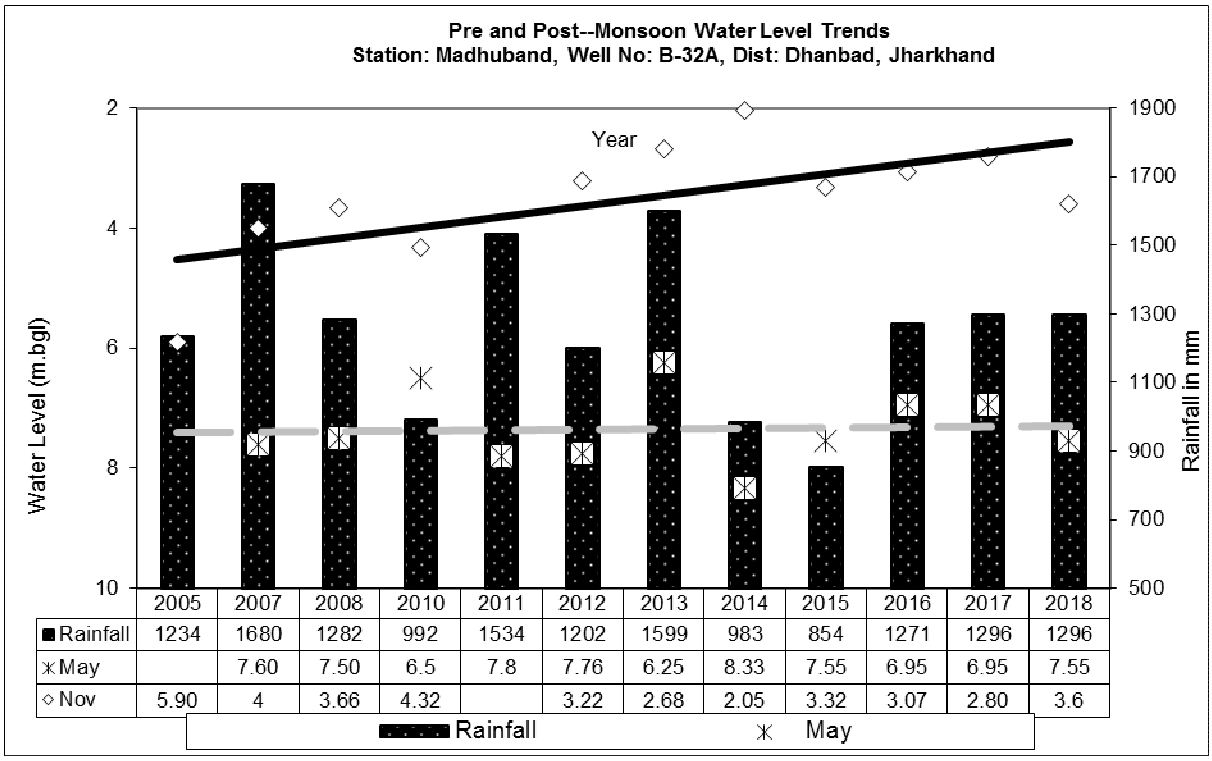
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	8.89	4.09	5.19	6.14	9.14	3.71	5.27	6.57	7.86	6.81	7.74	
Nov	2.04	1.72	2.22	3.56		1.74	1.39	2.74	4.29	2.41	2.14	



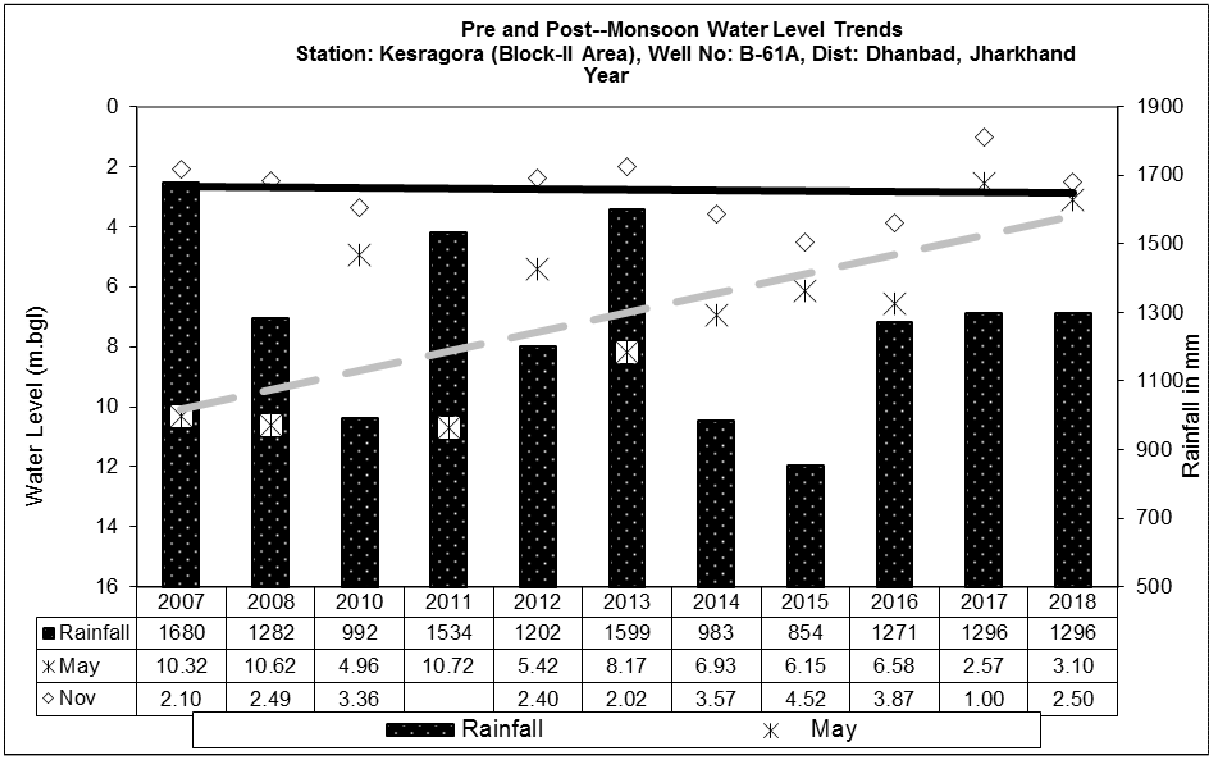
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	10.9	8.75	11.00	11.25	8.55	9.73	9.80	9.23	9.53	10.00	10.10
Nov	4.93	6.85	10.69		6.50	5.31	3.72	5.53	4.30	2.15	4.55

Annexure – VI

HYDROGRAPHS OF CLUSTER-XV



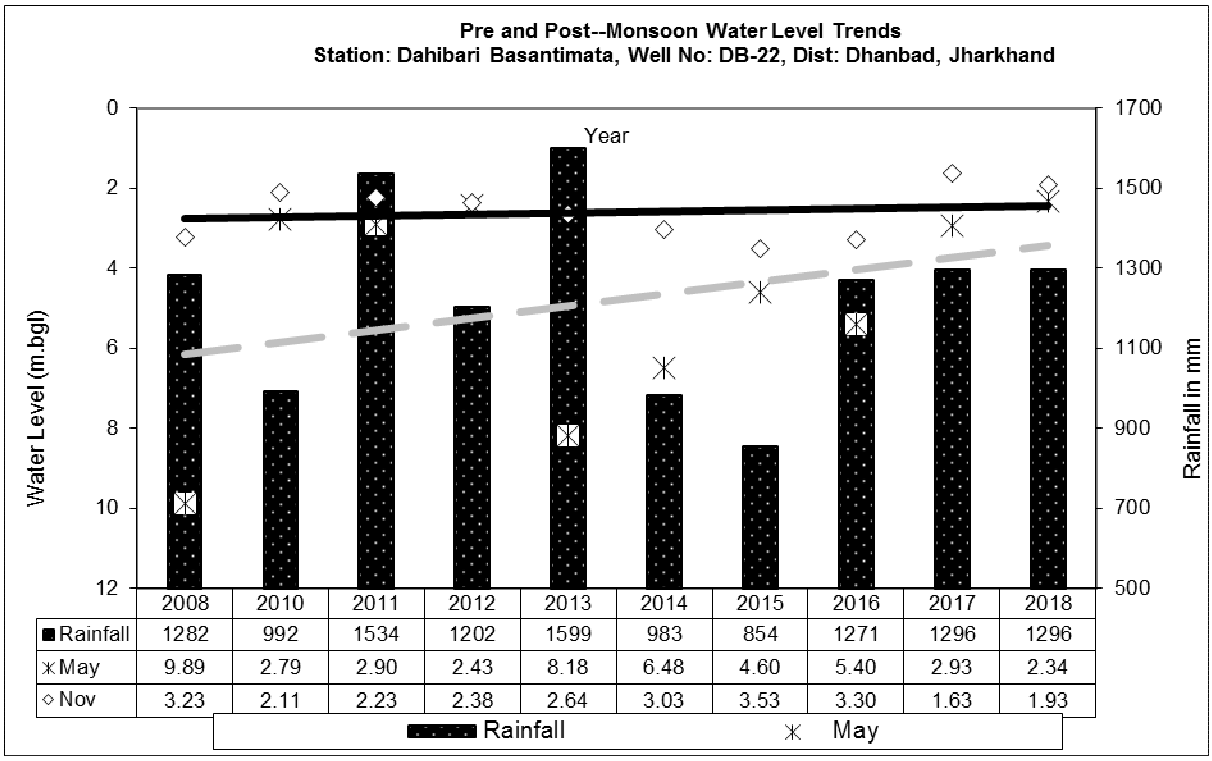
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May		7.60	7.50	6.5	7.8	7.76	6.25	8.33	7.55	6.95	6.95	7.55
Nov	5.90	4	3.66	4.32		3.22	2.68	2.05	3.32	3.07	2.80	3.6



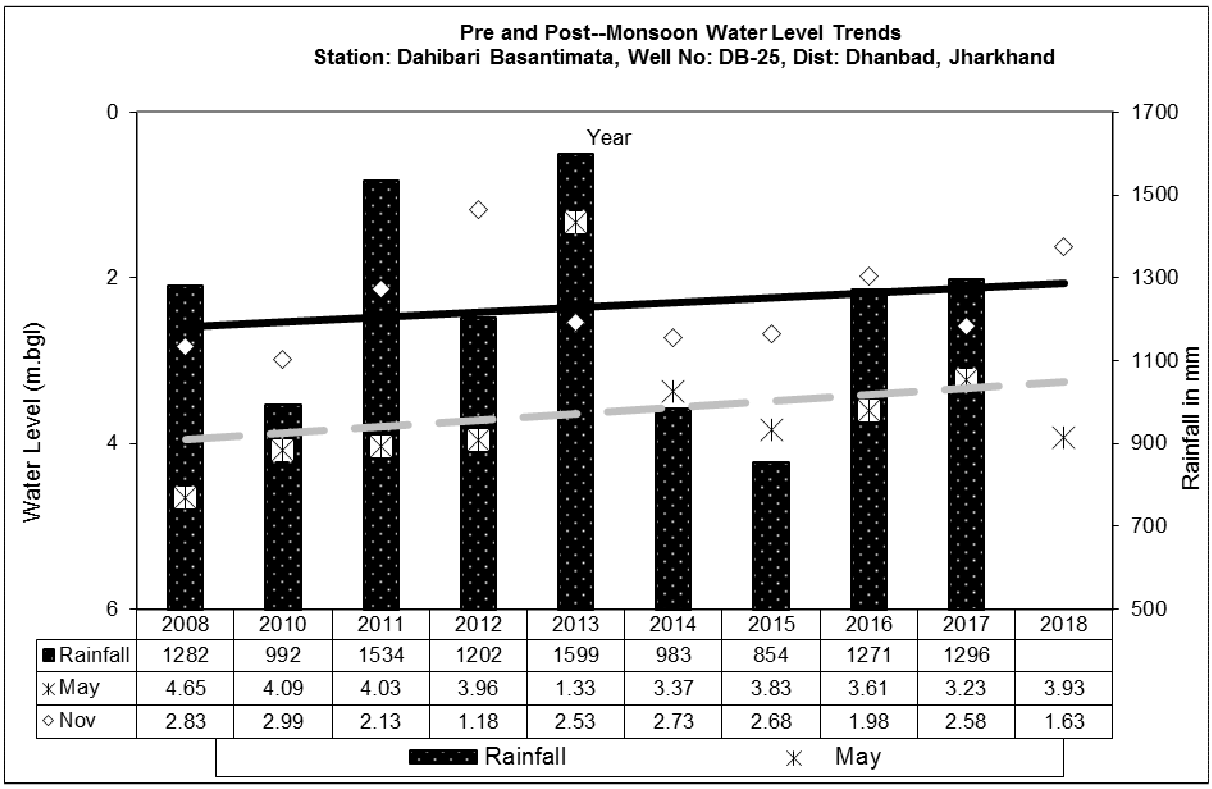
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	10.32	10.62	4.96	10.72	5.42	8.17	6.93	6.15	6.58	2.57	3.10
Nov	2.10	2.49	3.36		2.40	2.02	3.57	4.52	3.87	1.00	2.50

Annexure – VI

HYDROGRAPHS OF CLUSTER-XVI



	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	9.89	2.79	2.90	2.43	8.18	6.48	4.60	5.40	2.93	2.34
Nov	3.23	2.11	2.23	2.38	2.64	3.03	3.53	3.30	1.63	1.93



	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1282	992	1534	1202	1599	983	854	1271	1296	
May	4.65	4.09	4.03	3.96	1.33	3.37	3.83	3.61	3.23	3.93
Nov	2.83	2.99	2.13	1.18	2.53	2.73	2.68	1.98	2.58	1.63

Abbreviations

AMSL: Above mean sea level

Avg.: Average

APT: Aquifer Pumping Test

BCCL: Bharat Coking Coal Ltd.

bgl: Below Ground Level

Buffer zone: periphery of the 10 km radius from the project boundary

Core zone: Project / mine / colliery boundary (leasehold area)

CMPDI: Central Mine Plan & Design Institute

DVC: Damodar Valley Corporation

DTW: Depth to water level

GW: Groundwater

IMD: Indian Meteorological Division

JCF: Jharia Coalfield

RCF: Raniganj Coalfield

MADA: Mineral Area Development Authority

MCM: Million Cubic Meter

MGD: Million Gallon per day

NTU: Nephlometric Turbidity unit

OC / UG: Opencast / Underground

OCP / UGP: Opencast Project / Underground Project

RL: Reduced Level

RWH: Rainwater Harvesting

FF: Fire Fighting

PERSONNEL ASSOCIATED

FIELD EXERTION

Debasis Bandyopadhyay Manager (Hydrogeology)

HYDROGEOLOGICAL DOCUMENTATION

Prabhu Prasad Chief Manager (Hydrogeology)

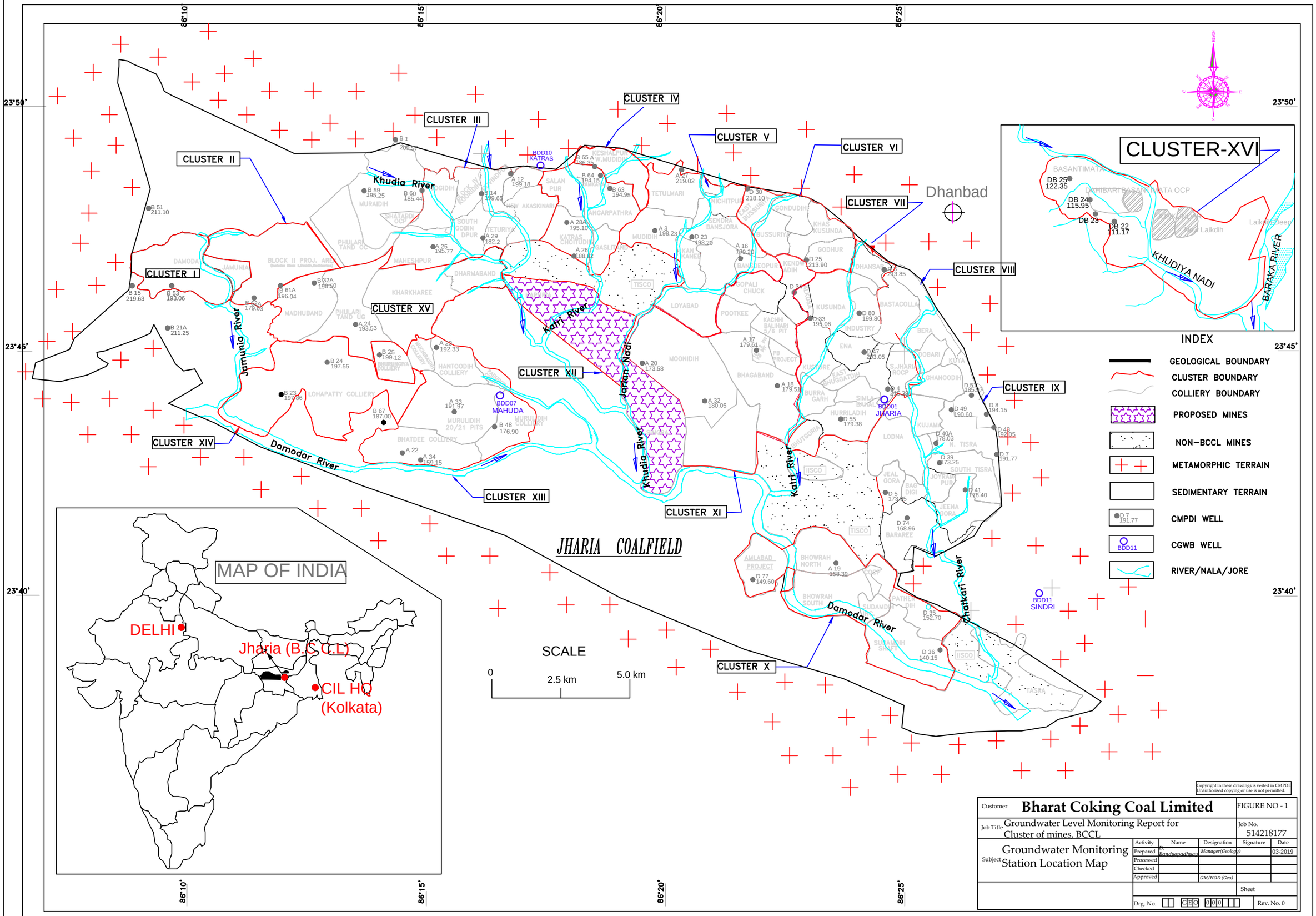
Debasis Bandyopadhyay Manager (Hydrogeology)

OVERALL GUIDANCE

A.K.Mohanty General Manager (Exploration)

Prabhu Prasad Chief Manager (Hydrogeology)

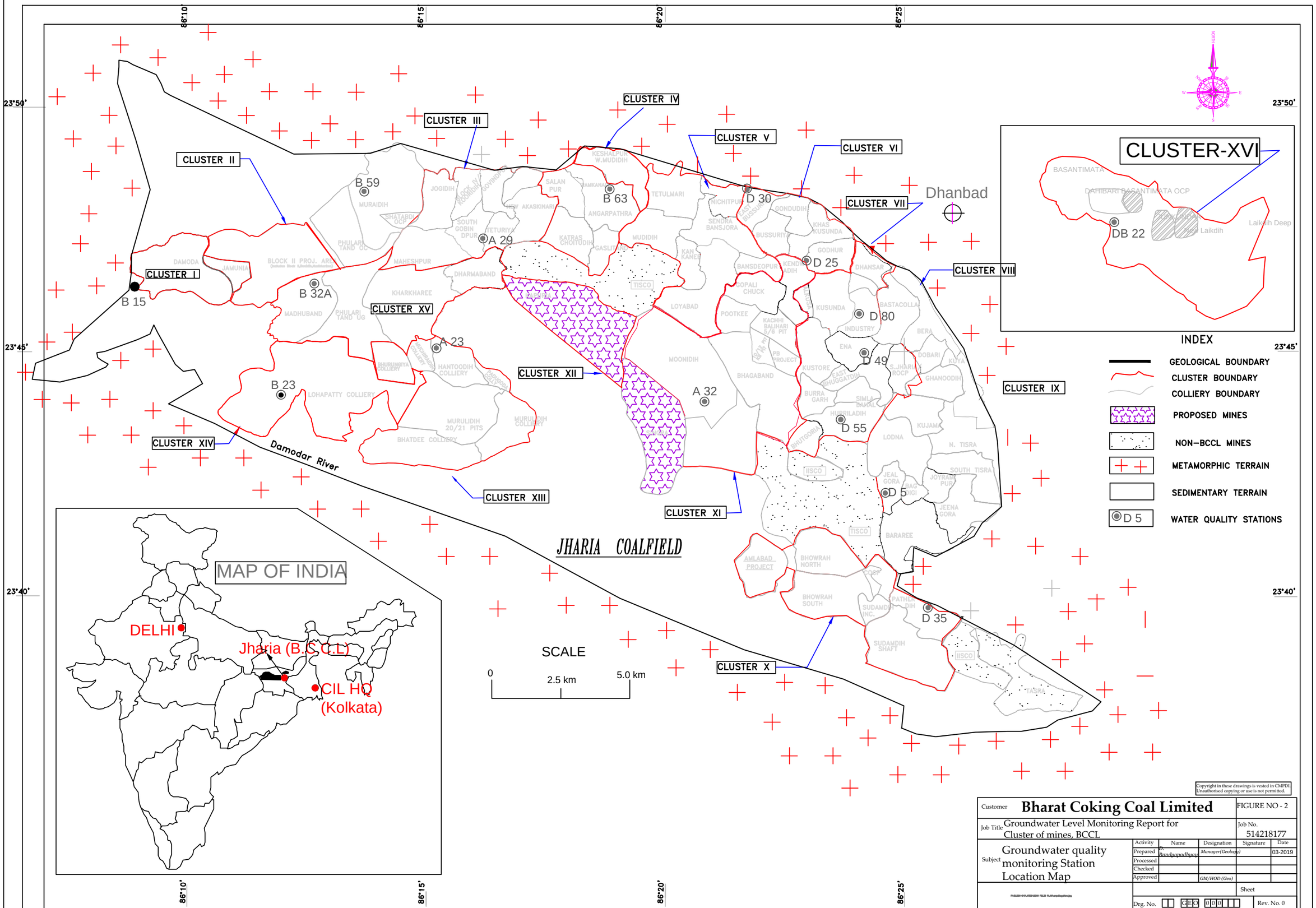
GROUNDWATER MONITORING STATION LOCATION MAP



Copyright in these drawings is vested in CMPDI
Unauthorised copying or use is not permitted.

Customer	**Bharat Coking Coal Limited**					FIGURE NO - 1
Job Title	Groundwater Level Monitoring Report for Cluster of mines, BCCL					Job No. 514218177
Subject	Groundwater Monitoring Station Location Map	Activity	Name	Designation	Signature	Date
		Prepared	S. Bandyopadhyay	Manager(Geolog.)		03-2019
		Processed				
		Checked				
		Approved		GM/HOD (Geo)		
					Sheet	
		Drg. No.		CEO		Rev. No. 0

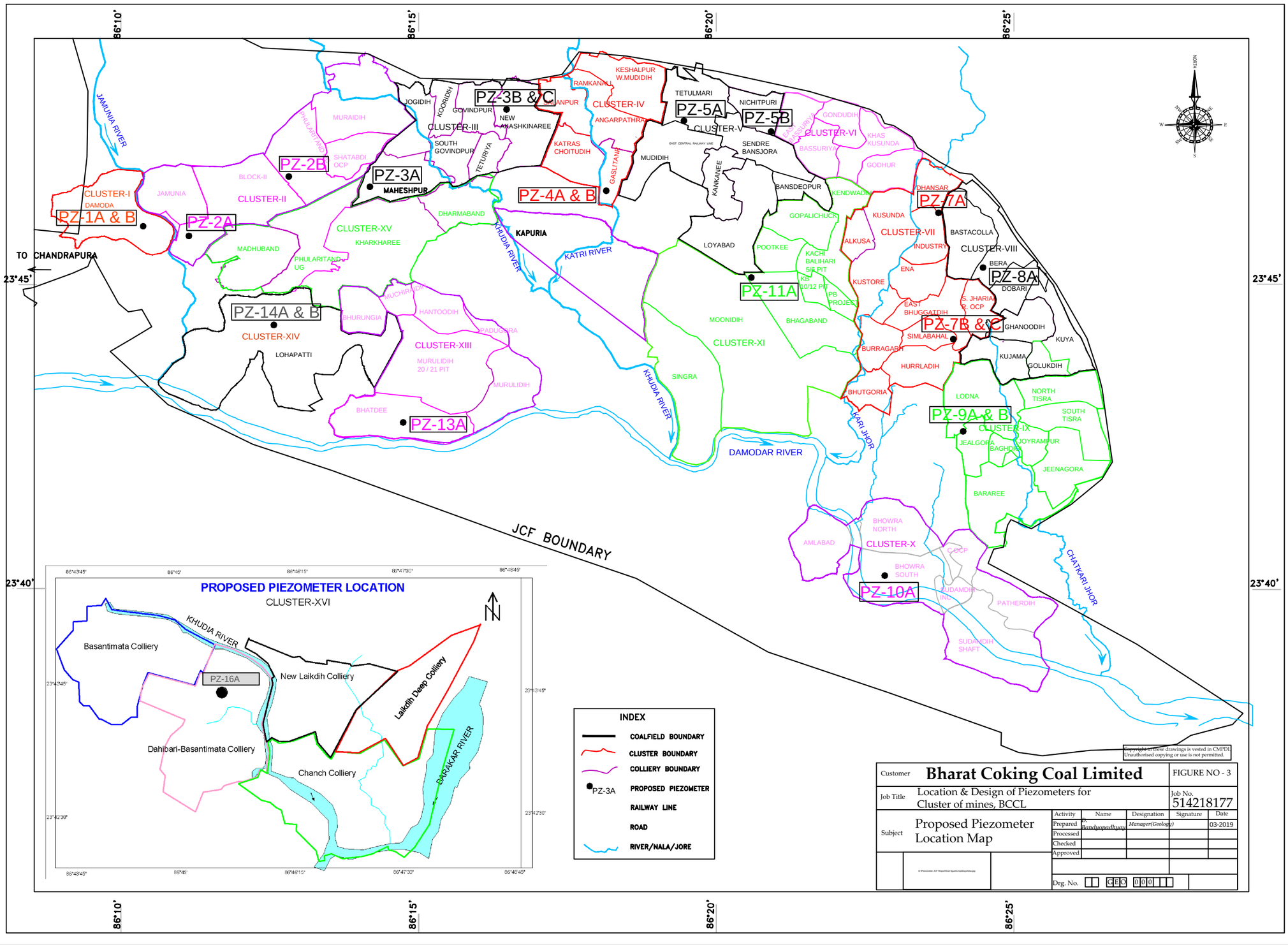
GROUNDWATER QUALITY MONITORING STATION LOCATION MAP



Copyright in these drawings is vested in CMPDI
Unauthorised copying or use is not permitted.

Customer	**Bharat Coking Coal Limited**					FIGURE NO - 2
Job Title	Groundwater Level Monitoring Report for Cluster of mines, BCCL					Job No. 514218177
Subject	Groundwater quality monitoring Station Location Map	Activity	Name	Designation	Signature	Date
		Prepared	P. Bandyopadhyay	Manager(Geology)		03-2019
		Processed				
		Checked				
		Approved		GM/HOD (Geo)		
					Sheet	
		Drg. No.	CEC	0 0 0		Rev. No. 0

PROPOSED PIEZOMETER LOCATION MAP, JCF & RCF (part)



INDEX

- COALFIELD BOUNDARY
- CLUSTER BOUNDARY
- COLLIERY BOUNDARY
- PZ-3A — PROPOSED PIEZOMETER
- RAILWAY LINE
- ROAD
- RIVER/NALA/JORE

Copyright of these drawings is vested in CMPDI. Unauthorised copying or use is not permitted.

Customer	**Bharat Coking Coal Limited**	FIGURE NO - 3
Job Title	Location & Design of Piezometers for Cluster of mines, BCCL	Job No. 514218177
Subject	Proposed Piezometer Location Map	

Activity	Name	Designation	Signature	Date
Prepared	Dr. Bandyopadhyay	Manager(Geology)		03-2019
Processed				
Checked				
Approved				

Drg. No. CEC 000

WATER TABLE CONTOUR MAP OF PRE-MONSOON 2018

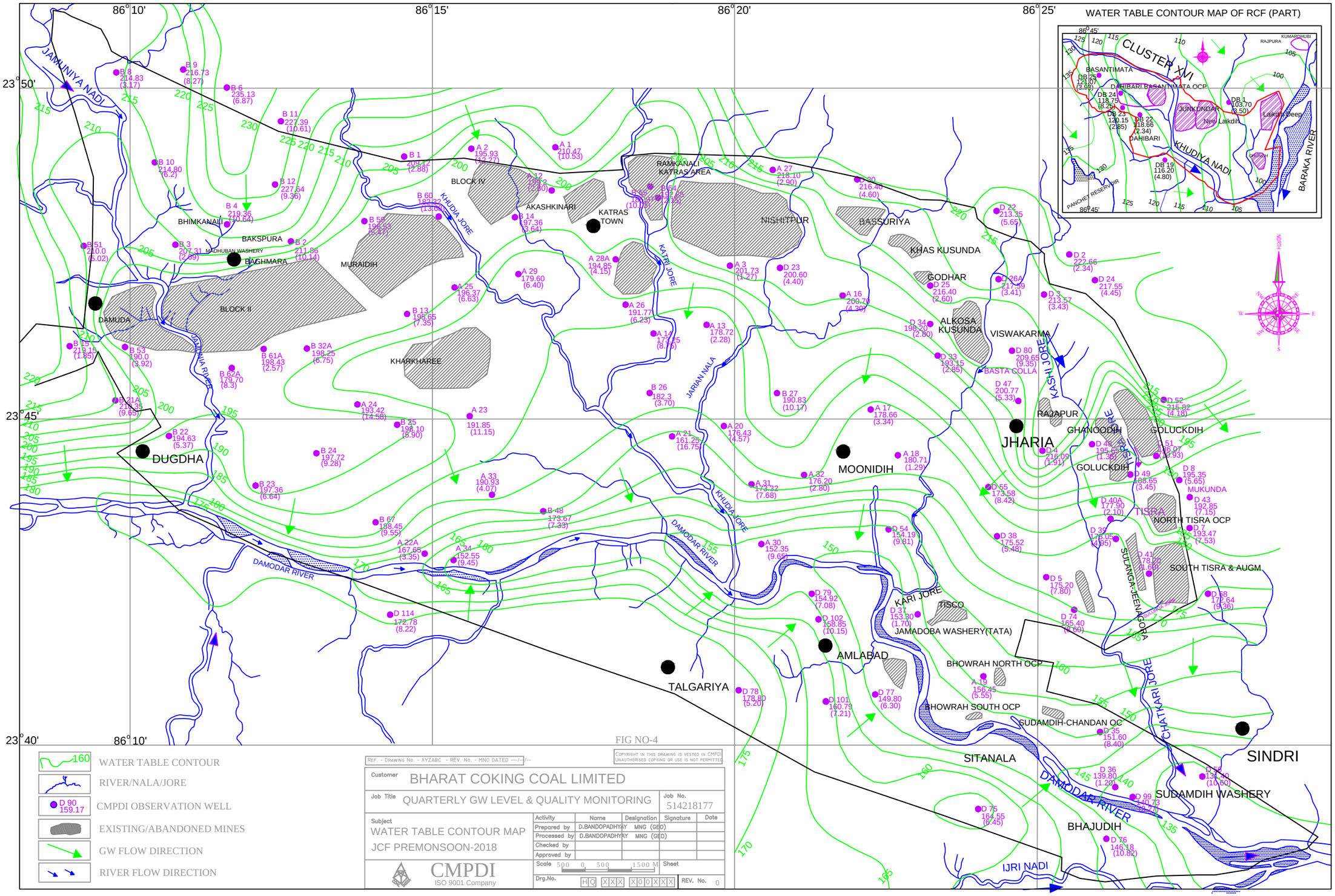


FIG NO-4

160 WATER TABLE CONTOUR

RIVER/NALA/JORE

D 90 159.17 CMPDI OBSERVATION WELL

EXISTING/ABANDONED MINES

GW FLOW DIRECTION

RIVER FLOW DIRECTION

REF. - DRAWING No. - XYZABC - REV. No. - MNO DATED ----/--/--

COPYRIGHT IN THIS DRAWING IS VESTED IN CMPDI
UNAUTHORISED COPYING OR USE IS NOT PERMITTED

Customer: BHARAT COKING COAL LIMITED

Job Title: QUARTERLY GW LEVEL & QUALITY MONITORING

Job No.: 514218177

Subject: WATER TABLE CONTOUR MAP JCF PREMONSOON-2018

Activity	Name	Designation	Signature	Date
Prepared by	D.BANDOPADHYAY	MNG (GEO)		
Processed by	D.BANDOPADHYAY	MNG (GEO)		
Checked by				
Approved by				

CMPDI ISO 9001 Company

Scale 500 0 500 1500 M

Sheet

Drg.No. HQ XXX X0 0 XXX

REV. No. 0

LIST OF VILLAGE FOR SUPPLIED WATER

Surplus mine water is being supplied to nearby villages for domestic purposes (non drinking purpose). In cluster X (under Eastern Jharia area), there is three nos. of Rapid Gravity Pressure Filter plant of total 1.72 MGD capacity, which is used for supply of water in nearby villages, colonies, houses, quarters. After treatment and filtration, treated water is supplied to nearby residents both employees and non employees peoples.

List of villages for supplied water is given below:

S. No.	Colliery/Mine Name	Village list for supply of water
1	Sudamdih & Patherdih mine	Sudamdih colony, Patherdih colony, Patherdih Basti, Patherdih Basti, Supkar Basti, Hattala basti, etc
2	Bhowra Group of mines (Bhowra North & Bhowra South)	Gaurkhuti, 12 no. basti, 13 no.basti, 35 no. basti; 6 no. dhowra, Manjhi Basti, Gandhi Nagar, 19 no. Basti upar, 19 no. Basti niche, Bhowra 16 no., Bhowra 9 no. etc.
3	Amlabad colliery	Amlabad colony and nearby basti

Annexure - VI

YEAR WISE DRY CARBON SLURRY PRODUCED FROM SUDAMDIH COAL WASHERY

Year	Dry Carbon Slurry Produced (in metric Ton)
2013-14	43488
2014-15	6775
2015-16	9880
2016-17	12609
2017-18	6513
2018-19	4405

LIST OF MEDICINAL PLANTS PRESENT IN KAMINI KALYAN HERBAL GARDEN

S. No.	Biological Names	Local Names	Hindi Names
1	Aegle marmelos	Bel	Bel
2	Alangium Lamarckii	Dhela	Dhela
3	Albizzia lebbek	Siris	Siris
4	Alstonia scholaris	Chatni	Chatni
5	Azadirachta indica	Neem	Neem
6	Bombax ceiba	Semal	Semal
7	Butea frondosa	Palas	Palas
8	Casearia tomentosa	Beri	Beri
9	Dalbergia sissoo	Shisham	Shisham
10	Emblica officinalis	Amla	Amla
11	Eugenia jamb	Jamun	Jamun
12	Arotocarpus integrifolia	Kathal	Kathal
13	Ficus religiosa	Pipal	Pipal
14	Gmelina arborea	Gamhar	Gamhar
15	Mangifera indica	Mango	Mango
16	Pongamia glabra	Karanj	Karanj
17	Tectona grandis	Sagwan/Teak	Sagwan/Teak
18	Terminalia arjuna	Arjun	Arjun
19	Terminalia belerica	Bahera	Bahera
20	Dendro calamus strictus	Bans/Bamboo	Bans/Bamboo
21	Spondias mangifera	Amra	Amra
22	Saraca asoca	ashok	ashok
23	Cocos nucifera	Nariyal	Nariyal
24	Annona reticulata	Sarifaa	Sarifaa
25	Psidium guajava	amrud	amrud
26	Citrus limon	Nimboo	Nimboo
27	Ficus racemosa	Gular	Gular
28	Eucalyptus globulus	safeda	safeda
29	Neolamarckia cadamba	Kadamba	Kadamba
30	Alstonia scholaris	Chatri	Chatri
31	Araucaria heterophylla	Christmas tree	Christmas tree

CHAPTER – V

TIME SCHEDULE FOR POST-CLOSURE ACTIVITIES

5.1 It is very difficult to predict the various parameters which would be prevalent at the time of final mine closure (when the entire block reserve would get exhausted) and therefore a mine closure activity schedule cannot be rigidly prepared at this point of time.

5.2 The closure of mine involving technical aspects, environmental aspects, socio-political aspects and financial assurances as implementing post-closure activities will run for three years. The time schedule envisaged for completion of all closure activities is presented in the following table in the form of bar chart.

Table5.1: Implementation Schedule for post-closure activities for Bhowrah South Group of mines.

Sl. No.	Major Activities	Time Period	Year-wise Phasing			
			Y1	Y2	Y3	Y4
1	Technical aspects	2 years				
2	Environmental aspects	2 years				
3	Post closure environment monitoring	3 years				
4	Socio-political aspects	3 years				

5.2.1 Technical Aspects:

i) **Safety & security**: In the mine closure plan, action will be taken to cover all the safety aspects including management of fire & subsidence and mine inundation.

ii) **Management of pit slopes and waste dump**:

The same has been addressed in detail in the Para No. 3.4 and in Para. 3.6.2.

iii) **Management of hydrology and hydro-geology**: After closure of mining activities, the workings will be waterlogged which will help in maintaining the water table in the surrounding areas and may become a source of water supply to the neighbouring areas.

iv) **Closure of Mine Entries**: After closure of the mining activities, all the entries to the mine will be effectively sealed off to avoid any accident and to prevent access to any unauthorized person. The area that is not reclaimed shall be properly fenced/ sealed to prevent any unauthorized entry into the area. However, the guidelines / instructions from DGMS, if any, will be followed.

v) **Disposal of mining machinery**: All the opencast machineries, which will have residual life, will be shifted to the other collieries of the area/company. The salvaging and shifting operation of mining machinery and other equipment will be done considering the ground realities during the period 1 (one) year advance of final mine closure.

vi) **Details of surface structure proposed to be dismantled**:

As far as possible, industrial structures will be utilised by the adjacent mine. However, if these structures are not found fit at the end of mine life, the same will be dismantled and salvaged. The equipments will be removed and used somewhere else. Every effort will be made to restore the area to economic utilization value in line with mine closure plan.

a. **Service Buildings**: The service buildings/ structures, viz. workshop, stores, office building, Site office, rooms, etc. are to be demolished after collecting all re-useable items, or be used for some other projects and the land covered by them restored for productive use. However, it has to be ensured that as and when a service building is vacated/ abandoned, the same should be demolished to prevent any unauthorized occupation.

b. **Other Infrastructures**: All other infrastructures like sub-stations, transformers, community services, pump-houses, water-treatment/ filtration plants, waterlines, power lines, roads etc. will be utilized for the neighbouring projects.

However, possibility shall be explored for handing over the buildings and other infrastructures including the reclaimed land to the State Government for the benefit of local villagers and strengthening the area infrastructures. The end use of these facilities shall be decided by the State Government with the help of District Authorities and Village Panchayat. The peripheral village community facilities developed by the Mine Authorities will be left to the Local Body/ State Government for their management and public use.

Prior to surface demolition/ restoration, a surface audit will be undertaken on all surface structures, spoil heaps etc. to assess whether there is any hazardous material that could cause problem, i.e. explosive, asbestos, chemical, oil, etc.

A list of surface, UG and OCP assets (Plant & Machinery) will be prepared and made available to potential purchasers or transferred to other new/ working mines of the company. This will ensure that the assets perform during their economic life.

5.2.2 Environment Aspects

i) **Mined-out land and proposed final land use:** At Bhowrah South Group of mines it is proposed to extract coal by both opencast & underground method. The existing infrastructures, if not usable, will be dismantled and the land will be graded & will be handed over to the local authorities for community use.

ii) **Air & Water quality management:** Appropriate air and water pollution control measures will be taken to contain the air and water pollution for maintaining the ambient air and water quality within the stipulated standards besides making the mining operation eco-friendly in the project. These

measures (both preventive and suppressive) are enumerated in Para 3.2.3 of the present report.

iii) **Management of waste:** The solid wastes generated by the mine during the coal production are non-hazardous and non-toxic in nature. The above solid wastes will be disposed off by backfilling the mined out area and then re-vegetating without causing any siltation problem on surface water bodies. However, scientific studies shall be undertaken regarding applicability of solid wastes for various uses. Toxic solid wastes like used oil, used batteries, oily sludge, besides filters and filter materials containing oil during maintenance of vehicles, will be generated by the mining project. Used oil will be stored in drums safely for disposal through auction to the authorized re-processors. Similarly, used batteries will be stored safely for auction to the authorized re-processors. The oily sludge, besides filter and filter materials, will be disposed off in impervious layer lined pits without causing environmental hazards.

iv) **Management of final voids**: It will be dealt as per the directive provided in the EMP.

v) **Land reclamation and rehabilitation:** If any cracks or void is created due to mining activities, it will be restored to original profile by filling up cracks/ voids. It is proposed that the site restoration should be kept progressive so that the restoration is more or less similar to the rate of mining.

vi) **Reclamation of forest/ vegetation and plantation:** No forest land is required for the project. However, regular plantation will be taken up during the life of the mine to create green barrier. The plant species will be selected in consultation with the state forest department.

The objective of restoration of post mining area will be determined through consultation with local community and the Government authority, so that the potential/ required end use of the mined out land is determined in advance. Such usage may be agriculture, forestry, amenity development or nature reserve.

5.2.3 Post Closure Environment Monitoring

After cessation of mining and its related activities, there will be no effect on ambient air and water quality due to this mine as proper mitigation measures for air and water pollution control are to be taken by the authorities of the mine. However, the air and water quality parameters in the mined out area will be monitored by some external agency for next three years after closure of the mine.

Air and water samples will be taken from the specified sampling stations at regular frequency for 3 consecutive years after the closure of the mining project. 1 sample of mine water will be collected and analyzed with fortnightly frequency and 2 samples of ground water from core & buffer zones with monthly frequency. Similarly, 1 air sample will be taken at core zone, and 1 air sample each in upwind and downwind directions of the project at fortnightly frequency.

5.2.4 Socio-Political Aspects

i) **Re-deployment of work force**: Due to closure of mining operations, the persons directly employed in the mine will be surplus. Suitable manpower re-deployment plan may be formulated by the mining company sufficiently before closure of mine for re-deployment of the work force in other units of the company. Alternatively, they would be given option of voluntary retirement.

ii) **Civic facilities**: It is proposed that the civic facilities developed during the mining phase will be transferred to the local government/ municipality so that the region transforms smoothly into post mining phase. A one-time payment should be made by the mine for obtaining its release from providing these facilities, which will there from be taken care of by the local and state bodies.

iii) **Channelisation of available water**: If the mine has sufficient water, this can be used for domestic and agriculture purpose by the local community. The water from this area shall be discharged after treatment for domestic and agricultural usages.

iv) **Emancipation for project affected population**: There are six habitation sites in the leasehold of Bhowra South colliery which are proposed for Rehabilitation in Phase-II of the Master Plan for dealing with Fire, Subsidence and Rehabilitation., as given in Table No. 5.2.

Table 5.2 Phasewise Rehabilitation as per Master Plan of JCF

Village/Site	BCCL	Pvt.	Enchr	Oth	Total
PHASE-I					
Total(Phase-I)	**0**	**0**	**0**	**0**	**0**
PHASE-II					
12 No. Area Colliery Office to Kumar Patti/ 16	23	50	0	0	73
35 Area Chhapra More/12	12	14	71	0	97
36 Jore Area behind Area Office/14	0	0	57	0	57
4 no. Dhowrah/Amlabad Road/18	35	0	243	0	278
Gourkhunti 35 Incline/13	0	21	29	0	50
Jahaj Tand/19	6	10	14	0	30
Total(Phase-II)	**76**	**95**	**414**	**0**	**985**
Total(Phase I+II)	**76**	**95**	**414**	**0**	**985**

5.3 Although, it is very difficult to conclusively predict the likely impacts due to closure of the mining activities in the in the leasehold area of the Instant Project and the likely activities that would be taken up at that point of time, but a broad mine closure activity schedule may be prepared as per guidelines of Ministry of Coal. The post closure implementing activities will run for three years. The following activities are most likely to be implemented as per the given bar chart.

IMPLEMENTATION SCHEDULE FOR MINE CLOSURE IN 3 PIT OCP MINE

(LIFE OF THE MINE : 1 YEAR)

S.N	Activity	Time Frame	Year			
			Final Phase	Post Closure Phase		
			1	PC1	PC2	PC3
A	**Dismantling of Structures**					
	Service Buildings	2 years				
	Residential Buildings	2 & ½ years				
	Industrial structures like CHP, Workshop, field sub-station, etc.	2 & ½ years				
B	**Permanent Fencing of mine void and other dangerous area**					
	Random rubble masonry of height 1.2 metre including leveling up in cement concrete 1:6:12 in mud mortar	2 years				
C	**Grading of highwall slopes**					
	Levelling and grading of highwall slopes	2 years				
D	**OB Dump Reclamation**					
	Handling/Dozing of OB Dump and backfilling	Throughout the life of the mine including 3 years after cessation of mining operation				
	Technical and Bio-reclamation including plantation and post care	Throughout the life of the mine including 3 years after cessation of mining operation				
E	**Landscaping**					
	Landscaping of the open space in the leasehold area for improving its esthetics and eco value	Throughout the life of the mine including 3 years after cessation of mining operation				

S.N	Activity	Time Frame	Year			
			Final Phase	Post Closure Phase		
			1	PC1	PC2	PC3
F	**Plantation**					
	Plantation over cleared area obtained after dismantling	2 years				
	Plantation around the quarry area and in safety zone	Throughout the life of the mine including 3 years after cessation of mining operation				
	Plantation over the external OB Dump	Throughout the life of the mine				
G	**Post Closure Env Monitoring / testing of parameters for three years**					
	Air Quality	3 years				
	Water Quality	3 years				
H	**Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	Throughout the life of the mine				
I	**Miscellaneous and other mitigative measures**	Throughout the life of the mine including 3 years after cessation of mining operation				
J	**Post Closure Manpower cost for supervision**	3 years				

NOTE: *: To be covered under Progressive Mine Closure activities also**.**

NOTE: The progressive mine closure will be done as per the provisions made out in the Project report and as per the situation/requirement that may arise in course of execution of the Project Report.

IMPLEMENTATION SCHEDULE FOR MINE CLOSURE IN 3 PIT WEST OCP (PROPOSED)

(LIFE OF THE MINE : 5 YEAR)

S.N	Activity	Time Frame	Year			
			Final Phase	Post Closure Phase		
			1st -5th	PC1	PC2	PC3
A	**Dismantling of Structures**					
	Service Buildings	2 years				
	Residential Buildings	2 & ½ years				
	Industrial structures like CHP, Workshop, field sub-station, etc.	2 & ½ years				
B	**Permanent Fencing of mine void and other dangerous area**					
	Random rubble masonry of height 1.2 metre including leveling up in cement concrete 1:6:12 in mud mortar	2 years				
C	**Grading of highwall slopes**					
	Levelling and grading of highwall slopes	2 years				
D	**OB Dump Reclamation**					
	Handling/Dozing of OB Dump and backfilling	Throughout the life of the mine including 3 years after cessation of mining operation				
	Technical and Bio-reclamation including plantation and post care	Throughout the life of the mine including 3 years after cessation of mining operation				
E	**Landscaping**					
	Landscaping of the open space in the leasehold area for improving its esthetics and eco value	Throughout the life of the mine including 3 years after cessation of mining operation				
F	**Plantation**					

S.N	Activity	Time Frame	Year			
			Final Phase	Post Closure Phase		
			1st -5th	PC1	PC2	PC3
	Plantation over cleared area obtained after dismantling	2 years				
	Plantation around the quarry area and in safety zone	Throughout the life of the mine including 3 years after cessation of mining operation				
	Plantation over the external OB Dump	Throughout the life of the mine				
G	**Post Closure Env Monitoring / testing of parameters for three years**					
	Air Quality	3 years				
	Water Quality	3 years				
H	**Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	Throughout the life of the mine				
I	**Miscellaneous and other mitigative measures**	Throughout the life of the mine including 3 years after cessation of mining operation				
J	**Post Closure Manpower cost for supervision**	3 years				

NOTE: *: To be covered under Progressive Mine Closure activities also**.**

NOTE: The progressive mine closure will be done as per the provisions made out in the Project report and as per the situation/requirement that may arise in course of execution of the Project Report.

IMPLEMENTATION SCHEDULE FOR MINE CLOSURE IN CHANDAN OCP MINE

(LIFE OF THE MINE : 2 YEAR)

S.N	Activity	Time Frame	Year			
			Final Phase	Post Closure Phase		
			1st – 2nd	PC1	PC2	PC3
A	**Dismantling of Structures**					
	Service Buildings	2 years				
	Residential Buildings	2 & ½ years				
	Industrial structures like CHP, Workshop, field sub-station, etc.	2 & ½ years				
B	**Permanent Fencing of mine void and other dangerous area**					
	Random rubble masonry of height 1.2 metre including leveling up in cement concrete 1:6:12 in mud mortar	2 years				
C	**Grading of highwall slopes**					
	Levelling and grading of highwall slopes	2 years				
D	**OB Dump Reclamation**					
	Handling/Dozing of OB Dump and backfilling	Throughout the life of the mine including 3 years after cessation of mining operation				
	Technical and Bio-reclamation including plantation and post care	Throughout the life of the mine including 3 years after cessation of mining operation				
E	**Landscaping**					
	Landscaping of the open space in the leasehold area for improving its esthetics and eco value	Throughout the life of the mine including 3 years after cessation of mining operation				
F	**Plantation**					

S.N	Activity	Time Frame	Year			
			Final Phase	Post Closure Phase		
			1st – 2nd	PC1	PC2	PC3
	Plantation over cleared area obtained after dismantling	2 years				
	Plantation around the quarry area and in safety zone	Throughout the life of the mine including 3 years after cessation of mining operation				
	Plantation over the external OB Dump	Throughout the life of the mine				
G	**Post Closure Env Monitoring / testing of parameters for three years**					
	Air Quality	3 years				
	Water Quality	3 years				
H	**Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	Throughout the life of the mine				
I	**Miscellaneous and other mitigative measures**	Throughout the life of the mine including 3 years after cessation of mining operation				
J	**Post Closure Manpower cost for supervision**	3 years				

NOTE: *: To be covered under Progressive Mine Closure activities also**.**

NOTE: The progressive mine closure will be done as per the provisions made out in the Project report and as per the situation/requirement that may arise in course of execution of the Project Report.

IMPLEMENTATION SCHEDULE FOR MINE CLOSURE IN BHOWRAH SOUTH UG MINE

(LIFE OF THE MINE : 9 YEAR)

S.N	Activity	Time Frame	Year				
			1st Phase	Final Phase	Post Closure Phase		
			1st – 5th	6th – 9th	PC1	PC2	PC3
A	**Dismantling of Structures**						
	Service Buildings	2 years					
	Residential Buildings	2 & ½ years					
	Industrial structures like CHP, Workshop, field sub-station, etc.	2 & ½ years					
B	**Permanent sealing of mine entries (incline mouth and air shaft)**						
	Sealing of incline mouths and air shafts	2 years					
C	**Subsidence Management**	Throughout the life of the mine, if required including 3 years after cessation of mining operation					
D	**Landscaping**						
	Landscaping of the cleared land for improving its esthetic	Throughout the life of the mine including 3 years after cessation of mining operation					
E	**Plantation**						
	Plantation over leasehold area and on other open spaces	Throughout the life of the mine including 3 years after cessation of mining operation					
F	**Post Closure Env Monitoring / testing of parameters for three years**						
	Air Quality	3 years					
	Water Quality	3 years					

S.N	Activity	Time Frame	Year				
			1st Phase	Final Phase	Post Closure Phase		
			1st – 5th	6th – 9th	PC1	PC2	PC3
G	**Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	Throughout the life of the mine					
H	**Miscellaneous and other mitigative measures**	Throughout the life of the mine including 3 years after cessation of mining operation					
I	**Post Closure Manpower cost for supervision**	3 years after mine closure					

NOTE: *: To be covered under Progressive Mine Closure activities also**.**

NOTE: The progressive mine closure will be done as per the provisions made out in the Project report and as per the situation/requirement that may arise in course of execution of the Project Report.

पर्यावरण विभाग

टिप्पणी पत्र

पत्र-संख्या:-उप-महाप्रबंधक (पर्यावरण) /फ-पर्यावरण/2019/290(N) दिनांक: 04.02.2019

Subject: Regarding Board resolution approving Mining Plan of Amalgamated Sudamdih-Patherdih, Bhowrah South & Moonidih Mines.

Board Approved Mining Plans of Amalgamated Sudamdih-Pathedih, Bhowrah South & Moonidih Mines are required for consideration in the upcoming EAC meeting (likely to be held by 20th February 2019) for modification of Environment Clearance of Cluster X and XI. The Board's approval is needed to be uploaded on MoEF& CC website within two days else the consideration of modification of EC of Cluster X and XI will be delayed by a month.
The above mining plans were considered in the 348th Board meeting held on 29.01.2019. Competent Authority is kindly requested to direct Company Secretary for providing the Board resolution immediately on urgent basis.

4/2/19
Sr.Manager (Min)

Dy.GM(Env) for kind approval and direction to Co' Secy for needful

4/2/19

D(T)

06/02/2019

CMD

Advance Copy

Co. Secy

The above proposals were put up in 348th Board meeting held on 29/01/19 and were approved. formal resolutions will be issued in due course.

Dy. GM(Env.)

6/2/19

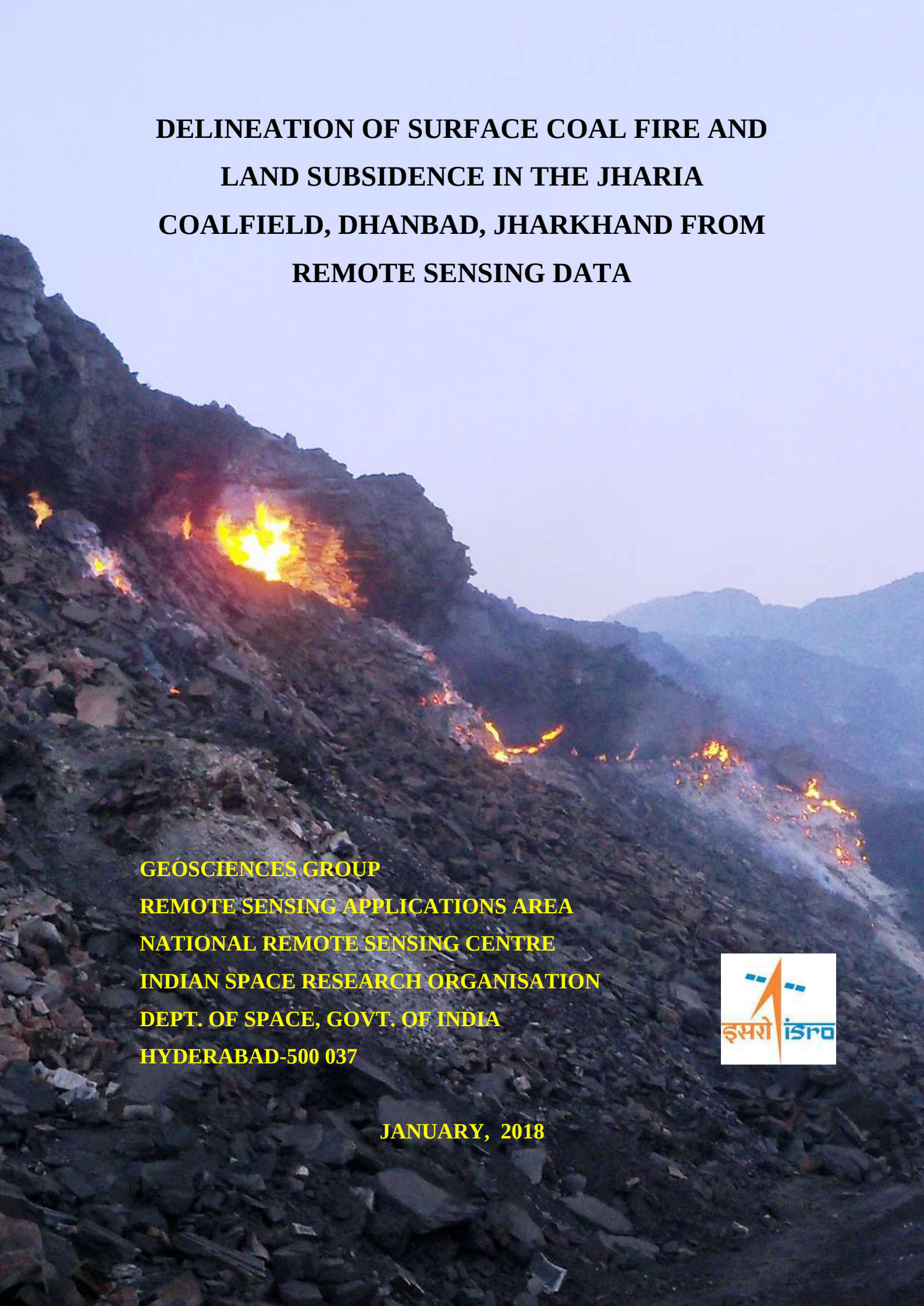
DIDOP, SUPDTL, B.C.C.L., KOYLA BHAWAN
Diary No. 871N
Dt. 6/2/19

This Space is not for use.

BCCL Press 04/17-17 18 100 Pads x 100 Lvs.

Scanned by CamScanner

DELINEATION OF SURFACE COAL FIRE AND LAND SUBSIDENCE IN THE JHARIA COALFIELD, DHANBAD, JHARKHAND FROM REMOTE SENSING DATA



GEOSCIENCES GROUP

REMOTE SENSING APPLICATIONS AREA

NATIONAL REMOTE SENSING CENTRE

INDIAN SPACE RESEARCH ORGANISATION

DEPT. OF SPACE, GOVT. OF INDIA

HYDERABAD-500 037

JANUARY, 2018

DELINEATION OF SURFACE COAL FIRE **AND** LAND SUBSIDENCE IN THE JHARIA COALFIELD, DHANBAD, JHARKHAND FROM REMOTE SENSING DATA

Report for

BHARAT COKING COAL LIMITED (BCCL)

(A SUBSIDIARY OF COAL INDIA LTD.)

ENVIRONMENT DEPARTMENT, KOYLA BHAWAN

KOYLA NAGAR, DHANBAD – 826 005, JHARKHAND

GEOSCIENCES GROUP

REMOTE SENSING APPLICATIONS AREA

NATIONAL REMOTE SENSING CENTRE

INDIAN SPACE RESEARCH ORGANISATION

DEPT. OF SPACE, GOVT. OF INDIA

HYDERABAD-500 037

JANUARY, 2018

PROJECT TEAM

1. **Dr. K VINOD KUMAR**, Group Head, Geosciences Group
   Project formulation and coordination
2. **Dr. Tapas R. Martha**, Scientist 'SF'
   Field survey and report preparation
3. **Shri Priyom Roy,** Scientist 'SD'
   Image processing, interpretation, field survey, maps and report preparation

CONTENTS

ACKNOWLEDGEMENTS i

EXECUTIVE SUMMARY ii

LIST OF FIGURES AND TABLES iii

CHAPTER – I INTRODUCTION 1

1.1 BACKGROUND 2

1.2 OBJECTIVES 2

1.3 STUDY AREA 3

CHAPTER – II GENERAL DESCRIPTION OF THE STUDY AREA 4

2.1 LOCATION AND ACCESSIBILITY 4

2.2 PHYSIOGRAPHY, DRAINAGE AND CLIMATE 4

2.3 GENERAL GEOLOGY 4

CHAPTER – III DATA REQUIREMENTS 7

3.1 REMOTE SENSING DATA 7

3.2 ANCILLARY DATA 7

CHAPTER – IV REMOTE SENSING DATA ANALYSIS 8

4.1 METHODOLOGY 8

4.1.1 PROCESSING OF LANDSAT 8 DATA 8

4.1.2 THRESHOLDING OF RADIANT TEMPERATURE IMAGE 9

4.2 METHODOLOGY FOR SUBSIDENCE DETECTION 12

4.2.1 PROCESSING OF ALOS-PALSAR-2 DATA 12

CHAPTER – V FIELDWORK 17

CHAPTER – VI POST FIELD WORK ANALYSIS 19

CHAPTER – VII DISCUSSIONS AND CONCLUSIONS 20

7.1 DISCUSSION 20

7.2 CONCLUSIONS 22

CHAPTER – VIII LIMITATIONS 24

REFERENCES 26

Annexure – I 27

Annexure - II 29

Annexure - III 31

Annexure - IV 34

ACKNOWLEDGEMENTS

The project team is grateful to Dr. Y.V.N. Krishnamurthy, Director, NRSC, for his support at various stages during execution of this project. We are extremely grateful to Dr. P.V.N. Rao, Deputy Director (RSAA), NRSC for his overall guidance and encouragement. We thank Shri D. Gangopadhyay (Director, P&P). BCCL, for this project initiative and for providing Geosciences group, NRSC, the opportunity to carry out the task. We are thankful to Shri A. K. Singh (GM, I/C), BCCL for taking keen interest in the project work and for the support during our fieldwork. We also thank Shri Dipankar Maity, Surveyor (Mining) and Shri Mithilesh Kumar, Sr. Manager (Mining) for their support and fruitful discussion during the fieldwork. The support of all the BCCL officials in the various collieries visited during the course of the ground truth verification is duly acknowledged.

EXECUTIVE SUMMARY

Coal fire is a serious problem in Jharia coal field, where high ranking coals are gradually burnt due to these fires. The combined effect of surface and sub-surface fires and mining related subsidence has endangered the environmental stability of Jharia coal field. Coupled with the ecological changes instigated by open cast mining, the landscape in and around Jharia have changed drastically over the years. In the present study, delineation of coal fire and mining related land subsidence have been addressed. Thermal band of Landsat-8 (100m resolution) have been used to demarcate the coal mine fire areas from non fire areas. For this study, Landsat-8 data of May, 2017 have been used. The band 10 (10.60-11.19 μm) of Landsat-8 data is used to derive the relative radiant temperature. Further ALOS-PALSAR 2, L band microwave data has been used to delineate zone of probable land subsidence (using differential interferometry) due to mining. The study reflects that, compared to 2012, the eastern flanks (Lodna and Tisra) show a larger fire area. The western flank (Nadkhurkee and Shatabdi) and the northern flank (Katras and Gaslitand) show isolated fire pockets in active mines as well as OB dumps. Among all the colliery areas, Kusunda and Lodna area is most affected by coal mine fire. The current fire area mapped is 3.28 sq.km. Apart from this, five distinctive areas of land subsidence have been identified using interferometric method. These are primarily caused by older or active underground mining. The Moonidih Project is most affected by subsidence. The coal mine fire and subsidence areas are further verified on the ground. The final coal mine fire and subsidence map of Jharia coal field is prepared by using remote sensing data analysis with field validation.

LIST OF FIGURES AND TABLES

Figure 1 : Study area map of Jharia Coalfield, Jharkhand

Figure 2 : Geological map of Jharia coal field, Dhanbad, Jharkhand (published by CMPDIL)

Figure 3 : False colour composite image of Jharia Coalfield (VNIR 3N,2,1) , with subset blocks (in red) to obtain temperature values (from radiant temperature image) within the Barakar formation across the Jharia coalfield.

Figure 4 : Maximum temperature plotted against mean temperature for various locations; cluster separation observed around 39 °C (marked with arrow)

Figure 5 **:** Coal mine fire map (May, 2017) of Jharia coal field, Dhanbad. The fire areas shown in this map have been verified in the field as per field points in figure 13.

Figure 6 : DInSAR acquisition scheme

Figure 7 : Work flow diagram for generating land subsidence map using DInSAR technique

Figure 8 **:** ALOS-PALSAR - 2 Master-Slave pairs for short and long temporal base line processing

Figure 9 : Fringe patterns generated from short baseline processing (e.g. Master: Oct, 16, Slave: Feb, 17)

Figure 10 : Fringe patterns generated from long baseline processing (e.g. Master: Oct, 15, Slave: Feb, 17)

Figure 11 : Subsidence map of Jharia coal field, Dhanbad

Figure 12 : Total fire area statistics

Figure 13 : Field data points for coal fire verification

Figure 14 : Field data points for subsidence verification

Field Photographs

Figure 15 : Fume cracks in Lodna-Tisra Area. (point 39 in figure 13 and table 4)

Figure 16 : Burnt area near OB dump in Lodna area (point 41 in figure 13 and table 4).

Figure 17 : Coalfries in active seams in Kusunda (point 23 in figure 13 and table 4)

Figure 18 : Sagged area due to subsidence, south of Block II OCP. (point 1 in figure 14 and table 5).

Figure 19 : Fire in OB dumps in Kusunda area. (point 24 in figure 13 and table 4).

Figure 20 : Fume cracks in the Bhulanbarari area.

List of Tables

Table 1 : Generalised stratigraphy of JCF

Table 2 : List of satellite data used in the present study

Table 3 : Threshold temperature for fire area estimation of individual mines.

Table 4 : Coal Fire observations during fieldwork (see figure 13 for reference)

Table 5 : Coal Fire observations during fieldwork (see figure 14 for reference)

Table 6 : Colliery wise break-up of change in fire area from 2012 to 2017

CHAPTER I

INTRODUCTION

Coal fire is a perennial problem in Jharia coal field (JCF) covering 447 sq. km. area in the Dhanbad district of Jharkhand state. Subsurface and surface coal fires are a serious problem in many coal-producing countries. The severity and extent of mine fires in some of the Indian coalfields, particularly Jharia and Raniganj coalfields, are quite alarming. Combustion can occur either within coal or in coal dumps on the surface. Considerable economic loss and environmental problem arises due to the coal fire. Coal fire burns valuable coal and also creates difficulties in mining by increasing the cost of production or making existing operations difficult. Noxious gases like sulphur dioxide, nitrogen oxide, carbon monoxide, carbon dioxides, which are the result of coal burning processes, often affect the immediate surroundings of an active coal fire area (Gangopadhyay, 2003). These greenhouse gases not only affect local atmosphere but also play a crucial role in the damages, found associated with coal fire such as land surface subsidence and surface cracking. Coal fires are caused by oxidation of coal but the reaction involved in oxidation of coal is not understood till date. Broadly, the potential for spontaneous combustion lies in its ability to react with oxygen at ambient temperature. This occurs through the reaction of oxygen at the surface of the coal resulting in an exothermic reaction. As a consequence, the temperature of coal rises and if temperature reaches the threshold temperature, ranging between 80^0 to 120^0C, a steady reaction starts, which produces carbon dioxide. Temperature keeps on increasing once CO_2 started to form and at 2300°C, the exothermic reaction becomes rapid. It is known that high grade coals (high carbon content) are more fire prone, though the reason behind this is not well understood. Another important parameter, which controls fire, is the size of the particles. Larger the effective area of coal (fire particles), more rapidly the reaction proceeds. Cracks, fissures play a role like positive catalysts to coal oxidation by slowly supplying oxygen / air through their conduits.

Coal mining in Jharia Coal Field (JCF) started way back in 1895. History of fire in Jharia Coal Field date back to 1916 when the first incidence of fire was reported from XIV seam of Bhowrah colliery. JCF was nationalised in 1972 and over the decades, the fire has spread or been contained but never extinguished. The combination of underground fire and subsidence have affected vast areas of JCF.

1.1 Background

Remote sensing technique in thermal band offers a cost-effective and time-saving technology for mapping various geoenvironmental / hazardous features such as coal fires, forest fires, oil well fires, volcanic eruptions etc. NRSC has carried out coal fire mapping projects in the past; conducting an airborne campaign in 1989 and using Landsat-5 TM data in 1995 (Bhattacharya *et. al.*, 1995), over Jharia coalfield, Jharkhand and using Landsat-5 TM data for 2001 over Raniganj coalfield, West Bengal. Further, projects were executed in 2006 and 2012 in which coal fires of the JCF were mapped using Landsat-7 ETM+ and ASTER data, respectively. Additionally, a R&D study was taken up in 2013 to delineate subsidence areas using differential interferomteric (DInSAR) technique. In view of the past experiences, based on the letter (Ref. no. NRSC/16/76) from Director (Tech.), Operations, BCCL addressed to Director, NRSC on 01 February 2016. a project was formulated to take up Coal fire and Land Subsidence study of the Jharia Coal Field using space-borne remote sensing technique. The formal Memorandum of Understanding between BCCL and NRSC was signed on 23rd of Dec, 2016.

1.2 Objectives

The following objectives are formulated on the basis of the above mentioned background:

I. To map Coal fire in the study area based on pixel integrated relative radiant temperature derived from latest available Landsat-8 data of 2016-17 time period.

II. To compare the change in the coal fire distribution in the Jharia coalfield within the period of 2012 and 2016-17.

III. To delineate probable subsidence areas in the region using differential interferometry method.

1.3 Study Area

Jharia Coalfield is located in the Dhanbad district of Jharkhand state (Figure 1) and it is named after the main coal mining town of Jharia. It is situated in the Damodar River valley and is about 250 km NW of Kolkata. The coalfield is contained roughly within latitudes 23º 42' N and 23º 50'N and longitudes 86º 09'E and 86º 30'E.

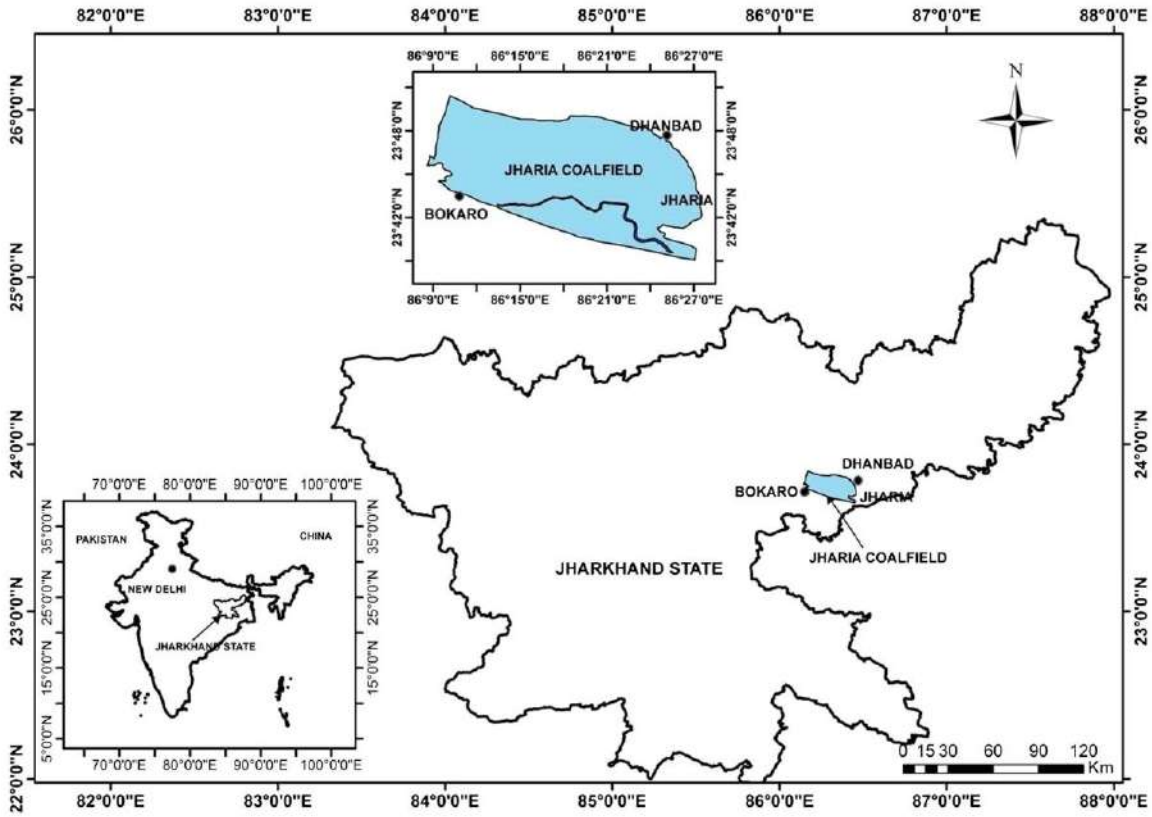


Figure 1: Study area map of Jharia Coalfied, Jharkhand

CHAPTER II

GENERAL DESCRIPTION OF THE STUDY AREA

2.1 Location and Accessibility

Jharia is an old mining town in the Dhanbad district of Jharkhand. This town is famous for its surrounding mines producing high grade coal and supplying mainly to the neighbouring industrial areas. Jharia is approximately 6 km in south western direction from Dhanbad town and connected by metal road. Dhanbad is well connected to Kolkata by road and rail.

2.2 Physiography, Drainage and Climate

Jharia coalfield is characterised by undulatory topography with very low rolling slope towards the eastern part of the area. The average height of the area is around 200 meters above the mean sea level. Damodar is the major river in the study area. The other tributaries to the Damodar River in this area are Jamuniya Nadi, Khudia Nadi, Khatri Nadi, Jarian Nala, Kari Jora and Domohani Nadi. Damodar River flows from west to east in this area. The minimum temperature is <10º C in the month of December – January and maximum temperature is >50º C in the month of May – June.

2.3 General Geology

Gondwana Super Groups of rocks of Up. Carboniferous to Lr. Cretaceous age (i.e. from 320 MY to 98 MY) are exposed here. Gondwana Super Group rocks unconformably overlie Archaean rocks. In Gondwana Rocks, Raniganj and Barakar Formations of Permian age have more potential as far as the coal production is concerned. Barakar Formation is exposed in north and north eastern part of the basin (Figure 2). Most of the coal mines are confined to the Barakar Formation in JCF. Barakars consists of coarse, medium grey and white sandstones, shales and coal seams. Raniganj consists of grey and greenish soft feldspathic sandstones, shales and coal seams. Faults are prevalent in this portion of basins (Figure 2). NW trending faults are conspicuous north to Jharia. Many lamprophyre and dolerite dykes are also exposed in this area in a criss-cross manner. The Raniganj Formation though coal bearing, has suffered much deformation due to faulting, thus causing difficulty for

mining in the area. The generalised stratigraphy of JCF is mentioned below (after Saraf, et al., 1995).

FORMATION	LITHOLOGY	MAXIMUM THICKNESS
Supra Panchet	Red and Grey sandstones and shales	300m
Panchet	Micaceous Yellow and Grey sandstones, Red and Greenish shales	600m
Raniganj	Grey and Greenish soft feldspathic sandstones, shales and coal seams	1050m
Ironstone Shales	Dark carbonaceous shales with ironstone bands	360m
Barakar	Coarse and medium Grey and white sandstones, shales and coal seams	630m
Talchir Boulder Bed	Coarse sandstones above and Greenish shales below	300m

Table 1: Generalised stratigraphy of JCF.

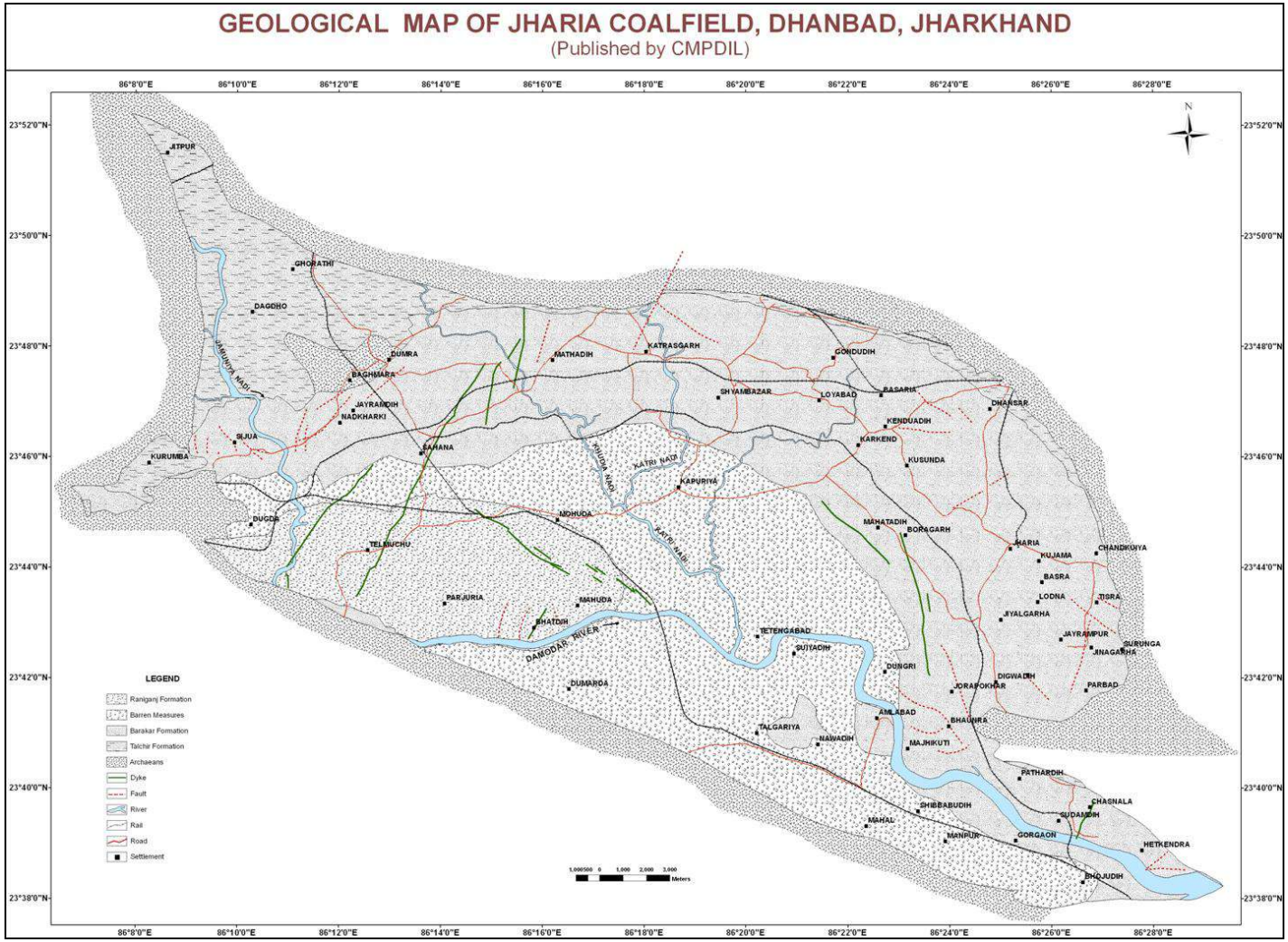


Figure 2 : Geological map of Jharia coal field, Dhanbad, Jharkhand (published by CMPIDL)

CHAPTER III

DATA REQUIREMENTS

3.1 Remote Sensing Data

The most recent available thermal satellite data was used in conjunction with the fieldwork for mapping coal fire in JCF. A coal fire map generated from the same, would serve as a reference for the fieldwork, as the observations can be verified in the field. For this purpose, a coal fire map was created from LANDSAT 8 TIRS data of 14-May 2017 .

Further, the coal fire map of 2012 prepared by NRSC (NRSC, 2012) from ASTER data was used as a reference to identify the changes that has occurred in the extent and disposition of the fires from 2012 to 2017.

For the land subsidence study, L-band microwave data from ALOS-PALSAR satellite (JAXA) were used. Five scenes of "Fine mode" SLC data were taken from PALSAR-2 archives over a period from October, 2014 to February, 2017. This was done to identify long term terrain changes and differentiate the same from short term changes due to mining excavations and overburden dumping.

Table 2: List of satellite data used in the present study.

Sl. No	Satellite	Sensor	Time	Date	Data source
1	LANDSAT-8	TIRS	Daytime	14 May 2017	USGS, USA
2	ALOS-PALSAR-2 (Fine mode)	PALSAR-2	-	4 October. 2014	JAXA, Japan
3				3 October, 2015	
4				20 February. 2016	
5				01 October, 2016	
6				18 February. 2017	

3.2 Ancillary data

1. Geological map of Jharia coal field.
2. Mine surface plans as provided by BCCL.

CHAPTER IV

REMOTE SENSING DATA ANALYSIS

4.1 Methodology

4.1.1 Processing of Landsat 8 Data

With the launch of the LANDSAT-8 mission in February, 2013; thermal space borne data is available from its thermal infrared sensor (TIRS). This has enabled monitoring of the earth with a spatial resolution of 100 m in the thermal domain with a repeat cycle of 16 days. The LANDSAT-8 has two channels (Band 10 and Band 11) in the thermal infrared region (Table 1) which ranges from 10.4 micrometer to 12.5 micrometer. In present study, band 10 of TIRS sensor (acquired on 14 May, 2017) has been used coal fire mapping (Gangopadhyay et al. 2012). The spectral domain of the band is known for its maximum transmittance (Chatterjee et al. 2007; Martha et al. 2010). The data are freely accessible through USGS portal (Landsat 8 download source: http://landsatlook.usgs.gov).

Landsat-8 data are available in GeoTiff format and the data are converted to top of the atmosphere spectral radiance using the radiance rescaling factors provided in the metadata file, using equation 1.

$$L_\lambda = M_L Q_{cal} + A_L \text{ …….. (1)}$$

Where:

L_λ = Spectral radiance (Watts/ (m2 * srad * μm)).

M_L = Band-specific multiplicative rescaling factor from the metadata.

A_L = Band-specific additive rescaling factor from the metadata.

Q_{cal} = Quantized and calibrated standard product pixel values (DN).

Once the spectral radiance (Lλ) for ASTER Band 13 and Landsat-8 band 10 data is generated, it is possible to calculate radiant (brightness) temperature directly using equation 2. Planck's radiation function (Planck, 1914) forms the basis of radiant temperature derivation from spectral radiances and the theory is discussed in detail in existing literatures (Gupta, 2003).

$$T_R = K_2 / \ln ((K_1 / L_\lambda) + 1) \text{…….. (2)}$$

T_R = Radiant (brightness) temperature,

K_1 = Calibration constant (1260.56 K),

K_2 = Calibration constant (666.09 watts/ (m2 *ster*μm)),

L_λ = Spectral radiance

4.1.2 Thresholding of radiant temperature image

Once the Landsat-8 data are converted to radiant temperature image, the next step was to segregate fire pixels from the background, which requires the estimation of the cut-off temperature (Roy et al. 2015). This has been attempted by the statistical analysis of sensor derived radiant temperature to delineate clusters (in the scatter-plot) indicative for fire and non-fire pixels. Mean and maximum radiant temperatures are derived from randomly sampled uniform sized pixel blocks distributed in entire spatial extent of Barakar formation (Figure 3) known for fire bearing coal seams. The pixel block sizes are chosen to adequately represent the overall areal extent of the coalfield and homogeneously encompass all the mining blocks (27x27 pixels for Landsat-8, Figure 3). The maximum temperature value recorded in each representative area, derived from each of the datasets, is plotted against the mean temperature. The maximum temperature represents that of fire (wherever present), whereas the mean temperature represents the average background temperature, for normalization. The fire and background populations show considerable variance, separating coal fire and background radiant temperatures. The cut-off temperature derived is the maximum temperature of the background cluster, above which all temperatures represent coal fires. In the case of the Landsat-8 data used in this study, the cut-off temperature was determined around 39°C (Figure 4). Based on this cut-offs, regional coal fire map was prepared (Figure 5).

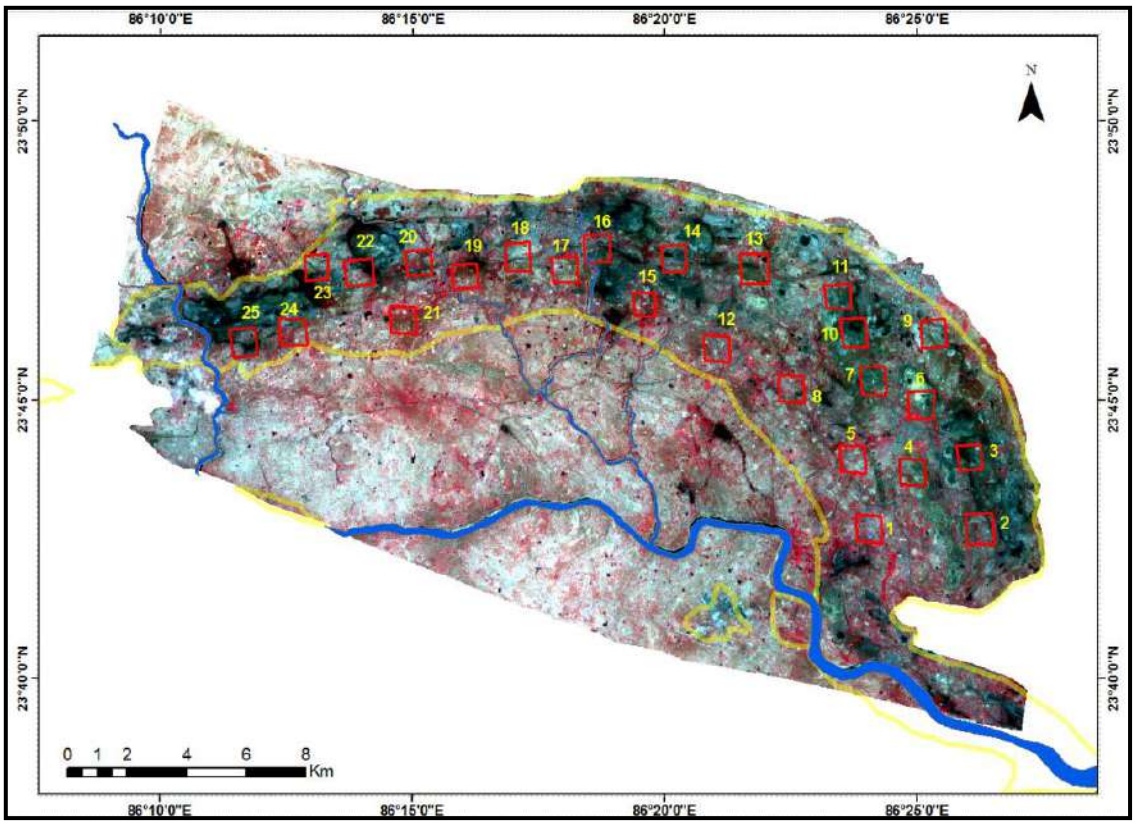


Figure 3. False colour composite image of Jharia Coalfield, with subset blocks (in red boxes) to obtain temperature values (from radiant temperature image) within the Barakar formation across the Jharia coalfield.

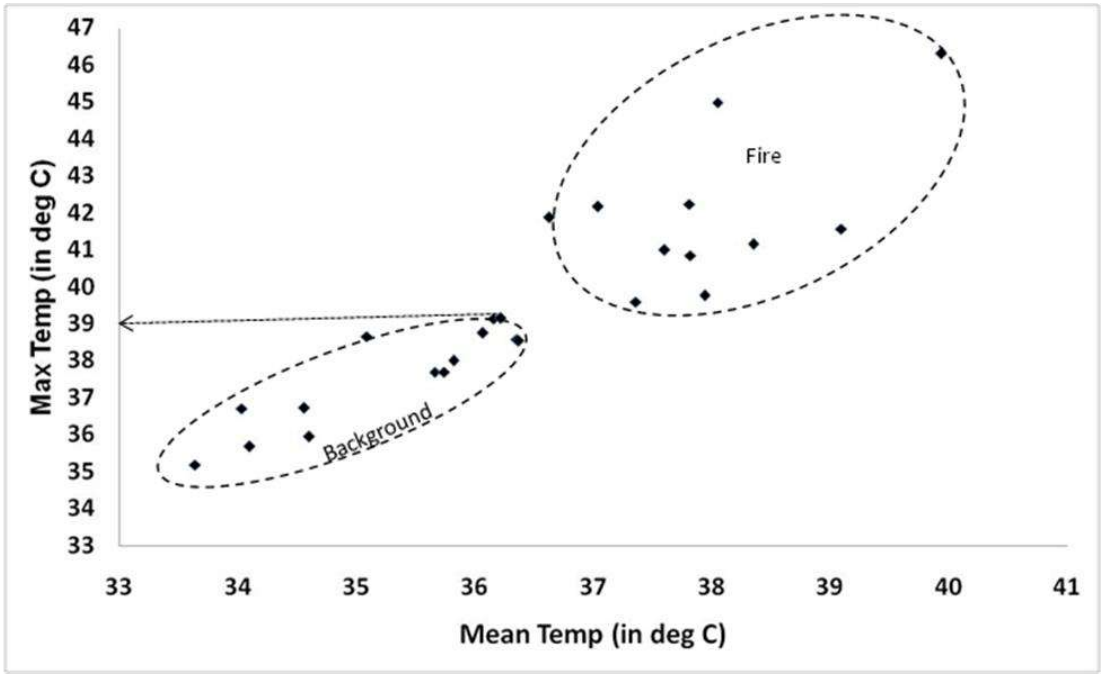


Figure 4. Maximum temperature plotted against mean temperature for various locations; cluster separation observed around 39 °C (marked with arrow)

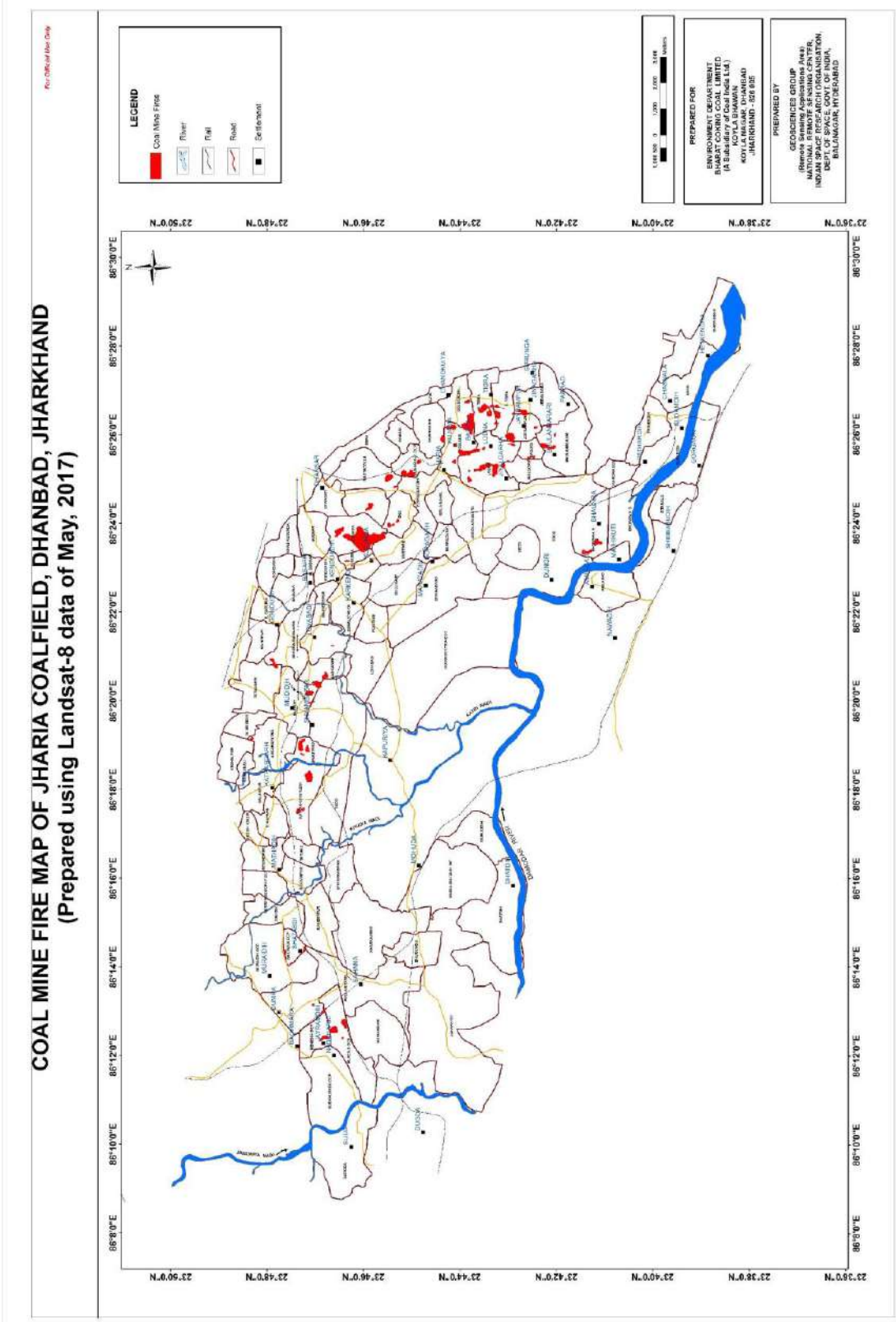


Figure 5: Coal mine fire map (May, 2017) of Jharia coal field, Dhanbad. The fire areas shown in this map have been verified in the field as per field points in figure 13.

4.2 Methodology For Subsidence Detection

4.2.1 Processing of ALOS-PALSAR 2 Data

Differential Interferometric SAR (DInSAR) techniques consist of combination of two SAR images of the same area acquired from slightly different positions (Figure 6).

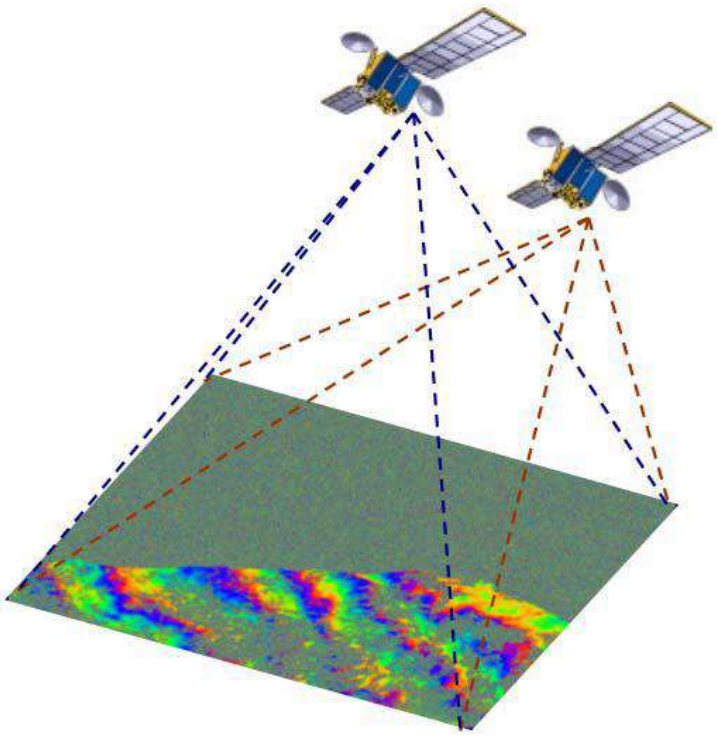


Figure 6. DInSAR acquisition scheme.

The result of this combination provides a new image, known as 'interferogram', whose phase component is formed by the following term:

$$\Delta\Phi Int = \Phi Topo + \Phi Mov + \Phi Atm + \Phi Noise \quad (3)$$

where, ΦTopo denotes the topographic component, ΦMov denotes the terrain deformation/ displacement component, ΦAtm is the noise component and ΦNoise is the thermal noise.

Topography, atmospheric effects and thermal noise needs to be removed or optimized to obtain precise measurements of terrain movement. When working with classical DInSAR interferograms (combination of two SAR images) the main problem is the presence of atmospheric artefacts, since there is no way to cancel them without a priori information. On the other hand, the term related with topography can be cancelled out using and external Digital Elevation Model (DEM) and the orbital ephemeris from the SAR acquisitions, considering no height errors on the DEM.

$$\Delta\Phi dif = \Phi ErrorTopo + \Phi Mov + \Phi Atm + \Phi Noise \qquad (ii)$$

Since the coal mine area is very dynamic in terms of its surfacial changes (open cast mine, abandoned mine, fire affected waste/reclaimed land, over burden dumps) over time, it is proposed to utilize an advanced DInSAR technique. It is a recent remarkable improvements in SAR differential interferometry that has led to an innovative approach based on the use of a large dataset of SAR images over the same area to overcome the intrinsic limitations of conventional DInSAR in terms of temporal and geometrical decorrelation as well as atmospheric disturbances (Ferretti et al 2001; Hooper et al 2004; Kampes, 2006; Lanari et al 2004; Mora et al 2003;Werner et al 2003).

Broad work flow diagram for generating land subsidence map using satellite based DInSAR technique is shown in Figure 7.

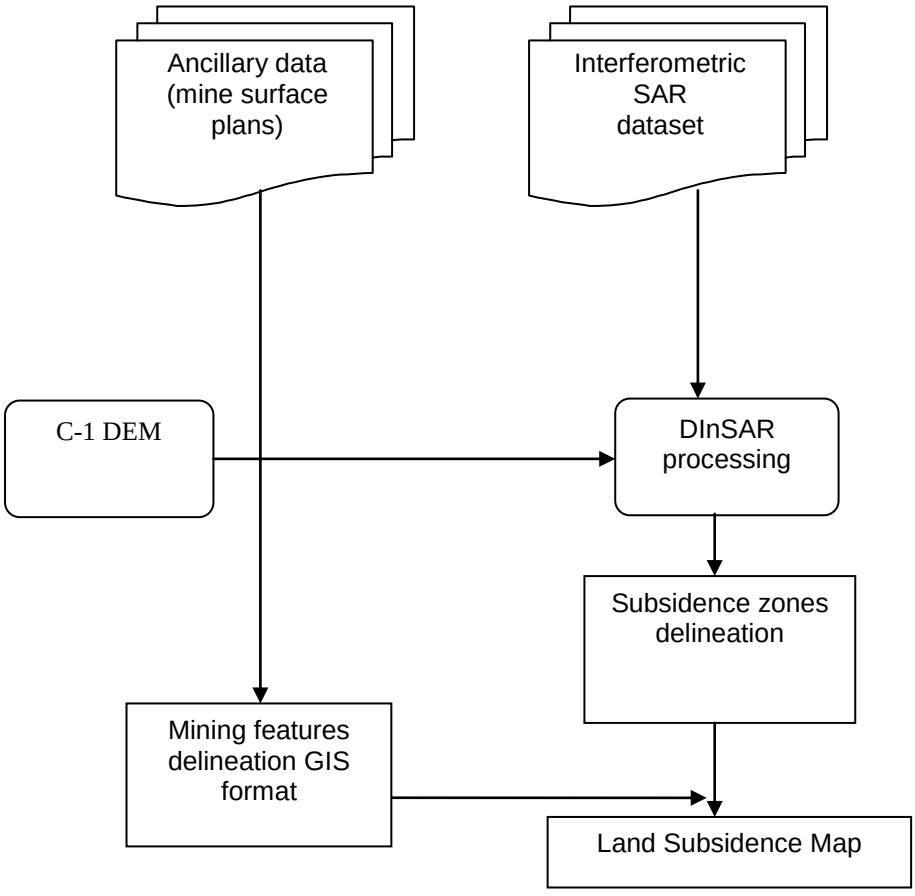


Figure 7. Work flow diagram for generating land subsidence map using DInSAR technique.

In the present study, 5 sets of ALOS-PALSAR L-band microwave data (as mentioned in table 1) were procured. The datasets were paired into master-slave pairs as per short and long temporal baselines. The short temporal baseslines include master slave pairs of time difference of six months or less, whereas long temporal baselines include data pairs of time difference of one year or more. This has been illustrated in figure 8.

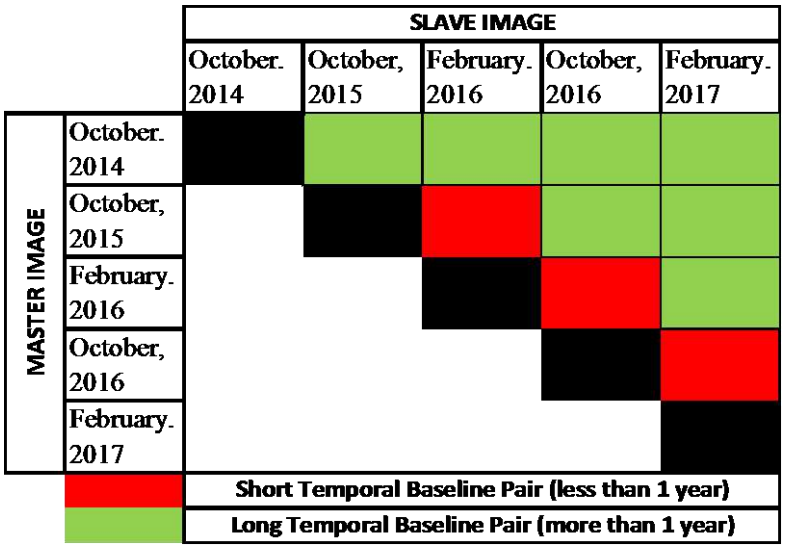


Figure 8. ALOS-PALSAR - 2 Master-Slave pairs for short and long temporal base line processing

The interferometric fringes generating from short baseline pairs will generally indicate terrain changes due to mining activity happening over a short period of time. This will include mining excavations and creation of new OB dumps adjacent to the mining area. Any incidences of slow land subsidence will not be demarcated in the results (figure 9).

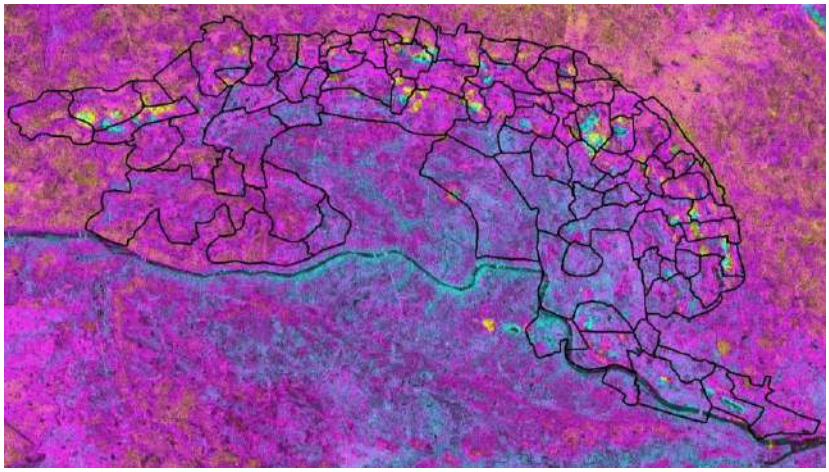


Figure 9. Fringe patterns generated from short baseline processing (e.g. Master: Oct, 16, Slave: Feb, 17).

On the other hand, master-slave pairs of long temporal baseline (one year or more, as shown in figure 8) will incorporate terrain changes due to mining activities as well, as long term ground subsidence from underground mining where ever present (figure 10).

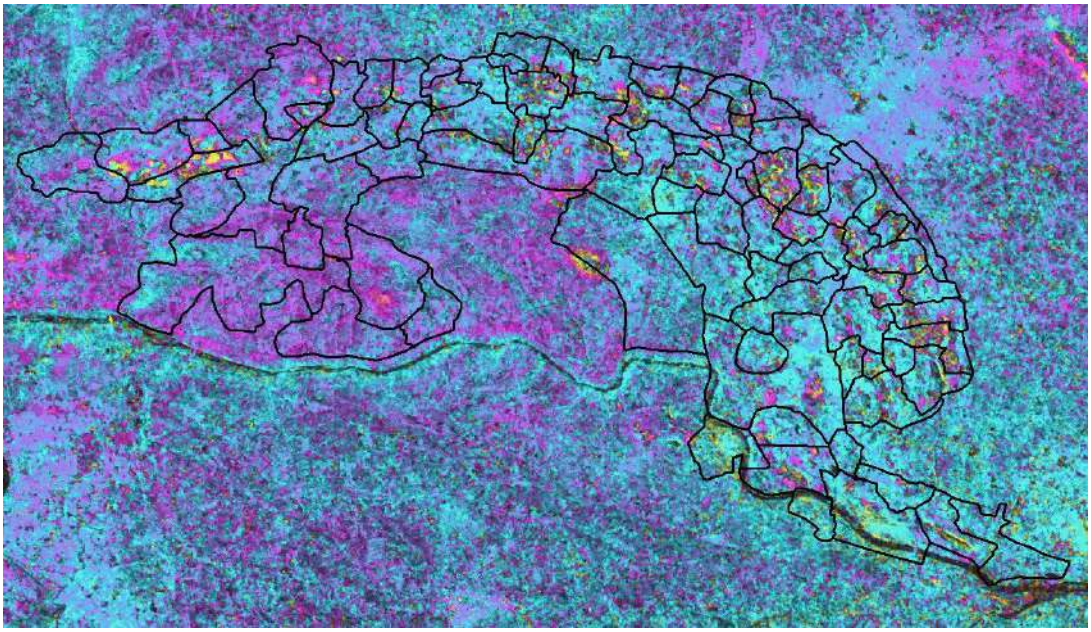


Figure 10. Fringe patterns generated from long baseline processing (e.g. Master: Oct, 15, Slave: Feb, 17).

The results from the long and short baseline processing can be compared and zone where fringes have been developed due to terrain changes due to mining excavation and dumping, can be systematically identified and demarcated. The remaining fringes from the long temporal baseline processing will then indicated towards zones where subsidence has taken place due to underground mining. Using this, a terrain change

map of the Jharia Coalfield was generated demarcating terrain changes due to mining activities and subsidence areas (Figure 11).

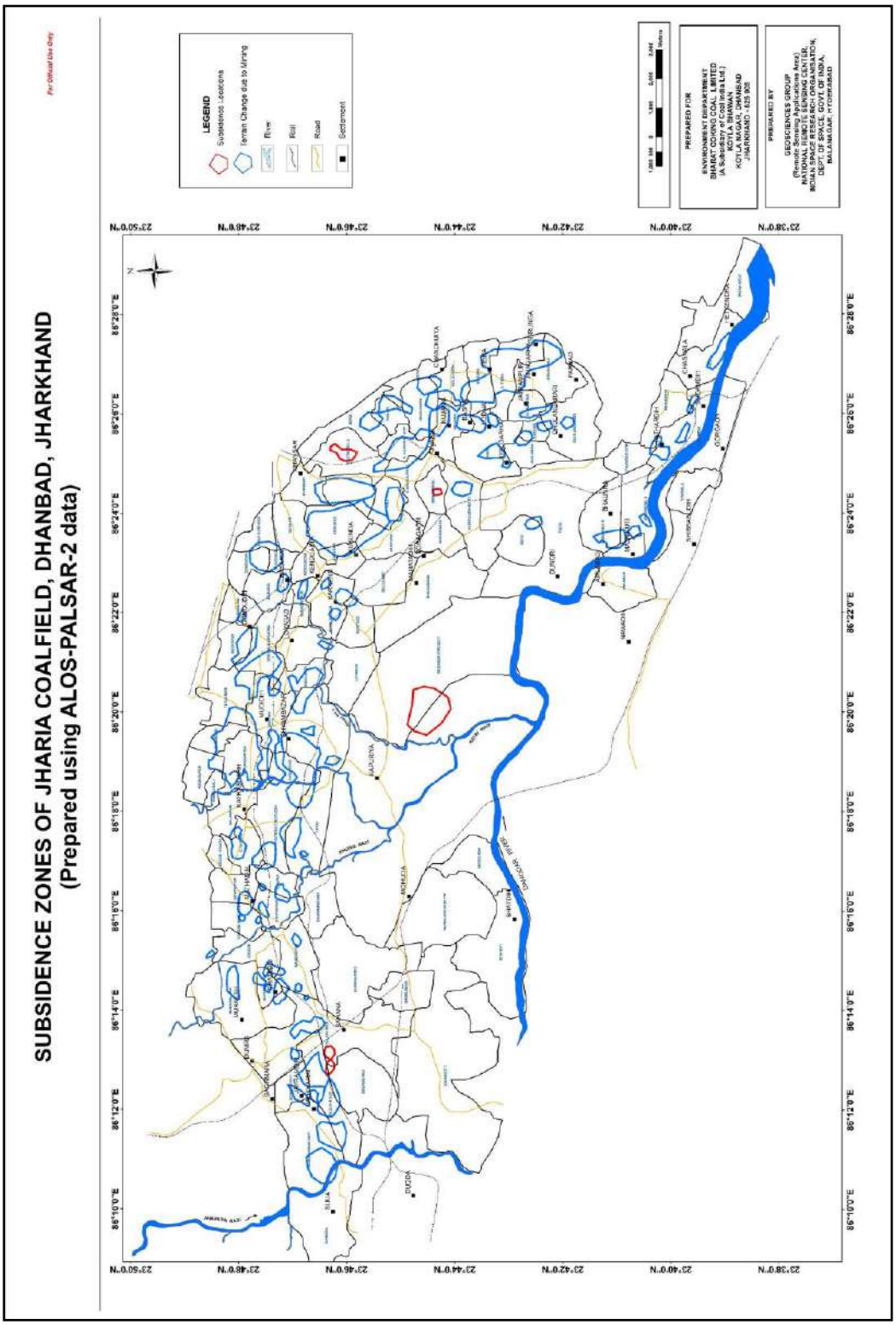


Figure 11: Subsidence map of Jharia coal field, Dhanbad.

CHAPTER V

FIELD WORK

A field work for verification of the coal fire locations and the subsidence zones as identified by the satellite data were taken up in December, 2017. A total of 53 coal fire points and 37 land subsidence locations were identified from the satellite data analysis. The locations of these points along with geographic coordinates were given to BCCL prior to the December, 2017 field work for their feedback on the status of these points. Out of the 53 coal fire locations identified, 52 points were confirmed to be fire bearing as per the present masterplan of the Jharia coalfield created by BCCL Both the coal fire and the subsidence locations were further independently verified by NRSC during the fieldwork in December, 2017. The locations and the observations are coal fire and subsidence are provided in annexure 1 and annexure 2 of this report respectively.

The salient overview of the field observations are as follows:

Coal-fire observations:

1. The coal fires as observed identified by the Landsat-8 data are mostly accurately delineated. Fires have been identified in the western, northern and eastern flank of the coalfield with considerable accuracy in the spatial locations.
2. In the eastern flank, the main fire affected mines are Kusunda, Lodna and Tisra. Active fires area present in the mines and fumes can be seen from the OB dumps. The Bhowra and Bhulanbarari mines also show presence of fire, however, the extent of the fire area appears to be underestimated in the data. Similarly, the extent of fires in Lodna and Tisra appears to have been overestimated in the data. The largest extent of fire in the single mine block is that in Kusunda.
3. In the northern flank, the main fire bearing mines are Katras, Gaslitand and Mudidih, However, it is seen that in these areas, the fires appears in pockets and are not pervasively present. The spatial extent of the fires on the ground and as estimated in the data can be correlated.

4. In the western flank, the Block II OCP is the primary fire affected region. However, it is seen that the Shatabdi OCP also bears fire pockets along semi-vertical mine walls, This is not identified in the data.

Subsidence location observations:

1. Subsidence locations as identified by the data area difficult to verify in the field, unless there are tell-tale signatures like large cracks or fissures on the ground or damage to anthropogenic constructions like vertical cracks on building cracks etc.
2. Out of the 37 identified subsidence locations from the microwave data, it is seen that 32 are due to terrain changes resulting from mining activities like ongoing excavations or formation of new mining dump. These decrease or increase in elevations has resulted in forming of interferometric fringes in the data thus creating false positives.
3. Five areas were firmly established as subsidence zones. Out of these, the main area where subsidence is occurring in a pervasive scale, is that in the Moonidih Underground Project. The Moonidih Project is an underground long wall mine where excavations are going on for over decades. This may have resulted in pervasive subsidence in the region. The signatures of subsidence such as ground cracks are observed in the area.
4. Two adjacent locations are observed south of the Block II OCP and in Phularitand mining block. This may be resulted due to older underground mining in the area. Signatures such as sagging of ground is seen.
5. Another minor subsidence region was identified around the Simlabahal underground mining project. This is again due to active underground mining in the area. A similar region was also observed in the northern part of the Bastacolla mines where active underground mining is ongoing.

In lieu of the observations in field on the fire and subsidence locations, few post field work correction in the coal fire and subsidence maps was necessitated and has been discussed in the next chapter.

CHAPTER VI

POST FIELDWORK ANALYSIS

As observed in the fieldwork, there were certain mine areas where the presence of fire was not detected by the satellite data. For example in Shatabdi and Bhulanbarari mine areas, the fire appears in small pockets on mine faces and was possibly not detected by the threshold temperature calculated for the entire mine area. On the other hand, in the Bhowra, Lodna and Tisra mine areas, the spatial extent of fire appears to have been overestimated by the regional threshold temperature use to separate the fire and the background areas.

Therefore, mine specific threshold temperature analysis was carried out for Shatabdi, Bhulanbarari, Bhowra, Lodna and Tisra mine areas to correctly depict the fire areas on the ground. The threshold temperature selected from each of these mine areas are given in Table 3.

Table 3: Threshold temperature for fire area estimation of individual mines.

Name of the Mine Block	Threshold Temperature (in °C)
Bhowra	38.5
Tisra (north and south)	North : 41; South : 40.5
Lodna	41
Bhulanbarari	38.5
Shatabdi	38

Using the threshold temperatures as mentioned in the table 3, the previously undetected fire areas in the Shatabdi and Bhulanbarari mines were detected. Further the spatial extent of the fire areas in Bhowra, Lodna and Tisra mines were changed to adequately represent the actual extent of the fire on the ground. These were incorporated in the coalfire map shown in figure 5.

CHAPTER VII

DISCUSSIONS AND CONCLUSIONS

7.1 Discussions

7.1.1 Coal fire analysis

The present study is aimed to provide the status of coal fire in the Jharia coal field for the period of 2017. Landsat-8 data of May, 2012 was used to prepare the coal mine fire map (Figure 5) for the year 2017. The data have 100 m spatial resolution in the thermal bands and is as on study date, the best thermal satellite data available. The Coal fire maps of 2017 when compared to map of 2012 (NRSC, 2014) depicts the dynamics of coal fire. Coal fire is difficult to mitigate because of its dynamic nature. But the understanding the trend in the shift of coal fire zones and over all distribution of coal fire will help in environmental and risk management related to coal mining activities.

The coal mine fire map for the year 2017 (Figure 5 illustrates the overall fire distribution in the area). The maps reveal that the coal fires are distributed across the Jharia coal field in pockets associated with major open cast mining activities. All most all the coal mine fires are restricted to the Barakar Formation where coal seams are exposed. In the eastern flank of the arcuate shaped mining extent, the collieries in Lodna and Tisra (North and South) is the highest fire affected mining blocks and Bhowra, Bhulanbarari, Kujama and Jharia are also affected by multiple smaller fire pockets. The fire in the areas is mostly manifested by high temperature fume cracks with occasional presence of active flames especially the the Lodna-Tisra area. Further, towards the north east, in Ena and Kusunda active fires are more prevalent and the area is extensively affected. The highest radiant temperatures (in order of ~50°C) are recorded by the satellite sensors in these areas. In the north, a large number of moderate to small fire pockets are seen in the areas around Shyambazar (Figure 5 & 6). These are related to the mining areas of Katras, Gaslitand, Mudidih and Kankanee. Mining activity, over the last few of years has exposed new, isolated and discontinuous fires in these regions.

In the western flank, three distinguishable fire affected zones are seen. Toward the western end of the mining area, the Benedih and Block II OCP are affected by smaller fires from isolated coal seams. These again are surfacialy manifested in the

form of fume cracks with smoke emanating from them. The Shatabdi OCP are also affected but fire is manifested in the along vertical mining wall sections.

Comparison of the 2017 coal fire map with that of 2012 (NRSC, 2014) indicated the dynamism in the spatial extent and distribution of the coal fires. The changes are highlighted as follows:

i. In reference to the map generated in 2012, the 2017 map shows that the emergence/re-emergence of fires in the eastern flank, namely Kujama, Tisra, Lodna and Jharia etc. The entire zone has been affected by multiple fire occurrences. The spatial disposition of fires in Bastacolla, Jharia and Bhulanbarari appear to have a minor increase.
ii. The areal extent of major fire zone around Kusunda/Kenduadih and Ena appears to remain the same, though here again the spatial location of the anomalies has changed. This is probably due to the mitigation and active mining in this region.
iii. The fire zones in Benedih/Block II OCP and Shatabdi OCP have also changed/diminished in areal extent with presence of isolated smaller anomalies. There has been a considerable reduction in fire areas in and around the Shatabdi OCP.
iv. The spatial disposition of fire areas around Katras, Gaslitand and Mudidih show minor change. In 2012, a number of small fire pockets were seen, however presently those fire pockets have given away to a few fire zones of moderate disposition.
v. It needs to be noted that the 2012 study was carried out using ASTER data whereas the present study is carried out using Landsat-8 data. Therefore, the difference of sensor sensitivities will have a influence on the way the fires are sensed on the ground. Difference of sensor sensitivities will influence the number of fires identified as well as the areal extent of the fires in the data.

In summary, there is a change in the areal disposition of the fires from 2012 to 2017. Observations suggest the emergence/re-emergence of new areas in the eastern flanks in areas around Lodna and Tisra. Concurrently, there is a decrease in extent of fire areas Shatabdi, Nadkhurkee area in the western flank from 2012 to 2017. A quantitative comparison of the 2012 and 2017 data was carried out. As compared

2012, when the total fire affected extent of about 2.18 km^2; in 2017 total fire affected extent is about 3.28 km^2. The colliery wise break-up of change in fire area from 2012 to 2017 is given in Annexure III.

7.1.2 Subsidence analysis

An attempt to identify subsidence zones in the Jharia Coalfield was also carried out using ALOS-PALSAR-2 L band microwave data using differential interferometric technique. 5 scenes of PALSAR-2 data spanning over a period of 2014 to 2017 were used to delineate the subsidence if any in the region and separately identify them from the terrain changes due to mining. Verification of the subsidence zones as seen from data is difficult as it requires visible signatures of subsidence in the form of cracks on the ground and damage to anthropogenic structures. In this study, data analysis and consequent field verification resulted in identification is 5 prominent subsidence areas. Of these, the major area where considerable ground subsidence is occurring is the Moonidih UG project. Long term underground mining has resulted in continuous subsidence in the area. Apart from this, the other four areas are south of Block II OCP, Simlabahal and Bastacolla. No quantitative estimates of the subsidence has been carried out in the study.

7.2 Conclusions

The following conclusions can be made:

1. As of the date of study in the year 2017 and in comparison with the previous study done in 2012, there has been a change in areal extent and disposition of the fire affected areas.
2. Compared to 2012, the eastern flanks (Lodna, Tisra areas) show considerable increase in fire disposition and the western flank (Shatabdi and Block II area) show diminished fire presence.
3. The major new fire areas are observed in the northern flank in the areas around Lodna and Tisra etc. These areas were not mapped as fire in the 2012 study.
4. The mines in Kenduadih and Lodna remain to be the worst affected with maximum presence of active fires.
5. There is a increase in areal extent of the fire (Figure 12) from 2012 to 2017.

Note: *Estimations of fire extent (in terms of sq.km.) both in 2012 and in the present 2017 study are pixel based. They do not represent the actual ground area under fire. These estimations are made for comparative purpose only, to indicate the increase or decrease of areal disposition of fire. Hence, they should not be quoted as fire area on the ground.*

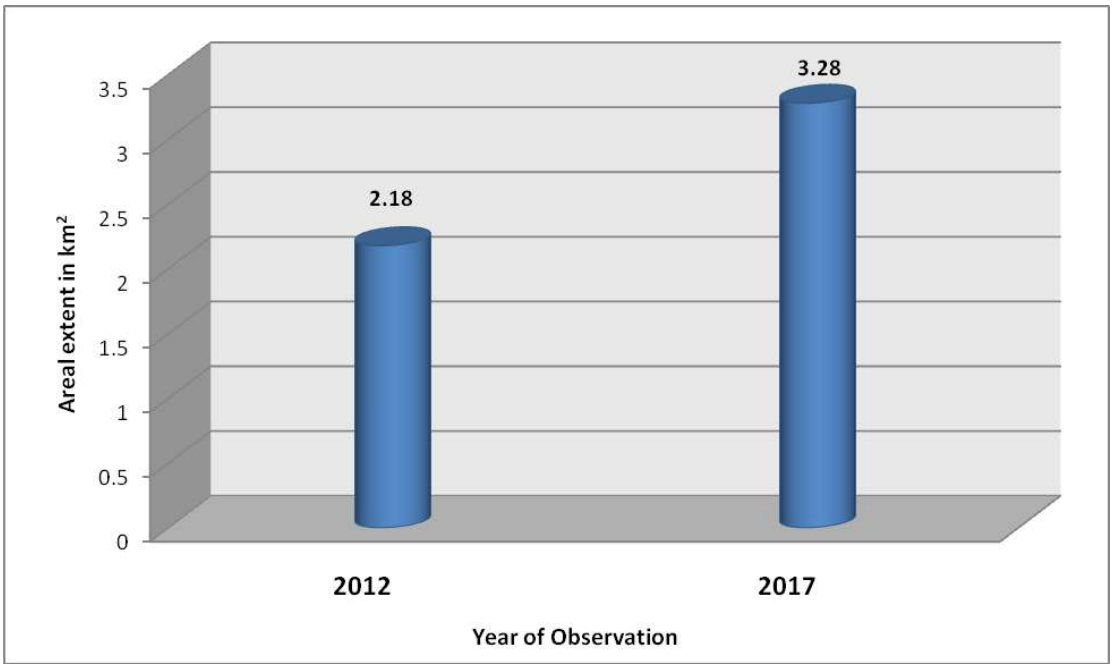


Figure 12: Total fire area statistics

CHAPTER VIII

LIMITATIONS

Delineation and mapping of coal fire from thermal data of remote sensing platforms carries with it some inherent limitations which needs to be understood in order to decipher the results obtained from it. This will assist is deducing the correct information and remove any ambiguity associated with the results. The key limitations of the data and the results obtained are as follows:

1) An anomalous pixel from LANDSAT data represents an area of 30m x 30m (resampled from spatial resolution of 100m) on the ground whose temperature is considerably higher than its surroundings. This can be attributed to two circumstances, namely the area has a very high intensity fire located within a smaller pocket or there are a number of low intensity fires spread across it. In both the mentioned cases the actual areal extent of the fire on the surface differs, but appears as a single anomalous pixel in the data. Hence, representation of fire affected ground area by means of pixel area is ambiguous and hence should be considered with caution.

2) There are locations as observed during the fieldwork, where coal seams are affected by active fires along vertical/semi-vertical sections of open cast mines (see cover page). In such cases, the actual areal expression of the fire affected area as seen by the sensor changes considerably and the representation from the same is not accurate.

3) As discussed in section 4.2.1, thresholding the data to separate the fires from the non fire areas, is a statistical technique. However, this method is dependent on how the temperature of non-fire background area is distinctive from the fire temperature.

4) The background temperatures vary with the time of the day when the data is collected, topography, and season of the year when the data is acquired. Night-time data has lower background temperature as compared to day-time. Similarly a data collected in October-November will have a considerably lower background temperature than that collected in May-June due to seasonal temperature variations. Hence, identification of the background temperature range becomes essential in

estimation of threshold temperature and the same varies depending upon the discussed controlling factors.

5) Generally, a constant threshold temperature is estimated over the entire study area, and the same is applied to delineate the fire areas from those of non-fire. However, it is seen that the application of such global thresholding may mask fires which are in turn seen in the field and that the threshold temperature value may vary locally. In the current scenario, it is seen that the fire locations as verified in the fieldwork at Bhulanbarari and Shatabdi were not identified in the data on application of a global threshold of 39°C. However, a subset of the data within the Bulanbarari area only, is analyzed with a lower threshold of 38.5°C, the fire pixels are manifested in the data. Hence, the appropriateness of a singular thresholding temperature value may need to be relooked upon. Future studies can be carried out using colliery wise statistical local thresholding to create a composite coal fire map.

6) Due to the mitigation measures taking place in various mines, it is seen that in a number of places the fire affected seam is excavated and dumped as overburden. However, these overburden dumps retains the excavated burning coals and thus are seen to have active fires occasionally. There lies a possibility that the same will be identified as anomalous pixels and hence, although the fire is not a part of any active coal seam, it will be included as a fire affected area in the final map.

7) Verification of the subsidence zones as detected from the interferometric technique is sometimes difficult due to lack in observable signatures of subsidence such as cracks on the ground and damage to anthropogenic structures.

Therefore, in quantitative estimation of fire affected areas and areas denoted as subsidence, the above mentioned limitations needs to be taken into account diligently, as it is inevitable that the area estimate will not define the actual fire/subsidence affected area on the ground. However, the areal extent estimated from the data can be "like to like" compared to earlier estimates of similar studies to understand the change and dynamism of the fire in terms of area affected and spatial disposition.

References

1. Gangopadhyay, P.K., Lahiri-dutt, K., Saha, K. (2005): "Application of remote Sensing to identify coal fires in the Raniganj coal belt, India." *Int. Jour of Applied Earth Observation and Geoinformation.*
2. Gangopadhyay, P.K., Malthuis.B, Van Dink (2005): "Aster Derived emissivity and coal-fire related surface temperature anomaly a case study in Wuda, North China," *Int. Jour. of Remote Sensing*, vol-26, No.-24, pp-5555-5571.
3. Schmugge, T., French, Ritchie, J.C., Rango, A., Pelgrum, H. (2002): "Temperature and emissivity separation from multispectral thermal infrared observation," *Remote Sensing of Environment*, 79, pp-189-198.
4. Saraf A.K., Prakash A., Sengupta, S., Gupta, R.P (1995): "Landsat-TM data for estimating ground temperature and depth of sub-surface coal fire in the Jharia coalfiled, India," *Int. Jour. Remote sensing vol-16, no-12*, 2111-2124.
5. Gangopadhyay P.K., (2003): "Coalfire detection and monitoring in Wuda, North China, A multispectral and multi-sensor approach:-Ph.D. Thesis, ITC Netherland.
6. Gupta, R.P. (2003): "Remote Sensing Geology", *Springer-Verlag.Third ed.*pp-183-216.
7. Kealey, P.S and Hook S.J(1993): "Separating temperature and emissivity in thermal infrared Multispectral Scanner Data: Implication for recovering land surface temperatures", *IEE Transaction on Geoscience and Remote Sensing,vol,31,no-6,*pp-1155-1164
8. Zhang, J., Wagner, W., Prakash, A., Mehl,H. and Voigt,S.(2004): "Detecting coal fires using remote sensing techniques,*" Int. Jour. Remote sensing, vol-25, no-6,* pp3193-3220.
9. Bhattacharya, A. and Reddy, C.S.S. (1995): Inventory and monitoring of underground and surface coal mine fire in Jharia coalfield, Bihar using thematic mapper thermal IR data: *Geosciences Group, Official report, NRSA.*
10. Coal mine fire delineation and surface features mapping using satellite data in Jharia coal field, Dhanbad, Jharkhand. Geology and Geophysics division. *Official report, NRSA, 2006*
11. Coal mine fire delineation and surface features mapping using satellite data in Jharia coal field, Dhanbad, Jharkhand. Geosciences Group. *Official report, NRSC, 2014*

Annexure –I

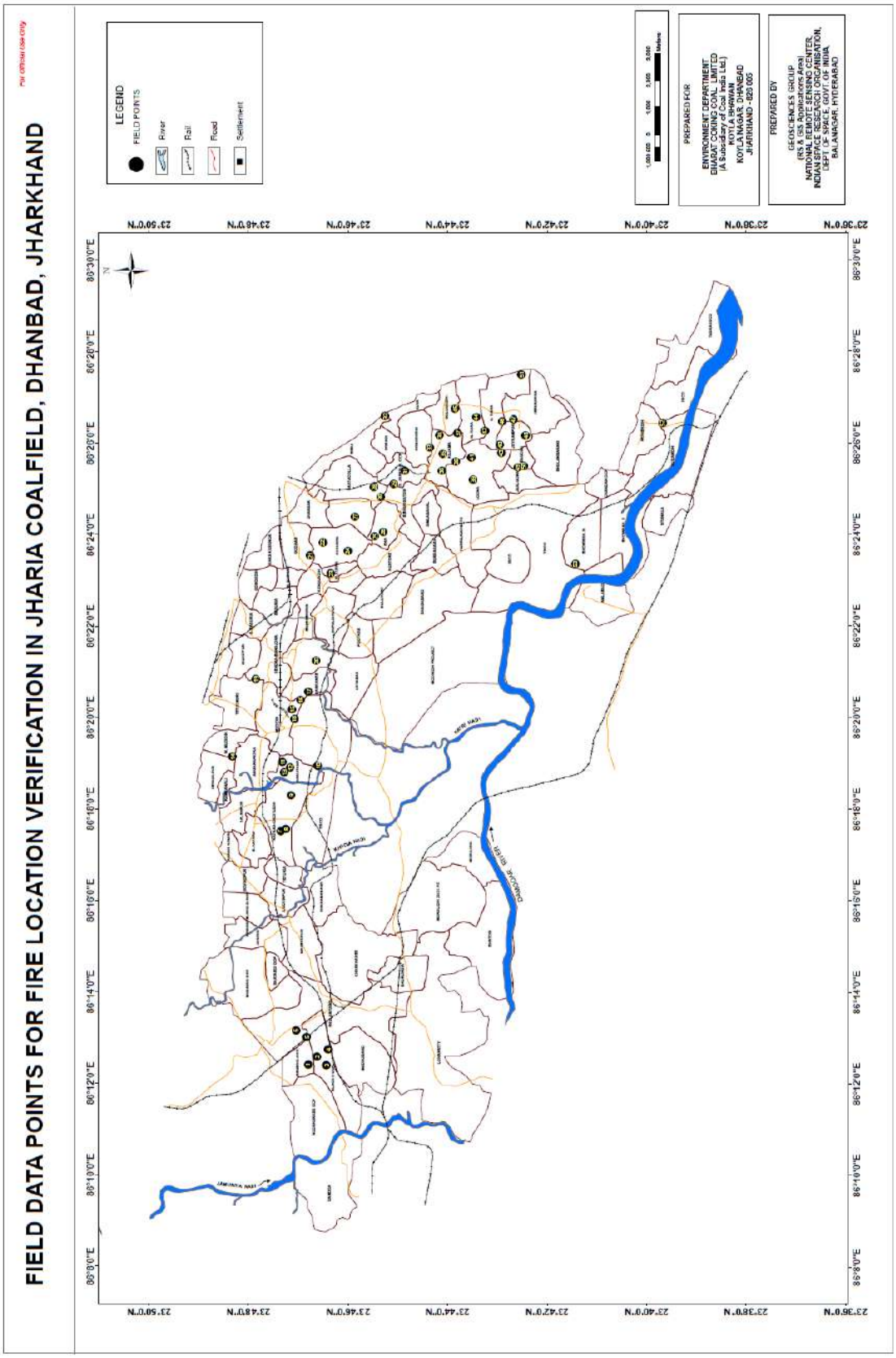


Figure 13. Field data points for coal fire verification

Table – 4: Coal Fire observations during fieldwork (see figure 13 for reference)

SL. No.	Point of Observations		Comments		
	Latitude	Longitude	Type of Mining Activity	Presence of Coal Fire	Mine name and Any other Comments
1	23.7801	86.2068	OB Dump	Fire	ABOCP
2	23.7771	86.2097	Active Mine	Fire	ABOCP
3	23.7739	86.2066	Active Mine	Fire	ABOCP
4	23.7733	86.2124	OB Dump	Fire	ABOCP
5	23.7806	86.2168	No Working	Fire	ABOCP
6	23.7841	86.2192	No Working	Fire	Phularitand
7	23.7893	86.2919	No Working	Fire	Katras Chatudih
8	23.7875	86.2926	No Working	Fire	Katras Chatudih
9	23.7857	86.3049	Working	Fire	Gaslitand
10	23.7768	86.3157	Outside Jharia Mines		Tata
11	23.7887	86.3170	OB Dump	Fire	Gaslitand
12	23.7862	86.3151	OB Dump	Fire	Gaslitand
13	23.7880	86.3133	OB Dump	Fire	Gaslitand
14	23.8054	86.3191	Working	Fire	AKWMC
15	23.7855	86.3363	OB Dump	Fire	Mudidh
16	23.7826	86.3397	Working	Fire	Kankanee
17	23.7800	86.3427	Working	Fire	Kankanee
18	23.7848	86.3327	OB Dump	Fire	Mudidih
19	23.7977	86.3473	OB Dump	Fire	Sendra Bansjora
20	23.7775	86.3540	OB Dump	Fire	Loyabad
21	23.7793	86.3924	No Working	No fire	Kusunda (Domestic coal burning)
22	23.7753	86.3970	Working	Fire	Kusunda
23	23.7724	86.3858	Working	Fire	Kusunda
24	23.7669	86.3940	OB Dump	Fire	Kusunda
25	23.7578	86.3993	OB Dump	Fire	Ena
26	23.7550	86.4009	OB Dump	Fire	Ena
27	23.7645	86.4065	Working	Fire	ADIC
28	23.7580	86.4172	Old Quarry	Fire	ROCP
29	23.7515	86.4184	OB Dump	Fire	ROCP
30	23.7559	86.4137	OB Dump	Fire	ROCP
31	23.7476	86.4232	Working	Fire	ROCP
32	23.7543	86.4431	Outside Jharia Mines		Unknown site (Out side of Kuya)
33	23.7394	86.4317	Active Mine	Fire	Ghanoodih
34	23.7360	86.4362	OB dump	Fire	Goluckdih
35	23.7349	86.4293	OB Dump	Fire	Kujama
36	23.7354	86.4232	No Working	Fire	Kujama
37	23.7301	86.4369	Working	Fire	NT-ST
38	23.7305	86.4265	OB dump	Fire	Kujama
39	23.7249	86.4200	No Working	Fire	Lodna
40	23.7159	86.4327	Working	Fire	Joyrampur
41	23.7254	86.4280	No Working	No fire	Lodna
42	23.7209	86.4376	Working	Fire	NT-ST
43	23.7154	86.4296	Working	Fire	Lodna
44	23.7238	86.4427	Working	Fire	NT-ST
45	23.7309	86.4457	OB dump	Fire	NT-ST
46	23.7151	86.4412	Active Mine	Yes	NT-ST
47	23.7114	86.4419	OB Dump	Fire	NT-ST
48	23.7073	86.4360	Active Mine	Fire	Joyrampur
49	23.7097	86.4243	Working	Fire	Bagdigi/Joyrampur
50	23.7079	86.4249	Active Mine	Fire	Bagdigi/Joyrampur
51	23.7086	86.4582	Outside Jharia Mines		Unknown site (Out side of NT-ST)
52	23.6614	86.4404	Outside Jharia Mines		Chasnala
53	23.6906	86.3892	OB dump	Fire	Bhowrah (North)

Annexure –II

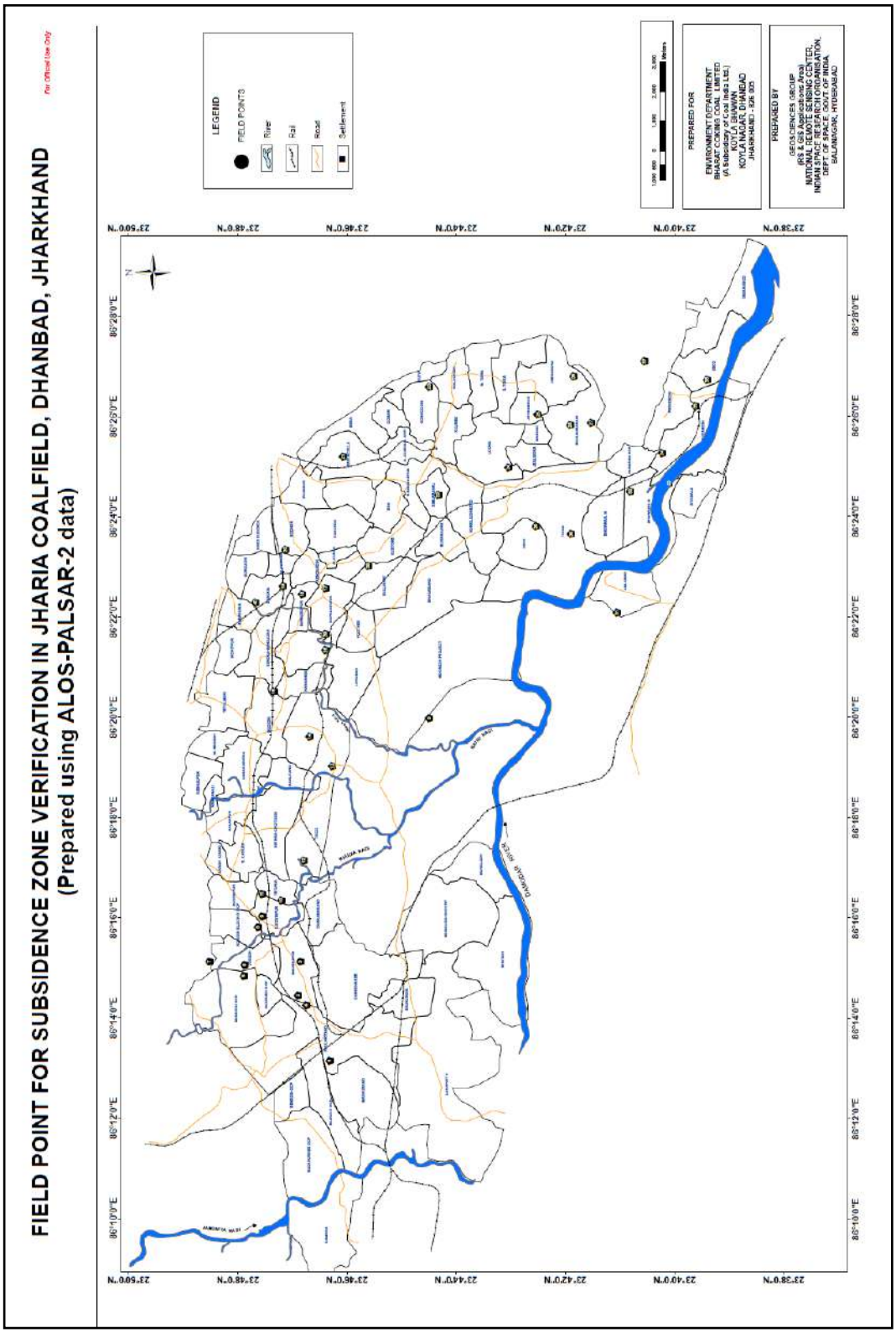


Figure 14. Field data points for subsidence verification

Table – 5: Coal Fire observations during fieldwork (see figure 14 for reference)

	Point of Observations		Comments	
Sr. no.	Latitude	Longitude	Mine name and Any other Comments	Signs of Subsidence (crack on building/ground crack etc.)
0	**23.7416**	**86.3338**	Moonidih UG Project	Sagged area, Building damage
1	**23.7722**	**86.2192**	South of Block II (2 areas)	Cracks on the ground
2	**23.7817**	**86.2409**	Terrain Change due to mining	
3	**23.7811**	**86.2521**	Terrain Change due to mining	
4	**23.7792**	**86.2376**	Terrain Change due to mining	
5	**23.7983**	**86.2473**	Terrain Change due to mining	
6	**23.7981**	**86.2510**	Terrain Change due to mining	
7	**23.8088**	**86.2521**	Terrain Change due to mining	
8	**23.7941**	**86.2636**	Terrain Change due to mining	
9	**23.7926**	**86.2671**	Terrain Change due to mining	
10	**23.7868**	**86.2724**	Terrain Change due to mining	
11	**23.7928**	**86.2746**	Terrain Change due to mining	
12	**23.7800**	**86.2857**	Terrain Change due to mining	
13	**23.7713**	**86.3171**	Terrain Change due to mining	
14	**23.7783**	**86.3270**	Terrain Change due to mining	
15	**23.7893**	**86.3419**	Terrain Change due to mining	
16	**23.7734**	**86.3556**	Terrain Change due to mining	
17	**23.7734**	**86.3762**	Terrain Change due to mining	
18	**23.7804**	**86.3742**	Terrain Change due to mining	
19	**23.7865**	**86.3769**	Terrain Change due to mining	
20	**23.7855**	**86.3890**	Terrain Change due to mining	
21	**23.7679**	**86.4199**	Bastacolla	Sagged areas
22	**23.7390**	**86.4071**	Simlabahal UG	Sagged areas
23	**23.7417**	**86.4431**	Terrain Change due to mining	
24	**23.7176**	**86.4163**	Terrain Change due to mining	
25	**23.7085**	**86.4339**	Terrain Change due to mining	
26	**23.6986**	**86.4304**	Terrain Change due to mining	
27	**23.6923**	**86.4312**	Terrain Change due to mining	
28	**23.6977**	**86.4466**	Terrain Change due to mining	
29	**23.7092**	**86.3967**	Terrain Change due to mining	
30	**23.6985**	**86.3942**	Terrain Change due to mining	
31	**23.6845**	**86.3681**	Terrain Change due to mining	
32	**23.6804**	**86.4083**	Terrain Change due to mining	
33	**23.6685**	**86.4110**	Terrain Change due to mining	
34	**23.6706**	**86.4211**	Terrain Change due to mining	
35	**23.6603**	**86.4366**	Terrain Change due to mining	
36	**23.6568**	**86.4454**	Terrain Change due to mining	
37	**23.6760**	**86.4516**	Terrain Change due to mining	
38	**23.7603**	**86.3836**	Terrain Change due to mining	
39	**23.7734**	**86.3609**	Terrain Change due to mining	
40	**23.7948**	**86.3715**	Terrain Change due to mining	

Annexure –III

SL. NO.	COLLIERY AREA NAME	FIRE AREA 2012 (SQ. KM.)	FIRE AREA 2017 (SQ. KM.)	AREA CHANGE (SQ. KM.)	Increase/Decrease
1	DAMODA	0.0000	0.0000	0.000	**NO FIRE**
2	TISCO (west)	0.0000	0.0000	0.000	**NO FIRE**
3	IISCO	0.0000	0.0000	0.000	**NO FIRE**
4	TISCO (north)	0.0885	0.0153	-0.073	**DECREASE**
5	NUDKHURKEE OCP	0.0000	0.0000	0.000	**NO FIRE**
6	BENEDIH OCP	0.0530	0.0453	-0.008	**DECREASE**
7	BLOCK-II OCP	0.0530	0.1353	0.082	**INCREASE**
8	MURAIDIH OCP	0.1478	0.0022	-0.146	**DECREASE**
9	SHATABDI OCP	0.0378	0.0361	-0.002	**DECREASE**
10	TETURIA	0.0000	0.0000	0.000	**NO FIRE**
11	S.GOVINDPUR	0.0000	0.0000	0.000	**NO FIRE**
12	KORIDIH BLOCK-IV OCP	0.0000	0.0000	0.000	**NO FIRE**
13	JOGIDIH	0.0000	0.0000	0.000	**NO FIRE**
14	DHARAMABAND	0.0000	0.0000	0.000	**NO FIRE**
15	MAHESHPUR	0.0000	0.0000	0.000	**NO FIRE**
16	PHULARITAND	0.0133	0.0205	0.007	**INCREASE**
17	MADHUBAND	0.0000	0.0000	0.000	**NO FIRE**
18	AKASH KINARI	0.0000	0.0000	0.000	**NO FIRE**
19	GOVINDPUR	0.0000	0.0000	0.000	**NO FIRE**
20	E. KATRAS	0.0133	0.0000	-0.013	**DECREASE**
21	KATRAS-CHOITUDIH	0.1021	0.1368	0.035	**INCREASE**
22	KESHALPUR	0.0000	0.0013	0.001	**INCREASE**
23	RAMKANALI	0.0000	0.0000	0.000	**NO FIRE**
24	NICHITPUR	0.0000	0.0000	0.000	**NO FIRE**
25	E. BASURIA	0.0000	0.0000	0.000	**NO FIRE**
26	KHAS KUSUNDA	0.0000	0.0000	0.000	**NO FIRE**
27	GONDUDIH	0.0000	0.0000	0.000	**NO FIRE**
28	W. GODHAR	0.0012	0.0000	-0.001	**DECREASE**
29	BASURIA	0.0000	0.0000	0.000	**NO FIRE**
30	TETULMARI	0.0223	0.0220	0.000	**DECREASE**
31	DHANSAR	0.0000	0.0000	0.000	**NO FIRE**
32	GODHAR	0.1073	0.0000	-0.107	**DECREASE**
33	INDUSTRY	0.0119	0.0513	0.039	**INCREASE**
34	KUSUNDA	0.4243	0.7398	0.315	**INCREASE**
35	SENDRA-BANSJORA	0.0796	0.0275	-0.052	**DECREASE**
36	BASTACOLLA	0.0663	0.0810	0.015	**INCREASE**
37	BERA	0.0000	0.0000	0.000	**NO FIRE**
38	KUYA	0.0000	0.0000	0.000	**NO FIRE**
39	GOLUCKDIH	0.0301	0.1122	0.082	**INCREASE**
40	KUJAMA	0.0398	0.2404	0.201	**INCREASE**

41	S. JHARIA-R. OCP	0.0244	0.1118	0.087	INCREASE
42	DOBARI	0.0000	0.0000	0.000	NO FIRE
43	GONHOODIH	0.0398	0.0322	-0.008	DECREASE
44	SIMLABAHAL	0.0000	0.0000	0.000	NO FIRE
45	HURRILADIH&STD	0.0000	0.0000	0.000	NO FIRE
46	ENA	0.0918	0.0432	-0.049	DECREASE
47	BURRAGARH	0.0000	0.0000	0.000	NO FIRE
48	N. TISRA	0.0098	0.1802	0.170	INCREASE
49	LODNA	0.0000	0.3527	0.353	INCREASE
50	S. TISRA	0.0000	0.1015	0.102	INCREASE
51	BARAREE	0.1037	0.1074	0.004	INCREASE
52	AMLABAD	0.0000	0.0000	0.000	NO FIRE
53	PATHERDIH	0.0000	0.0000	0.000	NO FIRE
54	SUDAMDIH	0.0000	0.0000	0.000	NO FIRE
55	SITANALA	0.0000	0.0000	0.000	NO FIRE
56	MURULIDIH 20/21 PIT	0.0000	0.0000	0.000	NO FIRE
57	MURULIDIH	0.0000	0.0000	0.000	NO FIRE
58	BHATDIH	0.0000	0.0000	0.000	NO FIRE
59	LOHAPATTY	0.0000	0.0000	0.000	NO FIRE
60	IISCO	0.0000	0.0000	0.000	NO FIRE
61	TASRA-IISCO	0.0000	0.0000	0.000	NO FIRE
62	KENDUADIH	0.0610	0.0000	-0.061	DECREASE
63	BULLIHARY	0.0000	0.0000	0.000	NO FIRE
64	GOPALICHUCK	0.0000	0.0000	0.000	NO FIRE
65	POOTKEE	0.0000	0.0000	0.000	NO FIRE
66	BHURUNGIA	0.0000	0.0000	0.000	NO FIRE
67	KHARKHAREE	0.0000	0.0000	0.000	NO FIRE
68	GASLITAND	0.1194	0.1215	0.002	INCREASE
69	KANKANEE	0.0530	0.0525	-0.001	DECREASE
70	MUDIDIH	0.1141	0.1104	-0.004	DECREASE
71	W. MUDIDIH	0.0171	0.0000	-0.017	DECREASE
72	LOYABAD	0.0133	0.0063	-0.007	DECREASE
73	BHAGABAND	0.0000	0.0000	0.000	NO FIRE
74	MOONIDIH PROJECT	0.0000	0.0000	0.000	NO FIRE
75	E.BHUGGATDIH	0.0022	0.0214	0.019	INCREASE
76	ALKUSHA	0.0326	0.0294	-0.003	DECREASE
77	KUSTORE	0.0524	0.0463	-0.006	DECREASE
78	ANGARAPATRA	0.1331	0.0149	-0.118	DECREASE
79	SALANPUR	0.0000	0.0000	0.000	NO FIRE
80	BHOWRAH. N	0.0133	0.0980	0.085	INCREASE
81	BHOWRAH. S	0.0000	0.0000	0.000	NO FIRE
82	BAGDIGI	0.0000	0.0209	0.021	INCREASE
83	JEALGORA	0.0000	0.0067	0.007	INCREASE
84	JEENAGORA	0.0000	0.0470	0.047	NO FIRE

85	JOYRAMPUR	0.0099	0.1042	0.094	**INCREASE**
86	CHANDAN OCP	0.0000	0.0000	0.000	**NO FIRE**
87	BANSDEOPUR	0.0000	0.0000	0.000	**NO FIRE**
	TOTAL AREA	**2.18**	**3.28**	**1.10**	**INCREASE**

Table 6: Colliery wise break-up of change in fire area from 2012 to 2017

Note:
1) "**NO FIRE**" implicates that the fire has not been identified satellite data *(either absent or below sensor resolution)*
2) "**INCREASE**" implies, increase in fire area OR emergence of fire areas not identified in 2012 study.
3) "**DECREASE**" implies, decrease in fire area OR fire areas of 2012, which are not identified in present study *(either absent or below sensor resolution).*
4) Estimations of fire extent (in terms of sq.km.) both 2012 and in present 2017 study are pixel based. They do not represent the actual ground area under fire. These estimations are made for comparative purpose only, to indicate the increase or decrease of areal disposition of fire. Hence, they should not be quoted as fire area on the ground.

Annexure –IV

Figure 15: Fume cracks in Lodna-Tisra Area. (point 39 in figure 13 and table 4)

Figure 16: Burnt area near OB dump in Lodna area (point 41 in figure 13 and table 4)

Figure 17: Coalfries in active seams in Kusunda (point 23 in figure 13 and table 4)

Figure 18: Sagged area due to subsidence, south of Block II OCP. (point 1 in figure 14 and table 5)

Figure 19: Fire in OB dumps in Kusunda area. (point 24 in figure 13 and table 4)

Figure 20: Fume cracks in the Bhulanbarari area.

भारत कोकिंग कोल लिमिटेड
एक मिनीरत्न कंपनी
(कोल इंडिया लिमिटेड का एक अंग)
पंजीक्रत कार्यालय कोयला भवन ,कोयला नगर ,
(धनबाद)झारखंड826005(
CIN:U10101JH1972GOI000918
Tele: 0326 2230174 FAX: 0326 2230176
ईमेल :cgmsafety@bccl.gov.in

Bharat Coking Coal Limited
A Miniratna Company
(A subsidiary of Coal India Ltd)
Office of GM I/C(S&R)
Koyla Bhawan, Koyla Nagar,
Dhanbad, Jharkhand-826005
CIN:U10101JH1972GOI000918
Tele: 0326 2230174 FAX: 0326 2230176 Email: cgmsafety@bccl.gov.in

पत्र संख्या भाकोकोलि/उप महाप्रबंधक(एस&आर)I/C/संचिका-MP/17 323 दिनांक-:07.04.2017

To,
Dr, Vinod Kumar,
Group Head, Geosciences group
National Remote Sensing Center
India Space Research Organization
Dept of Space, Govt of India,
Balanagar, Hyderabad - 500037

Sub:- Work –Order for " Delineation of Surface Coal Fire and associated Land Subsidence in Jharia Coalfield, Jharkhand using satellite based remote – sensing techniques"

Dear Sir,

Consequent upon competent approval of proposal on aforesaid subject and subsequent signing o MOU between BCCL and NRSC, the aforesaid work is awarded to NRSC for Rs.18,10500/- (Eighteen lac ten thousand five hundred) only, against 100% payment in advance subject to terms and conditions listed in MOU. As per agreed payment terms and Demand Note No. 07/2016-17,

You are therefore requested to initiate all necessary activities for commencing the subject work as early as possible.

Thanking you,

Yours faithfully,

7/4/17

General Manager I/C (S & R)

Cc to :
1. Director (T) P&P, BCCL- for kind information.
2. TS to CMD, BCCL – for kind information.
3. Sri Mithilesh Kumar, Sr.Mgr.(M),Safety.Deptt., KoylaBhawan

भारत कोकिंग कोल लिमिटेड

(कोल इंडिया लिमिटेड का एक अंग)

BHARAT COKING COAL LIMITED

(A Subsidiary of Coal India Limited)

Corporate Identity No. (CIN): U10101JH1972GOI000918

Civil Engineering Department, Koyla Nagar, Dhanbad – 826 005 (JH), India.

Phone: 0326-2230338, FAX: 0326-2230338, e-mail: gmcivil@bccl.gov.in

NIT Ref. No.: BCCL/CED/TC/eNIT-20/2018-19/ 1098 **Date: 14.02.2019**

E – Tender Notice

Open E-Tender invited vide BCCL/CED/TC/eNIT-20/2018-19/ dated: 14.02.2019, for the work of "Drilling for establishment of 23 nos. Piezometric wells for cluster of mines of BCCL Command Area for Ground Water Monitoring."

Estimated cost: ₹ 48,93,151.75 **EMD: ₹ 61,200.00** **Period of Work: 180 days**

The tender documents can be downloaded from **01.03.2019 to 12.03.2019**. All prospective bidders are advised to visit website **https://coalindiatenders.nic.in** for further details and to participate against this tender. Full details of this tender are also available on website "**eprocure.gov.in**".

14/02/19.

(Shiv Raj)
Asst. Manager (Civil), TC

Copy to:-

1) CVO/ D (T), P&P/ D (P), BCCL ..... for kind information
2) Prof (Dr.) L.C Singhi, IAS (Retd.), L-31, Third Floor, Kailash Colony, New Delhi-110048
3) Shri Pramod Deepak Sudhakar, IAS (Retd.), A-002, Stellar Park Apartments, C-58/24 Sector-62, Noida (UP) - 201301.
4) CGMs/GMs of all Areas of BCCL.
5) GM (Systems), Koyla Bhawan.
6) General Manager (Civil), CED HQ
7) HOD (Envt.), BCCL, Koyla Bhawan.
8) HOD (Finance), Pay Section, Koyla Bhawan.
9) Builders Association of India, Central Akashkinaree Kanta, Katras Garh, Dhanbad-828113.
10) PRO, BCCL – with 5 copies for wide publication of the following abridged NIT in News Paper as per BCCL norms **on or before 01.03.2019.**
11) Notice Board.

Scanned by CamScanner

भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, पूर्वी झरिया क्षेत्र
पो.ओ.- भौरा, जिला - धनबाद (झारखण्ड)
पिन - 828302. दूरभाष - 0326-2320077,
ईमेल-cgmej@bccl.gov.in
पंजीकृत कार्यालय: कोयला भवन, कोयला नगर,
धनबाद- 825005, (झारखण्ड)
CIN: U10101JH1972GOI000918

Bharat Coking Coal Limited
A MINI RATNA Co.
(A Subsidiary of Coal India Ltd)
Office of the General Manager, Eastern Jharia Area
P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302
Tel.:0326-2320077, Email-cgmej@bccl.gov.in
Regd.Off: Koyla Bhawan, Koyla Nagar, Dhanbad-825005,
CIN: U10101JH1972GOI000918,
Tel.:0326-2230190/FAX: 0326-2230050, Email – cos@bccl.gov.in

Ref. No.: BCCL/EJ/GM/ Env./2019/ Date: 18/04/2019

To,
The Dy. GM / HoD (Env.)
BCCL
Koyla Bhawan

Sub.: To conduct study of the conditions mentioned in EC of Cluster X by CMPDIL

Dear Sir,

Environmental clearance of Cluster X is granted by MoEFCC under the Cluster X vide letter no. J-11015/380/2010-IA.II (M) dated 06.02.2013. Monitoring of Compliance of Conditions of the EC was done by RO, MOEFCC, Ranchi and submitted his report on 15.02.2019. For compliance of the Specific Condition of EC by MOEFCC following study must be conducted through CMPDIL/other agency at the earliest:

Specific Condition no. XVIII quote:

"A part of cluster X is under River Damodar. It was clarified that although the mine is underground, there is no coal underneath River Damodar, which would be mined. The Committee desired that the data of bore wells near River Damodar require to be monitored for permeability and seepage of waster of River Damodar."

Unquote

Therefore, competent authority is hereby requested to take necessary action for conducting the study of permeability & seepage of waster of Damodar River and installation of Bore wells near river.

Enclosed: as above

20/4/19
General Manager
E.J. Area

Copy to:
1. AGM, EJA
2. AM (Env.), EJA
3. Office Copy

Annexure -XI

UNIT WISE OB REMOVED (IN M3) OF CLUSTER X

Mine Name	2013-14	2014-15	2015-16	2016-17	2017-18
Bhowra North – Mix	399948	1299740	442128	0.00	0.00
Bhowra South – Mix	581650	318400	6222675	4491830	3488184
Sudamdih Incline	0.00	0.00	0.00	0.00	0.00
Patherdih - Mix	261808	77424	87648	67870	53808
Sudamdih Shaft	0.00	0.00	0.00	0.00	0.00
Amlabad UG	0.00	0.00	0.00	0.00	0.00

UNIT WISE BACKFILLED AREA (IN Ha) OF CLUSTER X

Mine Name	2013-14	2014-15	2015-16	2016-17	2017-18
Bhowra North – Mix	1.76	3.17	0.00	0.00	0.00
Bhowra South – Mix	4.10	6.50	6.50	5.24	5.24
Sudamdih Incline	0.00	0.00	0.00	0.00	0.00
Patherdih – Mix	1.93	0.96	0.60	0.58	0.51
Sudamdih Shaft	0.00	0.00	0.00	0.00	0.00
Amlabad UG	0.00	0.00	0.00	0.00	0.00

UNIT WISE EXCAVATED AREA (IN Ha) OF CLUSTER X

Mine Name	2013-14	2014-15	2015-16	2016-17	2017-18
Bhowra North – Mix	12.50	10.42	0.00	0.00	0.00
Bhowra South – Mix	29.97*				
Sudamdih Incline	0.00	0.00	0.00	0.00	0.00
Patherdih - OC Section	0.96	0.60	0.58	0.51	0.52
Sudamdih Shaft	0.00	0.00	0.00	0.00	0.00
Amlabad UG	0.00	0.00	0.00	0.00	0.00

* Data showing cumulative excavated area of Bhowra south (mix) from 2013-14 to 2017-18.

भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, पूर्वी झरिया क्षेत्र
पो.ओ.- भौरा, जिला - धनबाद (झारखण्ड)
पिन - 828302. दूरभाष - 0326-2320077,
ईमेल-cgmej@bccl.gov.in
पंजीकृत कार्यालय: कोयला भवन, कोयला नगर,
धनबाद- 825005, (झारखण्ड)
CIN: U10101JH1972GOI000918

Bharat Coking Coal Limited
A MINI RATNA Co.
(A Subsidiary of Coal India Ltd)
Office of the General Manager, Eastern Jharia Area
P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302
Tel.:0326-2320077, Email-cgmej@bccl.gov.in
Regd.Off: Koyla Bhawan, Koyla Nagar, Dhanbad-825005,
CIN: U10101JH1972GOI000918,
Tel.:0326-2230190/FAX: 0326-2230050, Email – cos@bccl.gov.in

Ref. No.: BCCL/EJ/GM/ Env./2019/ 666

Date: 18/04/2019

To,
The Divisional Forest Officer
Dhanbad

Sub.: Need based survey for plantation (Block plantation/Gabion/Avenue plantation) under the leasehold Area & along leasehold boundary of cluster X (E.J. Area) for complying of Environmental clearance conditions.

Dear Sir,

Under your guidance and direction, we have been very conscious about development of greenbelt within E.J. Area (Cluster X) leasehold boundary. Plantation of 2500 Nos of gabion trees was undertaken through your office. We have always been getting encouragement & support from your office for the plantation work and we are optimistic of getting your support in future also.

We would like to conduct a combined survey at E.J. Area along with team from forest Department for further development of green belt within the leasehold & leasehold boundary of cluster X. During combined survey, suitable land/dumps for long term plantation will be identified and accordingly a phase wise plan for green belt development will be formulated.

Therefore, it is requested to solicit your kind attention regarding the combined survey & development of green belt/avenue plantation in Cluster X (E.J Area).

General Manager
E.J. Area

Copy to:
1. Dy.GM/HOD (Env.), KB, BCCL
2. AGM, EJA
3. AM (Env.), EJA
4. Office Copy

भारत कोकिंग कोल लिमिटेड
एक मिनी रत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
उप महाप्रबंधक (पर्यावरण) का कार्यालय
कोयला भवन,कोयला नगर, धनबाद–826005

Bharat Coking Coal Limited
A Mini Ratna Company
(A Subsidiary of Coal India Limited)
Office of the Dy. GM (Environment)
Koyla Bhawan, Koyla Nagar, Dhanbad -826005

CIN : U10101JH1972GOI000918

पत्र संख्या :भाकोकोलि/उपमहाप्रबंधक)पर्या/(SOURCE APPORTIONMENT (MoU) /NEERI /2018/
दिनांक:12.05.2018

To,
The Director,
CSIR-NEERI,
Nehru Marg,
Nagpur– 440020
Maharashtra

Sub.: Work Order for the Project "Source Apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand".

Ref: **(i)Memorandum of Understanding between CIL & NEERI dated 03.12.2015**
(ii)your proposal vide email dated 12.09.2016 and subsequent amendment including GST rates
(iii) "Terms of reference for the Project "Source Apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand" dated 09.03.2018.
(iv) NEERI's acceptance of "TOR" vide email dated 08.05.2018

Dear Sir,
This has reference to proposal **"Source Apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand" vide email** dated 12.09.2016. The Competent Authority has approved the award of work to NEERI namely **"Source Apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand" for One Crore forty one Lakh and sixty thousand only inclusive of GST(Rs. 1,41,60,000/-)** for a period of Twelve(12) months under the MOU dated 03.12.2015 between CIL & NEERI, extended to all subsidiaries of CIL & the terms of reference. The Project-in-charge will be HOD(Environment) or any of his authorized representative.

You are required to comply the scope, objective & terms and conditions in respect of above mentioned work as agreed in the "Terms of Reference" as given below.

1. Scope of the Work:

- To conduct Source Apportionment Study for varying sources of gasses/smoke/dust emission from source to source (fuel wood, coal, fly-ash, TPPs, coke plants, traffic, silica from natural dust etc., but not limited to this) for the entire Jharia Coalfields (within and up to 10 Km from the periphery / boundary of BCCL mines)

- Study of Mineralogical composition of the suspended particulate matter (PM10 and PM2.5) with their characterization and quantification.
- Ascertaining sources(fuel wood, coal, fly-ash, TPPs, coke plants, traffic, silica from natural dust etc., but not limited to this) and extent of the air pollution of Jharia coalfield with suggesting cluster-wise appropriate techno-economically viable, mitigation management plan including action plan for the control of pollution level.
- The Environment Clearance has been granted to mines of BCCL on Cluster Basis, the final report must be submitted to BCCL on Cluster Basis. JCF has been divided into Clusters. The study to include the entire Jharia Coalfield along with area up to 10 Km from the periphery / boundary of BCCL mines (Key Plan showing Clusters in Jharia Coalfield enclosed)
- Two Presentations to be made by NEERI- One to BCCL Management before submission of Final report & another to the various stake holders including regulatory agencies after submission of the report.
- The dispersion Model should be on GIS platform
- The Hotspots/bottleneck points to be identified where there is increased pollution on GIS platform.
- Skill transfer and capacity building training for BCCL personnel.
- Accomodation , travel , local transport, other incidental cost and anciallary expenditures to be borne by NEERI.

2. Objectives of the study:

The major objective of the study is to assess the current ambient air quality, sources of air pollution and propose the priorities for the actions for improvement of air quality. The study to include the entire Jharia Coalfield along with area up to 10 Km from the periphery / boundary of BCCL mines. The detailed objectives are as following;

A) Ambient Air Monitoring related

- Monitoring of ambient air quality at selected receptor locations for pollutants including PM10, PM 2.5(limited), SO2, NOx, PAHs to establish the current status of the air quality in Jharia Coalfields along with area up to 10 K.M from the periphery / boundary of BCCL mines. Also review of the available air quality monitoring data from Central Pollution Control Board(CPCB) /Jharkhand State Pollution Control Board(JSPCB) .
- To calibrate dispersion modelling predictions using measured air quality parameters
- To draw supportive data through specific site related monitoring regarding impact causing sources such as kerbside monitoring.
- To establish the impact of meteorological conditions on a few select indicator pollutants in different micro meteorological conditions of the Jharia Coalfileds.

B) Emission Inventory related of Jharia Coalfields along with area up to 10 Km from the periphery / boundary of BCCL mines

- To identify the pollution load grid wise for point, line and area source
- To establish possibilities of receptor level concentrations of air pollutants by matching dispersion modelling and air quality monitoring data.

C) Source apportionment related

- To identify and apportion the pollution load at receptor level to various sources in the Jharia Coalfields along with area up to 10 Km from the periphery / boundary of BCCL mines.
- To carry out the source apportionment using molecular markers for a limited number of samples through a time resolved sample collection at various period of the day and day-of-the-week.

D) Any other item in consensus between both BCCL/CIL & NEERI evolved during the study

3. TERMS & CONDITIONS:

- You would assist BCCL in clarifying/defending/justifying data of report submitted to regulatory authority or information under RTI, Act or reply of parliamentary Questions or any other litigations if required by Dy. GM (Env).

- CSIR-National Environmental Engineering Research Institute (NEERI) shall associate BCCL in projecting the reports/findings at various national & international forums, Conferences, Seminars, CSIR-National Environmental Engineering Research Institute (NEERI) newsletters & annual reports, meetings of regulatory authorities etc.

- All the materials required with regard to monitoring/analysis, videography, photography and presentation for the work shall be arranged by NEERI at its own cost and shall be of appropriate quality.

- The responsibility for the arrangement of the all equipment tools and plants etc. required for monitoring/analysis, videography, photography and presentation for the work lies on NEERI.

- GST and cess as applicable shall be paid as per rule. The Duration of the project is 12 Months.

- The progress report of the work should be submitted every 3 months. These reports shall be in the form of a booklet and soft copies along with videography and photography. Reports should be in line with the scope of work.

- BCCL shall not have any liability in case of any accident etc. towards CSIR-National Environmental Engineering Research Institute (NEERI)'s personnel/ staffs during filed visits

- Child labour is prohibited under Mines Act, therefore, NEERI Nagpur shall not deploy any child labour in the aforesaid work.

You have to sign the Integrity Pact. This is as per the CVC guidelines. Name, address & contact No. of the Independent External Monitor(s) for this purpose is as given below:

1. Name: Prof (Dr.) L.C. Singhi, IAS (Retd.)
Address: L-31, Third Floor, Kailash Colony, New Delhi-110048
2. Name: Shri Pramod Deepak Sudhakar, IAS (Retd.)
Address: A-002, Stellar Park Apartments, C-58/24 Sector-62, Noida-201301

This terms of reference is given to you in duplicate. You are advised to submit your consent by returning second copy of the terms of referenceduly signed by you as a token of acceptance of the award within 7(seven) days from the date of receipt of this letter.

Failure to comply with the requirement as above shall constitute sufficient ground for cancellation of the award.

Enclosed:

1. Annexure-1 (Proforma of bank guarantee for performance security)
2. Annexure-2 FORMAT FOR CONTRACT AGREEMENT
3. Annexure -3 (Proforma for collecting payment through electronic mode including electronic fund transfer (ETF) & electronic clearing system (ECS))
4. Annexure -4 INTEGRITY PACT

Yours faithfully,

12/5/17

Dy. GM (Env.)

Copy to:

1) TS to D (T) OP/ D (F)/ D (T) P&P ..... for kind information
2) ES to CVO, BCCL ..... for kind information
3) TS to CMD, BCCL ..... for kind information
4) GM (Finance) I/C, BCCL, Koyla Bhawan
5) HOD(Fin)Pay.
6) GM(Env.), CIL ..... for kind information
7) Prof (Dr.) L.C Singhi, IAS (Retd.), L-31 Third Floor, Kailash Colony, New Delhi-1100481. Address: L-31, Third Floor, Kailash Colony, New Delhi-110048.
8) Concerned Fille.

Scanned by CamScanner

WATER TREATMENT PLANT/ FILTER PLANT

UNDER CLUSTER X, BHARAT COKING COAL LIMITED, DHANBAD

In cluster X (under Eastern Jharia area), there is three nos. of Rapid Gravity Pressure Filter plant of total 1.72 MGD capacity, which is used for supply of water in nearby colonies, houses, quarters. After treatment and filtration, treated water is supplied to nearby residents both employees and non employees peoples.

Effluent analysis is monitored by CMPDIL quarterly and gives environment monitoring report regularly for cluster X of BCCL. This report includes the effluent analysis report.

Detail of Water Treatment Plant/ Filter Plant in E.J. Area are given below:

Detail of Water Treatment Plant/ Filter Plant in E.J. Area					
S. No.	Location of source of water	Treatment method	Capacity (MGD)	In use (MGD)	Supply of water
1	Sudamdih	Rapid gravity filter	0.8	0.47	Sudamdih colony, Patherdih colony, Patherdih Basti, Patherdih Basti, Supkar Basti, Hattala basti, etc
2	Bhowra	Rapid gravity filter	0.66	0.39	Gaurkhuti, 12 no. basti, 13 no.basti, 35 no. basti; 6 no. dhowra, Manjhi Basti, Gandhi Nagar, 19 no. Basti upar, 19 no. Basti niche, etc.
3	Amlabad	Rapid gravity filter	0.26	0.02	Amlabad colony and nearby basti

Encl.: i. Photos of different filter plants under cluster X

ii. Effluent analysis / Env. Monitoring report

PHOTOGRAPHS SHOWING FILTER PLANTS IN CLUSTER X (EASTERN JHARIA AREA), BCCL, DHANBAD

A. Location of Filter Plant

B. Units of Filter Plant

C. Different units of Filter Plant

Fig.1: Sudamdih Filter Plant of Eastern Jharia Area, BCCL

A. Location of Filter Plant

B. Units of Filter Plant

C. Different units of Filter Plant

Fig.2: Amlabad Filter Plant of Eastern Jharia Area, BCCL

A. Location of Filter Plant

B. Units of Filter Plant

C. Different units of Filter Plant

Fig.3: Bhowra Filter Plant of Eastern Jharia Area, BCCL

WATER HARVESTING & ARTIFICIAL RECHARGE

Coal mining is the major industrial activity in the area. Ground water pumping is an integral part of mine management for safe and efficient coal extraction. Pumping from both underground and opencast mines may affect groundwater table near the mine area. In coal mining area the impact is observed to be mostly limited to 500 m from the mine boundary. Mining activity also creates high permeability aquifer zones during backfilling activities in opencast mines and depillaring/caving activities in underground mines. Besides this, groundwater utilization is mainly for domestic and irrigation use in the study area.

To minimize the impact of mining on ground water system, the project/mine authority has been adopting all possible measure to increase the ground water recharge potential.

The stage of ground water development in the buffer zone (10 km from the periphery of the core zone) of Cluster-X mines comes to about 40.15%. As per the data collected from the Central Ground Water Board, Ranchi, the stage of ground water development in the Jharia Block in which Cluster-X project and its buffer zone located is 53.62% in year 2004 and 105.63% in year 2008-09. CGWB observation well located at Jharia does not show any declining trend. The area falls within the “Critical” to “Overexploited category but both pre monsoon and post monsoon ground water level do not show any significant long term declining trend. Rather the pre-monsoon water level shows a rising trend. Again, core zone of cluster X is located in the discharge area near Damodar River. Therefore artificial recharge can be done in the buffer zone of the Cluster-X.

Artificial recharge has to be done to check the lowering of water level in the study area using rainwater harvesting and surplus mine water.

Groundwater inflow (11825 m^3/day) and mine influence area (maximum 500 m from the mine edge) have been estimated and the groundwater monitoring would be undertaken as corrective measure to avoid adverse effects. The mine discharge after passing through sedimentation tank is being discharged onto local jore / nala with check dams at suitable locations so that the groundwater gets additional recharge by the return flow.

The impact on ground water level will be minimized by artificial recharge by spreading of pumped out water, creation and filling of ponds with mine water and construction of rainwater harvesting structure.

Rain Water harvesting is a deliberate collection and storage of rain water that runs off on natural and man-made catchment area. The amount of water harvested depends on the frequency and intensity of the rain fall and characteristics of the catchment to allow the precipitate to infiltrate through the sub-soil and percolate down to recharge aquifers.

It is therefore proposed that during mining operation the rain water within the mining area will be accumulated in earthen water pool developed on the surface which will not only be helpful in re-charging the ground water of the area but will fulfil the non-drinking water demand of nearby inhabitants also.
Necessary check dams (Figure No-2) have been/will be made in the nala for recharging ground water aquifer. Roof-top rainwater harvesting (Figure No-3) will be taken up in the project area using the administrative buildings if required. Rainwater harvesting and artificial recharge will also take place through abandoned dug-wells and final voids of old mines for increasing ground water potential and check water level lowering.

Check dams / Nala bunds – Runoff conservation structures like check dams, nala bunds are constructed over the stream / nala bed thereby increasing the contact period of rainwater with the underlying formation. It is commonly

constructed across small streams with gentle slope and there is no submergence beyond stream course. The site selected should have sufficient thickness of permeable bed / weathered formation to facilitate recharge within short span of time. A check dams in Kari jore near Dhansar Colliery (western part) and another one at Nagri jore near Jogta/Nischitpur OC is provided to facilitate groundwater recharge.

Figure No-2: Check Dams / Nala bunds.

Rooftop Runoff Recharge –

- **Recharge through existing Dug/Tube well –** In areas where shallow aquifers have dried up and existing Dug/Tube wells are tapping deeper aquifer, rooftop rainwater harvesting through existing wells can be adopted to recharge the aquifers.
- **Filter Pit –** If the roof area is more, to accommodate excess rainwater a filter pit may be constructed. The shape and size of the filter pit is depending upon available runoff.

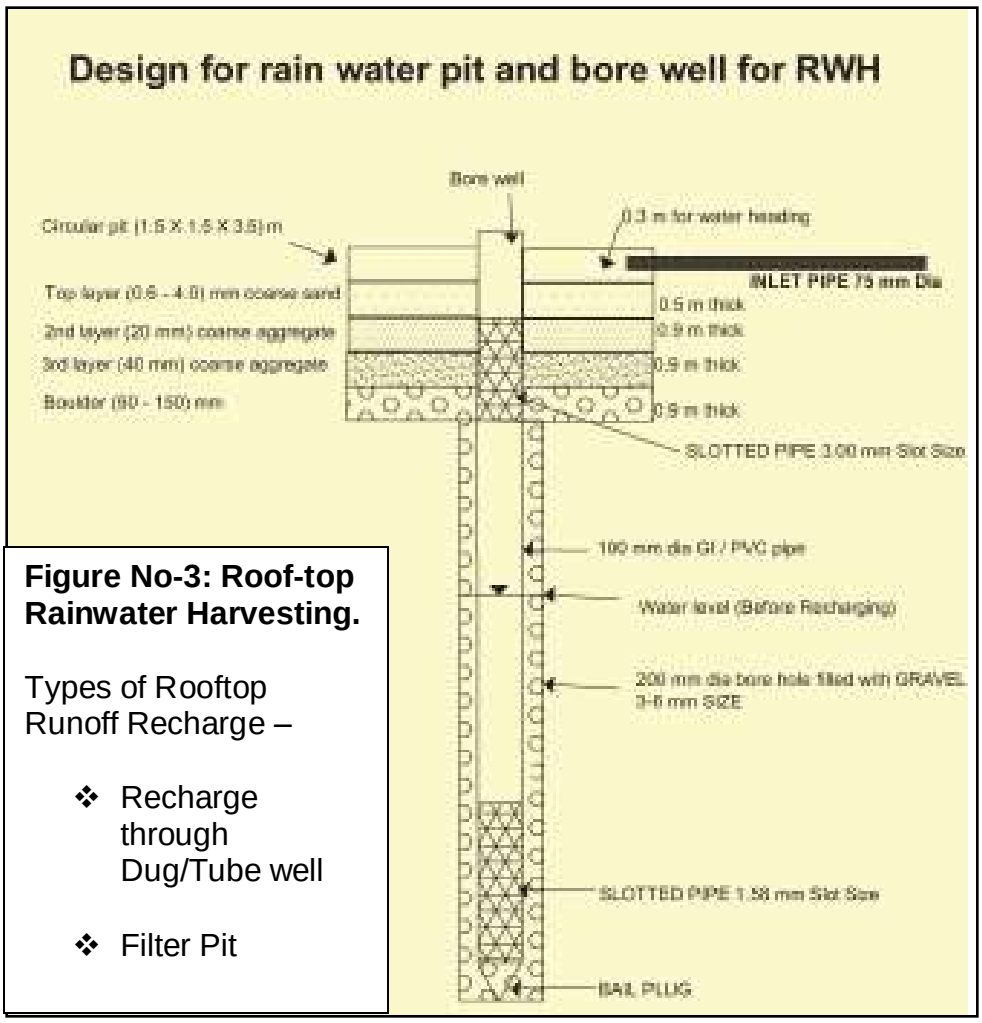


Figure No-3: Roof-top Rainwater Harvesting.

Types of Rooftop Runoff Recharge –

- Recharge through Dug/Tube well
- Filter Pit

Recharge Pit – The abandoned underground mine workings can be used as recharge pit which can act as artificial recharge structure to augment the recharge of deeper aquifers. It behaves as huge ground water reservoirs and contains groundwater runoff (i.e. planned recharge). After mine closure, voids of opencast and underground workings will be waterlogged. This will help in maintaining the water table in the surrounding areas and may become a source of water supply to the community. Out of 115.15 Ha of abandoned quarry in the core zone of Cluster-X, 46.15 Ha has already been backfilled. Remaining area of 69.00 Ha will be act as water body to recharge the groundwater.

Recharge through Dug well – Existing dug wells may also be used as recharge wells, as and when source water become available. In areas where

considerable de-saturation of aquifers have already taken place due to over-exploitation of groundwater resources resulting in the drying up of dug wells and lowering of piezometric head in bore/tube wells. Existing groundwater abstraction structures can be used as cost-effective mechanism for artificial recharge of the phreatic or deeper aquifer zones. Dug well has been made near or within the small streams / nala / jore to augment the groundwater recharge. Water is percolating from flowing stream into groundwater systems through dug wells.

Water harvesting through Settling tank and Percolation tank -These is an artificially created surface water body, submerging in its reservoir a highly permeable land so that surface runoff is made to percolate and recharge the ground water storage. Percolation tank should be located on highly fractured and weathered rock with lateral continuity. The size of the tank should be governed by the percolation capacity of strata in the tank bed.

The surplus mine water will be given to the local people for irrigation. Utilization of mine water for irrigation use will also enhance the ground water recharge potential through artificial recharge in the area.

The pond, tanks, stop dams etc constructed in the rehabilitated and affected villages also augment the groundwater recharge.

Efforts are being made to construct more recharge structures at suitable sites in the nearby villages in consultation with Central Ground Water Board.
Creation of awareness among workers and local peoples about rain water harvesting and artificial recharge will be given priority. This aspect is usually covered during the Environmental Week celebrated every year (5 to 12 June).

भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, पूर्वी झरिया क्षेत्र
पो.ओ.- भौरा, जिला - धनबाद (झारखण्ड)
पिन - 828302. दूरभाष - 0326-2320077,
ईमेल-cgmej@bccl.gov.in
पंजीकृत कार्यालय: कोयला भवन, कोयला नगर,
धनबाद- 825005, (झारखण्ड)
CIN: U10101JH1972GOI000918

Bharat Coking Coal Limited
A MINI RATNA Co.
(A Subsidiary of Coal India Ltd)
Office of the General Manager, Eastern Jharia Area
P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302
Tel.:0326-2320077, Email-cgmej@bccl.gov.in
Regd.Off: Koyla Bhawan, Koyla Nagar, Dhanbad-825005,
CIN: U10101JH1972GOI000918,
Tel.:0326-2230190/FAX: 0326-2230050, Email – cos@bccl.gov.in

Ref. No.: BCCL/EJ/GM/ Env./2019/

Date: 17/04/2019

To,
M/s, DECO
M/s, AT-Dev- Prabha
Dhanbad

Sub.: Regarding installation of oil & grease trap in your workshop for complying of Environmental clearance conditions.

Dear Sir,

As per NIT clause "*the contractor shall ensure the compliance of provisions of statutory obligations like prevention & control of pollution Act, 1974, Indian electricity rule, coal mines regulation etc. as applicable.*" It is stated that the contractor has to comply with the provision of the prevention and Control of Pollution Act, 1974 and as per Control and Pollution Act, 1974 section 25/26 of the Water (Prevention & Control of Poilution) act, 1974, it is necessary to comply the environmental clearance conditions issued by MoEF&CC.

As per specific condition no. XXXII:

"ETP shall also be provided for workshop, and CHP, if any. Effluents shall be treated to confirm to prescribe standards in case discharge into the natural water course."

Oil and grease trap shall be installed before discharge of workshop effluent. Sewage treatment plant of adequate capacity shall be installed for treatment of domestic waste water. Hence, as per the aforesaid clause under the control & Pollution Act, 1974 you have to establish oil & grease trap in your workshop. Effluents generated in the process of washing of machines must be drained out in the oil & grease trap before discharge into natural drainage system.

Therefore, it is instructed to take immediate action for installation of Oil & Grease trap system at your workshop which is necessary for the compliance of the specific condition mentioned above.

2019/4/19
General Manager
E.J. Area

Copy to:
1. Dy.GM/HOD (Env.), KB, BCCL
2. PO- Bh S, ASP
3. AM (Env.), EJA
4. Office Copy

भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, पूर्वी झरिया क्षेत्र
पो.ओ.- भौरा, जिला - धनबाद (झारखण्ड)
पिन - 828302. दूरभाष - 0326-2320077,
ईमेल-cgmej@bccl.gov.in
पंजीकृत कार्यालय: कोयला भवन, कोयला नगर,
धनबाद- 825005, (झारखण्ड)
CIN: U10101JH1972GOI000918

Bharat Coking Coal Limited
A MINI RATNA Co.
(A Subsidiary of Coal India Ltd)
Office of the General Manager, Eastern Jharia Area
P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302
Tel.:0326-2320077, Email-cgmej@bccl.gov.in
Regd.Off: Koyla Bhawan, Koyla Nagar, Dhanbad-825005,
CIN: U10101JH1972GOI000918,
Tel.:0326-2230190/FAX: 0326-2230050, Email – cos@bccl.gov.in

Ref. No.: BCCL/EJ/GM/ Env./2019/ Date: 19/04/2019

To,
Sri Bharat Jyoti
Additional Principal Chief Conservator of Forest
Ministry of Environment, Forest & climate Change
Regional Officer (ECZ)
Bunglow no. A-2, Shayamali colony
Ranchi – 834002
Jharkhand

Sub.: Regarding Subsidence in Cluster X.

Dear Sir,

This is to inform you that at present no depillaring operation is going on in underground mines of Cluster X. Hence, there is no case of subsidence in cluster X due to depillaring operation. However, cluster X is totally fire affected and unstable area.

This is for your kind information.

Project Officer
Amlg. Sud-Patherdih Colliery

Project Officer
Bhowra South Colliery

Project Officer
Bhowra North Colliery

Area Safety Officer
E.J. Area

Area Survey Officer
E.J. Area

Area Manager (Env.)
E.J. Area

Addl. GM
E.J. Area

General Manager
E.J. Area

Copy to:
1. Dy.GM/HOD (Env.), KB, BCCL
2. Office Copy

Certificate of high root density plant for controlling subsidence

This is to certify that BCCL has been doing plantation/ecological restoration under the guidelines of Forest Research Institute. The various species selected for the restoration are having a tap root system with branches which serve the purpose. These species have high root density and are already being planted at all the ecorestoration/plantation sites of BCCL. The various species having tap root system are given below.

S.No.	Species	Common name
1.	*Acacia nilotica*	Kikkar
2.	*Albizia odoratissima*	Kala siris
3.	*Bauhinia variegata*	Kachnar
4.	*Cassia fistula*	Amaltas
5.	*Ficus benghalensis*	Baniyan /bargad
6.	*Ficus racemosa*	Gular
7.	*Ficus religiosa*	Pipal
8.	*Gmelina arborea*	Ghamar
9.	*Lagerstroemea parviflora*	Jarul
10.	*Lannea coromandelica*	Zhingan
11.	*Madhuca latifolia*	Mahua
12.	*Mangifera indica*	Aam
13.	*Morus alba*	Shahtoot
14.	*Phyllanthus emblica*	Aonla
15.	*Pithecellobium dulce*	Jangal jalebi
16.	*Pongamia pinnata*	Karanj
17.	*Tamarindus indica*	Imli
18.	*Trema orientalis*	Tree
19.	*Terminalia arjuna*	Arjun
20.	*Terminalia bellerica*	Bahera
21.	*Dalbergia sissoo*	Shisham
22.	*Syzizium cuminii*	Jamun
23.	*Azadirachta indica*	Neem
24.	*Holoptelea integrifolia*	Indian elm
25.	*Butea monosperma*	Palash /dhak

वैज्ञानिक / Scientist
वन पारिस्थितिकी एवं जलवायु परिवर्तन प्रभाग
Forest Ecology & Climate Change Division
वन अनुसंधान संस्थान, देहरादून - 248006
Forest Research Institute Dehradun-248006

Scanned by CamScanner

भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, पूर्वी झरिया क्षेत्र
पो.ओ.- भौरा, जिला - धनबाद (झारखण्ड)
पिन - 828302. दूरभाष - 0326-2320077,
ईमेल-cgmej@bccl.gov.in
पंजीकृत कार्यालय: कोयला भवन, कोयला नगर,
धनबाद- 825005, (झारखण्ड)
CIN: U10101JH1972GOI000918

Bharat Coking Coal Limited
A MINI RATNA Co.
(A Subsidiary of Coal India Ltd)
Office of the General Manager, Eastern Jharia Area
P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302
Tel.:0326-2320077, Email-cgmej@bccl.gov.in
Regd.Off: Koyla Bhawan, Koyla Nagar, Dhanbad-825005,
CIN: U10101JH1972GOI000918,
Tel.:0326-2230190/FAX: 0326-2230050, Email – cos@bccl.gov.in

XVIII

Ref. No.: BCCL/EJ/GM/ENV/EC/2019/ Date: 15/04/2019

OFFICE ORDER

A Committee is hereby constituted for subsidence monitoring and surface mitigation measures under lease hold area of cluster X as per the Environmental Clearance specific condition no. XXXIII under section land reclamation and water conservation, members of committee are as under:

1. Addl. General Manager, E.J. Area -- Committee head
2. Area Safety Officer, E.J. Area -- Member
3. Area Survey Officer, E.J. Area -- Member
4. Area Manager (Estate/CD/CSR), E.J. Area -- Member
5. Area Manager (Environment), E.J. Area -- Member
6. Project Officer, Bhowra north Colliery -- Member
7. Project Officer, Bhowra south Colliery -- Member
8. Project Officer, ASP Colliery -- Member

All project officers are hereby advised to report to Addl. General Manager, EJ area in case of any subsidence movement and the appropriate surface mitigation measures under his mine leasehold area and Area safety officers, EJ area hereby instructed to maintain the monthly logbook of the subsidence monitoring within the cluster X lease hold area through concerned safety officers of the colliery.

20/4/19
General Manger
Eastern Jharia Area

Copy to:

1. Dy.GM / HOD (Env.), KB, BCCL
2. Executive concerned
3. Office copy

cmpdi
A Mini Ratna Company

सेंट्रल माइन प्लानिंग एण्ड डिज़ाइन इंस्टीट्यूट लिमिटेड
(कोल इंडिया लिमिटेड की अनुषंगी कम्पनी / भारत सरकार की एक लोक उपक्रम)
पंजीकृत कार्यालय : गोन्दवाना प्लेस , कांके रोड , राँची - 834031 (झारखण्ड) भारत
क्षेत्रीय संस्थान-2, पत्रा. बीसीसीएल टाउनशीप, कोयला नगर, धनबाद 826005 (झारखण्ड) भारत
Central Mine Planning & Design Institute Limited
(A Subsidiary of Coal India Limited / Govt. of India Public Sector Undertaking)
Registered Office : Gondwana Place, Kanke Road, Ranchi -834031(Jharkhand)
Regional Institute-II, P.O. BCCL Township, Koylanagar, Dhanbad 826005(Jharkhand) India
Corporate Identity No. U14292JH1975GOI001223

पत्रांक: आर.आई.-2/पर्यावरण/एम-30/ 1967-69 दिनांक: ~~02~~ 03.08.2016

सेवा में,
विभागाध्यक्ष (पर्यावरण)
बी. सी. सी. एल.
कोयला भवन
धनबाद

(Stamp: 633(M) 03/08/16)

विषय: Study of Installation of Rail-cum-Conveyor System in BCCL for transportation of coal.

संदर्भ: पत्र संख्या:
1. सी.एम.पी.डी.आई./पर्यावरण /2016/663, दिनंक: 14.07.2016.
2. BCCL/Dy.GM (Env)/F-EMP/16/1314-15 (M), Dated: 23.06.2016.
3. आर.आई.- 2/पर्यावरन / एम-30/1150, दिनांक : 20.06.2015.
4. E-17719

महोदय,

In reference to your letter no. BCCL/Dy.GM (Env)/F-EMP/16/1314-15 (M), Dated: 23.06.2016, to GM (Env), CMPDI-HQ, it has already been indicated in letter no.आर.आई.-2/पर्यावरन / एम-30/1150, दिनांक : 20.06.2015 that study for installation of Rail-cum-Conveyor System in BCCL for transportation of coal can be started only after the liquidation of coal mine fire, rehabilitation of 595 unstable sites, road realignment and relocation of railway sidings of BCCL and final report of RITES in regard to realignment of railway lines.

This is for your kind information.

भवदीय

(वि.कु. सिन्हा) 1/8/16
क्षेत्रीय निदेशक

Sri Amalkanta Act Mgr(Env), for record. 3/8/16
4.8.16.

प्रतिलिपि:
1. महाप्रबंधक (पर्यावरण) सी.एम.पी.डी.आई (मुख्यालय), राँची
2. विभागाध्यक्ष (खनन), आर.आई- II, धनबाद

फोन : (+91) 0326-2230850 फैक्स / Fax : (+91) 0326-2230500
वेब साइट / Website : www.cmpdi.co.in
ईमेल / Email : ri2@cmpdi.co.in

CSR ACTIVITY PLAN

OF

CLUSTER – X

AS PER

EC CONDITION (SPECIFIC CONDITION-XLII): Details of transportation, CSR, R&R and implementation of environmental action plan for each of the 17 clusters should be brought out in a booklet for and submitted to Ministry.

MAY, 2017

INTRODUCTION

Coal India has adopted CSR as a strategic tool for sustainable growth. For Coal India in the present context, CSR means not only investment of funds for Social Activity but also Integration of Business processes with Social processes. Even much before the issue of CSR became global concern; Coal India was aware of its Corporate Social Responsibility and was fulfilling the aspiration of the Society through well-defined "Community Development Policy" within the periphery of 8 Kms. of the Project sites. This has resulted into a harmonious relationship between Coal India and the peripheral Communities.

Coal India has identified land oustees, PAP and those staying within the radius of 25 Kms of the Project as primary beneficiaries. Poor and needy section of the society living in different parts of India are second beneficiaries. For carrying out CSR activities, 80% of the budgeted amount are be spent within the radius of 25 Km of the Project Site/Mines/Area HQ/Company HQ and 20% of the budget to be spent within the States in which operating.

SCOPE

As per Schedule VII Section 135 of New Companies Act 2013 the following should be the Scope of Activities under Corporate Social Activities:

i. Eradicating hunger, poverty and malnutrition, promoting healthcare including preventive health care and sanitation and making available safe drinking water.
ii. Promoting education, including special education and employment enhancing vocation skills especially among children, women, elderly, and differently able and livelihood enhancement projects;
iii. Promoting gender equality, empowering women, setting up homes and hostels for women and orphans, setting up old age homes, day care centers and such other facilities for senior citizens and measures for reducing inequalities faced by socially and economically backward groups;
iv. Ensuring environmental sustainability, ecological balance, protection of Flora and Fauna, animal welfare, agro-forestry, conservation of natural resources and maintaining quality of soil, air and water;
v. Protection of national heritage, art and culture including restoration of buildings and sites of historical importance and works of art; setting up public libraries, promotion and development of traditional arts and handicrafts;
vi. Measures for the benefit of armed forces veterans, war widows and their dependents
vii. Training to promote rural sports, nationally recognized sports, Paralympics sports and Olympic sports;
viii. Contribution to the Prime Minister's National Relief Fund or any other fund set up by the Central Government for socio-economic development and relief and welfare of the Scheduled Castes, the Scheduled Tribes, other backward classes, minorities and women;
ix. Contributions or funds provided to technology incubators located within academic institutions whichare approved by the Central Government;
x. Rural development projects

SOURCE OF FUND

The fund for the CSR should be allocated based on 2% of the average net profit of the Company for the three immediate preceding financial years or Rs. 2.00 per tone of Coal Production of previous year whichever is higher.

CURRENT STATUS

Healthcare: Annual CSR (Healthcare) Expenditure for the year 2015-16 and 2016-17.

I. Mobile Medical Van (MMV):

S. No.	Year (financial year)	No. of Mobile Medical VanCamp	Beneficiaries	Amount (inRs.)	Remarks
1	2015-16	229	7012	215927.76	Till Dec. 2016

II. General Medical Camps:

S. No.	Year (financial year)	Name of Medical Camp	Beneficiaries	Date
1.	2015-16	Family Planning Camp	33	03.02.2016
2.		Family Planning Camp	40	16.02.2016

Highlights of CSR Work under taken during 2015-16 and 2016-17 at Cluster-X

S. No.	Details	No. of units		Total Amount (in Rs.)	Remarks
		Girls	Boys		
1.	Construction of toilets in various schools in Saraikela-Kharsawan district of Jharkhand under "Swachh Vidyalaya Abhiyaan"under CSR activities of BCCL.	89	89	29,548,000	Work was done by state government.
	Total	178		29,548,000	

PROPOSED STATUS

CSR Work to be under taken during 2017-18 at Cluster- X

S. No.	Details	Remarks
1.	Construction of Marriage/Multipurpose Hall in Mayurdubhi (मयुरदुभी) village in Amai Nagar (आमाई नगर(Panchayat of Block Chandankyari	Proposed activity

*****

BCCL

C.S.R. PERFORMANCE REPORT MONTHWISE
April 2015 to December 2016
BHowrah REGIONAL HOSPITAL. E.J. AREA.

MOBILE MEDICAL VAN.

Date: 29.04.2016

SL.NO.	MONTH	NO.OF.CAMP	NO.OF.BENEFICIARIES	TOTAL EXPENDITURE
1.	April 15	26	1122	₹ 39,171.33
2.	May	25	937	₹ 35,270.12
3.	June	25	941	₹ 32,950.08
4.	July	27	1028	₹ 38,685.08
5.	August	25	1003	₹ 31,288.24
6.	September	26	634	₹ 17,211.73
7.	October	24	443	₹ 7,963.19
8.	November	24	517	₹ 7870.23
9.	December	27	387	₹ 5,517.76
10.	January 16			
11.	February			
12.	March			
	Total ---	229	7012	₹ 2,15,927.76

Dy.C.M.O. I/C
Sudamdih R/ Hospital
E.J.Area.

NAME OF VILLAGES COVERED UNDER CSR/MMV PROGRAMME

E.J. AREA - VILLAGES

1. Bhowrah 19 No. Basti.
2. Parghabad Basti
3. Supker Basti
4. Manjhi Basti.
5. Mohubani Basti.
6. Sheobabudih
7. Bhowrah 7No Basti.
8. Bhowrah 4 No Basti.
9. Bhowrah Jahaj Tand.
10. Thana Basti.
11. Manpur Basti.
12. Amlabad Basti.
13. New Riverside Basti.
14. Gourkhutti Basti.
15. Sawardih Basti
16. Hattala Basti.

Dy.C.M.O. I/C
Sudamdih R/Hospital

65959

FAMILY PLANNING CAMP

E.J.AREA

1. Sudamdih R/ Hospital date - 0 3.02.2016. Beneficiaries- 33
2. Bhowrah R/ Hospital date - 16.02.2016 Beneficiaries –40

Dy.C.M.O

Sudamdih R /Hospital

ANNEXURE –

CSR BUDGET & EXPENDITURE

BHARAT COKING COAL LIMITED			
CSR BUDGET AND EXPENDITURE			
Year	**CSR Budget (Rs in lakh)**	**Projects/ Activities**	**Expenditure incurred (In Rs. Lakhs)**
2013-14	3050	Drinking Water/ Water Supply	278
		Education	20
		Infrastructure Development	351.15
		Skill Development	82
		Medical/Healthcare	49
		Others (Uttrakhand Chief Minister Relief fund)	2000
		Total of 2013-14	**2780.15**
2014-15	3080	Drinking Water/ Water Supply & Sanitation	4.69
		Education	2.87
		Infrastructure Development	244.9
		Skill Development	55.73
		Medical/Healthcare	32.55
		Forestry & Environment	73.43
		Others	18.29
		PMNRF	1000
		Total of 2014-15	**1432.46**
2015-16	3300	Drinking Water/ Water Supply & Sanitation	3.33
		Swachh Vidyalaya Abhiyan	5868.51
		Education	17.01
		Infrastructure Development	161.75
		Skill Development	0.12
		Medical/Healthcare	33.06
		Forestry & Environment	2.94
		Conservation of Natural resources	63.76
		Others	13.23
		Transfer of CSR Expenditure spent by BCCL CSR Budget allotted by CIL (CIL the Holding Company has also incurred CSR expenditure to the tune of Rs.10.97 crore through BCCL, which has been borne and accounted for the books of CIL)	-1096.58
		Total of 2015-16	**5067.13**

CSR BUDGET AND EXPENDITURE for FY 2016-17

Expenditure under CSR for the year 2016-17				
S. No.	CSR Project or Activity identified	Sector in which the project is covered	Amount spent on the projects or programs Sub-heads:(1) Direct Expenditure on projects or programs(2) Overheads: (in lakhs)	
			Direct	Overheads
1	Construction of toilets in various school in Paschimi Singhbhum District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	389.32	3.00
2	Construction of toilets in various school in Bokaro District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	8.15	
3	Construction of toilet in various school in Dumka District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	341.96	
4	Construction of toilet in various school in Gumla District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	68.77	
5	Construction of toilet in various schools in Dhanbad District	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	1.17	

6	Construction of toilet in various schools in Simdega District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	132.02	
7	Construction of toilets in various schools in Purbi Singhbhum district of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	2.00	
8	Constn. of Toilets in various School in Koderma District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	16.91	
9	SVA LIABILITY	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	737.86	
10	SVA LIABILITY reversed	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	(1,022.52)	
Total			675.63	3.00
Grand Total			**678.63**	

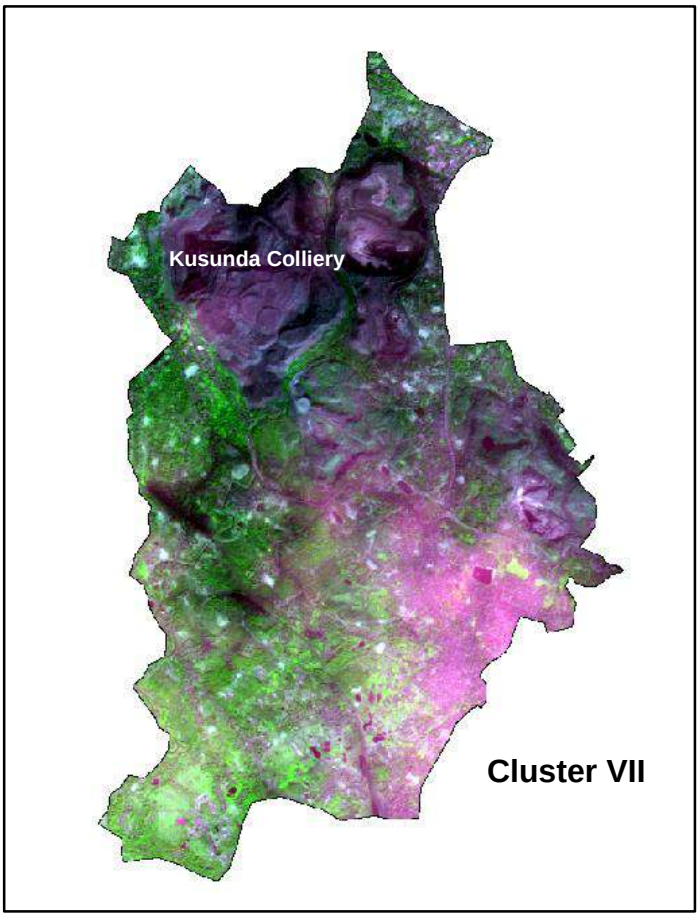
CSR BUDGET AND EXPENDITURE for FY 2017-18

Sl No	Particulars	Expenditure incurred (in Rs. Lakh)
1	Various health camps & allied activities (Project JYOTI)	2.20
2	Swachh Vidyalaya Abhiyan (toilets bill)	165.60
3	Construction of toilets at SSLNT Mahila Mahavidyalayaand at Bhatinda Pootki	14.30
4	Swachhta Pakhwada activities	0.30
5	Construction of PCC Road in Topchanchi Blocks	4.40
6	Deepening /renovation of ponds in Tundi and East Tundi	11.90
7	Handloom weaving training project	6.00
8	Construction of Community Hall at Johar Asthan, Hirapur,Dhanbad (bill)	0.40
9	BCCL Ke LAAL/BCCL Ki LAADLI	35.40
10	Others (including liability)	33.50
11	**Total**	**273.9**

CSR BUDGET AND EXPENDITURE for FY 2018-19 (upto Nov.2019)

Sl No	Particulars	Expenditure incurred (in Rs. Lakh)
1	Various medical camps under CSR	2.2
2	Swachh Bharat Abhiyan activites	2.2
3	BCCL Ke LAAL/BCCL Ki LAADLI	0.08
4	Deepening /renovation of ponds	4.22
5	Others	2.54
	Total	**11.24**

Land Restoration / Reclamation Monitoring of Clusters of (Opencast + Underground) Coal Mines of Bharat Coking Coal Limited based on Satellite Data for the Year 2018



Submitted to

Bharat Coking Coal Limited

cmpdi

A Mini-Ratna Company

Land Restoration / Reclamation Monitoring of Clusters of (Opencast + Underground) Coal Mines of Bharat Coking Coal Limited based on Satellite Data for the Year 2018

March-2019

Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi

CONTENTS

Executive Summary iii

1. Background 1
2. Objective 2
3. Methodology 2
4. Land Reclamation Status in Bharat Coking Coal Ltd 6

List of Tables

Table 1 Cluster wise Land Reclamation Status.....v
Table 2 Area Statistics of Land Use Classes in Clusters 7

List of Figures

Fig. 1 Cluster wise Land Reclamation Status-2018 (BCCL) vi
Fig. 2 Methodology of Land Reclamation Monitoring 3
Fig. 3 Land Reclamation status of Cluster I 12
Fig. 4 Land Reclamation status of Cluster IV 12
Fig. 5 Land Reclamation status of Cluster VII 13
Fig. 6 Land Reclamation status of Cluster X.....13

List of Plates

Plate 1 Land Use Map of Cluster I 8
Plate 2 Land Use Map of Cluster IV 9
Plate 3 Land Use Map of Cluster VII 10
Plate 4 Land Use Map of Cluster X.....11

List of Photographs

Photo 1 Ecological Restoration Site, Damoda Colliery, Cluster I.....14
Photo 2 Ecological Restoration Site in Cluster IV 14
Photo 3 Ecological Restoration Site in Cluster VII 15
Photo 4 Plantation on OB in Cluster X.....15

Executive Summary

1. Project

Land restoration / reclamation monitoring of clusters of (Opencast + Underground) coal mines of Bharat Coking Coal Ltd. (BCCL), based on satellite data, on every three year basis.

2. Objective

Objective of the land restoration / reclamation monitoring is to assess the area of backfilled, plantation, social forestry, active mining area, water bodies, and distribution of wasteland, agricultural land and forest in the leasehold area of the project. This will help in assessing the progressive status of mined land reclamation and to take up remedial measures, if any, required for environmental protection.

3. Salient Findings

- Four Clusters viz. I, IV, VII, X were selected in 2018-19 for land reclamation/restoration monitoring. These clusters consist of mainly opencast mines.

- Out of the total leasehold area of 5883.96 Ha., total mined out area is only 1075.76 Ha., belonging to the OC mines.

- It is evident from the analysis that 58.11% of excavated area is under technical reclamation and 35.02% of the excavated area is under active mining. Cluster wise details are given in Table-1 & Fig-1.

- 13.61% of total leasehold area has come under plantation (% green cover)

- Study reveals that out of total mine leasehold area of 5883.96 Ha. of the above mentioned 04 nos. clusters of BCCL taken up for the land reclamation monitoring during the year 2018-19; total excavated area is 1075.76 Ha. (18.28%) out of which 73.92 Ha. (6.87%) has been planted *(Biologically Reclaimed)*, 625.15 Ha. (58.11%) is under backfilling *(Technical Reclamation)* and

balance 376.69 Ha. (35.02%) is under active mining

- This report and the findings will act as the basis for further monitoring and reclamation related activities.

- Out of the four clusters of BCCL, maximum land reclamation has been done in Cluster VII (76.09%) followed by Cluster X (71.00%).

Table 1

Land Reclamation Status in Clusters of (Underground + Opencast) Projects of BCCL based on Satellite Data of the Year 2018

(Area in Hectare)

Sl. No.	Cluster No.	Total Leasehold Area	Technical Reclamation	Plantation			Area under Active Mining	Total Excavated Area	Total Area under Plantation (% Green Cover	Total Area under Reclamation
				Biological Reclamation	Other Plantations					
			Area under Backfilling	Plantation on Excavated / Backfilled Area	Plantation on External Over Burden Dumps	Social Forestry, Avanue Plantation Etc.				
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9 (=4+5+8)*	*10 (=5+6+7)*	*11(=4+5)*
1	Cluster I	575.00	10.11	7.29	47.99	25.53	28.39	45.78	80.80	17.40
			22.08%	15.91%			62.00%		14.05%	38.00%
2	Cluster IV	1123.79	147.22	0.00	27.11	165.09	166.67	313.88	192.20	147.22
			46.90%	0.00%			53.10%		17.10%	46.90%
3	Cluster VII	2127.70	351.54	37.47	15.52	238.67	122.23	511.24	291.67	389.01
			68.76%	7.33%			23.91%		13.71%	76.09%
4	Cluster X	2057.47	116.28	29.16	66.09	140.75	59.41	204.86	236.00	145.44
			56.76%	14.23%			29.00%		11.47%	71.00%
	TOTAL	**5883.96**	**625.15**	**73.92**	**156.71**	**570.04**	**376.69**	**1075.76**	**800.66**	**699.07**
			58.11%	**6.87%**			**35.02%**	**18.28%**	**13.61%**	**64.98%**

(% is calculated with respect to Excavated Area as applicable)

Note: In reference of the above Table, different parameters are classified as follows:

1. Area under Biological Reclamation includes Areas under Plantation done on Backfilled Area Only.
2. Area under Technical Reclamation includes Area under Barren Backfilling only
3. Area under Active Mining Includes Coal Quarry, Advance Quarry Site and Quarry filled with water etc., if any.
4. Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in the above Table.
5. (%) calculated in the above Table is in respect to Total Excavated Area except for “”Total Area under Plantation”” where % is in terms of “Leasehold Area””.

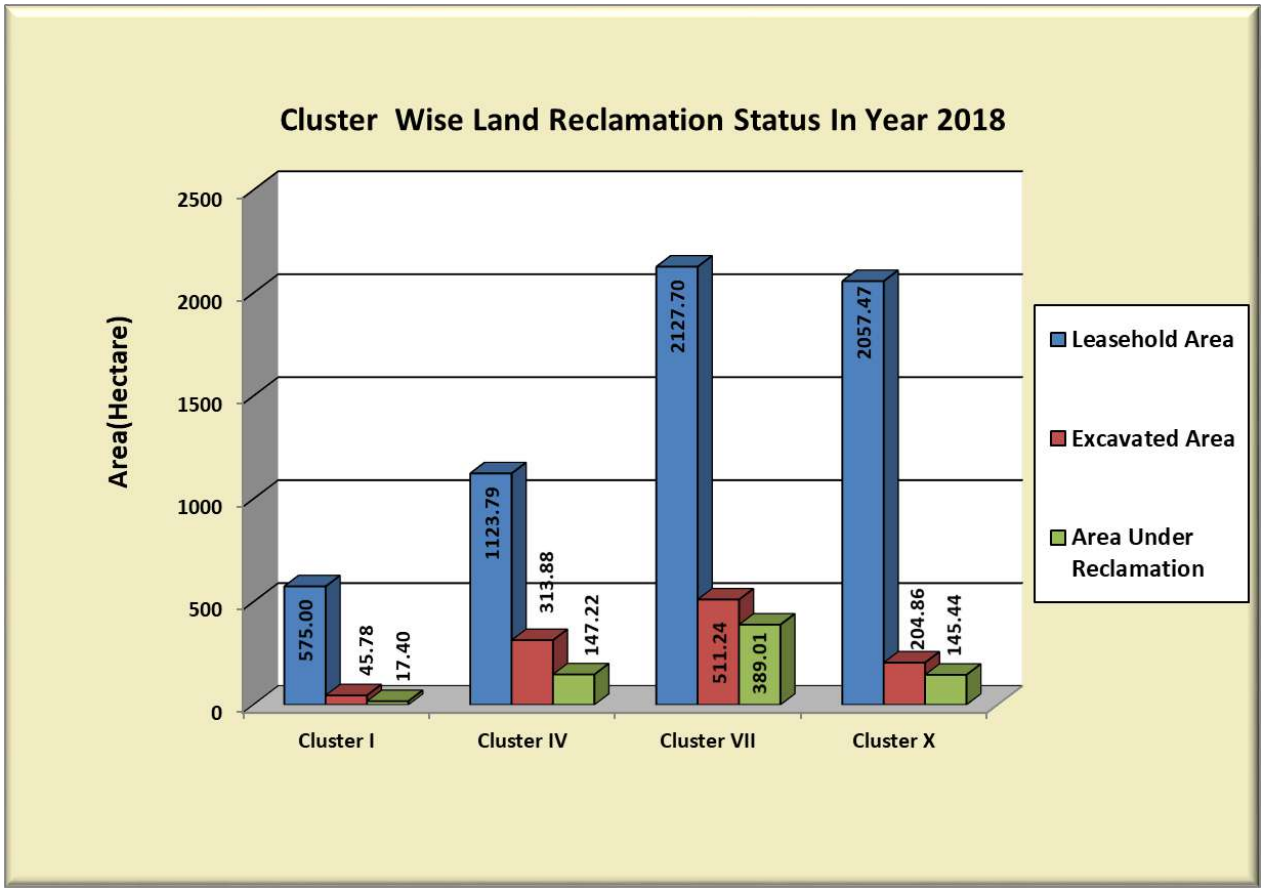


Fig. 1: Cluster wise Land Reclamation Status-2018 (BCCL)

1. Background

1.1 Land is the most important natural resource which embodies soil, water, flora, fauna and total ecosystem. All human activities are based on the land which is the scarcest natural resource in our country. Mining is a site specific industry and it could not be shifted anywhere else from the location where mineral occurs. It is a fact that surface mining activities do affect the land environment due to ground breaking. Therefore, there is an urgent need to reclaim and restore the mined out land for its productive use for sustainable development of mining. This will not only mitigate environmental degradation, but would also help in creating a more congenial environment for land acquisition by coal companies in future.

1.2 Keeping above in view, Coal India Ltd. (CIL) issued a work order vide letter no. CIL/WBP/ENV/2017/DP/8391 dated 22.06.2017 to Central Mine Planning & Design Institute (CMPDI), Ranchi, for monitoring of clusters with coal mines (both underground and open cast projects) having less than 5 million m^3 per annum capacity (Coal +OB) at an interval of three years based on remote sensing satellite data for sustainable development of mining. Earlier, CMPDI used to carry out land reclamation monitoring for individual projects of less than 5 million capacity, but from 2018 the same will be carried out cluster wise for mines of ECL & BCCL. For operational reasons and convenience, underground and opencast mines (often with multiple overlapping seams), have now been clustered together. The result of land reclamation status of all such mines are hosted on the website of CIL, (www.coalindia.in), CMPDI (www.cmpdi.co.in) and the concerned coal companies in public domain. Detailed report is submitted to Coal India and respective subsidiaries.

1.3 Land reclamation monitoring of all cluster coal mining projects would also comply the statutory requirements of Ministry of Environment & Forest (MoEF). Such monitoring would not only facilitate in taking timely mitigation measures against environmental degradation, but would also enable coal companies to utilize the reclaimed land for larger socio-economic benefits in a planned way.

1.4 Present report is embodying the finding of the study based on satellite data of the year 2018 carried out for four clusters of mines comprising both underground and OC projects for Bharat Coking Coal Ltd.

2. Objective

Objective of the land reclamation/restoration monitoring is to assess the area of backfilled, plantation, OB dumps, social forestry, active mining area, settlements and water bodies, distribution of wasteland, agricultural land and forest land in the leasehold area of the project. This is an important step taken up for assessing the progressive status of mined land reclamation and for taking up remedial measures, if any, required for environmental protection.

3. Methodology

There are number of steps involved between raw satellite data procurement and preparation of final map. National Remote Sensing Centre (NRSC) Hyderabad, being the nodal agency for satellite data supply in India, provides only raw digital satellite data, which needs further digital image processing for extracting the information and map preparation before uploading the same in the website. Methodology for land reclamation monitoring is given in fig 2. Following steps are involved in land reclamation /restoration monitoring:

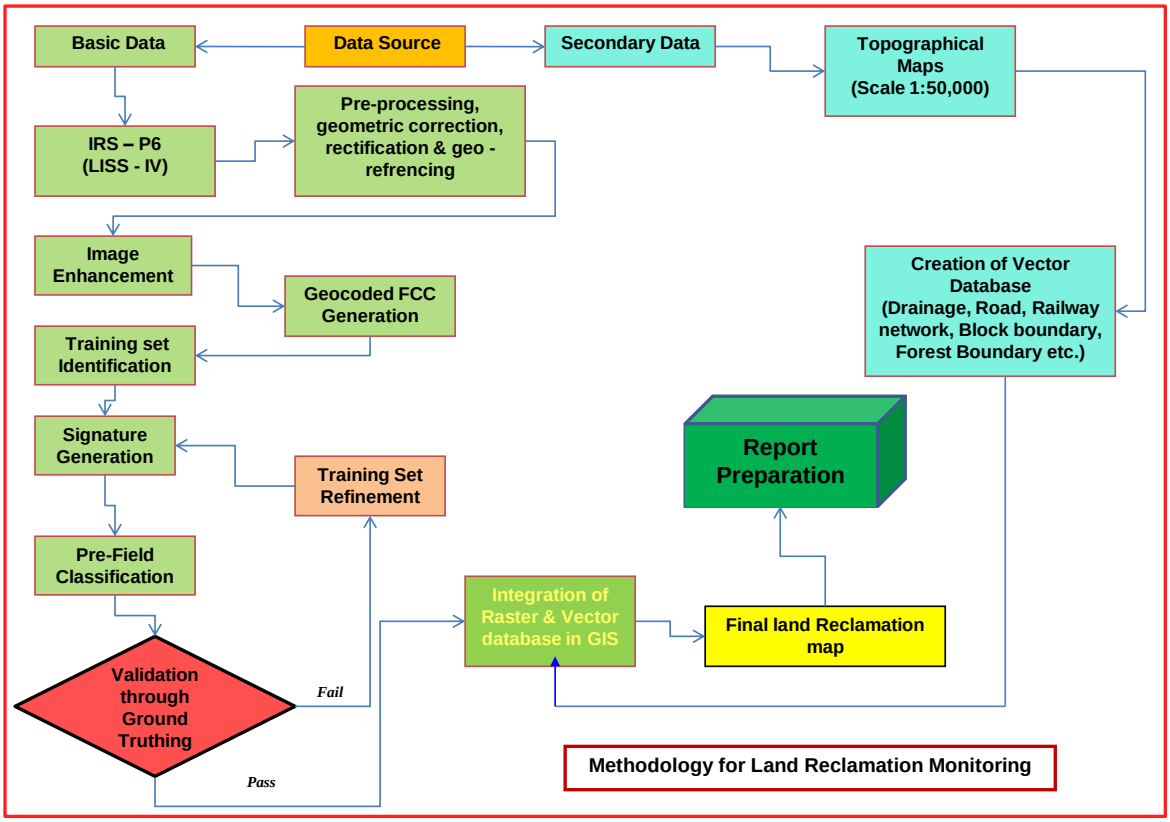


Fig. 2: Methodology of Land Reclamation Monitoring

3.1 **Data Procurement:** After browsing the data quality and date of pass on internet, supply order for data is placed to NRSC. Secondary data like leasehold boundary, toposheet are procured for creation of vector database.

3.2 **Satellite Data Processing:** Satellite data are processed using ERDAS IMAGINE digital image processing s/w. Methodology involves the following major steps:

- **Rectification & Geo-referencing:** Inaccuracies in digital imagery may occur due to 'systematic errors' attributed to earth curvature and rotation as well as 'non-systematic errors' attributed to satellite receiving station itself. Raw digital images contain geometric distortions, which make them

unusable as maps. Therefore, geo-referencing is required for correction of image data using ground control points (GCP) to make it compatible to SoI toposheet.

- **Image enhancement:**

  To improve the interpretability of the raw data, image enhancement is necessary. Local operations modify the value of each pixel based on brightness value of neighbouring pixels using ERDAS IMAGINE 14.0 s/w. and enhance the image quality for interpretation.

- **Training set selection**

  Training set requires to be selected, so that software can classify the image data accurately. The image data are analysed based on the interpretation keys. These keys are evolved from certain fundamental image-elements such as tone/colour, size, shape, texture, pattern, location, association and shadow. Based on the image-elements and other geo-technical elements like land form, drainage pattern and physiography; training sets were selected/identified for each land use/cover class. Field survey was carried out by taking selective traverses in order to collect the ground information (or reference data) so that training sets are selected accurately in the image. This was intended to serve as an aid for classification.

- **Classification and Accuracy assessment**

  Image classification is carried out using the maximum likelihood algorithm. The classification proceeds through the following steps: (a) calculation of statistics [i.e. signature generation] for the identified training areas, and (b) the decision boundary of maximum probability based on the mean vector, variance, covariance and correlation matrix of the pixels. After evaluating the statistical parameters of the training sets, reliability test of training sets is conducted by measuring the statistical separation between

the classes that resulted from computing divergence matrix. The overall accuracy of the classification was finally assessed with reference to ground truth data.

- **Area calculation**

  The area of each land use class in the leasehold is determined using ERDAS IMAGINE v. 14.0 s/w.

- **Overlay of Vector data base**

  Vector data base is created based on secondary data. Vector layer like drainage, railway line, leasehold boundary, forest boundary etc. are superimposed on the image as vector layer in the Arc GIS database.

- **Pre-field map preparation**

  Pre-field map is prepared for validation of the classification result

3.3 Ground Truthing:

Selective ground verification of the land use classes are carried out in the field and necessary corrections if required, are incorporated before map finalization.

3.4 Land reclamation database on GIS:

Land reclamation database is created on GIS platform to identify the temporal changes identified from satellite data of different cut - of dates.

4. Land Reclamation Status in Bharat Coking Coal Ltd.

4.1 In BCCL, a total of twelve clusters of mines are selected for land reclamation monitoring. Following four clusters of mines comprising both underground and OC projects of Bharat Coking Coal Ltd. have been taken up for land reclamation monitoring in 2018.

- Cluster I (Damoda OCP)
- Cluster IV (Salanpur Colliery, Katras Choitudih Colliery, Gaslitand Colliery, Amalgamated Keshalpur West Mudidih Colliery, Angarpathra Colliery & Ramkanali Colliery)
- Cluster VII (Amalgamated East Bhuggatdih Simlabahal Colliery, Ena OC, Vishwakarma OCP, Kustore OCP)
- Cluster X (Bhowrah North, Bhowrah South, Patherdih)

4.2 All the four above clusters, have been mapped during the year 2018 for assessing the progress of land reclamation.

4.3 Area statistics of different land use classes present in OC projects till the year 2018 is given in Table 2. Land use maps derived from the satellite data are given in Plate nos.1, 2, 3 & 4. The land use status are shown in Fig. 3, 4, 5 & 6.

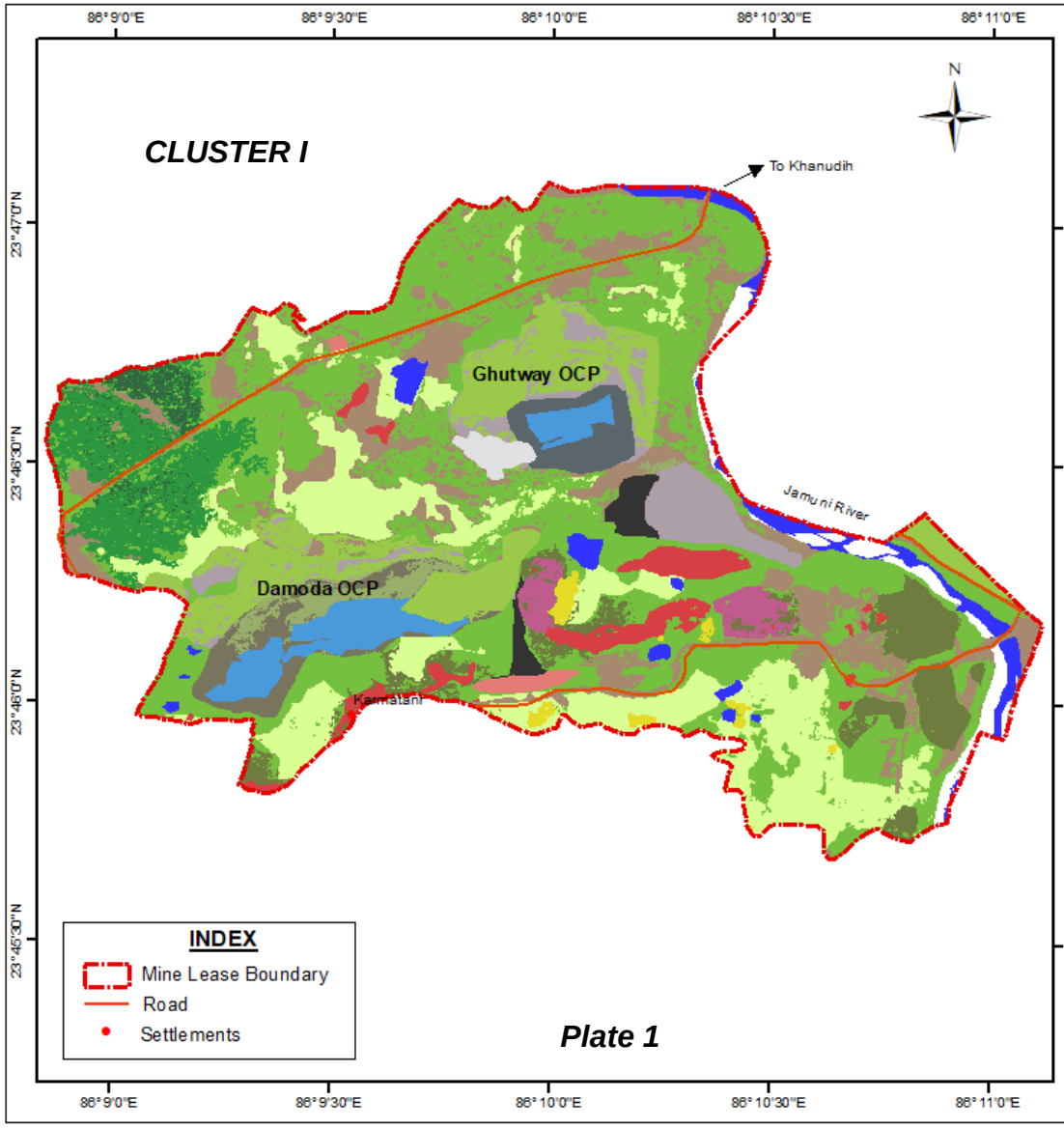
4.4 Study reveals that majority of the mines under the clusters considered for monitoring are of opencast type. 35.02% of excavated area is under active mining in the opencast mines. 58.11% of the excavated area have come under technical reclamation till 2018

Table 2

Status of Land Use/Reclamation Status in Clusters of (OC + Underground) mines of Bharat Coking Coal Limited based on Satellite Data of the year 2018

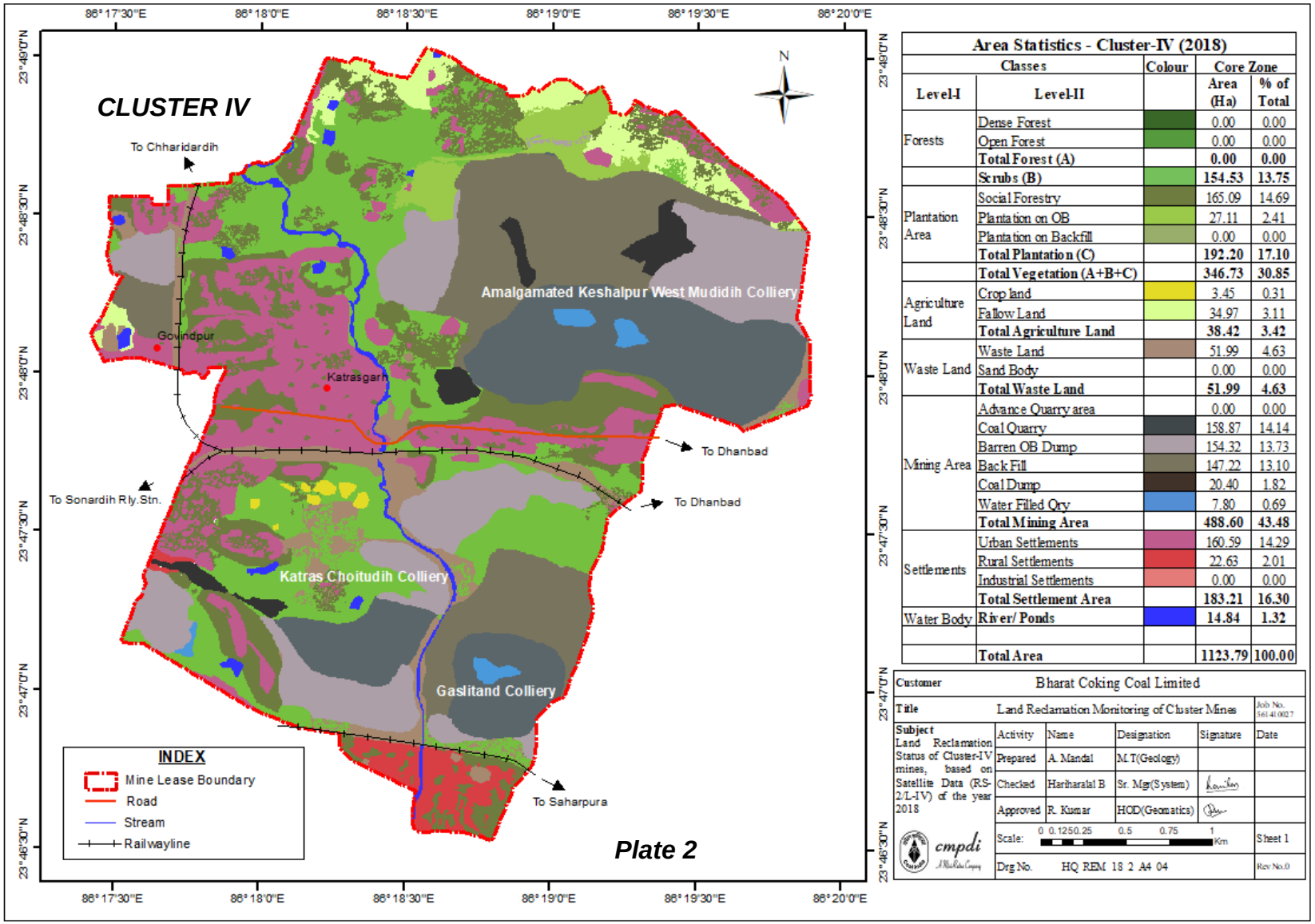
(Area in Hectare)

		CLUSTER I		CLUSTER IV		CLUSTER VII		CLUSTER X		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	5.36	0.93	0.00	0.00	0.00	0.00	0.00	0.00	5.36	0.09
	Open Forest	29.81	5.18	0.00	0.00	0.00	0.00	180.80	8.79	210.61	3.58
	Total Forest	35.17	6.12	0.00	0.00	0.00	0.00	180.80	8.79	215.97	3.67
SCRUBS	Scrubs	194.77	33.87	154.53	13.75	618.49	29.07	559.57	27.20	1527.35	25.96
PLANTATION	Social Forestry/Avenue Plantation	25.53	4.44	165.09	14.69	238.67	11.22	140.75	6.84	570.04	9.69
	Plantation on OB Dump	47.99	8.35	27.11	2.41	15.52	0.73	66.09	3.21	156.71	2.66
	Plantation on Backfill (Biological Reclamation)	7.29	1.27	0.00	0.00	37.47	1.76	29.16	1.42	73.92	1.26
	Total Plantation	80.80	14.05	192.20	17.10	291.67	13.71	236.00	11.47	800.66	13.61
	Total Vegetation	**310.75**	**54.04**	**346.73**	**30.85**	**910.15**	**42.78**	**976.37**	**47.45**	**2543.99**	**43.24**
	Coal Dump	5.26	0.91	20.40	1.82	16.03	0.75	2.84	0.14	44.53	0.76
ACTIVE MINING	Coal Quarry	8.79	1.53	158.87	14.14	119.18	5.60	46.10	2.24	332.94	5.66
	Advance Quarry Site	3.24	0.56	0.00	0.00	0.00	0.00	0.00	0.00	3.24	0.06
	Quarry Filled With Water	16.36	2.84	7.80	0.69	3.05	0.14	13.31	0.65	40.52	0.69
	Total Area under *Active Mining*	**28.39**	**4.93**	**166.67**	**14.83**	**122.23**	**5.74**	**59.41**	**2.89**	**376.69**	**6.40**
	Barren OB Dump	20.58	3.58	154.32	13.73	75.79	3.56	89.57	4.35	340.25	5.78
RECLAIMED	Area Under Backfilling (Technical Reclamation)	10.11	1.76	147.22	13.10	351.54	16.52	116.28	5.65	625.15	10.62
	Total Area under *Technical Reclamation*	**10.11**	**1.76**	**147.22**	**13.10**	**351.54**	**16.52**	**116.28**	**5.65**	**625.15**	**10.62**
	Total Area under Mine Operation	**64.33**	**11.19**	**488.60**	**43.48**	**565.59**	**26.58**	**268.10**	**13.03**	**1386.62**	**23.57**
WASTELAND	Waste Lands	69.03	12.00	51.99	4.63	162.76	7.65	153.62	7.47	437.40	7.43
	Fly Ash Pond / Sand Body	9.94	1.73	0.00	0.00	0.00	0.00	44.69	2.17	54.63	0.93
	Total Wasteland	**78.97**	**13.73**	**51.99**	**4.63**	**162.76**	**7.65**	**198.30**	**9.64**	**492.02**	**8.36**
WATERBODIES	Reservoir, nallah, ponds	14.43	2.51	14.84	1.32	18.39	0.86	194.65	9.46	242.30	4.12
	Total Waterbodies	**14.43**	**2.51**	**14.84**	**1.32**	**18.39**	**0.86**	**194.65**	**9.46**	**242.30**	**4.12**
AGRICULTURE	Crop Lands	3.52	0.61	3.45	0.31	37.65	1.77	18.29	0.89	62.91	1.07
	Fallow Lands	79.43	13.81	34.97	3.11	20.73	0.97	91.05	4.43	226.18	3.84
	Total Agriculture	**82.95**	**14.43**	**38.42**	**3.42**	**58.37**	**2.74**	**109.35**	**5.31**	**289.09**	**4.91**
SETTLEMENTS	Urban Settlement	7.17	1.25	160.59	14.29	380.73	17.89	228.39	11.10	776.88	13.20
	Rural Settlement	13.83	2.41	22.63	2.01	9.93	0.47	57.90	2.81	104.29	1.77
	Industrial Settlement	2.58	0.45	0.00	0.00	21.79	1.02	24.42	1.19	48.80	0.83
	Total Settlement	**23.58**	**4.10**	**183.21**	**16.30**	**412.45**	**19.38**	**310.71**	**15.10**	**929.96**	**15.80**
	Grand Total	**575.00**	**100.00**	**1123.79**	**100.00**	**2127.70**	**100.00**	**2057.47**	**100.00**	**5883.96**	**100.00**



Area Statistics - Cluster-I (2018)				
Classes		Colour	Core Zone	
Level-I	Level-II		Area (Ha)	% of Total
Forests	Dense Forest		5.36	0.93
	Open Forest		29.81	5.18
	Total Forest (A)		**35.17**	**6.12**
	Scrubs (B)		**194.77**	**33.87**
Plantation Area	Social Forestry		25.53	4.44
	Plantation on OB		47.99	8.35
	Plantation on Backfill		7.29	1.27
	Total Plantation (C)		**80.80**	**14.05**
	Total Vegetation (A+B+C)		**310.75**	**54.04**
Agriculture Land	Crop land		3.52	0.61
	Fallow Land		79.43	13.81
	Total Agriculture Land		**82.95**	**14.43**
Waste Land	Waste Land		69.03	12.00
	Sand Body		9.94	1.73
	Total Waste Land		**78.97**	**13.73**
Mining Area	Advance Quarry area		3.24	0.56
	Coal Quarry		8.79	1.53
	Barren OB Dump		20.58	3.58
	Back Fill		10.11	1.76
	Coal Dump		5.26	0.91
	Water Filled Qry		16.36	2.84
	Total Mining Area		**64.33**	**11.19**
Settlements	Urban Settlements		7.17	1.25
	Rural Settlements		13.83	2.41
	Industrial Settlements		2.58	0.45
	Total Settlement Area		**23.58**	**4.10**
Water Body	**River/ Ponds**		**14.43**	**2.51**
	Total Area		**575.00**	**100.00**

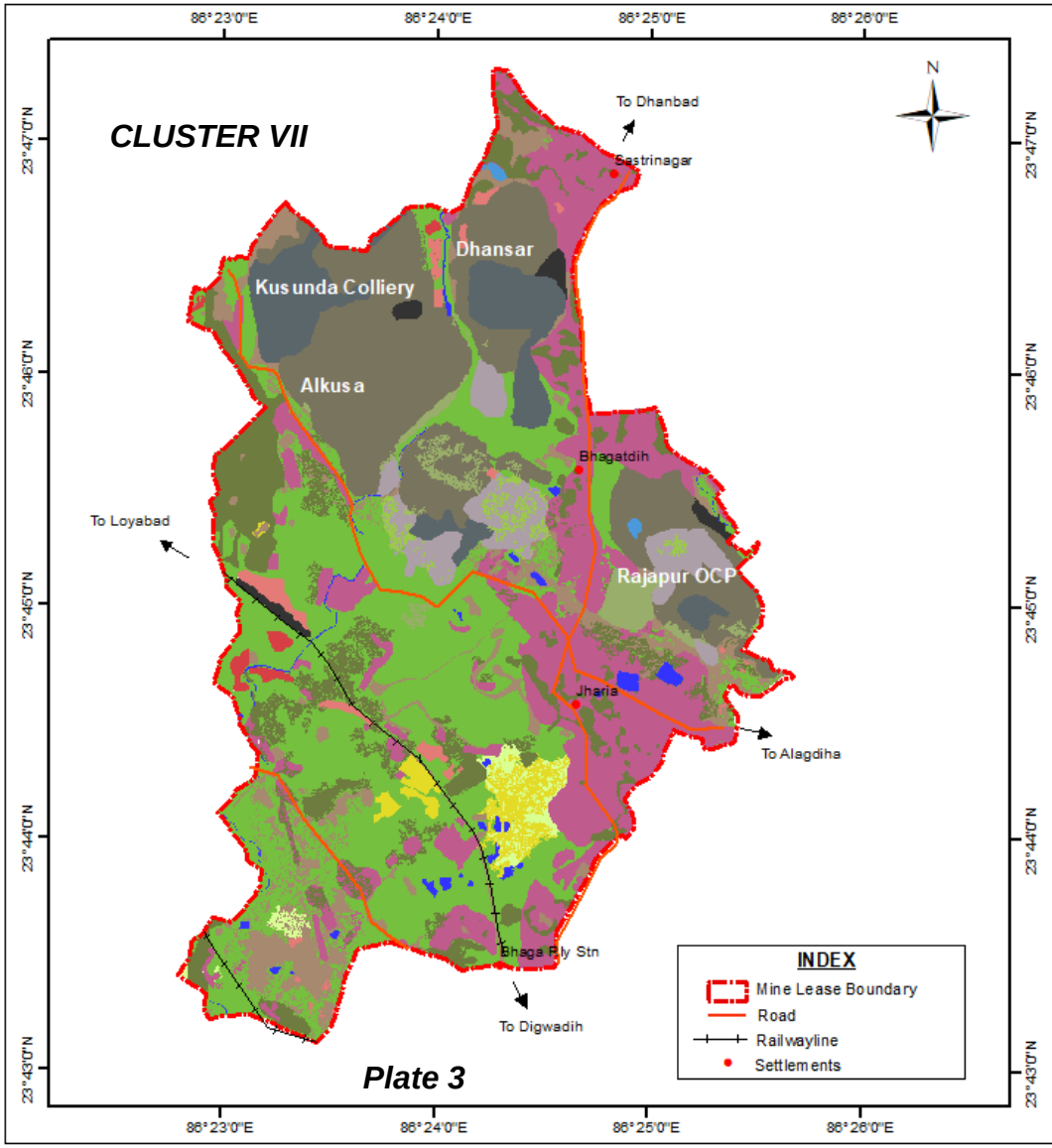
Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of Cluster Mines				Job No. 561410027
Subject: Land Reclamation Status of Cluster-I mines, based on Satellite Data (RS-2/L-IV) of the year 2018	Activity	Name	Designation	Signature	Date
	Prepared	A. Mandal	M.T (Geology)		
	Checked	Hariharalal B	Sr. Mgr(System)		
	Approved	R. Kumar	HOD(Geomatics)		
cmpdi	Scale: 0 0.1 0.2 0.4 0.6 0.8 Km				Sheet 1
	Drg No. HQ REM 18 2 A4 03				Rev No.0



Area Statistics - Cluster-IV (2018)

Classes		Colour	Core Zone	
Level-I	Level-II		Area (Ha)	% of Total
Forests	Dense Forest		0.00	0.00
	Open Forest		0.00	0.00
	Total Forest (A)		**0.00**	**0.00**
	Scrubs (B)		**154.53**	**13.75**
Plantation Area	Social Forestry		165.09	14.69
	Plantation on OB		27.11	2.41
	Plantation on Backfill		0.00	0.00
	Total Plantation (C)		**192.20**	**17.10**
	Total Vegetation (A+B+C)		**346.73**	**30.85**
Agriculture Land	Crop land		3.45	0.31
	Fallow Land		34.97	3.11
	Total Agriculture Land		**38.42**	**3.42**
Waste Land	Waste Land		51.99	4.63
	Sand Body		0.00	0.00
	Total Waste Land		**51.99**	**4.63**
Mining Area	Advance Quarry area		0.00	0.00
	Coal Quarry		158.87	14.14
	Barren OB Dump		154.32	13.73
	Back Fill		147.22	13.10
	Coal Dump		20.40	1.82
	Water Filled Qry		7.80	0.69
	Total Mining Area		**488.60**	**43.48**
Settlements	Urban Settlements		160.59	14.29
	Rural Settlements		22.63	2.01
	Industrial Settlements		0.00	0.00
	Total Settlement Area		**183.21**	**16.30**
Water Body	**River/ Ponds**		**14.84**	**1.32**
	Total Area		**1123.79**	**100.00**

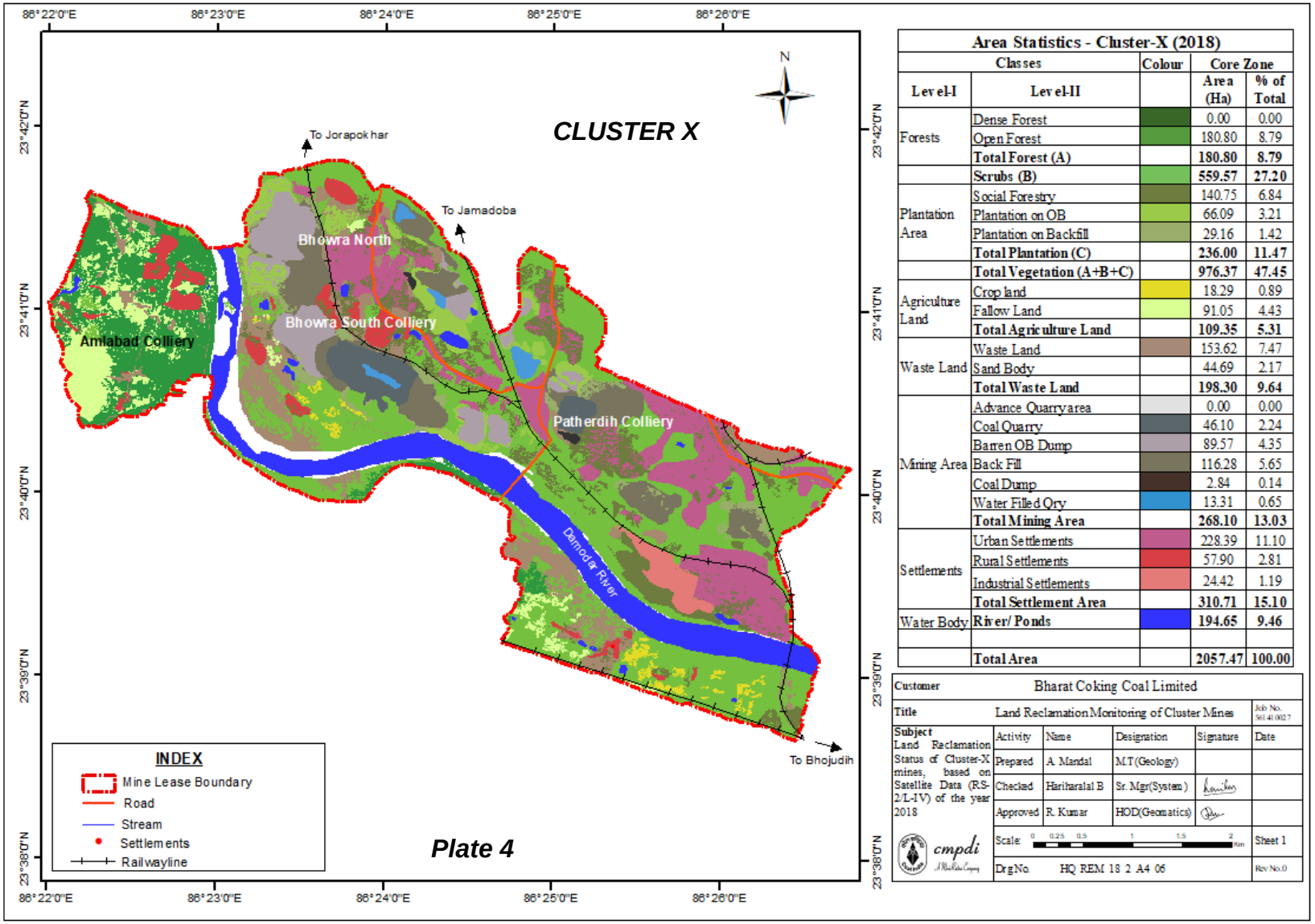
Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of Cluster Mines				Job No. 561410027
Subject: Land Reclamation Status of Cluster-IV mines, based on Satellite Data (RS-2/L-IV) of the year 2018	Activity	Name	Designation	Signature	Date
	Prepared	A. Mandal	M.T(Geology)		
	Checked	Hariharalal B	Sr. Mgr(System)		
	Approved	R. Kumar	HOD(Geomatics)		
cmpdi	Scale: 0 0.125 0.25 0.5 0.75 1 Km				Sheet 1
	Drg No. HQ REM 18 2 A4 04				Rev No.0



Area Statistics - Cluster-VII (2018)

Classes		Colour	Core Zone	
Level-I	Level-II		Area (Ha)	% of Total
Forests	Dense Forest		0.00	0.00
	Open Forest		0.00	0.00
	Total Forest (A)		**0.00**	**0.00**
	Scrubs (B)		**618.49**	**29.07**
Plantation Area	Social Forestry		238.67	11.22
	Plantation on OB		15.52	0.73
	Plantation on Backfill		37.47	1.76
	Total Plantation Area (C)		**291.67**	**13.71**
	Total Vegetation (A+B+C)		**910.15**	**42.78**
Agriculture Land	Crop land		37.65	1.77
	Fallow Land		20.73	0.97
	Total Agriculture Land		**58.37**	**2.74**
Waste Land	Waste Land		162.76	7.65
	Sand Body		0.00	0.00
	Total Waste Land		**162.76**	**7.65**
Mining Area	Advance Quarry area		0.00	0.00
	Coal Quarry		119.18	5.60
	Barren OB Dump		75.79	3.56
	Back Fill		351.54	16.52
	Coal Dump		16.03	0.75
	Water Filled Qry		3.05	0.14
	Total Mining Area		**565.59**	**26.58**
Settlements	Urban Settlements		380.73	17.89
	Rural Settlements		9.93	0.47
	Industrial Settlements		21.79	1.02
	Total Settlement Area		**412.45**	**19.38**
Water Body	**River/ Ponds**		**18.39**	**0.86**
	Total Area		**2127.70**	**100.00**

Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of Cluster Mines				Job No. 561410027
Subject: Land Reclamation Status of Cluster-VII mines, based on Satellite Data (RS-2/L-IV) of the year 2018	Activity	Name	Designation	Signature	Date
	Prepared	A. Mandal	M.T(Geology)		
	Checked	Hariharalal B	Sr. Mgr(System)		
	Approved	R. Kumar	HOD(Geomatics)		
cmpdi	Scale: 0 0.25 0.5 1 1.5 2 Km				Sheet 1
	Drg No. HQ REM 18 2 A4 05				Rev No 0



Area Statistics - Cluster-X (2018)

Classes		Colour	Core Zone	
Level-I	Level-II		Area (Ha)	% of Total
Forests	Dense Forest		0.00	0.00
	Open Forest		180.80	8.79
	Total Forest (A)		**180.80**	**8.79**
	Scrubs (B)		**559.57**	**27.20**
Plantation Area	Social Forestry		140.75	6.84
	Plantation on OB		66.09	3.21
	Plantation on Backfill		29.16	1.42
	Total Plantation (C)		**236.00**	**11.47**
	Total Vegetation (A+B+C)		**976.37**	**47.45**
Agriculture Land	Crop land		18.29	0.89
	Fallow Land		91.05	4.43
	Total Agriculture Land		**109.35**	**5.31**
Waste Land	Waste Land		153.62	7.47
	Sand Body		44.69	2.17
	Total Waste Land		**198.30**	**9.64**
Mining Area	Advance Quarry area		0.00	0.00
	Coal Quarry		46.10	2.24
	Barren OB Dump		89.57	4.35
	Back Fill		116.28	5.65
	Coal Dump		2.84	0.14
	Water Filled Qry		13.31	0.65
	Total Mining Area		**268.10**	**13.03**
Settlements	Urban Settlements		228.39	11.10
	Rural Settlements		57.90	2.81
	Industrial Settlements		24.42	1.19
	Total Settlement Area		**310.71**	**15.10**
Water Body	**River/ Ponds**		**194.65**	**9.46**
	Total Area		**2057.47**	**100.00**

Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of Cluster Mines				Job No. 561410027
Subject: Land Reclamation Status of Cluster-X mines, based on Satellite Data (RS-2/L-IV) of the year 2018	Activity	Name	Designation	Signature	Date
	Prepared	A. Mandal	M.T (Geology)		
	Checked	Hariharalal B	Sr. Mgr(System)		
	Approved	R. Kumar	HOD(Geomatics)		
	Scale: 0 0.25 0.5 1 1.5 2 Km				Sheet 1
	Drg No. HQ REM 18 2 A4 06				Rev No.0

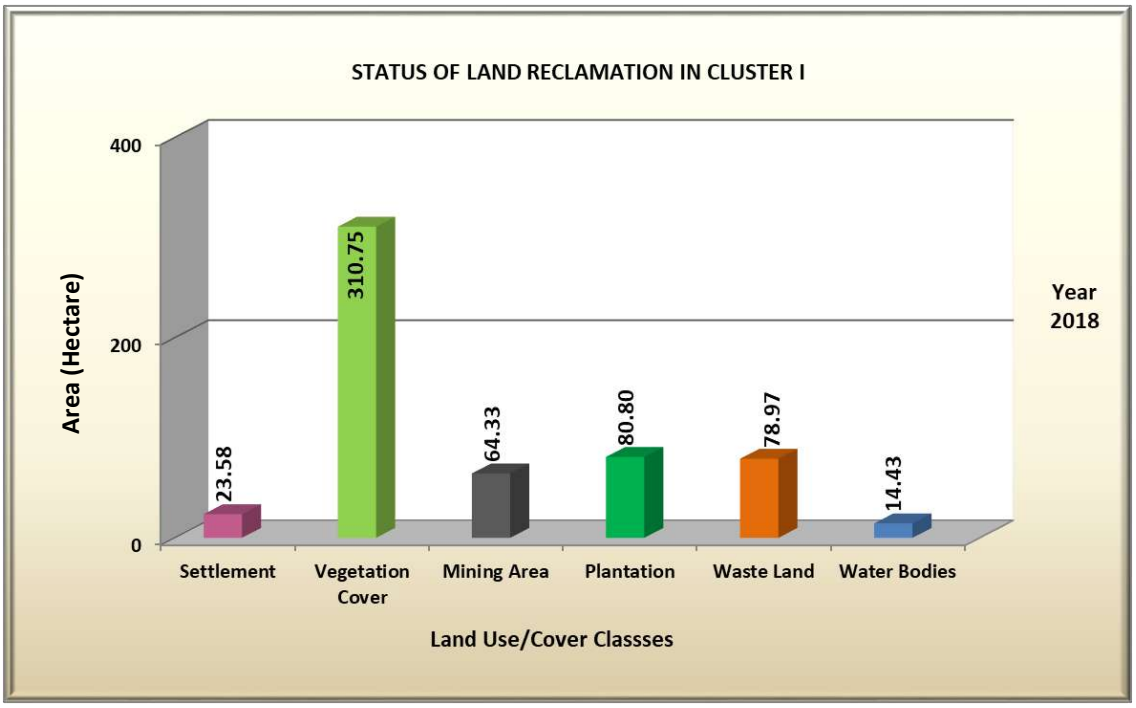


Fig. 3: Land Reclamation status of Cluster I

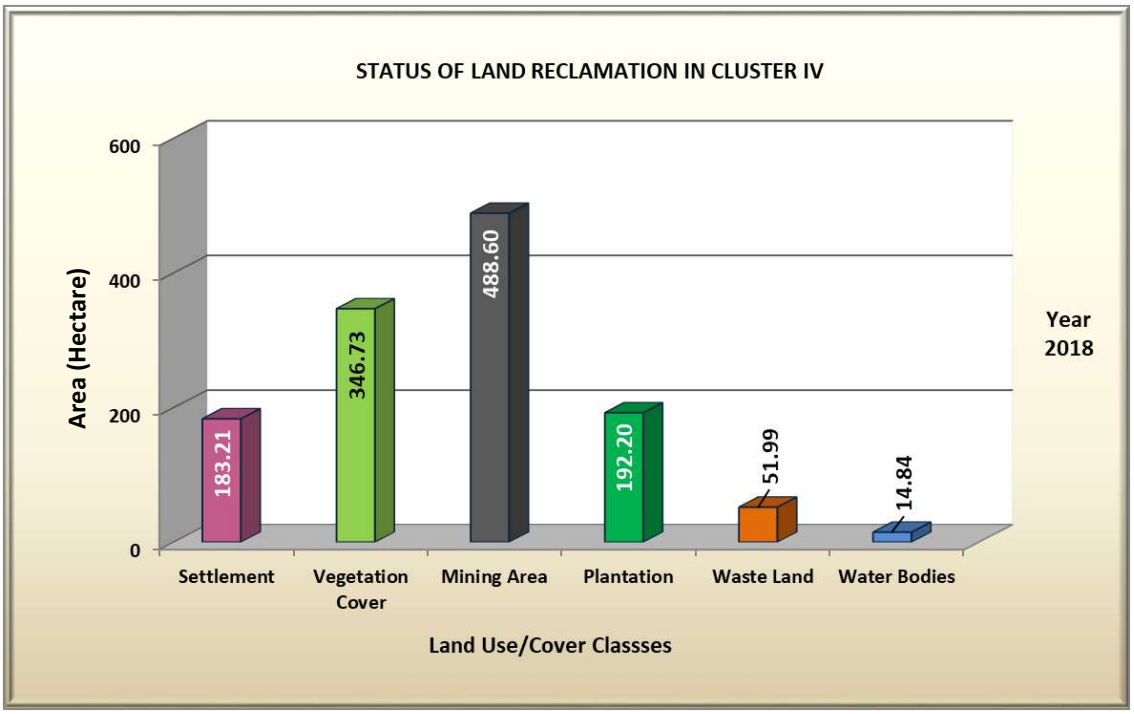


Fig. 4: Land Reclamation status of Cluster IV

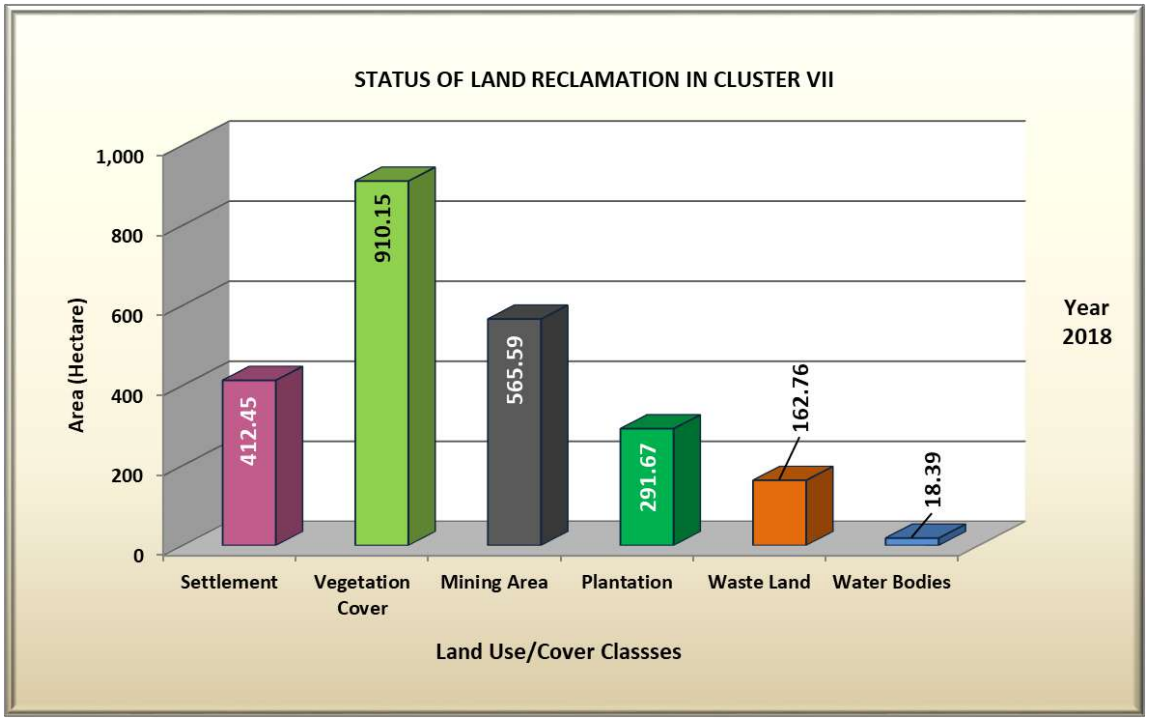


Fig. 5: Land Reclamation status of Cluster VII

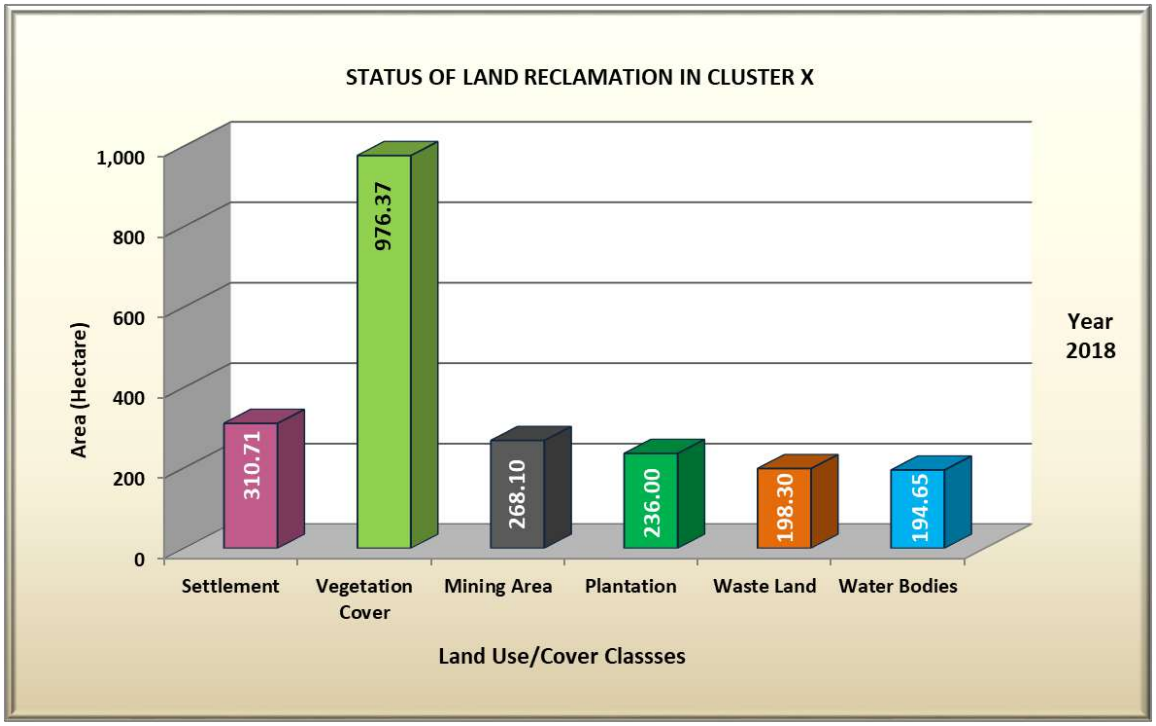


Fig. 6: Land Reclamation status of Cluster X

Photo 1: Ecological Restoration Site, Damoda Colliery, Cluster I

Photo 2: Ecological Restoration Site in Cluster IV

Photo 3: Ecological Restoration Site in Cluster VII

Photo 4: Plantation on OB in Cluster X

Central Mine Planning & Design Institute Ltd.
(A Subsidiary of Coal India Ltd.)
Gondwana Place, Kanke Road, Ranchi 834031, Jharkhand
Phone : (+91) 651 2230001, 2230002, 2230483, FAX (+91) 651 2231447, 2231851
Website : www.cmpdi.co.in, Email : cmpdihq@cmpdi.co.in

भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, पूर्वी झरिया क्षेत्र
पो.ओ.- भौरा, जिला - धनबाद (झारखण्ड)
पिन - 828302. दूरभाष - 0326-2320077,
ईमेल-cgmej@bccl.gov.in
पंजीकृत कार्यालय: कोयला भवन, कोयला नगर,
धनबाद- 825005, (झारखण्ड)
CIN: U10101JH1972GOI000918

Bharat Coking Coal Limited XXIII
A MINI RATNA Co.
(A Subsidiary of Coal India Ltd)
Office of the General Manager, Eastern Jharia Area
P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302
Tel.:0326-2320077, Email-cgmej@bccl.gov.in
Regd.Off: Koyla Bhawan, Koyla Nagar, Dhanbad-825005,
CIN: U10101JH1972GOI000918,
Tel.:0326-2230190/FAX: 0326-2230050, Email – cos@bccl.gov.in

Ref. No.: BCCL/EJ/GM/ENV/EC/2019/ Date: 18/04/2019

OFFICE ORDER

An Environment Management Cell (EMC) of Eastern Jharia Area is hereby constituted with following members:

1. General Manager, E.J. Area	-- Chairman
2. Addl. General Manager, E.J. Area	-- Vice Chairman
3. Area Manager (Environment), E.J. Area	-- Member
4. Area Safety Officer, E.J. Area	-- Member
5. Area Manager (Planning), E.J. Area	-- Member
6. Area Finance Manager, E.J. Area	-- Member
7. Area Personnel Manager, E.J. Area	-- Member
8. Area Manager (Survey), E.J. Area	-- Member
9. Area Manager (E&M), E.J. Area	-- Member
10. Area Manager (Excavation), E.J. Area	-- Member
11. Area Manager (Estate/CD/CSR), E.J. Area	-- Member
12. Project Officer – Bh N/Bh S/ ASP Colliery	-- Member

Environment Management Cell will monitor & co-ordinate with project officers to ensure the compliance of conditions imposed in Environment Clearance granted by Ministry of Environment, Forest & Climate Change.

20/4/19
General Manger
Eastern Jharia Area

Copy to:

1. Dy.GM / HOD (Env.), KB, BCCL
2. All Project Officers, E.J. Area
3. Executive concerned
4. Office copy

STRICTLY RESTRICTED
FOR COMPANY USE ONLY RESTRICTED
The information given in this report is not to be communicated either directly or indirectly to the press or to any person not holding an official position in the CIL /GOVERNMENT.

ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER –X

(FOR THE MONTH MARCH, 2019)

E. C. no. J-11015/380/2010-IA.II (M) dated 06.02.2013.

CMPDI
ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CONTENTS

SL. NO.	CHAPTER	PARTICULARS	PAGE NO.
1.	CHAPTER - I	EXECUTIVE SUMMARY	3-5
2.	CHAPTER-II	INTRODUCTION	6
3.	CHAPTER-III	ANALYSIS & RESULTS	7-13
4.	CHAPTER-IV	STANDARDS & PLANS	14
		PLATE NO. – I SURFACE PLAN SHOWING AIR/NOISE MONITORING STATIONS	
		PLATE NO. – II SURFACE PLAN SHOWING WATER MONITORING LOCATIONS	15

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the fauna and flora. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. The three major attributes are air, water and noise level.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by $23^0$37' N to $23^0$52' N latitudes and $86^0$09' E to $86^0$30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

The ambient air quality monitoring stations were selected to represent core, buffer zone area. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

2.2 Water sampling stations

The Water sampling stations were selected for mine sump water.

2.3 Noise level monitoring locations

Noise levels vary depending on the various activities in mining areas. The monitoring of noise level in different locations will be helpful to take appropriate mitigating measures. The noise levels were recorded in mining area, washery and in residential area.

3.0 Methodology of sampling and analysis

3.1 Ambient air quality

Parameters chosen for assessment of ambient air quality were Particulate Matter (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di-oxide (SO_2) and Nitrogen Oxides (NO_X). Respirable Dust Samplers (RDS) and Fine Dust

Sampler ($PM_{2.5}$ sampler) were used for sampling of $PM_{10,}$ SO_2, & NO_X and Fine Dust Sampler ($PM_{2.5}$ sampler) were used for sampling of $PM_{2.5}$ at 24 hours interval once in a fortnight and the same for the gaseous pollutants. The samples were analyzed in Environmental Laboratory of CMPDI, RI-II, Dhanbad.

3.2 Water quality

Water samples were collected as per standard practice. The Mine effluent samples were collected and analyzed for four parameters on fortnightly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory of CMPDI, RI- II, Dhanbad.

3.3 Noise level monitoring

Noise level measurements in form of 'L_{EQ}' were taken using Integrated Data Logging Sound Level Meter. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB(A).

4.0 Results and interpretations

4.1 Air quality

It has been seen from the analysis results that the 24 hours average concentration parameters like $PM_{10,}$ $PM_{2.5}$, SO_2 and NO_X are mostly within the permissible limits in all sampling locations as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines and National Ambient Air Quality Standard -2009. Sometimes the concentration of PM_{10}& $PM_{2.5}$ exceeds the limits due to heavy public traffic, poor road condition, coke oven plants, burning of coal by surrounding habitants, brick making, municipal waste dumps and industries like Steel Plant, thermal Plants including their fly ash etc.

The following preventive and suppressive mitigative measures can be undertaken to contain the pollution level within prescribed level:-

- Wet drilling and controlled blasting should be practice.
- Explosive used should be optimised to restrict the dust generation.
- Transportation roads should be permanently asphalted free of ruts, potholes etc.
- Water should be sprayed on coal transportation road, service road more frequently and at regular interval.
- Dust from roads should be removed physically or mechanically.
- Greenbelts around industrial sites, service building area besides Avenue plantation along roads should be created.
- Coal dust should be suppressed by using fixed sprinklers.
- Regular maintenance of plant and machinery should be undertaken.

4.2 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mineswere within permissible limits.

4.3 Noise Level

During the noise level survey it has been observed that the noise level in the sampling locations is within the permissible limits prescribed as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines for Industrial Area and Noise pollution (Regulation and Control) Rules, 2000.

INTRODUCTION

1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India.

The very purpose of environmental monitoring is to assess the quality of various attributes which affects the environment. As per quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. The three major attributes are air, water and noise level.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

1.1 The Cluster-X is in the Eastern part of the Jharia coalfield. It includes a group of 6 Mines (viz. Amlabad UG, Bhowra north, Bhowra South, Patherdih, Sudamdih Incline&Sudamdih Shaft. The Cluster–X is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster–X are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by Damodar River.

1.2 The Cluster-X is designed to produce 1.762 MTPA (normative) and 2.289 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 1.762 MTPA (normative) and 2.289 MTPA (peak) capacity of coal production vide letter no. J-11015/380/2010-IA.II (M) dated 06thFebruary, 2013.

Ministry of Environment, Forest and Climate Change while granting environmental clearance has given one of the General conditions that " Four ambient air quality monitoring stations should be established in the core zone as well as in the buffer zone for PM_{10}, $PM_{2.5}$, SO_2, NOx monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets, other conditions regarding water / effluent and noise level monitoring in consultation with the State Pollution Control Board."

In compliance of these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC& JSPCB and other statutory authorities.

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

(As per G.S.R. 742 (E) dt. 25th December, 2000)

2.1.1 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) Bhowrah North (A14): Industrial Area

The location of the sampling station is 23°41'37.00"N 86°23'54.00"E. The sampler was placed at an elevated platform of around 1.5m height from ground level at Guest House of EJ Area.

ii) Sudamdih Washery (A15): Industrial Area

The location of the sampling station is 23°39'31.00"N 86°25'48.00"E. The sampler was placed at elevated platform of around 1.5m height from ground level at Coal lab near washery.

II. BUFFER ZONE Monitoring Location

i) Jeenagora (A13): Industrial Area

The location of the sampling station is 23°42'31.00"N 86°26'38.00"E. The sampler was placed elevated platform of around 1.5m height from ground level at Safety Office.

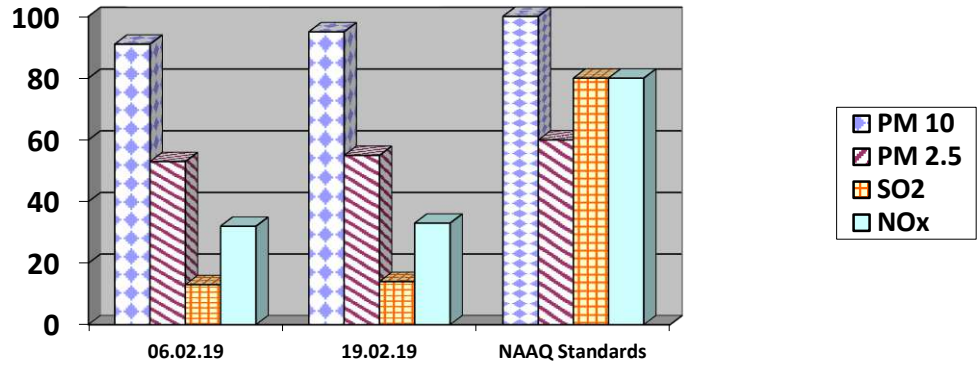
ii) Sitanala (A30): Industrial Area

This location of the sampling station is 23°41'15.00"N 86°22'39.00"E, at the Amlabad Project office which is currently in-operational. It has been selected to study the impact of Air pollution in the buffer zone on the Cluster.

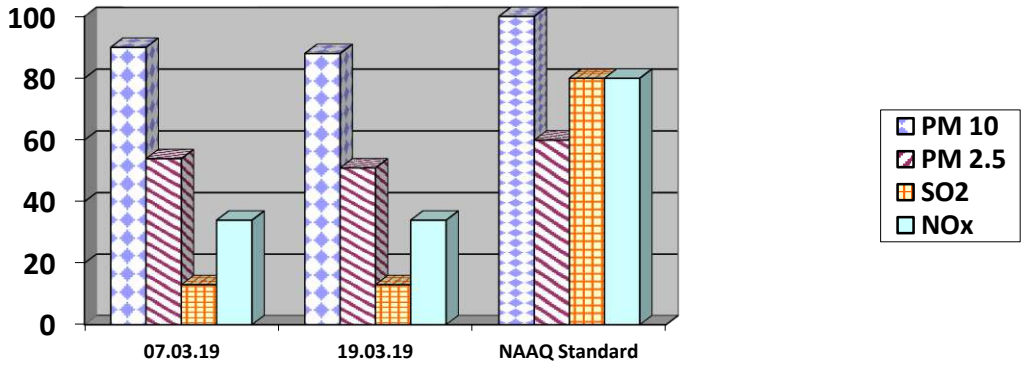
AMBIENT AIR QUALITY DATA

Cluster – X, Bharat Coking Coal limited Month: **MARCH ,2019** Year: **2018-19.**

Station Name: A14-Bhowrah North		Zone: Core		Category: Industrial	
Sl. No.	**Dates of sampling**	**PM 10**	**PM 2.5**	**SO2**	**NOx**
1	06.03.19	92	54	14	33
2	19.03.19	89	49	14	32
	NAAQ Standards	100	60	80	80



StationName: A15-Sudamdih Washery		Zone: Core		Category: Industrial	
Sl. No.	**Dates of sampling**	**PM 10**	**PM 2.5**	**SO_2**	**NO_X**
1	07.03.19	90	54	13	34
2	19.03.19	88	51	13	34
	NAAQ Standard	100	60	80	80

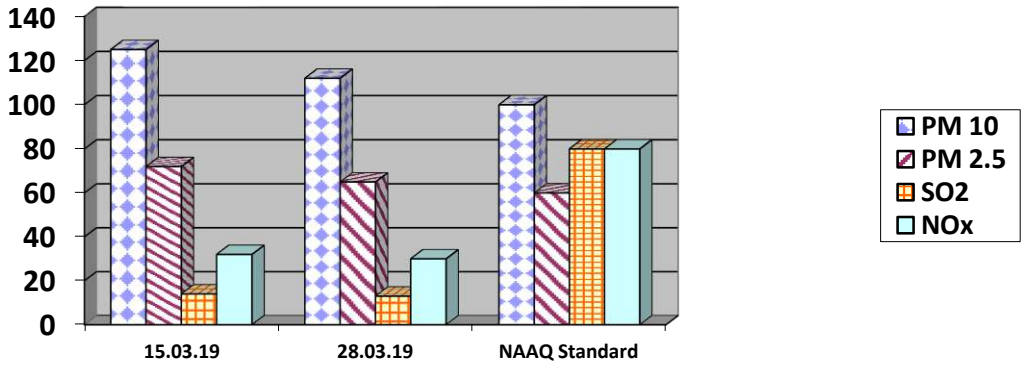


Analysed By
JSA/SA/SSA

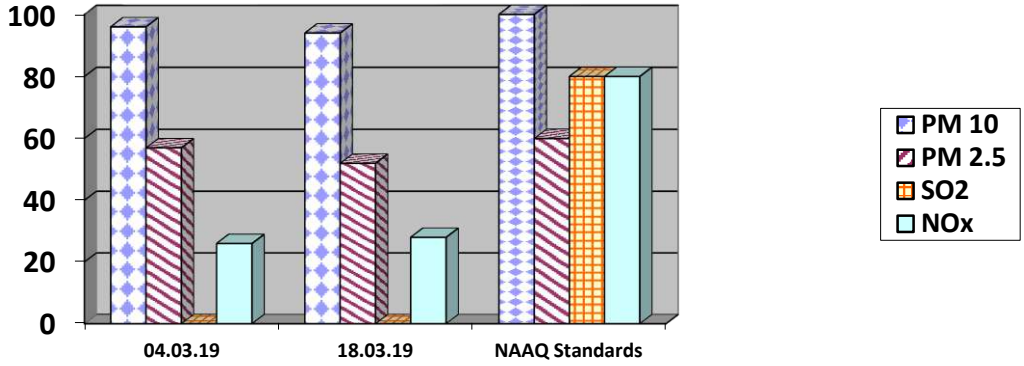
Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(Mining/Environment)
RI-2, CMPDI, Dhanbad

Station Name: A13 – Jeenagora		Zone: Buffer		Category: industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_X
1	15.03.19	125	72	14	32
2	28.03.19	112	65	13	30
	NAAQ Standard	100	60	80	80



StationName: A30 – Sitanala		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	04.03.19	96	57	<10	26
2	18.03.19	94	52	<10	28
	NAAQ Standards	100	60	80	80



- *All values are expressed in microgram per cubic meter.*
- *24 hours duration*

Analysed By
JSA/SA/SSA

Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(Mining/Environment)
RI-2, CMPDI, Dhanbad

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Bhowrah North (MW10)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Kashi jore.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analyzed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI RI-II, Dhanbad.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results are compared with Schedule - VI, effluent prescribed by MoEF&CC. Results show that most of the parameters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER- FOUR PARAMETERS)

Name of the Cluster: **Cluster -X**		Month: **MARCH , 2019**	Name of the Station: **Mine Discharge of Bhowrah North**	
Sl. No.	**Parameters**	**MW10** First Fortnight **06.03.19**	**MW10** Second Fortnight **20.03.19**	**As per MOEF General Standards for schedule VI**
1	Total Suspended Solids	36	22	*100 (Max)*
2	pH	8.01	7.87	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	56	40	*250 (Max)*

All values are expressed in mg/lit. except pH.

Analysed By
JSA/SA/SSA

Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(Mining/Environment)
RI-2, CMPDI, Dhanbad

NOISE LEVEL QUALITY MONITORING

4.1Location of sampling sites

1. **Bhowrah North (N14)**
2. **SudamdihWashery (N15)**
3. **Jeenagora (N13)**
4. **Sitanala (N30)**

Methodology of sampling and analysis

Noise level measurements in form of 'L_{EQ}' were taken using Integrated Data Logging Sound Level Meter (NL-52 OF RION CO. Ltd. Make) during day time. Noise levels were measured for about one hour time in day time. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

4.2 Results & Interpretations

Ambient noise levels were recorded during day time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day time on fortnightly basis are presented in tabular form along with the applicable standard permissible limits. The observed values in terms of L_{EQ} are presented**.** The observed values at all the monitoring locations are found to be within permissible limits.

NOISE LEVEL DATA

Name of the Project: **Cluster -X**			Month: **MARCH , 2019**		
Sl. No.	**Station Name/Code**	**Category of area**	**Date**	**Noise level dB(A)LEQ**	***Permissible Limit of Noise level in dB(A)***
1	Jeenagora (N13)	Industrial area	15.03.19	60.3	*75*
2	Jeenagora (N13)	Industrial area	28.03.19	64.7	*75*
3	BhowrahNorth(N14)	Industrial area	06.03.19	61.4	*75*
4	BhowrahNorth(N14)	Industrial area	19.03.19	55.6	*75*
5	SudamdihWashery (N15)	Industrial area	07.03.19	65.5	*75*
6	SudamdihWashery (N15)	Industrial area	19.03.19	66.4	*75*
7	Sitanala (N30)	Residential area	04.03.19	58.4	*55*
8	Sitanala (N30)	Residential area	18.03.19	56.3	*55*

Permissible limits of Noise Level as per MOEF Gazette Notification No. GSR 742(E) dt. 25.09.2000 Standards for Coal Mines and Noise Pollution (Regulation and Control) Rules, 2000.

*** Day Time: 6.00 AM to 10.00 PM.**

Analysed By
JSA/SA/SSA

Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(Mining/Environment)
RI-2, CMPDI, Dhanbad

Ambient Air Quality Standards for Jharia Coal Field
As per the Environment (Protection) Amendment Rules, 2000 notified vide notification G.S.R. 742(E), dated 25.9.2000.

Category	Pollutant	Time weighted average	Concentration in Ambient Air	Method of Measurement
1	2	3	4	5
III Coal mines located in the coal fields of • Jharia • Raniganj • Bokaro	Suspended Particulate Matter (SPM)	Annual Average * 24 hours **	500 µg/m^3 700 µg/m^3	- High Volume Sampling (Average flow rate not less than 1.1 m^3
	Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average * 24 hours **	250 µg/m^3 300 µg/m^3	Respirable Particulate Matter sampling and analysis
	Sulphur Dioxide (SO_2)	Annual Average * 24 hours **	80 µg/m^3 120 µg/m^3	1.Improvedwest and Gaeke method 2.Ultraviolet fluorescene
	Oxide of Nitrogen as NO_2	Annual Average * 24 hours **	80 µg/m^3 120 µg/m^3	1. Jacob &Hochheiser Modified (Na-Arsenic) Method 2. Gas phase Chemilumine-scence

Note:

* Annual Arithmetic mean for the measurements taken in a year, following the guidelines for frequency of sampling laid down in clause2.

** 24hourly/8hourlyvaluesshallbemet92%ofthetimeinayear.However,8% of the time it may exceed but not on two consecutivedays.

NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th FEBRUARY 2009

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th October 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect.

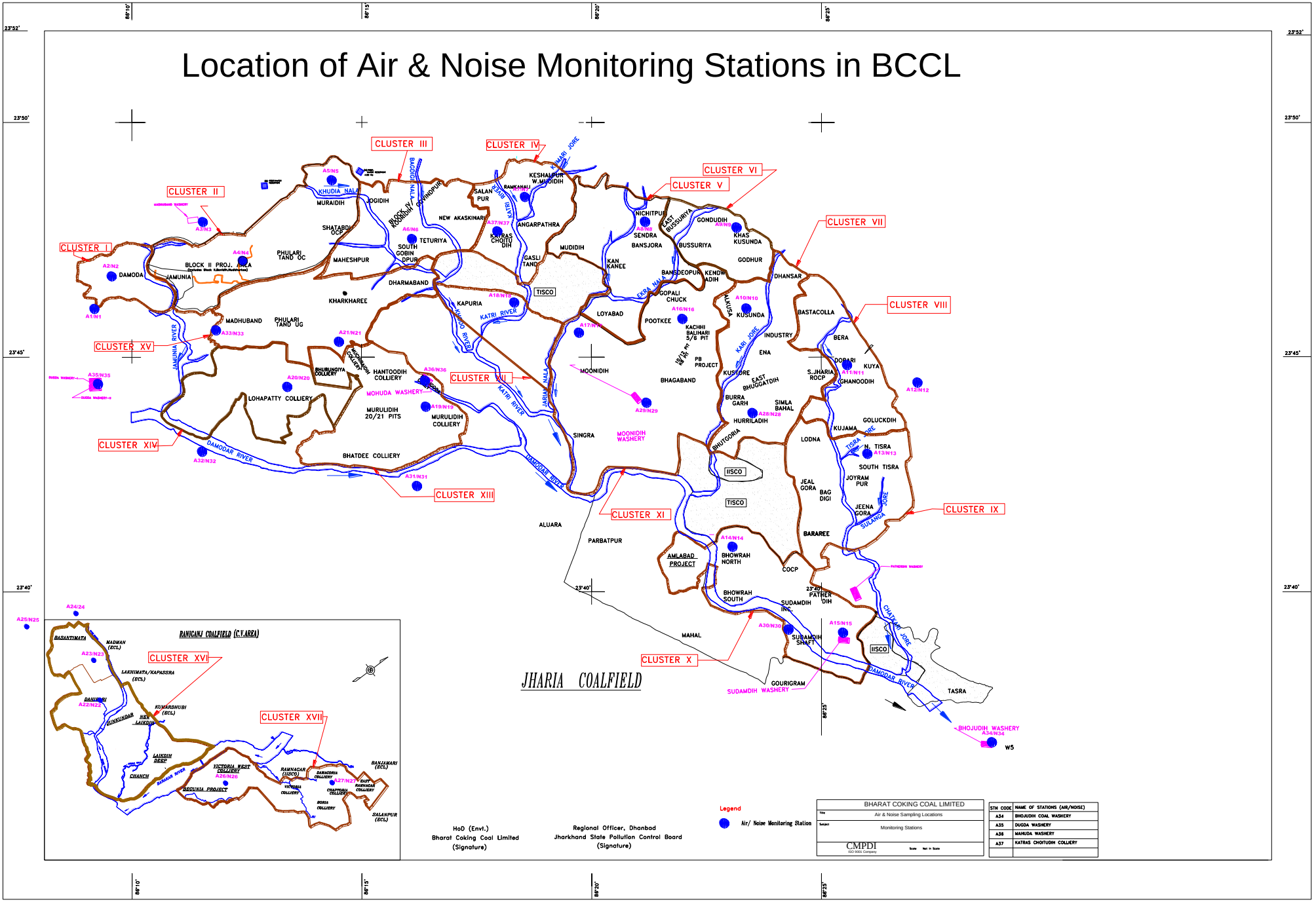
Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO_2), µg/m³	Annual * 24 Hours **	50 80	20 80	-Improved West and Gaeke Method -Ultraviolet Fluorescence
Nitrogendioxide (NO_2), µg/m³	Annual * 24 Hours **	40 80	30 80	-Jacob &Hochheiser modified ($NaOH$-$NaAsO_2$) Method -Gas Phase Chemiluminescence
Particulate Matter (Size less than 10µm) or PM_{10}, µg/m³	Annual * 24 Hours **	60 100	60 100	-Gravimetric -TEOM -Beta attenuation
Particulate Matter (Size less than 2.5µm) or $PM_{2.5}$, µg/m³	Annual * 24 Hours **	40 60	40 60	-Gravimetric -TEOM -Beta attenuation
Ozone (O_3) , µg/m³	8 Hours * 1 Hour **	100 180	100 180	-UV Photometric -Chemiluminescence -Chemical Method
Lead (Pb) , µg/m³	Annual * 24 Hours **	0.50 1.0	0.50 1.0	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
Carbon Monoxide (CO), mg/m³	8 Hours ** 1 Hour **	02 04	02 04	-Non dispersive Infrared (NDIR) Spectroscopy
Ammonia (NH_3), µg/m³	Annual * 24 Hours **	100 400	100 400	-Chemiluminescence -Indophenol blue method
Benzene (C_6H_6), µg/m³	Annual *	05	05	-Gas Chromatography (GC) based continuous analyzer -Adsorption and desorption followed by GC analysis
Benzo(a)Pyrene (BaP) Particulate phase only, ng/m³	Annual *	01	01	-Solvent extraction followed byHPLC/GC analysis
Arsenic (As), ng/m³	Annual *	06	06	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
Nickel (Ni), ng/m³	Annual *	20	20	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

* Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

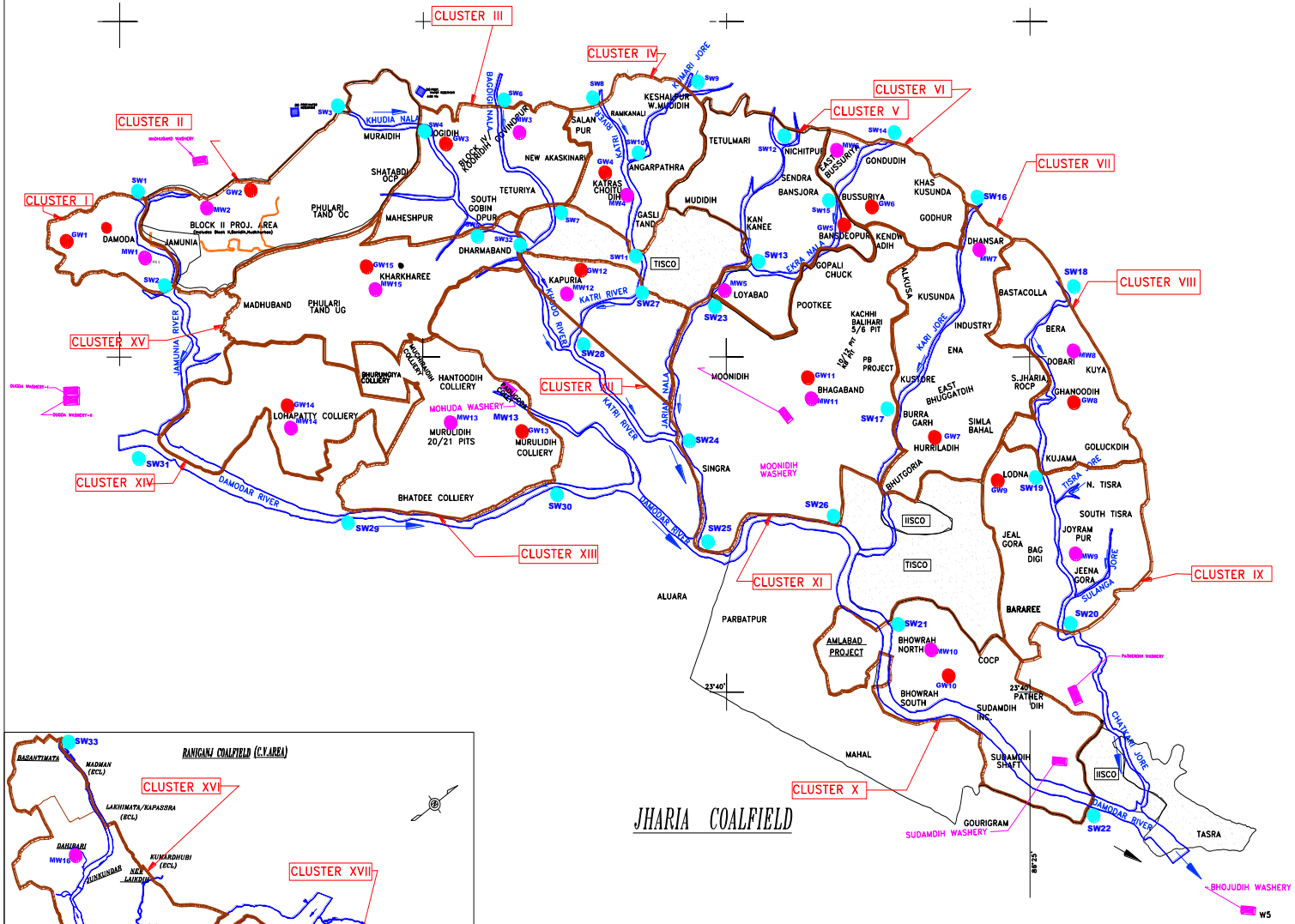
** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

NOTE: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigations.

Location of Air & Noise Monitoring Stations in BCCL



Water Sampling Locations in BCCL



INDEX

Cluster	Suface Water (U/S, D/S)	Name of River/ Nala / Jore	Mine/ Effluent Water	Sampling Location	Ground Water	Sampling Location
I	SW1, SW2	Jamunia River	MW1	Damoda Area	GW1	Ghutway Village
II	SW3, SW4	Khudia Nala	MW2	Block II OCP	GW2	Joyrampur Village
III	SW4, SW5, SW6, SW7	Khudia Nala, Bagdigi Nala	MW3	Govindpur Colliery	GW3	Jogidih Village
IV	SW8, SW11, SW9, SW10	Katri River, Kumari Jore	MW4	Chotudih	GW4	Kankanee Village
V	SW12, SW13, SW15	Jarian Nala, Ekra Nala	MW5	Mudidih	GW5	Nichitpur
VI	SW14, SW15	Ekra Nala	MW6	East Bassuria UGP	GW6	Bansjora Borewell
VII	SW16, SW17	Kari Jore	MW7	Dhansar UGP	GW7	Hurriladih
VIII	SW18, SW19	Kashi Jore	MW8	Dobari UGP	GW8	Ghanudih
IX	SW19, SW20	Kashi Jore	MW9	Jeenagora	GW9	Lodna
X	SW21, SW22	Damodar River	MW10	Bhowrah North	GW10	Bhowrah South
XI	SW23, SW24, SW25, SW26	Jarian Nala, Damodar River	MW11	Bhagaband h UGP	GW11	Bhagabandh
XII	SW27, SW28	Katri River	MW12	Kapuria	GW12	Kapuria
XIII	SW29, SW30	Damodar River	MW13	Murulidih (20/21)	GW13	Murulidih
XIV	SW31, SW29	Damodar River	MW14	Lohapatti	GW14	Lohapatti
XV	SW5, SW32	Khudia Nala	MW15	Kharkharee UGP	GW15	Kharkharee
XVI	SW33, SW34	Khudia River	MW16	Dahibari OCP	GW16	Patlabari Village
XVII	SW35, SW36	Barakar River	MW17	Damagoria Colliery	GW17	Chaptoria

HoD (Envt.)
Bharat Coking Coal Limited
(Signature)

Regional Officer, Dhanbad
Jharkhand State Pollution Control Board
(Signature)

Legend
- Sampling Locations of Surface Water (Upstream/ Downstream)
- Sampling Locations of Mine Water
- Sampling Locations of Ground/ Drinking Water

Customer: BHARAT COKING COAL LIMITED
Title: WATER SAMPLING LOCATIONS
Subject: MONITORING STATIONS
CMPDI (ISO 9001 Company)
Scale: Not to Scale

POLLUTION UNDER CONTROL CERTIFICATE

Vehicle Emission Test Certificate

License No: 284/2016

Sl. No:	00000127	Regis Date:	2018	Test Time:	12:14 PM
Vehicle No:	JH01AD 1547	Fuel:	DIESEL	Odometer:	NA
Make:	TATA	Engine No:	20722	Owner Name:	
Model:	TIPPER	Chassis No:	13852	Remark:	
Category:	TIPPER	Test Date:	15-3-2019		

FLUSH CYCLE

	AVERAGE		
	RPM Min	RPM Max	Oil Tmp
	0630	4250	43

DETAIL

RPM Min	RPM Max	Temp	HSU	K value
640	4250	54	20.75	0.54
610	4280	61	27.86	0.76
630	4250	62	24.62	0.66
MEAN			24.42	0.65
RESULT		PASS		

Result: Pass **Valid Up To:** 14-9-2019

This Vehicle Meets the Emission Standards Prescribed By Rule 115 (2) of Central Motor Vehicle Rule 1989.
This Certificate is Valid for Six Months Only.

Seal of Testing Centre **Test Station Code: 284/2016** **Authorized Signatory**

POLLUTION UNDER CONTROL

Lic No. 397/18 See Under Rule 252/01 JH(MVR)

TRANSPORT DEPTT. GOVT. OF JHARKHAND

Veh No.	Type of Vehicle
JH10AG 9659	TIPPER
	TIPPER
DATE OF ISSUE	VALID UPTO
05/12/2018	03/06/2019

POLLUTION UNDER CONTROL

OUR DREAM INDIA GREEN

प्रपत्र पी.यू.सी.

झारखंड मोटर वाहन नियमावली, 2001 के नियम 252 (12) देखें

प्रदूषण नियंत्रण के अन्तर्गत प्रमाण-पत्र

प्रदूषण स्तर प्रमाण-पत्र

जाँच केन्द्र का नाम

कोयलांचल

वाहन प्रदूषण जाँच केन्द्र

बालाजी फ्यूल स्टेशन, धुर्वाडीह, धनबाद-

अनुज्ञप्ति संख्या : 397 / 18 क्रम संख्या BC-/14555

मोटर वाहन संख्या : JH10AG 9659 D.O.Regn. 11/12/2012

मेक : TML निर्गत की तिथि : 05/12/2018

मोडल : 2012 वाहन का प्रकार TIPPER

निरस्तरण स्तर को जाँच एवं मिल पठन पाया गया

पेट्रोल / LPG वाहन

CMVR 1989 के नियम 115 (2) के अन्तर्गत निर्धारित मापदण्ड | गैस का नाम | वास्तविक पठन

CO :- 0.5%-4.5%

HC :- 750-9000

CO -

HC -

डीजल वाहन

CMVR 1989 के नियम 115 (2) के अन्तर्गत निर्धारित मापदण्ड | गैस का नाम | वास्तविक पठन

H.S.U-65 19

फुल लोड

CMVR 1989 के नियम 115 के अन्तर्गत निर्धारित मापदण्ड को पूरा करता है / नहीं करता है

03/06/2019

ALL INDIA VALID

प्राधिकृत हस्ताक्षर

यह प्रमाण पत्र निर्गत की तिथि से ... माह तक वैध है

KOYLANCHAL VAHAN PRADUSHAN JANCH KENDRA * AUTH. BY GOVT. OF JHARKHAND * KARKEND BAZAR, KORIYA DHANBAD

koylanchalpuc@gmail.com

परिवहन विभाग

Sl. No: 00000127
Vehicle No: JH10R-1438
Make: TML
Model: TIPPER
Category: TIPPER

Regis Date: 2010
Fuel: DIESEL
Engine No: 20732
Chassis No: 12682
Test Date: 15-3-2019

Test Time: 12:14 PM
Odometer: NA
Owner Name:
Remark:

FLUSH CYCLE

AVERAGE		
RPM Min	RPM Max	Oil Temp
0610	4250	43

DETAIL

RPM Min	RPM Max	Temp	HSU	K value
630	4250	59	29.75	0.54
610	4250	61	27.88	0.76
630	4250	62	24.62	0.66
MEAN			27.42	0.65
RESULT		PASS		

Result: Pass **Valid Up To: 14-9-2019**

This Vehicle Meets the Emission Standards Prescribed By Rule 115 (2) of Central Motor Vehicle Rule 1989.
This Certificate is Valid for Six Months Only.

VAHAN PRADUSHAN JANCH KENDRA AUTH. BY GOVT. OF JHARKHAND KAMLEY BAZAR

Seal of Testing Centre **Test Station Code: 284/2016** **Authorized Signatory**

POLLUTION UNDER CONTROL CERTIFICATE

COMPUTERIZED EMISSION TEST CERTIFICATE

(Rule 160B(3) of MV Rules 1992)

Transport Department
Govt. Of JHARKHAND

License: 440/2015

PUCC No.	[illegible]	Make	TATA Motors Ltd.	Name	GEC PROJECT LTD
Serial No.	1171	Model	TIPPER	Address	NA
Vehicle No.	JH01AC3505	Fuel	Diesel	Date	01/02/2019
Date of Mfg.	NA	Chasis	12160	Time	02:13:25
Category	GVW	Engine	06158		

Photo of Vehicle

Sl No.	Opacity [1/m]	Opacity [%]	RPM (Max)
1	56	46.13	1209
2	0.58	46.16	1214
3	0.57	46.12	1216
4	0.6	46.14	1212
5	0.56	46.15	1218
--	--	--	--
--	--	--	--
Mean	0.58	46.136	1213.8

Grade PASS Valid Upto 31/07/2019

Certified that the vehicle's smoke emission confirms to the standards prescribed under rule 115(2) of central motors vehicle under 1989

Seal of Testing Centre

Test Station Code: 440/2015

Authorised Signatory

POLLUTION UNDER CONTROL

Lic.No. 397/18 See Under Rule 252(01 JH(MVR)

TRANSPORT DEPTT. GOVT. OF JHARKHAND

Veh No. JH22A 1658

Type of Vehicle TIPPER

TIPPER LPT

POLLUTION UNDER CONTROL

DATE OF ISSUE 03/12/2018

VALID UPTO 01/06/2019

OUR DREAM INDIA GREEN

प्रपत्र पी.यू.सी.

झारखंड मोटर यान नियमावली, 2001 के नियम 252 व (2) देखें

प्रदूषण नियंत्रण के अन्तर्गत प्रमाण-पत्र

1658

प्रदूषण स्तर प्रमाण-पत्र

जाँच केन्द्र का नाम

वाहन प्रदूषण जाँच केन्द्र

अनुज्ञप्ति संख्या : 397 / 18 क्रम संख्या BC-/14513

मोटर वाहन संख्या : JH22A 1658 D.O.Reg. 29/07/2007

मेक : TML निर्गत की तिथि : 03/12/2018

मॉडल : 2007 वाहन का प्रकार : TIPPER LPT 2515

नियन्त्रण स्तर की जाँच एवं निष्कर्ष प्रपत्र —

पेट्रोल / LPG वाहन

CMVR 1989 के नियम 115 (2) गैस का नाम वास्तविक पठन

के अन्तर्गत निर्धारित मापदण्ड CO- HC-

CO :- 0.5%-4.5%

HC :- 750-9000

डीजल वाहन

CMVR के नियम 115 (2) गैस का नाम वास्तविक पठन

मापदण्ड 21

B.S.U-85

01/06/2019

ALL INDIA VALID

प्राधिकृत हस्ताक्षर

KOYLANCHAL VAHAN PRADUSHAN JANCH KENDRA AUTH. BY GOVT. OF JHARKHAND KARKEND BAZAR

koylanchalpuc@gmail.com

POLLUTION UNDER CONTROL

Lic No. 397/18 See Under Rule 252/01 JH(MVR)

TRANSPORT DEPTT. GOVT. OF JHARKHAND

Veh No. JH22A 1658

Type of Vehicle TIPPER

TIPPER LPT

DATE OF ISSUE 03/12/2018

VALID UPTO 01/06/2019

POLLUTION UNDER CONTROL

प्रपत्र पी.यू.सी.

झारखंड मोटर यान नियमावली, 2001 के नियम 252 ट (2) देखें

प्रदूषण नियंत्रण के अन्तर्गत प्रमाण-पत्र

प्रदूषण स्तर प्रमाण-पत्र

जाँच केन्द्र का नाम

कोयलांचल वाहन प्रदूषण जाँच केन्द्र

बालाजी फ्यूल स्टेशन, झरिया, धनबाद-

अनुज्ञप्ति संख्या : 397 / 18		क्रम संख्या	BC-/14513
मोटर वाहन संख्या :	JH22A 1658	D.O.Reg.	29/07/2007
मेक :	TML	निर्गत की तिथि :	03/12/2018
मोडल :	2007	वाहन का प्रकार :	TIPPER LPT 2515

निरसरण स्तर की जाँच एवं निम्न पठन प्राप्त —

पेट्रोल / L.P.G. वाहन

CMVR 1989 के नियम 115 (2) के अन्तर्गत निर्धारित मापदण्ड — गैस का नाम — वास्तविक पठन

CO :- 0.5%-4.5% — CO

HC :- 750-9000 — HC

डीजल वाहन

CMVR के नियम 115 (2) के अन्तर्गत मापदण्ड — गैस का नाम — वास्तविक पठन — 21

H.S.U-65

फुल लोड —

झारखण्ड सरकार

CMVR नियम 115 के अन्तर्गत निर्धारित मापदण्ड को पूरा करता है / नहीं करता है।

01/06/2019

ALL INDIA VALID

जाँच केन्द्र की मुहर — प्राधिकृत हस्ताक्षर

यह प्रमाण पत्र निर्गत की तिथि से छः माह तक वैध है।

KOYLANCHAL VAHAN PRADUSHAN JANCH KENDRA — AUTH. BY GOVT. OF JHARKHAND — KARKEND BAZAR

koylanchalpuc@gmail.com

OUR DREAM INDIA GREEN

Annexure -XXV

YEARWISE DETAIL OF PROTECTIVE RESPIRATORY DEVICES / DUST MASK ISSUED

Colliery Name	**2016**	**2017**	**2018**
Bhowra North	200	180	70
Bhowra South	38	119	80
Sudamdih Incline & Patherdih Colliery	65	68	72

A-S-P. Colliery, E.J. Area

List of Work Persons who have receive Quat made in 2016.

Sl No.	Name	Design.	Sl No.	Name	Design.
1	Balram Bauri		36	Mahesh Das	
2	Balu kr Bauri		37	Jamini Bauri	
3	Bharat Mahto		38	Janki Mahto	
4	Bhukhal Mahto		39	Jhamaa . Bhuia	
5	Bijay Bauri		40	Kalo Bauri	
6	Billu Bauri		41	Kameswer Hansda	
7	Dhurb Paswar		42	Krisna Bauri	
8	Dilip kr Bauri		43	Lagen Manjhi	
9	Doctor Manjhi		44	Lakhi ram Manjhi	
10	Gotam Bagti		45	Nandlal Tanti	
11	Ganaesh kr Bhuia		46	Nandlal Bauri	
12	Guhiram Manjhi		47	Khemlal Mahali	
13	Changan Rawani		48	Mahat kr Rawani	
14	Charku Hari		49	Mansa Tudu.	
15	Cherpa Modi		50	Mathur Hari	
16	Chintaman Bhuia		51	Mathr Mahto	
17	Dasrath orang		52	S.K. Nasim.	
18	Dasu Bauri		53	Sadabirz Bhuia	
19	Fagu orang		54	Sadhan Bauri	
20	Fani Bauri		55	Ram Pukar	
21	Fudan Marandi		56	Ramnandan Paswar	
22	Bisu Bauri		57	Ramnaresh Kumhar	
23	Bistu Bauri		58	Puran Manjhi	
24	Bhundeo Mahto		59	Prakash Singh	
25	Umeswar Manjhi		60	Prakas Mahto	
26	Fulchand Manjhi		61	Panchanan Modi	
27	Haran Modi		62	Nisu Mahto	
28	Gupteswar Pd Satnami		63	Om Prakas Bhuia	
29	Fulchand Manjhi		64	Open Manjhi	
30	Indar Bhuia		65	Salim Ansari	
31	Iswar Sahis				
32	Jogeswar Das				
33	Jaleswar Mallik				
34	Lalit kr Gope				
35	Mahadeo Bauri				

List of Work Persons who have receive Dust Mask in 2017

Sl No.	Name	Design.	Sl No.	Name	Design.
1	Rambinay Singh	Dirillar	35	Sahadeo Maughi	EXPi
2	Anando Bauri	"	36	Jagdish Sathami	"
3	Chetlal Koyari	"	37	Anandi Singh	"
4	Bhaskar Mahto	"	38	Jamuna Devi	G. Mazdoor
5	Makar Modi	"	39	Sohagi Nauthin	"
6	Parsuram Roy	"	40	Darsani Hansda	"
7	Mohan Rai	"	41	Kumari Gulabi Munda	Pamp. OP
8	Gopal Gorai	"	42	Nakul Mahto	L.H
9	Dasrath Mahto	"	43	Binod kr Singh	O/M
10	Kali Kole	"	44	Sanjay kr Ojha	"
11	Motilal Mahli	"	45	Raj kumar Thakur	"
12	Sadanand Rohidas	"	46	D.K. Singh	"
13	Sunil Pathak	CBM Dirillar	47	I.P. Paswan	"
14	Manharan Ram	"	48	R.N. Sahoo	"
15	Islam Mig	D.C.F	49	J.K. Manti	"
16	Tofik Ahamad	Dirill OP	50	C.K. Singh.	"
17	Subash Chyadav	EXPI	51	V.K. Singh	"
18	Bhagirath Mandal	"	52	I.K. Singh	"
19	Mathur Rajwar	"	53	J.N.Paswan	"
20	Dukhan Mallik	"	54	Ganori Rabidas	"
21	Kholtu Mahto	"	55	Rosan Sing	M/S
22	Nibaran Mahto	"	56	B.K. Rana	"
23	Basudeo Gorai	"	57	Gama ram	F/M/I
24	Jagdis Kole	"	58	Satyam Kumar	"
25	Dharni Mahto	"	59	Sudhansu kr singh	"
26	Harilal Mahto	"	60	Suresh Paswan	"
27	Chakradhar Mahto	"	61	Jogendar Ram	"
28	Sistydhar Mahto	"	62	Bhawani Nayak.	"
29	Usman Ansari	"	63	Kishori Pd Viswakarma	"
30	Gonda Mahli	"	64	S.B. Tiwari	"
31	Dawarika Chamar	"	65	Atul Bauri	Tramor
32	Sagar Rai	"	66	Lakhindara Rajwar	"
33	Niranjan Mahto	"	67	Rajesh kr Mahto	"
34	Birju Bhuig	"	68	Rajendra Das Chamar	"

A.S.P. colliery, E.J. Area

List of Work Persons who have receive Dust Mask in 2018

Sl No	Name	Design.
1	Indardeo Singh	G. mazdoor
2	Larmi Bhuiya	"
3	Pradip Kr Bauri	"
4	Bijay Bhuiya	"
5	Ragunadan Rasidas	"
6	Uday Dusadh	"
7	Om Prakas Prasad	"
8	Charitar Bhuiya	"
9	Sukhlal Manjhi	"
10	Munilal Bauri	"
11	Bhagirath Mahto	"
12	Rajesh Hembram	"
13	Nanku Hembram	"
14	Jiblal Bhuiya	"
15	Sahdeo Kr Deswali	"
16	Ratram Satnami	"
17	Narendra Kr Harizan	"
18	Kanhai lal Mahto	"
19	Rami Jaswara	"
20	Premshankar Misra	"
21	Sahadeo Yadav	Saport Mazdoor
22	Baleswar Barhi	
23	Sukhlal Murmu	
24	Saryu Manjhi	
25	Amiruddin Ansari	
26	Sakur Mia	
27	Deonath Manjhi	
28	Ramuday Mahto	
29	Manoj Kumar	
30	Sunil Kumar	
31	Ram Karan Pasi	
32	Jitan Manjhi	
33	Thakur Manjhi	
34	Badu Manjhi	
35	Rajkumar Das	
36	Krisna Paswan	

Sl No	Name	Design.
37	Nizam Mia	T/M
38	Ashok Modi	"
39	Suresh Kumar	"
40	Samar Singh	"
41	Basu Rawani	"
42	Suleman Ansari	"
43	Ramesh Mahto	"
44	Shakti Pado Mahto	"
45	Lakhan Manjhi	"
46	~~Gr~~ Tuneswa Paswan	"
47	Nagaram Rajak	"
48	Chandarbali Jaswari	"
49	md. Abdul Satar	"
50	Hari Pado Horai	"
51	Sobrati mia	H/OP
52	Radhesyam singh	"
53	Sitaram Kayri	"
54	Badri Mahto	Sweep
55	Biru Kumar	"
56	Kr Jithi Harin	"
57	Bhutta Dome	"
58	Ashok Ram	"
59	Prbhulal Hari	"
60	Kali Ch Hari	"
61	Kishor Hari	"
62	Charku Hari	"
63	Adalat Rai	G/M
64	Asi Mia	
65	Amando Bauri	
66	Angada Bauri	
67	Anil Das	
68	Asman Soren	
69	Arjun Dusadh	
70	Ajij Mia	
71	Bablu Bauri	
72	Badri Narayan Ram	

DUST MUSK

Sl no	Name	P.no	[illegible]	Signature
1.	Ram Pd Rajak	02714889	23/2/17	[signature]
2.	Pado Lochan Mahato	02937187	23/2/17	[signature]
3.	Lakhiram Soren	02714756	23/2/17	[signature]
4.	Prabhas Roy	02933365	23/2/17	Prabhas Roy
5.	Samu Soren	02825636	23/2/17	[signature]
6.	Subal Rajwar	02785663	23/2/17	[signature]
7.	Shankar Chammar	03032661	24/2/17	[signature]
8.	Bharat Manghi	03024916	24/2/17	[signature]
9.	Santosh chakravarthi	02770105	25/2/17	[signature]
10.	Bhim Manghi	02855070	25/2/17	[signature]
11.	Rajesh Kumar	02956746	27/2/17	Rajesh Kumar
12.	Dukaloo Das B.P.	10 PIC	01.03.17	[signature]
13.	Bijay Kr Baidnath	02925667	3-3-17	[signature]
14.	Raj Kr. Prasad	02786491	3-3-17	Raj Kumar Prasad
15.	Ram bhajan Bhuia	02944700	3.3.17	[signature]
16.	Hesab Mahato	02912589	3.3.17	[signature]
17.	Gagatchand Rajwar	02757995	3.3.17	[signature]
18.	Giridhari Bhuia	03022548	3.3.17	[signature]
19.	K.D. KUMAR (I/P)	01025370	11.3.17	[signature]
20	S.D. yadav (I/P)		11.3.17	[signature]
21.	B.P. I.O.C. P(IO)		11.3.17	[signature]
22	Mohan Hari		17.3.17	[signature]
23.	S.P. Adhikari	surgan	31-3-17	[signature]
24	S.N. Dubey	chowkidar	31-3-17	
25.	Kalpatro Rajwar	"	31.3.17	
26.	Krishna Modak	"	31.3.17	
27.	Bikaram Roy	"	31-3.17	
28.	R.K. Singh	"	31-3.17	
29.	Ram lal Rajbhar	"	31.3.17	
30.	Ramu lal	"	31.3.17	
31.	[illegible]	01339955	12.05.17	[signature]
32.	Debanand Mahato.		19.05.17	[signature]
33.	Bimal Hembram.		19.05.17	Bimal
34.	Shankar Chammar		19.05.17	[signature]
35.	Betulal Mahato.		19.05.17	[signature]
36.	Debnath Harija		19.05.17	[signature]
37.	Bharat Manghi		19.05.17	[signature]

Sl	Name	P.No	Date of issue	Signature
	Sonkar Robidas	03017696	30/5/17	Shankar Robidas
	Ichha Ram	03037017	"	इच्छा राम
	Bastudeo Singh	03029588	"	[illegible]
	Badhu Soren	02825594	"	
	Lakhi Ram Majhi	02718120	01/06/17	
	Ramu Bowri	03036323	"	Ramu Bowri
	Dilip Rajwar	03020815	02/06/17	दिलीप राजवार
	[illegible]	02960680	03/06/17	[illegible]
	Khogen Gorai	03002953	19/06/17	Khogen Gorai
47	Jitendra Bhuiya	03021862	"	
48.	Sankar Rabidas	03017696	22/6/17	
49	Ichha Ram	03037017	22/6/17	
50	Dilip Rajwar		"	
51	Kalachand		"	इच्छाराम
52	Bhadu Soren		"	22/6/17
53.	Bastu deo Singh		"	
54	Arun Kr Goswami	01324706	30/6/17 - 35 [illegible]	अरुण कु० स्वामी
55	Jeet Bowri (Ten Bus + Mast issued for Driller and Cable man S.D.L. Dept of R.K Prasad O/m)	02970788	28/8/17	
56	Amrit Bowri	03008612	23/8/17	Amrit Bowri
57	Ramu Bowri five pin for Drill cb (R.K.Singh Prasad)	03036373	23/8/17	Ramu Bowri
58	Kogen Gorai one pin for R.K. Prasad shift for Cable man	03002953	25/8/17	Khogen Gorai
59	Kaushal Das B.P	02993855	5/09/17	Kaushal Das
	अरुण कु० स्वामी	01324706	12-9-17	अरुण कु० स्वामी
60	Dilip Rajwar	03020815	15-9-17	दिलीप राजवार
	do	do	21.11.17	दिलीप राजवार
61	Ichha Ram	03037017	15-9-17	इच्छाराम
				[illegible]
62	Kalachand Deswali	03041793	22-9-17	

S.No	NAME	P.No	Desg	Sign
63.	Devanand Harijan V.V. Tiwari (6 (Six nos) of Dust mask issued on - 13/10/17	03031655	R/Bolts	देवानन्द हरिजन 13/10/17
64.	Rudal Pashwan 3 RIF West (30 Drethy)	01323955	30 Pic	Rudal Pasw
65.	Shyamdeo [illegible]	02960680	1 P. dust mask	[illegible]
66	Manoj Rana 35 No incline		20 Pic	मनोज राणा 16/12/17
67.	Dhananjay Ka E&M Section, B4(S)	0144579	03 nos.	[illegible] 16/12/17
68.	Dust Mask - 35 (Thirty five) nos. issued to Brajakishore Mukherjee for 3 Pit top (W) Safety work.	01329788		[illegible]
69-	डस्ट मास्क - [illegible]	03040813	1 Pic -	[illegible]
70-	डस्ट मास्क - [illegible]	02993865	1 Pic -	Kaushal [illegible]
71.	Dust Mask - 1 (One) Piece	01329788	1 Piece.	[illegible]
72.	Shambhoo Paswan	02770022	7. Piece 35 [illegible]	[illegible]
73	Rudal Paswan	01323955	21 nos issued of spray for Blasting Crew on 06/03/18	Rudal Pa[illegible] 6/3/18
74-	अशोक कुमार स्वामी	01324706	1 Pic 15/03/18	[illegible]
75	Md Taibe Mia	02956803	One Pic - 03/04/18	[illegible]
76.	Bijay Bouri	03006236		Bijay Bauri
77	Nagina Rajbhar	02215316	04/05/18	[illegible]
78	Teka Ram	03037017	14/06/18	[illegible]
79	Sankar Rabidas	03007696	14/06/18	Shankar Rabi[illegible]

S.No	Name	P.No	Desi	Sign
80	Manik Bauri	02953040	S.F Maz	[illegible]
81	Jagatpal Rajwar	02757995	" "	[illegible] 19/1/18
81	Kagan Gorai	03002951	Cableman	Kagan Gorai
82	Magad Bauria		Cl. Maz	[illegible]
83	Shiv Kr Bhuia	03022704	Cl. Maz →	→
84	Shankar Rabidas	03017896	R Bolt	Shankar Rabidas
85	Jewnan Mahato	02770188	Driller.	[illegible] 24/1/18
86	Krishna Chaudhary	03010261	Tyndal	[illegible]
87	K.D. Kumar 20 (Twenty nos of Dust mask issued for 3 pit OCP. for blasting crew	01425370	Overman.	[illegible] 13/1/18
88.	Madan lal Turi five for 35 nos Blasting crew.	02736122	Mining Sirdar	Madan lal Turi
89.	Bikram Roy	01467919	Cl. Maz	Bikram Roy } 22/1/18
90	Krinshna Modak	02985810	Survey Maz	[illegible]
91	Kalpotaru Rajwar	02769974	HO chainman	[illegible]
92.	Rajkishor Singh (eight nos of dust mask give to worker going at Brought Siding)	01358508 22/01/19	Olman.	[illegible]

3/4/18
[illegible]

[illegible] 4/4/18
Blasting [illegible]

ANNEXURE -

LIST OF INITIAL MEDICAL EXAMINATION & PERIODICAL MEDICAL EXAMINATION

PME & VTC

	Year	Target	Actual	Excess/ shortfall	Achievement
PME	2018 (May 18)	385	464	+79	>100%
	2017	891	927	+36	>100%
	2016	951	993	+42	>100%
VTC	2017-18 (till Dec.17)	338	392	+54	>100%
	2016-17	472	488	+16	>100%

Contractual Workers :	Training	IME	
2014-15	15	2014-2015	15
2015-16	78	2015-2016	74
2016-17	78	2016-17 (till Dec.16)	62
2017-18 (till Dec.17)	163	2017-18 (till Dec.17)	124

भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, पूर्वी झरिया क्षेत्र
पो.ओ.- भौरा, जिला - धनबाद (झारखण्ड)
पिन - ८२८३०२. दूरभाष - ०३२६-२३२००७७,
ईमेल-cgmej@bccl.gov.in
पंजीकृत कार्यालय: कोयला भवन, कोयला नगर,
धनबाद- ८२६००५, (झारखण्ड)
CIN: U10101JH1972GOI000918
दूरभाष-०३२६-२३२००७७/फैक्स:०३२६-२२३००५०,
ईमेल-cos@bccl.gov.in

Bharat Coking Coal Limited
A MINI RATNA Co.
(A Subsidiary of Coal India Ltd)
Office of the General Manager, Eastern Jharia Area
P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302
Tel.:0326-2320077, Email-cgmej@bccl.gov.in
Regd.Off: Koyla Bhawan, Koyla Nagar, Dhanbad-825005,
CIN: U10101JH1972GOI000918,
Tel.:0326-2230190/FAX: 0326-2230050, Email – cos@bccl.gov.in

XXVI

Ref. No.:

Date: 17-4-19

TO WHOMSOEVER IT MAY CONCERN

No Occupational Disease has been detected in mines of Eastern Jharia Area (Cluster X), BCCL at Bhowra Regional Hospital and Sudamdih Hospital till date.

17/4/19

Area Medical officer
Bhowra Regional Hospital

Area Medical Officer
E. J. AREA
B.C.C.L.

YEAR WISE EXPENDITURE MADE ON ENVIRONMENT PROTECTION MEASURES

S. No.	Activity	Expenditure in Rs.
	FY 2013-14	
1	Environmental Monitoring	480000 (through HQ)
2	Expenditure on Air Pollution Control	through HQ
3	Gabion Plantation	2041100
	FY 2014-15	
1	Environmental Monitoring	480000 (through HQ)
2	Expenditure on Air Pollution Control	through HQ
3	Statutory Fee	75000
4	Gabion Plantation	1511508
5	Plantation (Eco-restoration material)	44899
	FY 2015-16	
1	Environmental Monitoring	480000 (through HQ)
2	Expenditure on Air Pollution Control	through HQ
3	Statutory Fee	1125000
4	Gabion Plantation	1140831
5	Plantation (Eco-restoration material)	56166
	FY 2016-17	
1	Environmental Monitoring	446000 (through HQ)
2	Expenditure on Air Pollution Control	through HQ
3	Gabion Plantation	1116388
	Environmental studies	Through HQ
	FY 2017-18	
1	Environmental Monitoring	2055000 (through HQ)
2	Expenditure on Air Pollution Control	through HQ
3	Source Apportionment Study	14160000 (through HQ)

Annexure - XXVIII

Advertisement of EC of cluster X in Newspaper

Newspaper Detail: Hindustan date-01.03.2013

भारत कोकिंग कोल लिमिटेड
(कोल इण्डिया लिमिटेड का एक अंग)

सभी संबंधित व्यक्तियों को यह सूचित किया जाता है कि निम्नलिखित 09 (नौ) भारत कोकिंग कोल लिमिटेड का समूह (Cluster) जिसमें 63 खाने एवं 02 वाशरीज सम्मिलित हैं, को पर्यावरण एवं वन मंत्रालय के द्वारा पर्यावरण सफाया (Environmental Clearance) प्रदान किया जा चुका है।

क्र. सं.	समूह (Cluster) का नाम	स्वीकृति आदेश संख्या एवं तिथि
1.	समूह (Cluster) I : मेसर्स भारत कोकिंग कोल लिमिटेड, झारिया कोलफिल्ड्स में स्थित, ब्लॉक चन्द्रपुरा, जिला- धनबाद, झारखंड की दामोदा समूह की 3 खानें- दामोदा (एलबियॉन शाखा) ओसीपी, दामोदा यूजीपी एवं दामोदा बीजे सेक्शन समूह की खानें (575 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 0.9 एम टी पी ए सामान्य एवं 1.17 एम टी पी ए (उच्च))	जे-11015/93/ 2009-1ए. 11 (एम) दिनांक : 6 फरवरी 2013
2.	समूह (Cluster) II : मेसर्स भारत कोकिंग कोल लिमिटेड, झारिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की 2025.71 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में (20.215 एम टी पी ए की उच्च उत्पादन के साथ 15.55 एम टी पी ए सम्मिलित उत्पादन क्षमता की 5 खानें)	जे-11015/35/ 2011-1ए. 11 (एम) दिनांक : 6 फरवरी 2013
3.	समूह (Cluster) III : मेसर्स भारत कोकिंग कोल लिमिटेड, झारिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की 1420.61 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 3.6 एम टी पी ए की उच्च उत्पादन की 7 खानें (04.11.2010 को प्रदान की गई टी ओ आर पर आधारित ईसी)	जे-11015/213/ 2010-1ए. 11 (एम) दिनांक : 6 फरवरी 2013
4.	समूह (Cluster) IV : गसलीटाँड कोलियरी भूमिगत को छोड़कर मेसर्स भारत कोकिंग कोल लिमिटेड, झारिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की 1123.79 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 2.851 एम टी पी ए (सामान्य) 3.706 एम टी पी ए (उच्च) की उत्पादन क्षमता के साथ 6 खानें।	जे-11015/212/ 2010-1ए. 11 (एम) दिनांक : 6 फरवरी 2013
5.	समूह (Cluster) V : मेसर्स भारत कोकिंग कोल लिमिटेड, झारिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की 1957.08 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 4.854 (सामान्य) 6.311 (उच्च) एम टी पी ए के उत्पादन की 7 खानें (16.03.2011 को प्रदान की गई आई टी ओ आर पर आधारित ई सी)	जे-11015/01/ 2011-1ए. 11 (एम) दिनांक : 11 फरवरी 2013
6.	समूह (Cluster) VII : मेसर्स भारत कोकिंग कोल लिमिटेड, झारिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की 2127.7 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 8.16 एम टी पी ए की उच्च उत्पादन के साथ 6.227 एम टी पी ए की सम्मिलित क्षमता (09.12.2010 को प्रदान की गई टी ओ आर पर आधारित ईसी) (कुस्तौर भूमिगत एवं पूर्वी भगतडीह को छोड़कर)	जे-11015/238/ 2010-1ए. 11 (एम) दिनांक : 6 फरवरी 2013
7.	समूह (Cluster) X : मेसर्स भारत कोकिंग कोल लिमिटेड, झारिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की (2057.95 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 1.762 एम टी पी ए की सामान्य एवं 2.289 एम टी पी ए की उच्च उत्पादन की 6 खानें) एवं 18 हेक्टेयर के एक क्षेत्र के लिए 1.6 एम टी पी ए सामान्य तथा 2.08 एम टी पी ए उच्च उत्पादन की सुदामडीह कोल वाशरी (सुदामडीह शॉफ्ट माईन के लीज होल्ड के अन्दर) (09.02.2011 को प्रदान की गई टी ओ आर पर आधारित ई सी)	जे-11015/380/ 2010-1ए. 11 (एम) दिनांक : 6 फरवरी 2013
8.	समूह (Cluster) XVI : मेसर्स भारत कोकिंग कोल लिमिटेड, जिला- धनबाद, झारखंड में कोयला खानें (दहीबाड़ी -बसंतीमाता ओ सी पी, बसन्तीमाता भूमिगत खान, नई लायकडीह ओ सी पी (दहीबाड़ी कोल वाशरी सहित), लायकडीह डीप भूमिगत, चाँच भूमिगत) (1964.21 हेक्टेयर के एक सम्मिलित एम एल क्षेत्र में 1.51 एम टी पी ए सामान्य तथा 1.963 एम टी पी ए उच्च) तथा 12 हेक्टेयर के क्षेत्र में 1.6 एम टी पी ए की दहीबाड़ी वाशरी (28.05.2010 को प्रदान की गई टी ओ आर पर आधारित ई सी)	जे-11015/185/ 2010-1ए. 11 (एम) दिनांक : 6 फरवरी 2013
9.	समूह (Cluster) VIII : मेसर्स भारत कोकिंग कोल लिमिटेड, झारिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड के 10 खानों का समूह (1183.92 हेक्टेयर के एक सम्मिलित एम एल क्षेत्र में 5.603 एम टी पी ए की उच्च उत्पादन के साथ 4.31 एम टी पी ए को सम्मिलित क्षमता (12.0041 हेक्टेयर - 1649 हेक्टेयर = 1183.92 हेक्टेयर)	जे-11015/298/ 2010-1ए. 11 (एम) दिनांक : 15 फरवरी 2013

सफाया पत्र की प्रतिलिपि झारखंड राज्य प्रदूषण नियंत्रण बोर्ड के पास उपलब्ध है तथा इसे पर्यावरण एवं वन मंत्रालय की वेबसाईट "http://envfor.nic.in" और भा. को. को. लि. के कार्यालय वेबसाईट "http://www.bccl.gov.in" पर भी देखा जा सकता है।

ह0/-

भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, पूर्वी झरिया क्षेत्र
पो.ओ.- भौरा, जिला - धनबाद (झारखण्ड)
पिन - ८२८३०२, दूरभाष - ०३२६-२३२००७७,
ईमेल-cgmej@bccl.gov.in
पंजीकृत कार्यालय: कोयला भवन, कोयला नगर,
धनबाद- ८२६००५, (झारखण्ड)
CIN: U10101JH1972GOI000918
दूरभाष-०३२६-२३२००७७/फैक्स:०३२६-२२३००५०,
ईमेल-cos@bccl.gov.in

Bharat Coking Coal Limited
A MINI RATNA Co.
(A Subsidiary of Coal India Ltd)
Office of the General Manager, Eastern Jharia Area
P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302
Tel.:0326-2320077, Email-cgmej@bccl.gov.in
Regd.Off: Koyla Bhawan, Koyla Nagar, Dhanbad-825005,
CIN: U10101JH1972GOI000918,
Tel.:0326-2230190/FAX: 0326-2230050, Email – cos@bccl.gov.in

Ref. No.: BCCL/EJ/GM/Env./EC/2019/ 665

Date: 15/04/2019
20

To,
The Municipal Commissioner
Dhanbad Municipal Corporation
Dhanbad

Sub.: Regarding Environmental Clearance of Cluster X Coal Mining Project of M/s, Bharat Coking Coal Limited.

Dear Sir,

The Ministry of Environment, Forests & climate Change has granted the Environmental Clearance to Cluster X group of mines vide EC no.- J-11015/380/2010-IA.II(M) dated 06.02.2013. Please find enclosed herewith a copy of Environmental Clearance to Cluster X coal mining project.

This is for your kind information.

Encl: As Above

Yours Sincerely

20/4/19
General Manager
E.J. Area

Copy to:

Dy. GM (Env.), BCCL

कार्यालय नगर निगम
प्राप्ति तिथि 30/4/19

o/c

Bharat coking coal limited

(A Subsidiary of Coal India Ltd)
Office of the Project Officer, Bhowra (N), Eastern Jharia Area,
P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302

Ref. No:- BCCL/EJA/BH(N)//2018/ 231 Date:-15/06/2018

To,
The Member Secretary,
Jharkhand State Pollution Control Board
T. A. Division Building (Ground Floor)
H. E. C. Dhurva.
Ranchi – 834004

Sub:- Submission of Environmental Statement in From – V

Dear Sir,

Environmental Statement is Form – V is being submitted to you for financial year 2017-18 in respect of Bhowra (N) U/G Mines.

Enclosures:- As above.

Received
Dely
18/6/18
Jharkhand State Pollution Control Board
Regional Office
Dhanbad

Yours Faithfully

14/6/18
PROJECT OFFICER
BHOWRA (N) U/G MINES
Project Officer
Bhowra (N) U/G Mines

Distribution:-
1.The Regional Officer, JSPCB Office, Dhanbad
2. The General Manager (Env.), BCCL, KoylaBhawan.
3. The Area Manager (Env.), E. J. Area, Bhowra.
4. Office File.

(Form – V)

(See rule 14)

Environmental Statement for the financial year ending the 31st March 2018

PART – A

(i) Name and address of the owner/occupier of the industry operation or process : Sri N.K. Tripathy, D.T. (P&P) BCCL, KoylaNagar, Dhanbad

(ii) Industry category : Coal Mining Industry

(iii) Production capacity : U/G - 0.143 MTY
OCP – 0.546 MTY (presently no OCP working)

(EC no:- J-11015/380/2010-1A-II(M) dated 06/02/2013

(iv) Year of establishment : Colliery operating since pre nationalization period and vested in BCCL through Coal MineNationalisation Act 1972-73

(v) Date of last environmental statement submitted : 17.06.2017, (Ref.No:BCCL/EJA/Bh(N)/2017/333)

PART - B

Water and River Material Consumption

Water Consumption	
Process (Dust separation)	$20M^3$/day
Cooling	Nil
Domestic	$120M^3$/day

Name of Products	Process water consumption pre unit of product output	
	During the previous financial year	During the current financial year
COAL	----	4.194 KL/T

Raw Material Consumption

Name of materials	Name of products	Consumption of raw material per Unit of output	
		During the previous financial year (2016-17)	During the current financial year (2017-18)
Diesel	Coal	0.1368 L/Te	0.153 L/Te
Explosive	Coal	0.2347 Kg/ Te	0.315 Kg/ Te
Timber	Coal	Sleeper-- 0.081 nos./Te Props-- 0.019 nos./Te	Sleepers-- 0.026 nos./Te Props-- 0.030 nos./Te

PART- C

Pollution discharged to environment/unit of output (parameter as specified in the consent issued)

Pollutants	Quantity of pollutants discharge	Concentrations of pollutants in discharge(mass/volume)	Percentage of variation from prescribed standards with reasons
Water	--	*(MW- 10 , 22.02.18)* **TSS** – 50 **PH** – 7.66 **Oil & Grease** - <2.0 **COD** - 44	Within Limit
Air	--	*(as on 22.02.18)* **PM 10**– 96 **PM 2.5** – 53 SO_2 – 13 NO_x– 29	Within Limit

PART – D

Hazardous Wastes

(as specified under Hazardous waste management and handling rules, 1989)

Hazardous Waste	Total Quantity (Kg.)	
	During the previous financial year (2016-17)	During the current financial year (2017-18)
From process	Burnt oil - 200 Litre	Burnt oil -400Litre
From pollution control facilities	N/A	N/A

PART – E

Solid Wastes

Solid Wastes		Total Quantity	
		During the previous financial year	During the current financial year
(a) Process		Nil	Nil
(b) Pollution control facility		Nil	Nil
(c)	1.Quantity recycled or re-utilized within the unit	Nil	Nil
	2. Sold	Nil	Nil
	3. Disposed	Nil	Nil

PART – F

Please specify the characterizations (in terms of composition of quantum) of hazardous as well as solid waste and indicate disposal practice adopted for both these categories of wastes.

(i)	Type of Rocks	: -	N/A
(ii)	Type of soil	: -	N/A
(iii)	Chemical properties of soil: -		N/A
(iv)	Disposal process for Solid Waste (backfilling practice): -		N/A

PART – G

Impact of pollution abatement measures taken on conservation of nature resources and on the cost of production

(i)	No. of plants planted	: 7575 nos.
(ii)	Cost of plants	:Rs.3.00 per sapling
(iii)	Plantation cost incurred	:Rs,22725
(iv)	Backfilling cost	: nil

PART – H

Additional measures/investment proposal for environmental protection including abatement of pollution, prevention of pollution

(i) Water sprinkling is being done in transporting road, siding, working faces, etc. to reduce dust emission.

(ii) Proper and timely maintenance of dumper, SDL machine, fan, pumps, haulages etc. is being done to control noise pollution.

(iii) Monitoring of air quality, water quality and noise levels are being done periodically.

PART – I

Any other particulars for improving the quality of the environment

---

14/8/18

PROJECT OFFICER
BHOWRA (N) U/G MINES

Project officer
Bhowra (N) U/G Mines

O/C

STRICTLY RESTRICTED
FOR COMPANY USE ONLY RESTRICTED
The information given in this report is not to be communicated either directly or indirectly to the press or to any person not holding an official position in the CIL /GOVERNMENT.

ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER –X

(FOR THE MONTH FEBRUARY, 2018)

E. C. no. J-11015/380/2010-IA.II (M) dated 06.02.2013.

CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

भारत कोकिंग कोल लिमिटेड
(कोल इंडिया लिमिटेड का एक अंग)
BHARAT COKING COAL LIMITED
A Mini Ratna Company)
(A Subsidiary of Coal India Limited)
Office of the Project Officer, ASP Colliery

A.S-P Colliery
P.O.- Sudamdih
Dist.–Dhanbad
Jharkhand 828126

Ref No– EJA/ASP/SMD/18/ 1476

Dated: 25.09.18

To,
The Member Secretory,
Jharkhand State Pollution Control Board,
TA. Division Building
HEC, Dhurwa.
RANCHI – 834004.

Sub. :- **Submission of Environmental Statement (From –V) for the year 2017-18.**

Dear Sir,

Please find herewith the Environmental Statement duly filled in the financial year 2017 – 18 in respect of Amal. S – P. Colliery.

This is for your kind information, Sir.

Encl. - As Above

Received 26/09/2018 Jharkhand State Pollution Control Board Regional Office Dhanbad

Yours faithfully

Project Officer
Amal. S – P. Colliery

Copy to:
1. Regional Officer, J.S.P.C.B, Dhanbad
2. Area Manager (Env.)E.J. Area.
3. Colliery Manager / Safety Officer, A.S – P. Colliery.
4. Office file.

"FORM – V"

(See rule 14)

Environmental statement for the financial year ending 31st March'2018

PART – A

Name and address of the owner / Occupier : Sri N.K. Tripathi ,D.T, Koyla Bhawan,

of the industry operation or process Koyla Nagar, BCCL, Dhanbad.

Industry category primary (STD Code) : Coal Mining Industry (A.S-P. Colliery)

Production capacity : 0.473 MTY.

Year of establishment : 1962

Date of last environmental statement : Dt. 21.09.2017 (Ref. No. EJA/ASP/SMD/17/1665) submitted.

PART – B

Water and Raw Material consumption:

Water Consumption	
1. Process (Dust suppression)	80 KL/ Day
2. Cooling	Nil
3. Domestic	273 KL/ Day

Name of products	Process water consumption per unit of product point	
	During the previous Financial year 2016-17	During the current Financial year 2017-18
N/A	N/A	N/A

2. Raw material consumption:

Name of Raw Material	Name of products	Consumption of Raw Materials per unit of product output	
		During the previous Financial year 2016-17	During the current Financial year 2017-18
Diesel	Coal	0.25 Ltrs./Ton.	1.258Ltrs./Ton.
Explosive	Coal	3.98 KG/Ton	0.445KG/Ton

Industry may two codes if disclosing details of raw material would violate contractual Obligations otherwise al industries have to name the materials used.

PART – C

Pollution discharged to Environment / unit of output (Parameter as specified in the consent issued).

Pollution	Quantity of pollutants discharged (mass/day)	Concentrations of Pollution in discharges (mass / volume)	Percentage of variation from prescribed stack with reason.
a) Water	—	Total suspended solid – 50 pH – 7.66 Oil & Grease - less than 2.0 COD - 44	Within the limit Within the limit Within the limit Within the limit
b) Air	—	PM10 – 89 PM 2.5 – 54 SO_2 - 14 NOx - 33	Within the limit Within the limit Within the limit Within the limit

PART – D

Hazardous wastes (As specified under Hazardous wastes Management and Handling rules 1989.

Hazardous waste	Total Quantity	
	During the previous Financial year 2016-17	During the current Financial year 2017-18
a) From process	Quantity of Burnt Oil – 65 Ltrs. Cotton waste – Nil Oil soaked filters – 21 Nos.	Quantity of Burnt Oil – 210 Ltrs. Cotton waste – Nil Oil soaked filters – 15 Nos.
b) From pollution control facilities	N/A	N/A

PART – E

Solid wastes

Solid wastes		Total Quantity	
		During the previous Financial year 2016-17	During the current Financial year 2017-18
a) From process		Quantity of Overburden generated –1884424 M^3	Quantity of Overburden generated – 1267838 M^3
b) From Pollution control facilities		Oil & Grease trap's bottom sludge – N/A	Oil & Grease trap's bottom sludge – N/A
c)	1. Quantity recycled or reutilized with the unit.	Quantity of O/B used for back filling -1884424 M^3	Quantity of O/B used for back filling -1267838 M^3
	2. Solid	Nil	Nil
	3. Disposal	Nil	Nil

PART – F

Please specify the characterization (in terms of composition of quantum) of hazardous as well as solid wastes and indicate disposal practice adopted for both these categories of wastes

Type of rock : Sedimentary

Type of soil : There is no soil. All soil has been removed earlier.

Chemical properties of soil – N/A

Disposal process for solid waste (Back filling practice) – By dumper for back filling of the excavated area.

PART – G

Impact of the pollution abatement measures taken on conservation of natural resources and on the cost of production.

Ecological restoration work is going on.

PART – H

Additional measures / investment proposal for environmental protection including abatement of pollution, prevention of pollution.

(i) There are two water tankers of (a) 20 KL Capacity, which sprinkle 04 trips water daily (except rainy season).

(ii) Fencing of ecological restoration site is being done.

(iii) There is no pressure filters.

(iv) Black toping of roads has not been done.

(v) Monitoring of air quality, water quality and noise levels are being done periodically.

PART – I

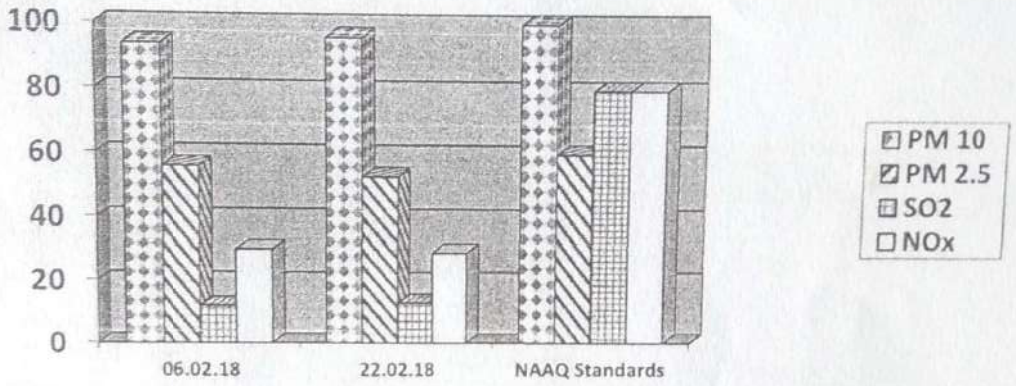
Any other particulars for improving the quality of the environment.

Carbon sequestration studies done at H.Q. Level /source appointment study and reduction in pollution load by reducing road transport study being done at H.Q. level.

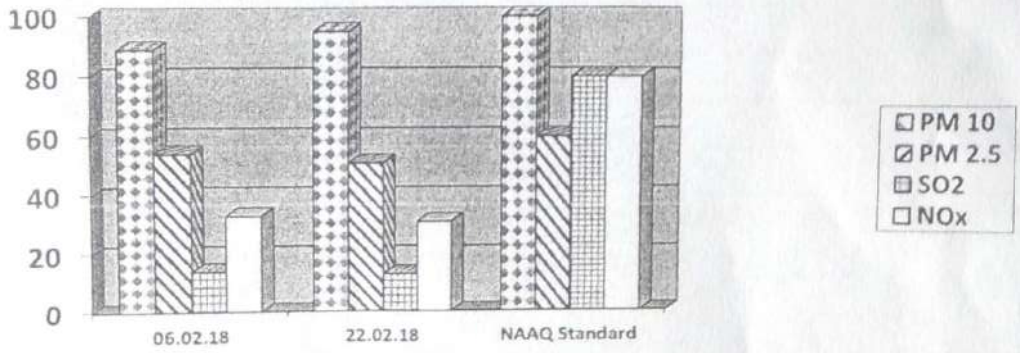
AMBIENT AIR QUALITY DATA

Cluster – X, Bharat Coking Coal limited Month: FEB. -2018 Year : 2017-18.

Station Name:A14-Bhowrah North		Zone: Core		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	06.02.18	94	56	12	30
2	22.02.18	96	53	13	29
	NAAQ Standards	100	60	80	80



StationName:A15-Sudamdih Washery		Zone: Core		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	06.02.18	89	54	14	33
2	22.02.18	95	51	13	31
	NAAQ Standard	100	60	80	80



Analysed By
JSA/SA/SSA

Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

21/2/18
Approved By
HOD(Mining/Environment)
RI-2, CMPDI, Dhanbad

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Bhowrah North (MW10)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Kashi jore.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analyzed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI RI-II, Dhanbad.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results are compared with Schedule - VI, effluent prescribed by MoEF&CC. Results show that most of the parameters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER- FOUR PARAMETERS)

Name of the Cluster: **Cluster -X**		Month: **FEBRUARY, 2018**	Name of the Station: **Mine Discharge of Bhowrah North**	
Sl. No.	**Parameters**	**MW10** First Fortnight	**MW10** Second Fortnight	**As per MOEF General Standards for schedule VI**
		12/2/2018	22/2/2018	
1	Total Suspended Solids	39	50	*100 (Max)*
2	pH	7.69	7.66	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	36	44	*250 (Max)*

All values are expressed in mg/lit. except pH.

Analysed By
JSA/SA/SSA

Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(Mining/Environment)
RI-2, CMPDI, Dhanbad