भारत कोकिंग कोल लिमिटेड
'एक मिनी रत्न कंपनी'
(कोल इंडिया का एक अंग)
महाप्रबंधक का कार्यालय
लोदना क्षेत्र ,पो.-भागा
धनबाद -828301,(झारखंड)
वेबसाइट :www.bccl.gov.in, mail.gov.in
ईमेल :cgmlodna@bccl.gov.in,
gmlodna.bccl@coalindia.in
सी.आई.एन.:U10101JH1972GO1000918

Bharat Coking Coal Limited
*A Mini Ratan Company*
(A Subsidiary of Coal India Limited)
Office of the General Manager
Lodna Area , PO-Bhaga
Dhanbad-828301 (Jharkhand).
Website: www.bccl.gov.in, mail.gov.in
Email: cgmlodna@bccl.gov.in,
gmlodna.bccl@coalindia.in
CIN:U10101JH1972GO1000918

Ref. No: - BCCL/LA/GM/25-26/ 605

**Through- Email Mode**
Dated:- 27/11/25

**To,**
**The Director,**
**Ministry of Environment, Forest & Climate Change, Govt. Of India.**
**2nd Floor, Headquarter- Jharkhand State Housing Board,**
**Harmu Chowk, Ranchi, Jharkhand – 834002**

**Sub: -Six monthly compliance report on implementation of Environmental Measures for the period from 1st April 2025 to 30th September 2025 in respect of Cluster – IX Group of Mines, Lodna Area of BCCL.**

*Ref. No. 1: EC Order No.-J-11015/307/2010-IA.II (M), dated – 21st May, 2013.*
*Ref. No. 2: EC Order No. -J-11015/307/2010-IA.II (M), dated – 1st March, 2018.*

Dear Sir,

Please find enclosed herewith the Six Monthly Compliance report on implementation of Environmental Measures for the period from 1st April 2025 to 30th September 2025 in respect of Cluster – IX Group of Mines, Lodna Area of BCCL.

Enclosure: as above.

Yours faithfully,

General Manager
Lodna Area

लोदना क्षेत्र–10, भा.को.को.लि.
General Manager
Lodna Area No.-X, B.C.C.L

**Cc to (Through E-mail):-**

1. Scientist & In-charge, Zonal Office, Central Pollution Control Board, 5th Floor 502, House & Conclave 1582, Rajdanga main Road, Kolkata-700107
2. Member Secretary, Jharkhand State Pollution Control Board, TA Division Building, H.E.C, Dhurwa, Ranchi-834004
3. Regional Office , Jharkhand State Pollution Control Board, Sardar Patel nagar, Dhanbad
4. HoD (Env) BCCL, Koyla Bhawan, Dhanbad.
5. File

# ENVIRONMENTAL CLEARANCE COMPLIANCE OF CLUSTER-IX
# (GRANTED VIDE – J-11015/307/2010-IA.II (M), dated – 21st May, 2013 and Amendment on dated- 1st March 2018)
# (From 1st April 2025 to 30th September 2025)

| Sl. No. | A.) Specific conditions by MOEF | Compliance |
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| i. | The Maximum production shall not exceed beyond that for which environmental clearance has been granted. | **Being Complied.**<br>The production from the cluster is within the limit for which environment clearance has been granted.<br>Both Mines of Cluster IX namely Amalgamated Joyrampur Colliery and NT-ST (Expansion) OCP is currently in operation mode. Annual Coal Production & Overburden Production of since FY 2018-19 to FY 2024-25 along with previous six months has been attached as **Annexure I.** |
| ii. | Action should be taken to segregate and isolate the fire areas eg. Trench cutting for isolation of fire. Area-wise Action Taken report for extinguishing the fire should be provided. | **Being Complied.**<br>Action taken report is enclosed as **Annexure II.**<br>Action has been taken for extinguishing the fire are as follows:<br>1. In NT-ST (Expansion) OCP, Fiery Hotspot are being dealt by only proven excavation method. The work was awarded to deal the fire by excavation with ref no. BCCL/GM/SECY/LODNA/HIRING-HEMM-OS/2015/498 dated 30/06/2015 and BCCL/GM/SECY/LODNA/HIRING-HEMM-OS/2019/532 dated 28/03/2019.<br>2. In Amalgamated Joyrampur Colliery Fiery Hotspot are being dealt by only proven excavation method.<br>2. To prevent the spread of fire some water pool has been created.<br>3. Cracks and potholes being blanketed by sand and soil to cut oxygen supply to minimize the spontaneous heating. |
| iii. | 'Mission Mode Program' for extinguishing fire is required wherein scientists and other experts be involved. Any international agency may also be contacted for their expertise in extinguishing the fire in such big area. | **Being Complied.**<br>Global expression of interest (EOI) was floated vide Ref no. BCCL/GM(CMC)/GLOBAL/EOI/FIRE/2014/870 dated 18.01.2014 by General Manager (Contract Management Cell) with the following description of work Dealing with coal mine fire in lease hold of BCCL in Jharia Coalfield, Dhanbad, Jharkhand , India. At Location of Leasehold of BCCL in Jharia coalfield Dhanbad, Jharkhand, India.<br>Two firms participated in the said EOI Namely DMT GmbH & Co. KG Essen/Germany and Met-Chem Canada Inc.<br>Both the Bidders were disqualified as they could not fulfil the requirements laid down in the EOI and failed to submit the required documents for evaluation by technical committee. |

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| | | Thus, BCCL by taking into consideration the earlier findings, suggestion of reputed Mining Institutes like ISM, Dhanbad and CIMFR, Dhanbad adopted the method of fire excavation for earliest fire dousing.<br>Latest communication has been made to IIT(ISM), Dhanbad, BIT Sindri & CIMFR, Dhanbad for providing their expertise/recommendation for control of fire and their reclamation.<br>Copy attached as **Annexure III.** |
| **iv.** | The recommendation of Indira Gandhi Centre of Atomic Research, Kalpakam should be followed dealing with fire in coal mine in Jharia Coalfield. | **Complied.**<br>An E-mail was sent and requested for providing recommendation in this regard. IGCAR replied that there is no any recommendation from their end.<br>Copy is attached as **Annexure IV.** |
| **v.** | Transportation Plan should be submitted to the MOEF. | **Complied.**<br>Transportation Plan prepared on proper scale has been attached as **Annexure V.**<br><br>Transportation is being done by covering vehicle with tarpaulin cover. |
| **vi.** | The finalized Mine Closure Plan of Cluster – IX should be submitted to MOEF. The void should be in 30 ha. Area with 30 mt. depth. | **Will be Complied.**<br>Presently no mine in Cluster IX is under Final Mine Closure stage. Mine closure plan as per the guideline of Ministry of coal prepared by CMPDIL is under implementation and progressive mine closure plan is being followed. Progressive Mine Closure plan has been attached as **Annexure VI**.<br>As on date no such voids are available. |
| **vii.** | The road transportation of coal during phase – 1 should be by mechanically covered trucks. The road used for coal transportation should be developed with avenue plantation on both sides. | **Being Complied.**<br>Request has been submitted to some of the vendors for making available details of mechanically covered trucks. Copy of the same is attached as **Annexure VII**.<br>At present Transportation is being done by covering vehicle with tarpaulin cover.<br><br>Avenue plantation is being done along the transportation route. 1200 nos. of Bamboo gabion avenue plantation have been done by DFO, Dhanbad in nearby colonies. |
| **viii.** | 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. | **Being Complied.**<br>It is under active compliance. Training and skill development programs are being conducted by VTCs and HRD of BCCL on regular basis. There are 02 Handloom Training Centres in Lodna area at Alakdiha and Mukunda, Dhanbad.<br>Photographs of VTC and Handloom Training Center is attached in **Annexure VIII.** |
| **ix.** | Details of transportation, CSR, R&R and implementation of environmental action plan for each of the 17 clusters | **Being Complied.** |

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| | should be brought out in a booklet form. | The Details of transportation, CSR, R&R and implementation of environmental action plan in Booklet form that is attached as **Annexure VIII**. |
| **x.** | A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport. | **Complied.**<br>More than 80% of coal is transported through railway which is environmentally better option than the road transportation. The study has been completed by the CMPDIL. The project proponent has submitted report of study to analyze the extent of reduction in pollution load every year by reducing road transport.<br>Enclosed as **Annexure IX.** |
| **xi.** | The expertise available internationally should be utilized for control of fire in Jharia coalfields and for their reclamation and to further minimize time for fire and subsidence control. | **Being Complied.**<br>Global expression of interest (EOI) was floated vide Ref no. BCCL/GM(CMC)/GLOBAL/EOI/FIRE/2014/870 dated 18.01.2014 by General Manager (Contract Management Cell) with the following description of work Dealing with coal mine fire in lease hold of BCCL in Jharia Coalfield, Dhanbad, Jharkhand, India. At Location of Leasehold of BCCL in Jharia coalfield Dhanbad, Jharkhand, India.<br>Two firms participated in the said EOI Namely DMT GmbH & Co. KG Essen/Germany and Met-Chem Canada Inc.<br>Both the Bidders were disqualified as they could not fulfill the requirements laid down in the EOI and failed to submit the required documents for evaluation by technical committee.<br>Thus, BCCL by taking into consideration the earlier findings, suggestion of reputed Mining Institutes like ISM, Dhanbad and CIMFR, Dhanbad adopted the method of fire excavation for earliest fire dousing.<br>Copy attached as **Annexure III**. |
| **xii.** | The abandoned pits and voids should be backfilled with OB and reclaimed with plantation and or may be used for pisciculture. | **Will be Complied.**<br>At present there is no open abandoned pit. Abandoned voids will be utilized for Pisciculture, if any in Post Mining Phase. |
| **xiii.** | BCCL may consider setting up a separate management structure for implementing environment policy and socio-economic issues and the capacity building required in this regard. | **Complied.**<br>Separate multidisciplinary environmental Management cell at Area Level has already been established. Office Order of the same has been enclosed as **Annexure X**. A full-fledged Environment Department, headed by a HOD (Environment) along with a suitable, qualified multidisciplinary team of executives has been established.<br>The activities are monitored on regular basis at Area and at Headquarters levels. GM (Environment) at Headquarters level, Coordinates 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 the company's Director (Technical) and CMD. Further |

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| | | capacity building at both corporate and operating levels is being done. |
| **xiv.** | The locations of monitoring stations in the Jharia Coalfields should be finalized in consultation with the Jharkhand State Pollution Control Board. | **Complied.**<br>The location of monitoring stations in Jharia Coal Field has been identified with the consultant advisory of CMPDIL and also finalized with the permission of Jharkhand State Pollution Control Board. The location of monitoring stations is:<br>(i) Jeenagora (A13)<br>(ii) Kusmatand Village (A12)<br>(iii) Bhowrah North (A14)<br>(iv) Hurriladih UGP (A28)<br>Enclosed as **Annexure XI.** |
| **xv.** | The 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 get carried out for the entire Jharia Coalfields. | **Complied.**<br>The said study of source apportionment has been conducted by NEERI, Nagpur. Final report is enclosed as **Annexure XII.** |
| **xvi.** | 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 air pollution, based on which appropriate mitigative measures could be taken. | **Complied.**<br>The said study of source apportionment has been conducted by NEERI, Nagpur. Final report is enclosed as **Annexure XII.** |
| **xvii.** | The proponent shall prepare time-series maps of the Jharia Coalfields through NRSA to monitor and prevent fire problems in the Jharia Coalfields 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. | **Complied.**<br><br>The National Remote Sensing Agency (NRSA) is undertaking periodic monitoring of the Jharia Coalfield region using satellite-based remote sensing techniques. A recent project report titled "Delineation of Surface Coal Fire and Associated Land Subsidence in Jharia Coalfield (2022–2024), Jharkhand" was submitted in May 2025.<br><br>According to the findings of this report:<br><br>• No surface coal fire area (0.000 sq. km) has been detected in the Bhagdigi, Bararee, Jealgora, Jeenagora, Lodna, and Joyrampur collieries.<br>• In North Tisra, the fire-affected area has reduced from 0.097 sq. km (2022) to 0.041 sq. km, indicating successful containment or natural extinction.<br>• In South Tisra, the coal fire area has decreased from 0.210 sq. km (2022) to 0.157 sq. km, reflecting a reduction in the extent of active fire zones. |

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| | | Report Enclosed as **Annexure-XIII.** |
| **xviii.** | Measures to prevent ingress of air (Ventilation) in such areas, to prevent restart fresh / spread fires in other areas including in mines of cluster IX shall be undertaken. | **Being Complied.**<br>Action is being taken as per Jharia Master Plan Approved by GOI and State Govt. of Jharkhand.<br>Excavation/ Open Cast mining is being done in the Fire/subsidence affected mines to dig out combustible materials to save the coal from burning and to prevent further spread of the fire. Once the fiery coal is dugout/ excavated there will be no chance of further restarting/ spreading of fresh fire into other areas.<br>Cracks and potholes being blanketed by sand and soil to cut oxygen supply to minimize the spontaneous heating. A letter to CISF, requesting for help at the time of filling of cracks and potholes is attached as **Annexure XIV**. Photographs are also attached herewith.<br><br>To prevent the spread of fire some water pool has been created. (Photographs are attached as **Annexure- XIV**). |
| **xix.** | Underground mining should be taken up after completion of reclamation of Opencast mine area after 15 Years. | **Will be complied.**<br>Underground Mining will be done after extraction of upper seams and beneath Backfilled and reclaimed area. |
| **xx.** | No mining shall be undertaken where underground fires continue. Measure shall be taken to prevent / check such fire including in old OB dump areas where the fire could start due to presence of coal / shale with sufficient carbon content. | **Being Complied.**<br>Action is being taken to control mine fires including old OB dump & areas as specified in Jharia Master Plan and the open cast mining is being done in fire affected areas. Soil has been spread to eliminate the spontaneous combustion. Photographs are attached as **Annexure XIV**. |
| **xxi.** | The rejects of washeries in Cluster – IX should be sent to FBC based plant. | **Complied.**<br>Coal washery does not exist in this cluster at present. |
| **xxii.** | There shall be no external OB dumps. 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. | **Being Complied.**<br>Action is being taken as specified in EMP. No Dumping has been done in non-coal bearing area. Dumping has been done after excavation of Coal in de-coaled area. Backfilling of OB is going on with mining.<br>Concurrent Grass seeds are being broadcasted on OB dumps for enhancing greenery and mitigating pollution.<br>At the end of Mining there shall be no void and area will be re-vegetated and reclaimed. |
| **xxiii.** | 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 – IX shall be drawn up and implemented. | **Being Complied.**<br>Mining operation is being done as per approved Calendar Plan. Calendar Plan has been prepared. Details are attached as **Annexure I**.<br>Mine closure plan as per the guidelines of Ministry of Coal has been prepared by Central Mine Planning and Design Institute (CMPDI). Progressive mine closure |

<table>
<tr><td></td><td></td><td>plan is being implemented. Activities under mine closure plan are:<br>(i) Subsidence Management<br>(ii) Reclamation of abandoned Quarry<br>(iii) OB dump Reclamation<br>(iv) Plantation<br>(v) Entrepreneurship Development<br>(vi) Miscellaneous activities</td></tr>
<tr><td>xxiv.</td><td>The void shall be converted into a water reservoir of a maximum depth of 15-20 m and shall be gently sloped and the upper benches of the reservoir shall be stabilized 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</td><td>Will be complied.<br>A part of the void will be converted into the water body as specified in EMP.<br>At present there is no open abandoned pit. Abandoned Voids will be utilized for Pisciculture, if any in Post Mining Phase.</td></tr>
<tr><td>xxv.</td><td>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 minimum 60 m width shall be maintained along 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.</td><td>Being Complied.<br>Mining is being carried out as per Statute from the streams/Nalas flowing within the lease and maintaining a safe distance (>60 m) from the nalas flowing along the lease boundary.</td></tr>
<tr><td>xxvi.</td><td>Active OB dumps near water bodies and rivers should be re-handled for backfilling abandoned mines voids. However, those which have been biologically reclaimed need not be disturbed.</td><td>Being Complied.<br>No active dumps near water bodies exist.</td></tr>
<tr><td>xxvii.</td><td>Thick green belt shall be developed along undisturbed areas, mine boundary and in mine reclamation. During post mining stage, a total of 937.84 ha. Area would be reclaimed. The total additional area under plantation would be 367.95 ha. (189.95) ha. abandoned quarry area, 178 ha. Active quarry area, 104.34 OB dump outside quarry area, 36.49 ha. service building / Mine infrastructure area / coal dump etc., 165.88 ha.</td><td>Being Complied.<br>Grassing is being done every year during the monsoon over the OB dumps.<br>1200 Nos of bamboo gabion plantation has been done in nearby area of colonies.<br>Year wise plantation is being done as per following details:
<table>
<tr><td>Year</td><td>Cluster/Mine/Area</td><td>Area of greenbelt (Ha.)</td></tr>
<tr><td>2014-15</td><td>Lodna</td><td>05</td></tr>
<tr><td>2015-16</td><td>Lodna</td><td>07</td></tr>
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| | Green belt around OCP, 263.22 ha. Barren area), by panting 2344700 plants at a total cost Rs. 10830.45 lakhs. | 2016-17 | Lodna | 07 | |
| | | 2017-18 | Lodna | 07 | |
| | | 2018-19 | Lodna | 3.8 | |
| | | 2019-20 | Lodna | 0.3 | |
| | | 2020-21 | Lodna | 16 | |
| | | 2022-23 | Lodna | 10 | |
| | | 2023-24 | Lodna | 05 | |
| **xxviii.** | The road should be provided with avenue plantation on both side as trees act as sink of carbon and other pollutant. | **Being Complied.**<br>1200 nos. of bamboo gabion avenue plantation has been done by DFO, Dhanbad along roadside.<br>400 nos. of plants from Indira Chowk to Patherdih, 25 nos. of plants in bararee More, 25 nos. of plants in chatkari jore, 25 nos. of plants in Magazine etc. Photographs are attached. Sneh Smriti Upvan has been established in which fruit bearing plants have been planted. | | | |
| **xxix.** | 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 IX shall be implemented. | **Being Complied.**<br>Specific mitigative measures have been taken for the Jharia Coalfields in the Environmental Action plan prepared for Dhanbad:<br>1. Covered transportation of coal.<br>2. Water sprinkling is being done by mobile water sprinklers and fog cannon along prominent dust generating roads.<br>3. Plantation.<br>4. Apprx. 1KM of Toe wall constructed along OB dump<br>5. Avenue Plantation along the road<br>6. Water sprinkling through Truck Mounted Fog Cannon.<br>7. Construction of Pucca Roads from South Tisra workshop to North tisra Checkpost.<br>8. Grass seeding on dormant OB Dumps.<br>9. Wetting of coal before loading at railway siding.<br>10. PM10 Analyser Instrument has been installed.<br>11. Trolley mounted Fog canons installed at GOL Siding No. 9 | | | |
| **xxx.** | The locations of monitoring stations in the Jharia Coalfields should be finalized in consultation with the Jharkhand State Pollution Control Board. The committee stated that smoke / dust emission very 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 the entire Jharia Coalfields. Mineralogical composition study should be undertaken on the composition for suspended particulate matter (PM 10 | **Complied.**<br>The locations of monitoring stations have been finalized with the Jharkhand State Pollution Control Board. The location of monitoring stations are:<br>(i) Jeenagora (A13)<br>(ii) Kusmatand Village (A12)<br>(iii) Bhowrah North (A14)<br>(iv) Hurriladih UGP (A28)<br><br>The said study of source apportionment has been conducted by NEERI, Nagpur. Final report is enclosed as **Annexure XII.** | | | |

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| | and PM 2.5) in Jharia coalfields and also qualified. These studies would help ascertain source and extent of the air pollution, based on which appropriate mitigative measures could be taken. | |
| **xxxi.** | No ground water 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. | **Being Complied.**<br>No ground water is being used for mining activities. Only Mine water is being used for the industrial purpose.<br>Mine water is being reused for industrial purposes by supplying them through water channel in different mines of Cluster IX. |
| **xxxii.** | 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 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. | **Being Complied.**<br>CMPDI RI-II is regularly Conducting study of groundwater level and quality of areas within Cluster IX. As per report ground water has not been declined. Groundwater monitoring data has been enclosed as **Annexure XV.**<br><br>Piezometer has been installed in Cluster IX. Photograph of piezometer is enclosed with **Annexure XV.**<br><br>Ground water quality monitoring data has been sent to State Pollution Control Board/Central Pollution Control Board. Details are attached as **Annexure XVI**.<br>To Monitor Ground water level DWLR has been fitted with both Piezometric Well. |
| **xxxiii.** | Mine discharge water shall be treated to meet standards prescribed standards before discharge into natural water coursed / 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. | **Being Complied.**<br>Mine discharge water is being allowed to settle down in the mine sumps before filtration through Pressure Filter. The monitoring of water quality parameters is regularly carried out by CMPDIL. The report of mine water discharge is uploaded on BCCL official website which is also given in the six-monthly EC compliance report. Mine water quality data has-been enclosed as **Annexure XVII.** |
| **xxxiv.** | 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. | **Being Complied.**<br>Conventional Oil and grease trap with recycling arrangement was installed at South Tisra workshop and is functional. But after the dismantling of aforesaid workshop , a new workshop is being constructed which included new oil & grease trap facility. |
| **xxxv.** | Regular monitoring of subsidence movement on the surface over and around the working area and impact on natural drainage pattern, water | **Being Complied.**<br>No UG working, only OC operation in the mine.<br>However, some cracks are developed naturally which are filled by incombustible materials regularly and |

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| | 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. | Some buildings and structures are being dismantled also for the purpose of shifting of fires and subsidence affected people to a safe place.<br>A copy of letter related to subsidence and subsidence record is attached as **Annexure XVIII**. |
| **xxxvi.** | Sufficient coal pillars shall be left un-extracted around the air shaft (within the subsidence influence area) to protect from any damage from subsidence, if any. | **Complied.**<br>No UG working, only OC operation in the mine. |
| **xxxvii.** | High root density tree species shall be selected and planted over areas likely to be affected by subsidence. | **Being Complied.**<br>No UG working, only OC operation in the mine.<br>Planation is regularly done in leasehold area of Cluster IX. High root density plants are regularly planted as per the roadmap prepared by Forest Research Institute, Dehradun. Copy is enclosed as **Annexure XIX**. |
| **xxxviii.** | Depression due to subsidence resulting in water accumulating within the low-lying areas shall be filled up or drained out by cutting drains. | **Being Complied.**<br>Time to time depression has been filled by the locally available material and overburden. |
| **xxxix.** | Solid barriers shall be left below the roads falling within the blocks to avoid any damage to the roads. | **Complied.**<br>No UG working, only OC operation in the mine. |
| **xl.** | No depillaring operation shall be carried out below the township / colony. | **Being Complied.**<br>At present no depillaring operation is going on. A document has been attached certifying that no depillaring operation has been done below the township/colony since 2013 as **Annexure XX**. |
| **xli.** | The transportation plan for conveyor-cum-rail for Cluster-IX should be dovetailed with Jharia Action plan. Road transportation of coal during Phase – 1 should be by mechanically covered trucks, which should be introduced at the earliest. The plan for conveyor-cum-rail for Cluster – IX should be dovetailed with Jharia Action Pan. The road transportation of coal during Phase – 1 should be done by mechanically covered trucks. | **Being Complied.**<br>Action has been taken for formulating adequate transportation plan for conveyor-cum-rail system of dispatch. CMPDIL has been requested to prepare the plan. However, CMPDIL had submitted that such transportation plan can be completed only after implementation of Master Plan and dousing of the fire. The copy of the reply submitted by CMPDI is attached as **Annexure XXI.**<br>Request has been submitted to some of the vendors for making available details of mechanically covered trucks. Copy of the same is attached as **Annexure VII.**<br>Transportation is being done by covering vehicle with tarpaulin cover and it is made mandatory in Transportation contracts. |
| **xlii.** | A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport. | **Complied.**<br>More than 80%of coal is transported through railway which is environmentally better option than the road |

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| | | transportation. The study has been completed by the CMPDIL. The Project Proponent has submitted the report of study to analyze the extent of reduction in pollution load every year by reducing road transport. **Enclosed as Annexure IX.** |
| **xliii.** | R&R of 12246 Nos. of PAF's involved. They should be rehabilitated at cost of Rs. 126092.027 Lakhs as per the approved Jharia Action Plan. | **Being Complied.**<br>Implementation is being done as per the Master Plan. As per the approved Master Plan prepared for dealing with fire subsidence and rehabilitation in the leasehold of BCCL for Jharia Coal Field, the master plan has identified 595 unstable sites in the entire Jharia Coal Field. Out of these, 98 sites covering an area of 224.56 Ha consisting of 12246 no. of houses/families fall in Cluster-IX mines. The cost for rehabilitation for the families is estimated to be Rs. 126092.03 lakhs. In the NT-ST-Jeenagora mining block, 1716 houses have to be rehabilitated. The cost for rehabilitation is estimated to be Rs. 6989.88 lakhs with an affected area of 22.74 ha.<br><br>The responsibility of shifting Fire affected families/encroachers is with Jharia Rehabilitation and Devlopment Authourity (JRDA) formulated under the Chairmanship of DC, Dhanbad. 547 Nos. of Quarters have been allotted for shifting of PAFs by JRDA at Belgaria Township. The shifted PAFs belongs to the fire affected areas of DB road and Bengal Jharia section of NT-ST OCP, 271 Nos. of Fire affected Families/Encroachers have been shifted to Belgaria Township.<br><br>A total of 98 sites covering 2,245,600 square meters were identified as affected, as per the Environmental Management Plan (EMP) 2013. The families impacted by the project amount to 12,246, comprising BCCL, private, encroacher, and other households. Compensation packages have been offered according to government-approved master plans. For rehabilitation, the total budget outlay is Rs. 12,692 lakhs, with Rs. 1,366.66 lakhs paid so far. Employment provided is reported as nil. At the JRDA site in Karmatand, Dhanbad, 2,365 families have been rehabilitated, leaving 9,861 families still awaiting relocation. |
| **xliv.** | A detailed CSR Action plan shall be prepared for Cluster IX group of mines. Specific activities shall be identified for CSR the budget of RS. 142.55 Lakhs per year @ Rs. 5/T of coal as recurring expenditure. The 391.28 ha. of area within Cluster IX Ml existing as waste | **Being Complied.**<br>A detailed CSR Action Plan is attached as **Annexure VIII.**<br>TISS has conducted the survey for effective and need based CSR activities implementation. Also Mid- term Evaluation of Project *Swablamban* - Reeling and Spinning Training Project under CSR has been |

| | | |
|---|---|---|
| | 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. In addition to afforesting 1942.12 ha. of area at the post-mining stage, the waste land / barren land within Cluster IX ML. shall be rehabilitated / reclaimed as forest / agricultural land under CSR Plan in consultation with 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 company and to the local youth, who are motivated to carry out the work in future. | conducted by TISS, Mumbai. Copy is attached as **Annexure XXII.**<br><br>Under the CSR activities in the purview of NTST-Jeenagora OC, the handloom making projects (Jharkraft) at Mukunda at an expenditure of about Rs.10.38 lakhs during the year 2015-17 and at Alakdiha at an expenditure of about Rs.10.72 lakhs during the year 2016-18 have been established. |
| **xlv.** | 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 3years (for any one particular season which is consistent in the time series), and the report submitted to MOEF and its Regional office at Bhubaneswar. | **Being Complied.**<br>The Project Proponent has submitted Land Use Map of Cluster IX which has been prepared by CMPDIL using remote sensing data for monitoring of land use pattern and for post mining land use. Enclosed as **Annexure XXIII.** |
| **xlvi.** | A final Mines Closure Plan along with details of Corpus Fund shall be submitted to the Ministry of Environment & Forest 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 during mine reclamation and at the post mining stage for habitat restoration. | **Being Complied.**<br>Progressive Mine closure plan as per approved MCP is under implementation. Final closure plan will be submitted at appropriate time. Ecological Restoration a mix of native species are being used in mine reclamation. Native species of flora and fauna can be seen on these site. Approval of Mine Closure Plan is attached as **Annexure VI.** |
| **xlvii.** | A separate environmental management cell with suitable | **Complied.** |

| | | |
|---|---|---|
| | 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 socio-economic issues and the capacity building required in this regard. | Separate multidisciplinary environmental management cell at Area Level has already been established. The Project Proponent has submitted Office Order of the same has been enclosed as **Annexure X**. Environmental Engineer provided at Mine and Area level. A full-fledged Environment Department, headed by a HOD (Environment) along with a suitable qualified multidisciplinary team of Executives has been established.<br>The activities are monitored on regular basis at Area and at Headquarters levels. GM (Environment) at Headquarters level, Coordinates 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 the company's Director (Technical) and CMD. Further capacity building at both corporate and operating levels is being done. |
| **xlviii.** | Implementation of final mine closure plan for Cluster IX, subject to obtaining prior approval of the DGMS in regard to mine safety issues. | **Will be Complied.**<br>Final Mine Closure Plan, will be prepared at appropriate time. Mine closure plan as per the guidelines of Ministry of Coal has been prepared by Central Mine Planning and Design Institute (CMPDIL) and progressive mine closure plan is being implemented. |
| **xlix.** | **Corporate Environment Responsibility**: -<br>The company shall have a well laid down Environment Policy approved by the Board of Directors.<br><br>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. | **Complied.**<br>A well-defined Corporate Environment Policy has been constituted at BCCL (https://bcclweb.in/environment/CEP_2025.pdf) and at CIL (https://d3u7ubx0okog7j.cloudfront.net/documents/CEP-2023_fzZZl1q.pdf ) level to promote sustainable development by protecting the environment through integrated project planning & design, prevention/mitigation of pollution, conservation of natural resources, restoration of ecology & biodiversity, recycling/ proper disposal of wastes, addressing climate change and inclusive growth.<br><br>**Complied.**<br><br>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.<br>https://bcclweb.in/environment/CEP_2025.pdf<br><br>Copy Enclosed in **Annexure XXXVI** |

| | | |
|---|---|---|
| | 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. | **Complied.**<br><br>A hierarchical system of the company to deal with environmental issue from corporate level to mine level already exists. Flow chart is attached as **Annexure XXIV.** |
| | To have proper checks and balances, the company shall have a well laid down system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large. | **Complied.**<br>A letter with reference no.23/3/2015-ASO/BA, Government of India, Ministry of Coal, dated 26/04/2017 is attached herewith as **Annexure- XXV**, regarding quarterly review of all environment compliances in board meeting. Board reviews all the environment compliance matters that creates a system of reporting infringements/ deviation/ violation of the environmental/forest/wildlife norms/conditions and/or shareholders /stake holders. |

| Sl. No. | B) General Conditions | Compliance |
|---|---|---|
| **i.** | No change in mining technology and scope of working shall be made without prior approval of the Ministry of Environment and Forests. | **Complied.**<br>No change in mining technology and scope of working has been undertaken. |
| **ii.** | No change in the calendar plan of production for quantum of mineral coal shall be made. | **Being Complied.**<br>The approved peak production of coal for Cluster IX is 8.512 MTPA. The production of coal for the cluster is well within the limit. Calendar plan has been enclosed as **Annexure I.** |
| **iii.** | Four ambient air quality monitoring stations shall be established in the core zone as well as in the buffer zone for PM 10, PM 2.5, $SO_2$ and $ND_X$ 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. | **Being Complied.**<br>The optimum location of monitoring stations in Jharia Coal Field has been identified with the consultant advisory of CMPDIL and finalized with the approval of Jharkhand State Pollution Control Board. The location of monitoring stations are:<br>(i) Jeenagora (A13)<br>(ii) Kusmatand Village (A12)<br>(iii) Bhowrah North (A14)<br>(iv) Hurriladih UGP (A28)<br>**Enclosed as Annexure XI.**<br><br>The work of monitoring of ambient environment (Air quality monitoring and water quality monitoring including monitoring of Heavy metals) had been started by Central Institute of Mining & Fuel Research (CIMFR), Dhanbad which is having CSIR Laboratory recognized under the EP Rules. Currently CMPDIL is carrying out the work of monitoring.<br>To maintain the air quality as per applicable standard following precaution measures is being taken: -<br>1. Covered transportation of coal.<br>2. Water sprinkling is being done by mobile water sprinklers and fog cannon along prominent dust generating roads.<br>3. Plantation.<br>4. Toe wall constructed along OB dump.<br>5. Avenue Plantation along the road<br>6. Water sprinkling through Truck Mounted Fog Cannon.<br>7. Construction of Pucca Roads from South Tisra workshop to North Tisra Checkpost.<br>8. Grass seeding on dormant OB Dumps.<br>9. Wetting of coal before loading at railway siding.<br>10. Graders deployed on haul roads<br><br>Air quality Monitoring report is attached in **Annexure XXVI**, Water quality monitoring report is attached in **Annexure XVII** and report of Monitoring of Heavy metals have been enclosed as **Annexure XXXIV.** |

| | | |
|---|---|---|
| **iv.** | Data on ambient air quality (PM 10, PM 2.5, $SO_2$ and $NO_X$) 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. | **Being Complied.**<br>Data is regularly submitted to ministry along with compliance report.<br>Air quality Monitoring report, Water quality monitoring report and report of Monitoring of Heavy metals are being submitted with six monthly compliance report. |
| **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. | **Being complied.**<br>Personnel operating HEMMs, drilling machine and other machines comply with safety regulation and are equipped with Personal Protective Equipment. The noise and vibration during blasting operations are controlled by using Electronic Detonators.<br><br>At present no U/G mine is in operation which is a high noise area. In the O/C mine, all equipment and machines are regularly maintained and the noise level is within prescribed limits. Noise monitoring data has been enclosed as **Annexure XXVII.** |
| **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. | **Being Complied.**<br>Industrial wastewater (workshop and wastewater from the Mine) is not discharged to any water body.<br>Effluents discharge standards are regularly monitored by CMPDIL for cluster IX group of mines. Mine water is being treated using filter<br>Plants (Pressure, Sand filters etc.) for its further use in industrial purpose and supply to the community. Mine water monitoring report has been enclosed as<br>**Annexure XVII.**<br>Proposal for construction of OIL & Grease Trap in New Workshop is under pipeline. |
| **vii.** | Vehicular emission shall be kept under control and regularly monitored. Vehicles used for transporting the mineral shall be covered with tarpaulins and optimally loaded. | **Being Complied.**<br>PUC Certificate some vehicle involved in transportation is enclosed as **Annexure XXVIII.** |
| **viii.** | Monitoring of environment 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 analyzed through a laboratory recognized under EPA Rules, 1986. | **Being Complied.**<br>Ambient environmental monitoring is being done by CMPDIL. Monitoring data report enclosed as **Annexure XXVI.** |
| **ix.** | Personnel working in dusty areas shall wear protective respiratory devices and | **Being Complied.**<br>Dust is suppressed at source by water sprinkling. Dust |

<table>
<tr>
<td></td>
<td>they shall also be provided with adequate training and information on safety and health aspects.</td>
<td>masks are provided to persons working in dusty areas. The Project Proponent has submitted the details of dust masks provided to Personnel workers which are as follows:
<table>
<tr><th>FY</th><th>Dust Mask</th></tr>
<tr><td>2015-16</td><td>1000</td></tr>
<tr><td>2016-17</td><td>940</td></tr>
<tr><td>2017-18</td><td>1000</td></tr>
<tr><td>2018-19</td><td>1000</td></tr>
<tr><td>2019-20</td><td>350</td></tr>
<tr><td>2020-21</td><td>300</td></tr>
<tr><td>2021-22</td><td>140</td></tr>
<tr><td>2022-23</td><td>260</td></tr>
<tr><td>2023-24</td><td>112</td></tr>
<tr><td>2024-25</td><td>123</td></tr>
</table>
Details of Safety Equipment distributed since FY 2019-20 till Oct 25 is enclosed in Annexure XXXV<br>
Vocational training Centres under separate Human Resource Development Dept. is conducting regular training programme on these issues. Details of training programme are as:
<table>
<tr><th>Year</th><th>Total</th></tr>
<tr><td>2013-14</td><td>1348</td></tr>
<tr><td>2014-15</td><td>1353</td></tr>
<tr><td>2015-16</td><td>2715</td></tr>
<tr><td>2016-17</td><td>1004</td></tr>
<tr><td>2017-18</td><td>2145</td></tr>
<tr><td>2018-19</td><td>1013</td></tr>
<tr><td>2019-20</td><td>794</td></tr>
<tr><td>2020-21</td><td>664</td></tr>
<tr><td>2021-22</td><td>566</td></tr>
<tr><td>2022-23</td><td>650</td></tr>
<tr><td>2023-24</td><td>398</td></tr>
<tr><td>2024-25</td><td>422</td></tr>
</table>
</td>
</tr>
<tr>
<td>x.</td>
<td>Occupational health surveillance programme of the workers shall be undertaken periodically to observe any contractions due to exposure to dust and to take corrective measure, 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.</td>
<td>Being Complied.<br>
Initial Medical Examination (IME) of contracted personnel and periodical Medical Examination (PME) of all the personnel are carried out as per the Statutes and Director General of Mines Safety (DGMS) guidelines. Details of IME/PME done since 2018 till Oct 25 is enclosed in Annexure XXXV<br><br>
Details of PME/IME:
<table>
<tr><th>Year</th><th>IME</th><th>PME</th></tr>
<tr><td>2014</td><td>09</td><td>1710</td></tr>
<tr><td>2015</td><td>333</td><td>1564</td></tr>
<tr><td>2016</td><td>257</td><td>1335</td></tr>
<tr><td>2017</td><td>245</td><td>1134</td></tr>
<tr><td>2018</td><td>Nil</td><td>1400</td></tr>
<tr><td>2019</td><td>380</td><td>1058</td></tr>
</table>
</td>
</tr>
</table>

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>2020</td><td>133</td><td>495</td></tr>
<tr><td>2021</td><td>Nil</td><td>1100</td></tr>
<tr><td>2022</td><td>Nil</td><td>1027</td></tr>
<tr><td>2023</td><td>Nil</td><td>558</td></tr>
<tr><td>2024</td><td>34</td><td>882</td></tr>
</table>
</td></tr>
<tr><td>xi.</td><td>A separate environment 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.</td><td>Complied.<br>Separate multidisciplinary environmental management cell at Area Level has already been established. Office Order of the same has been enclosed as Annexure X. Environmental Engineer provided at mine and Area level. The activities are monitored on regular basis at Area and at Head Quarters 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.</td></tr>
<tr><td>xii.</td><td>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.</td><td>Being Complied.<br>The funds are available at Area and HQ level for implementation of activities in the capital & revenue budget. Enclosed as Annexure XXIX.<br>Separate account for environment protection measures. The details are as follows:
<table>
<tr><td>Accounting ledger</td><td>Items</td></tr>
<tr><td>41100018</td><td>Environmental Expenses- Tree Plantation</td></tr>
<tr><td>41100019</td><td>Environmental Expenses- Other Environmental</td></tr>
<tr><td>41100020</td><td>Environmental Expenses-Statutory payment to SPCB</td></tr>
<tr><td>41100021</td><td>Envt Expenses-Handling/disposal/Hazardous/Bio-MediWastes</td></tr>
<tr><td>41100022</td><td>Environmental Expenses-Air,water, Noise monitoring</td></tr>
<tr><td>41100023</td><td>Envt Expenses-Expenditure on OB dumps reclamation</td></tr>
<tr><td>41100024</td><td>Environmental Expenses- fees for Consent to Operate</td></tr>
<tr><td>41100025</td><td>Environmental Expenses- ISO related Activities</td></tr>
</table>
</td></tr>
<tr><td>xiii.</td><td>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</td><td>Complied.<br>It has been complied and published timely. Enclosed as Annexure XXX.</td></tr>
</table>

| | | |
|---|---|---|
| | 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. | |
| **xiv.** | A copy of the environmental clearance letter shall be marked to concern Panchayat/ ZilaParished, 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. | It has been complied. Environmental Clearance letter received by Panchayat/ Zila Parishad is Enclosed as **Annexure XXXI.** |
| **xv.** | A copy of the environmental clearance letter shall 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 environmental quality parameter (air, water, noise and soil) and critical pollutant such as $PM_{10}$, $PM_{2.5}$, $SO_2$ and $NO_x$ (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. | **Being Complied.**<br>The EC, its compliance along with monitoring data is being uploaded regularly on BCCL official website. The photo of the display of critical sectoral parameters at the entrance of mine office is attached as **Annexure XXXII.**<br><br>http://www.bcclweb.in/?page_id=20425 |
| **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.**<br>Six monthly reports of cluster –IX is regularly submitted to (twice in a year) the Regional Office of MoEFCC, Ranchi along with required data and information in soft copy.<br>The same has been uploaded on Parivesh Portal. |
| **xviii.** | The Regional Office of this Ministry located at Bhubaneswar shall monitor compliance of the stipulated conditions. The Project authorities shall extend full | **Being Complied.**<br>Project will extend its all-possible support and cooperation to the Regional Office in any kind of monitoring/visit/data collection etc. |

| | | |
|---|---|---|
| | cooperation to the Office(s) of the Regional Office by furnishing the requisite data / information / monitoring reports. | |
| **xix.** | The Environment Statement for each financial year ending 31 March in for-V is mandated to be submitted by the project proponent for the concerned State Pollution Control Board as prescribed under the Environment (protection) Rules, 1996, 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. | **Complied.**<br>Complied regularly on time. Attached as **Annexure XXXIII.** |

| **Sl. No.** | **C.) Other Conditions by MOEF :** | **Compliance** |
|---|---|---|
| **i.** | The Ministry or any other Competent Authority may stipulate any further condition(s) for environmental protection. | **Complied.**<br>Following additional measure as informed by MoEF and JSPCB from time to time |
| **ii.** | Failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract the provisions of the Environment (Protection) Act, 1986. | Agreed. |
| **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. | The storage of materials does not attract PLA, 1991. |
| **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. |

27-11-25
**Project Officer**
**Amal. Joyrampur Colliery, BCCL**

**Addl. General Manager**
**Lodna Area, BCCL**

**General Manager**
**Lodna Area, BCCL**

**Project Officer**
**NT-ST (Exp.) OCP, BCCL**

Shubham Singh 27/11/25
**Area Mgr. (Env.)**
**Lodna Area, BCCL**

| Coal produced between Apr '25 to Sept '25 (Cluster IX, Lodna Area, BCCL) - Tonnes | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Patch** | **Apr-25** | **May-25** | **Jun-25** | **Jul-25** | **Aug-25** | **Sep-25** | **Total** |
| **Amal NTSTJG OCP** | 290640 | 631085 | 477990 | 645845 | 581600 | 565625 | 3957936.83 |
| **Amal Joyrampur Colliery** | 76950 | 25650 | 8646.1 | 32700 | 33870 | 30780 | 208596.1 |
| **Total** | 481865 | 783735 | 525686.1 | 743095 | 663395 | 661455 | 3859231.1 |

| Overburden produced between Apr '25 to Sept '25 (Cluster IX, Lodna Area, BCCL) - M3 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Patch** | **Apr-25** | **May-25** | **Jun-25** | **Jul-25** | **Aug-25** | **Sep-25** | **Total** |
| **Amal NTSTJG OCP** | 3572284.51 | 3929853.36 | 3513907.71 | 2706159.32 | 2516222.56 | 1776398.69 | 18014826.15 |
| **Amal Joyrampur Colliery** | 2448480.16 | 1828577.47 | 1190968.98 | 863686.77 | 1104965.36 | 940522.92 | 8377201.66 |
| **Total** | 7324233.747 | 7119349.438 | 5868813.482 | 4409510.5 | 4536895.471 | 3674503.674 | 32933306.31 |

| Yearwise Production (2018-2025) | | | | |
|---|---|---|---|---|
| | **Total Coal (Tonnes)** | | **OBR (M3)** | |
| **Year** | **NT-ST (Expansion) OCP** | **AJC** | **NT-ST (Expansion) OCP** | **AJC** |
| **2018-19** | 2484642 | Nil | 10362176 | Nil |
| **2019-20** | 2534760 | Nil | 11027419 | Nil |
| **2020-21** | 2264372 | Nil | 11953215 | Nil |
| **2021-22** | 3813224 | Nil | 10969702 | Nil |
| **2022-23** | 6048770 | Nil | 10961364 | Nil |
| **2023-24** | 6139275.64 | 706025 | 24773863.36 | 24271431.09 |
| **2024-25** | 5343635 | 807510 | 31902974.46 | 23419284.33 |

| Details of Top soil generated, Backfilling area and Reclaimed | | | |
|---|---|---|---|
| **Year** | **Top Soil generated (cum)** | **Backfilling area (Ha)** | **Reclaimed Area (Ha.)** |
| **2013-14** | 414332 | 3.6 | Nil |
| **2014-15** | 420456 | 4.38 | 5 |
| **2015-16** | 479584 | 5 | 7 |
| **2016-17** | 66049 | 1.6 | 7 |
| **2017-18** | 492342 | 4.75 | 7 |
| **2018-19** | 187598 | - | 3.8 |
| **2019-20** | 12552 | - | 0.3 |
| **2020-21** | 5000 | - | 16 |
| **2021-22** | 8400 | - | - |
| **2022-23** | Nil | 6 | 10 |
| **2023-24** | Nil | | |
| **2024-25** | Nil | | |

**Annexure II**

# Area-wise Action Taken Report

**AREA-WISE ACTION TAKEN REPORT FOR EXTINGUISHING THE FIRE IN CLUSTER IX (In compliance of EC Specific Condition no. ii)**

| Name of Area/site | Name of Mine | Action Taken |
|---|---|---|
| Patch-B | NT-ST(Exp.) OCP | Fiery Hotspot are being dealt by only proven excavation method. The work was awarded for extraction of coal with vide ref no. BCCL/GM/SECY/LODNA/HIRING-HEMM-OS/2015/498 dated 30/06/2015 and BCCL/GM/SECY/LODNA/HIRING-HEMM-OS/2019/532 dated 28/03/2019. After Excavation of Fiery Coal, firefighting of coal is being done by directing water through hose pipe before stacking coal in coal dumps. Water is sprayed over stacked coals at coal dump in order to extinguish any left off coal fire. |
| Patch-F | NT-ST(Exp.) OCP | |
| Lodna, Near Raksha Kali Mandir | Amal. Joyrampur Colliery | Sand and Loose Materials are used to fill the cracks through which smoke is observed in order to minimize the spontaneous heating |
| Joyrampur Near Bagdigi Bridge | Amal. Joyrampur Colliery | |
| Gokul Park | NT-ST(Exp.) OCP | Soil has been spreaded on the slope of the Gokul Park to minimize the spontaneous heating and also some water pool has been created in Gokul Park to minimize the fire. |

11/03/22 — General Manager, Lodna Area

11/3/22 — AGM, Lodna Area

11/3/22 — AM (Env.), Lodna Area

11/03/2022 — Project Officer, Amal. Joyrampur Colliery

11.3.22 — Project Officer, NT-ST(Exp.) OCP

Scanned with CamScanner

**BHARAT COKING COAL LIMITED**
(A Subsidiary of Coal India Limited)
Office of the Project Officer
Amalgamated Joyrampur Colliery
Lodna Area- X

Ref.No. BAR/AJC/SO/2021/ 419

Date:- 21/12/21

सेवा में,

सहायक समादेष्टा,
सी .आई.एस .एफ,
जियलगोरा कैम्प

विषय :-अवैध खनन की भराई में सहयोग करने हेतु सूचना

महाशय;

दिनांक 22.12.2021 दिन बुधवार को सुबह 10 बजे बरारी कोलियरी में X सीम लक्ष्मी इंकलाइन के पास प्रबंधन द्वारा अवैध खनन की भराई कराई जाएगी | अवैध खनन की भराई शांतिपूर्ण तरीके से हो इसके लिए हमे आपके सहयोग की आवश्यकता है |

अतः आपसे अनुरोध है की तथा कथित स्थान पर अपनी मौजूदगी सुनिश्चित करके भराई का कार्य को शांतिपूर्ण ढंग से करने में सहयोग प्रदान करे |

भवदीय
21/12/21
परियोजना पदाधिकारी
एकीकृत जयरामपुर कोलियरी

प्रतिलिपि:-

१ क्षेत्रीय प्रबंधक (सुरक्षा), लोदना क्षेत्र
२ सुरक्षा पदाधिकारी, अमल॰ जयरामपुर कोलयरी
३ प्रबन्धक, अमल॰ जयरामपुर कोलयरी
४ कार्यालय प्रति

Received
21/12/21
CISD
Amalj/Kenda
C.I.S.F

देवघर से प्रकाशित

# जोहार झारखण्ड

RNI.NO. JH-03/000-3257

■ वर्ष-1 ■ पृष्ठ-6 ■ अंक- 15 ■ मूल्य-03 रुपया ■ joharjharkhand48@gmail.com

# बीसीसीएल प्रबंधक द्वारा अवैध कोयला माईन्स की भराई

जोहार झारखण्ड/संवाददाता।

**जोड़ापोखर।** कोयला चोरी को रोकने को लेकर लगातार बीसीसीएल प्रबंधक द्वारा अवैध कोयला माईन्स की भराई की जा रही है। इसी के तहत आज बीसीसीएल क्षेत्र संख्या 10 अंतर्गत बरारी कोलियरी में कई जगह चल रहे कोयला के अवैध माईन्स के मुहानों को आज परियोजना पदाधिकारी ए के पांडेय के नेतृत्व में डोजरिंग कर भराई की गई। डोजरिंग के दौरान सीआईएसएफ तथा जोड़ापोखर पुलिस मुस्तैद दिखी। परियोजना पदाधिकारी ए के पांडेय ने बताया कि कोयला चोरी रोकने को लेकर लगातार छापेमारी कर अवैध कोयला के माइन्स की भराई की जा रही है। बरारी कोलियरी क्षेत्र के भूलन बरारी, भूलन 6 न., पंख घर, बाजार धौड़ा आदि जगहों पर अवैध कोयले की माईन्स की डोजरिंग के द्वारा भराई कराई गई है। उन्होंने कहा की क्षेत्र में अवैध कोयला के जरिये राजस्व का भारी नुकसान हो रहा है, हर हाल पर इसमें अंकुश लगाया जाएगा। मौके पर बीसीसीएल के प्रबंधक राम पूजन राम, सेफ्टी प्रबंधक केके महतो, सुखदेव मंडल आदि मौजूद थे।

धावाटोड़ के रहने वाले
पकरण कुमार की अब जो
ली में जॉब करते हैं, उनकी
र स्टेशन पर पड़े चिंतित
मण सिंह पर पड़ी तो उन्होंने
ा लालमणि वृद्ध सेवा आश्रम
खाना पूर्ति के बाद उन्हें आश्रम में रहने के लिए स्थान उपलब्ध कराई. आश्रम के अध्यक्ष नौशाद गद्दी ने कहा की विगत 2006 से वे वृद्ध जनों के सेवा में तत्पर है
लक्ष्मण सिंह को व्यवस्थित करने में आश्रम अध्यक्ष नौशाद गद्दी, सदस्य ओमकार मिश्रा, अभिकरण कुमार समेत ओल्ड एज होम के सेवाकर्ता उपस्थित थे.

## है हैं मनमानी पैसे

# से वाहनों

# सबब

## नहीं दिलाया निजात

सूली बाइक फंसने पर 100
पए वहीं कार व मालवाहक
सने पर 500 रुपए तक की
सूली की बातें सामने आयी है.
हीं ऑटो वालों से भी 200
पए तक वसूला जा रहा है.
लिस की तैनाती के बाद भी वे
ामोश रहते हैं.

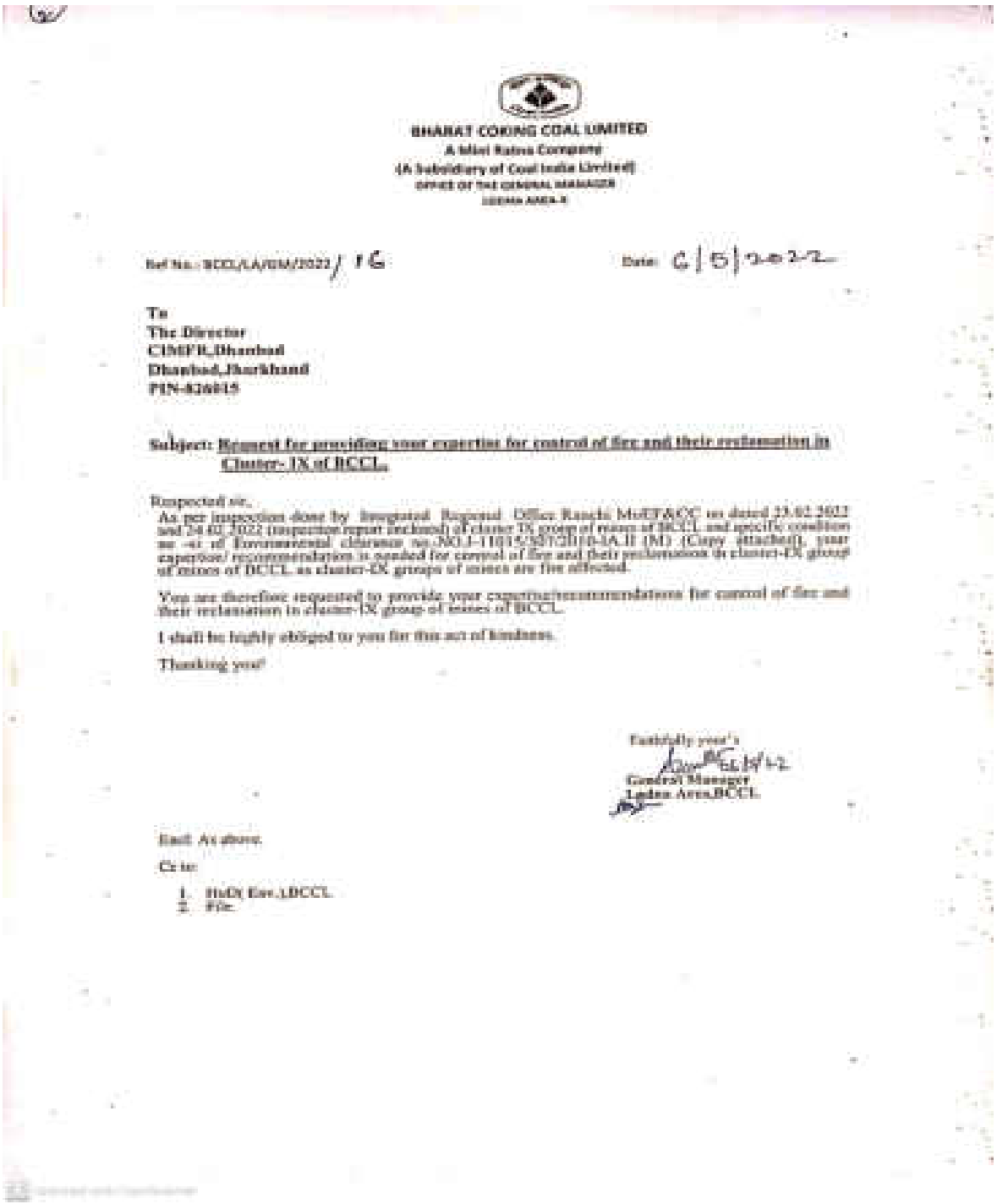
# बरारी कोलियरी क्षेत्र के कई स्थानो के अवैध उत्खनन मुहानों की जयरामपुर पीओ ने की भराई

**नई पत्रवार्ता प्रतिनिधि**

झरिया : लोदना क्षेत्र के बरारी कोलियरी के कई जगहों पर चल रहे कोयला के अवैध माइंस के मुहानों को बुधवार को एकीकृत जयरामपुर के परियोजना पदाधिकारी एके पांडेय ने डोजरिंग कराने पहुंचे, जिसके बाद कोयला तस्करों में हड़कम मच गया.डोजरिंग के दौरान सीआईएसएफ तथा जोड़ापोखर पुलिस मौजूद थी. परियोजना पदाधिकारी एके पांडेय ने बताया कि महाप्रबंधक के आदेश पर बरारी कोलियरी क्षेत्र के भूलन बरारी, कब्रिस्तान,भूलन बरारी 6 नंबर , पंखा घर, बाजार धौड़ा आदि जगहों पर अवैध कोयले की माइंस की डोजरिंग के द्वारा भराई कराई गई है. उन्होंने कहा की क्षेत्र में अवैध कोयला के उत्खनन से राजस्व का भारी नुकसान हो रहा है. हर हाल पर इस पर अंकुश लगाया जाएगा. मौके पर बीसीसीएल के प्रबंधक एसके सील, सुखदेव मंडल, राजेश महतो, अजित मांझी आदि मौजूद थे.

**Annexure III**

**Communication with IIT (ISM) and CIMFR, Dhanbad for providing expertise for control of fire.**



BHARAT COKING COAL LIMITED
A Mini Ratna Company
(A Subsidiary of Coal India Limited)
OFFICE OF THE GENERAL MANAGER
[illegible]

Ref No.: BCCL/LA/GM/2022/ 16 Date: 6/5/2022

To
The Director
CIMFR,Dhanbad
Dhanbad,Jharkhand
PIN-826015

Subject: Request for providing your expertise for control of fire and their reclamation in Cluster- IX of BCCL.

Respected sir,
As per inspection done by Integrated Regional Office Ranchi MoEF&CC on dated 23.02.2022 and 24.02.2022 (inspection report enclosed) of cluster IX group of mines of BCCL and specific condition no -xi of Environmental clearance no.:NO.J-11015/507/2010-IA.II (M) (Copy attached), your expertise/ recommendation is needed for control of fire and their reclamation in cluster-IX group of mines of BCCL as cluster-IX groups of mines are fire affected.

You are therefore requested to provide your expertise/recommendations for control of fire and their reclamation in cluster-IX group of mines of BCCL.

I shall be highly obliged to you for this act of kindness.

Thanking you!

Faithfully your's
6/5/22
General Manager
Ladna Area,BCCL

Encl: As above.

Cc to:
1. HoD( Env.),BCCL
2. File.

BHARAT COKING COAL LIMITED
A Mini Ratna Company
(A Subsidiary of Coal India Limited)
OFFICE OF THE GENERAL MANAGER
LODNA AREA-X

Ref No. : BCCL/LA/GM/2022/ 178 Date: 8/5/2022

To
The Director
ST(ISM), Dhanbad
Dhanbad,Jharkhand
PIN-826004

**Subject: Request for providing your expertise for control of fire and their reclamation in Cluster- IX of BCCL.**

Respected sir,

As per inspection done by Integrated Regional Office Ranchi MoEF&CC on dated 23.02.2022 and 24.02.2022 (inspection report enclosed) of cluster IX group of mines of BCCL and specific condition no -ix of Environmental clearance no.-No.J-11015/307/2010-IA.II (M) (Copy attached) , your expertise' recommendation is needed for control of fire and their reclamation in cluster-IX group of mines of BCCL as cluster-IX groups of mines are fire affected.

You are therefore requested to provide your expertise/recommendations for control of fire and their reclamation in cluster-IX group of mines of BCCL.

I shall be highly obliged to you for this act of kindness.

Thanking you!

Faithfully your's

8/5/22

General Manager
Lodna Area,BCCL

Encl: As above.

Cc to:

1. HoD( Env.)BCCL
2. File.

**BHARAT COKING COAL LIMITED**
**A Miniratna Company**
**(A Subsidiary of Coal India Limited)**
**OFFICE OF THE GENERAL MANAGER**
**LODNA AREA-II**

Ref No.: BCCL/LA/GM/2022/755 Date: 13/10/2022

**To**
**The Director**
**CIMFR,Dhanbad**
**Dhanbad,Jharkhand**
**PIN-826015**

**Subject: Request for providing Performa Invoice (PI)/Quotation for providing your expertise for control of fire and their reclamation in Cluster- IX of BCCL.**

Respected sir,

As per inspection done by Integrated Regional Office Ranchi MoEF&CC on dated 23.02.2022 and 24.02.2022 (inspection report enclosed) of cluster IX group of mines of BCCL and specific condition no -(i) of Environmental clearance no.-NO.J-11015/307/2010-IA.II (M) (Copy attached), your expertise/ recommendation is needed for control of fire and their reclamation in cluster-IX group of mines of BCCL as cluster-IX groups of mines are fire affected.

You are therefore requested to provide Performa Invoice(PI)/Quotation for providing your expertise/recommendations for control of fire and their reclamation in cluster-IX group of mines of BCCL.

I shall be highly obliged to you for this act of kindness.

Thanking you!

Faithfully yours
General Manager
Lodna Area,BCCL

Encl: As above.

Cc to:

1. HoD( Env.),BCCL
2. File.

**BHARAT COKING COAL LIMITED**
**A Mini Ratna Company**
**(A Subsidiary of Coal India Limited)**
**OFFICE OF THE GENERAL MANAGER**
**LODNA AREA-X**

Ref No. : BCCL/LA/GM/2022/757 Date: 18/10/2022

To
The Director
IIT Sindri, Dhanbad
Dhanbad,Jharkhand
PIN-828123

**Subject: Request for providing Performa Invoice (PI)/Quotation for providing your expertise for control of fire and their reclamation in Cluster- IX of BCCL**

Respected sir,

As per inspection done by Integrated Regional Office Ranchi MoEF&CC on dated 23.02.2022 and 24.02.2022 (inspection report enclosed) of cluster IX group of mines of BCCL and specific condition no -xi of Environmental clearance no.-No.J-11015/307/2010-IA.II (M) (Copy attached), your expertise/ recommendation is needed for control of fire and their reclamation in cluster-IX group of mines of BCCL as cluster-IX groups of mines are fire affected.

You are therefore requested to provide Performa Invoice(PI)/Quotation for providing your expertise/recommendations for control of fire and their reclamation in cluster-IX group of mines of BCCL.

We shall be highly obliged to you for this act of kindness.

Thanking you!!

Faithfully your's

18/10/22
General Manager
Lodna Area,BCCL

Encl: As above.

Cc to:

1. HoD( Env.),BCCL
2. File.

**BHARAT COKING COAL LIMITED**
**A Mini Ratna Company**
**(A Subsidiary of Coal India Limited)**
**OFFICE OF THE GENERAL MANAGER**
**LODNA AREA-II**

Ref No. : BCCL/LA/GM/2022/1756 Date: 13/10/2022

To
The Director
IIT(ISM), Dhanbad
Dhanbad,Jharkhand
PIN-826004

**Subject: Request for providing Performa Invoice (PI)/Quotation for providing your expertise for control of fire and their reclamation in Cluster- IX of BCCL.**

Respected sir,

As per inspection done by Integrated Regional Office Ranchi MoEF&CC on dated 23.02.2022 and 24.02.2022 (inspection report enclosed) of cluster IX group of mines of BCCL and specific condition no -xi of Environmental clearance no.-J-11015/207/2010-IA.II (M) (Copy attached), your expertise/ recommendation is needed for control of fire and their reclamation in cluster-IX group of mines of BCCL as cluster-IX groups of mines are fire affected.

You are therefore requested to provide Performa Invoice(PI)/Quotation for providing your expertise/recommendations for control of fire and their reclamation in cluster-IX group of mines of BCCL.

We shall be highly obliged to you for this act of kindness.

Thanking you!

Faithfully your's

General Manager
Lodna Area,BCCL

Encl: As above.

Cc to:

1. HoD( Env.),BCCL
2. File.

**Annexure IV**



Gmail Environment Lodna Area <envlodna@gmail.com>

## Fw: Recommendation of Indira Gandhi Centre of atomic Research, Kalpakkam for dealing the fire in coal mine in Jharia coalfield.

O.T.G.Nair <diradmn@igcar.gov.in> 24 February 2020 at 13:47
To: envlodna@gmail.com
Cc: "Venkatraman B.[Dir SQRMG]" <bvenkat@igcar.gov.in>, borah@igcar.gov.in

Sir,

It appears that the reference to IGCAR in the MoEF letter dated 21-5-2013 is erroneous. You may like to check-up with MoEF. .

Regards,

Director (P&A)

From: Environment Lodna Area
Sent: Saturday, February 15, 2020 12:35 AM
To: O.T.G.Nair ; borah@igcar.gov.in
Subject: Re: Fw: Recommendation of Indira Gandhi Centre of atomic Research, Kalpakkam for dealing the fire in coal mine in Jharia coalfield.

Dear Sir,

As per **EC no: J-11015/307/2010-IA-II (M) dated: 21st May 2013, Specific condition no. iv** (copy attached) of Cluster IX, it is mentioned that the recommendation of Indira Gandhi Centre for Atomic Research, Kalpakkam should be followed. Cluster IX of mines situated in Lodna Area of Jharial Coal field is highly affected by fire.

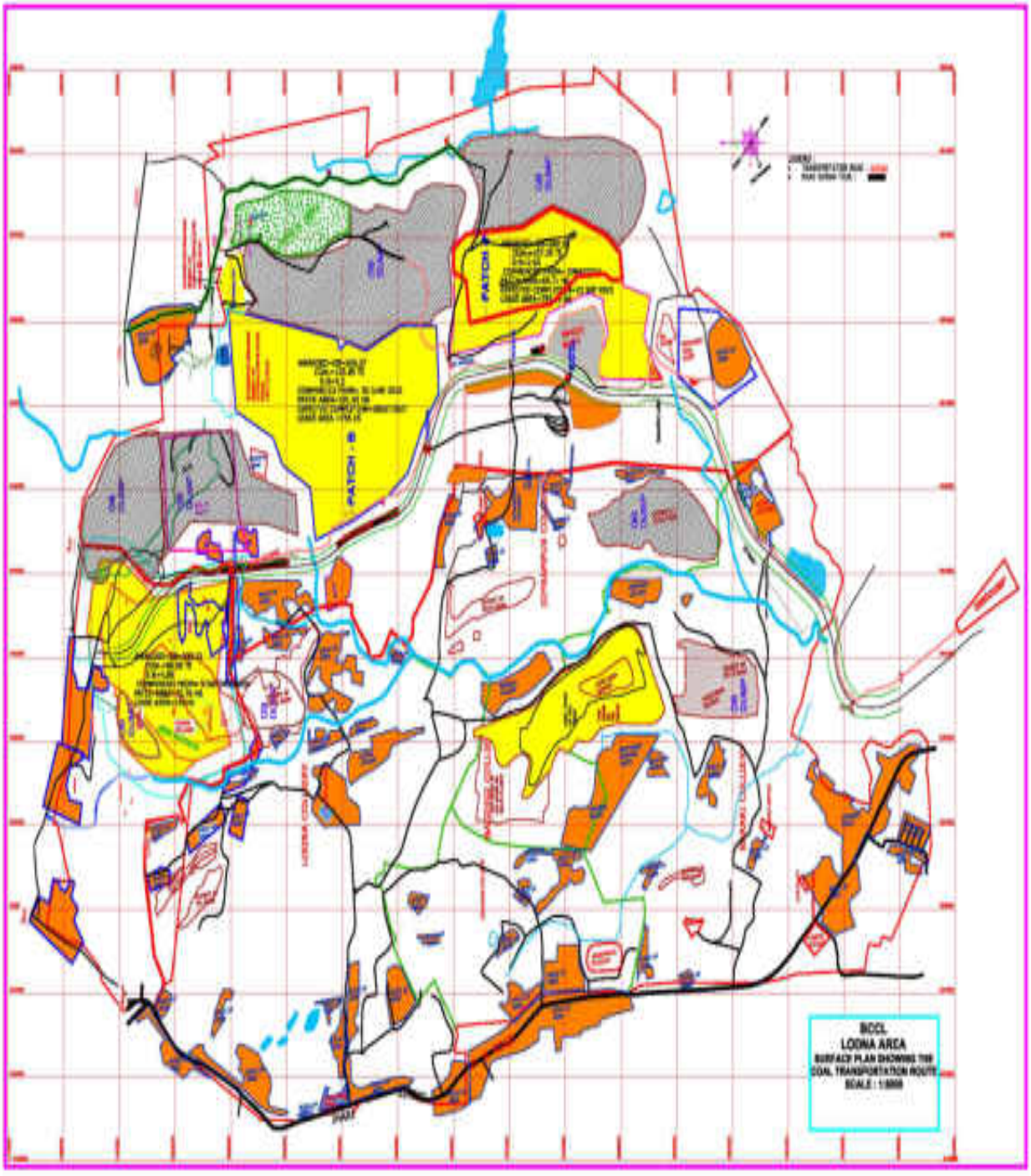
We request you provide us the recommendation made by your institution for dealing the fire in the following address.
Enclosure: EC (Cluster IX)

warm regards
General manager

On Thu, 9 Jan 2020 at 22:32, O.T.G.Nair <diradmn@igcar.gov.in> wrote:

> Dear Dr. Borah,
>
> The previous papers were sent to you for a response to the firm. Please look into this.
>
> Regards,
>
> OTG Nair
>
> From: Environment Lodna Area
> Sent: Saturday, January 11, 2020 12:59 AM
> To: O.T.G.Nair
> Subject: Re: Fw: Recommendation of Indira Gandhi Centre of atomic Research, Kalpakkam for dealing the fire in coal mine in Jharia coalfield.
>
> Dear Sir,
> Please give your recommendation. We need to comply this condition as per EC given by MoEF&CC and we have to submit the report to MoEF&CC.
> So You are kindly requested to do the needful at the earliest.
>
> warm regards
> General manager

**Annexure V**


PATCH - I
PATCH - II
BCCL
LODNA AREA
SURFACE PLAN SHOWING THE
COAL TRANSPORTATION ROUTE
SCALE : 1:5000

# TRANSPORTATION PLAN

**Fully covered tarpaulene road transport**

# Annexure VII

Gmail

Environment Lodna Area <envlodna@gmail.com>

## Fwd: Mechanically covered trucks for transportation of coal

**ARUN KUMAR** <gmlodna.bccl@coalindia.in> 19 April 2022 at 13:32
To: agmofficelodna <agmofficelodna@gmail.com>, planninglodna <planninglodna@gmail.com>, TAPAS KUMAR BANDOPADHYAY <tapas.bandopadhyay@coalindia.in>, Pankaj Kumar <pankaj.k3407@coalindia.in>, envlodna <envlodna@gmail.com>

For information and necessary action

---

**From:** "Rakesh Dwivedi" <rdwivedi.cil@coalindia.in>
**To:** "b bhadale" <b.bhadale@tatamotors.com>
**Cc:** "Pradeep Kumar Sinha" <gmenm.bccl@coalindia.in>, "KUMAR RANJEEV" <gmenv.bccl@coalindia.in>, "ARUN KUMAR" <gmlodna.bccl@coalindia.in>, "Nand Kishore Bharati" <gmcmc.bccl@coalindia.in>, "Shailendra Kumar Singh" <tstodtop.bccl@coalindia.in>, agmofficelodna@gmail.com
**Sent:** Tuesday, April 19, 2022 12:03:12 PM
**Subject:** Mechanically covered trucks for transportation of coal

To Sri Bapu Saheb Bhadale
Nodal Officer (Commercial Vehicles)
Tata Motors, Mumbai

Dear Sir,

REF: BCCL Work order no 191 DT 25-11--2011 for 173 nos Tata Tippers (Hywa) LPK2518

Our company Bharat Coking Coal Ltd, a Subsidiary of Coal India Ltd is engaged in the business of mining coking coal . Large no of tipping trucks of Tata make are in operation in our mines for transportation of coal and for reference a` work order issued to Tata Motors for procurement of tipping trucks has been referred above.
Ministry of Environment and Forest, Government of India has issued statutory directives to deploy tipping trucks with a mechanical system for covering the trucks to ensure that there is no spillage during coal transportation. This issue raised with Tata Motors officials and we were informed that Tata Motors would look into the matter

WE will be grateful if you confirm the availability of such mechanically covered tipping trucks in your company. Kindly let us no if it is possible to retrofit the operating Tata Moto Tippers with mechanical covers,

An early reply will be highly appreciated

Dr R. Dwivedi,
General Manager (E&M)/Solar
Bharat Coking Coal Limited
Dhanbad

## Avenue Plantation

**Annexure VIII**

# CSR, R&R AND TRANSPORTATION PLAN OF CLUSTER IX

## As per EC Condition (Specific Condition No. IX)

***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 form***

**Bharat Coking Coal Limited**
**(A Mini Ratna Company)**
**Lodna Area**
**Dhanbad**

**CIL'S POLICY FOR CORPORATE SOCIAL RESPONSIBILITY (CSR)**

## *Introduction:*

Bharat Coking Coal Limited is a subsidiary of Coal India Limited, a Maharatna Company. The company is currently operating in 12 administrative areas in Jharia Coalfields encompassing around 226 peripheral villages mainly in the District of Dhanbad, Jharkhand and in some part of West Bengal. 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 Km of the Project sites. This has resulted into a harmonious relationship between Coal India and the peripheral Communities. The Strategic CSR of BCCL states that the company's main objective is to improve the quality of life of people living in and around its command areas. The key areas of CSR invention are rural development, livelihood generation and skill development. It has a long history of philanthropic activities which were converged to align with the Corporate Social Responsibility mandate of the Companies Act 2013. Rural development, livelihood generation and skill development are thrust areas of the BCCL‟s CSR interventions.

**SCOPE**

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

1. Eradicating hunger, poverty and malnutrition, promoting healthcare including preventive health care and sanitation and making available safe drinking water.
2. Promoting education, including special education and employment enhancing vocation skills especially among children, women, elderly, and differently abled and livelihood enhancement projects;
3. 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;
4. Ensuring environmental sustainability, ecological balance, protection of Flora and Fauna, animal welfare, agroforestry, conservation of natural resources and maintaining quality of soil, air and water;
5. 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.
6. Measures for the benefit of armed forces veterans, war widows and their dependents
7. Training to promote rural sports, nationally recognized sports, Paralympics sports and Olympic sports;
8. 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;
9. Contributions or funds provided to technology incubators located within academic institutions which are approved by the Central Government;
10. Rural development projects

## *Policy on CSR*

CIL has well defined CSR policy framed on DPE's guidelines and on the Companies Act, 2013. The policy has CIL Board's approval. The Budget on CSR is allocated based on 2% on the average net profit of the company during the three immediate preceding financial years or R. 2.00 per tonne of coal produced in the previous year whichever is higher.

**CSR Activities at Lodna Area**: An Overview

- Healthcare
- Medical Camp
- Clinics at project level
- Health Awareness Programme
- Education
- Infrastructure Development
- Sanitation
- Environment protection
- Prime Minister's National relief fund (Contribution)
- Water Supply
- Electrical Supply

### 1. Healthcare:

Various health camps have been organized by Lodna Area for free health checkup and awareness of people in nearby villages. Some of the localities benefited from such camps include Belgaria, Golden Pahari, Bararee, Lodna etc.

Details of various free health checkup camps organized along with beneficiaries is given below:

| Sl. No. | Date | Beneficiaries |
|---|---|---|
| 1. | 11.09.2017 | 50 |
| 2. | 13.09.2017 | 69 |
| 3. | 15.09.217 | 22 |
| 4. | 18.09.2017 | 42 |
| 5. | 20.09.2017 | 67 |
| 6. | 22.09.2017 | 42 |
| 7. | 27.09.2017 | 19 |
| 8. | 11.10.2017 | 38 |
| 9. | 13.10.2017 | 42 |
| 10. | 18.10.2017 | 14 |
| 11. | 20.10.2017 | 21 |
| 12. | 23.10.2017 | 22 |
| 13. | 25.10.2017 | 35 |
| 14. | 27.10.2017 | 18 |
| 15. | 02.10.2019 | 111 |
| 16. | 11.11.2019 | 55 |
| 17. | 28.02.2020 | 65 |
| 18. | 01.04.2020- 11.04.2022 | 723 |

## 2. Education (School Grants):

For empowering the children of nearby villagers/ Project affected persons, Lodna Area management provide school grants to nearby schools annually, details of which are as follows:

| Sl. No. | Name of School | Financial Year | Amount (Rs) |
|---|---|---|---|
| 1. | **L P School, Golden Jeenagora** | 2017-18 | 93,000 |
| | | 2018-19 | 2,79,000 |
| | | 2019-20 | 93,000 |
| | | 2021-22 | 1,80,000 |
| 2. | **Middle School, North Tisra** | 2017-18 | 2,49,000 |
| | | 2018-19 | 7,47,000 |
| | | 2019-20 | 2,19,000 |
| | | 2021-22 | 4,20,000 |
| 3. | **Jealgora School of Learning, Jealgora** | 2017-18 | 2,37,000 |
| | | 2018-19 | 7,11,000 |
| | | 2019-20 | 2,37,000 |
| | | 2021-22 | 4,20,000 |

## 3. Infrastructure development Work (Welfare and CSR) done in Lodna Area, BCCL

| Financial Year 2017-18 | | | |
|---|---|---|---|
| **Sl. No.** | **Name of work** | **Amount (Rs.) in Thousand** | **Head** |
| 1. | CHANGING OF WINDOW AND DOOR AND FLOOR OF HANDLOOM JHARCRAPT AT OLD WORKSHOPNTC UNDER LODNA AREA. | 34.463 | Welfare Building |
| 2. | REPARING AND MAINTENANCE OF COMMUNITY CENTER SHIV MANDIR HANUMAN MANDIR, ATTACHAKKI, ALAKDIHA TOP AND KATTAGHAR JEENAGORA UNDER LODNA AREA. | 86.098 | Welfare Building |
| 3. | W/WASH, C/WASH, PAINTING OF COMMUNITY CENTER PANCHDEO MANDIR AT NOONUDIH UNDER LODNA AREA | 72.971 | Welfare Building |
| 4. | W/WASH, C/WASH, PAINTING AND OTHER CIVIL WORK AT CHHAT TALAB JOYRAMPUR UNDER LODNA AREA | 21.205 | Welfare Building |
| 5. | W/WASH, C/WASH, PAINTING OF MANAS MANDIR NEAR JEENAGORA STADIUM UNDER LODNA AREA. | 99.005 | Welfare Building |
| 6. | C/WAS, PAINTING OF COMMUNITY CENTRE, SHIV MANDIR AT BAGDIGI 5 NO. UNDER LODNA AREA. | 27.794 | Welfare Building |
| 7. | REPARING AND MAINTENANCE OF COMMUNITY CENTER BURAH BABA SHIV MANDIR AT JOYRAMPUR UNDER LODNA AREA. | 69.300 | Welfare Building |
| 8. | W/WASH C/WASH, PANTING AND MISC CIVIL WORK AT SHIV MANDIR PIRKUBANDH SANTOSHI AND HANUMAN MANDIR AT BHAGA NO-4 UNDER LODNA AREA. | 42.834 | Welfare Building |
| 9. | W/WASH C/WASH, PANTING ROOF REPARING AND RENOVATION OF CHABUTRA AT DURGA MANDIR AT P.G.PAHARI NT OCP UNDER LODNA AREA. | 97.344 | Welfare Building |

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| 10. | W/WASH C/WASH, PANTING ETC AT COMMUNITY CENTER SHIV MANDIR NHS QRT, DENOBLI MORE UNDER LODNA AREA. | 36.130 | Welfare Building |
| 11. | W/WASH C/WASH, PANTING etc. AT COMMUNITY CENTER D/M AT BHAGA UNDER LODNA AREA | 31.745 | Welfare Building |
| 12. | REPAIRING OF SHIV MANDIR AND YUTH CLUB AT BAGDIGI COLLIERY UNDER LODNA AREA. | 69.305 | Welfare Building |
| 13. | C/WASH PAINTINGUNDER MISC CIV WORK AT (SEWING AND COMPUTER SEC) AT KHUTTA DHOWRA BARAREE UNDER LA | 45.647 | Welfare Building |
| 14. | W/WASH C/WASH,PAINTING AND MISC CIVIL WORK AT RAKSHA KALI DHAM N.S LODNA UNDER LODNA AREA. | 244.613 | Welfare Building |
| 15. | W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK LODNA AT LODNA MASJID, LODNA COLLIERY LODNA UNDER LODNA AREA | 351.865 | Welfare Building |
| 16. | W/WASH, C/WASH, PAINTING OF COMMUNITY CENTER (D/M) AT LODNA AND BHAGA UNDER LODNA AREA | 77.225 | Welfare Building |
| 17. | W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK AT COMMUNITY CENTER (D/M) SECTOR-1,11 AND PG PAHARI NTG/ST OCP UNDER LODNA AREA. | 98.381 | Welfare Building |
| 18. | W/WASH, C/WASH, PANTING AT COMMUNITY CENTER (D/M) JEENAGORA AND JOYRAMPUR UNDER LODNA AREA. | 37.862 | Welfare Building |
| 19. | W/WASH, C/WASH, PANTING AT BAGDIGI AND CHHATTA DHOWRAH BARAREE AT LODNA AREA. | 59.695 | Welfare Building |
| 20. | REP OF SEPTIC TANK, B/WALL AND MISC CIVIL WORK AT COMMUNITY CENTER (D/M) LODNA UNDER LODNA AREA. | 86.34 | Welfare Building |
| 21. | MAINTENANCE OF COMMUNITY CENTER BURA BABA SHIV MANDIR AT JOYRAMPUR UNDER LODNA AREA. (G.S.T) | 83.394 | Welfare Building |
| 22. | REST PERMANENENT ROOF AND REPAIRING OF DAMAGED CHABUTRA AT JAMUNA SAHAY SMIRTI LODNA UNDER LODNA AREA. | 199.275 | Welfare Building |
| 23. | REP/MAINTANANCE OF COMMUNITY CENTER (LNH-417) AT BHAGA UNDER LODNA AREA | 69.20 | Welfare Building |
| 24. | REPARING/MAINTANANCE OF SHIV MANDIR NEAR BANIAHIR DAV SCHOOL AND SHIV SHAKTI NAGAR NEW COLONY UNDER LODNA AREA. | 135.279 | Welfare Building |
| 25. | W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK AT SHIV MANDIR PIRKU BANDH. | 2.908 | Welfare Building |
| 26. | W/WASH,C/WASH, PAINTING ETC AT COMMUNITY CENTER SHIV MANDIR NHS QRT DENOBILI MORE | 4.376 | Welfare Building |
| 27. | ROOF REPARING BY CGI SHEET ,OTHERS CIVILWORK AT KHAPRA DHOWRAH LODNA COLLIERY | 35.537 | Welfare Building |
| 28. | W/WASH,PAINTING,OF COMMUNITY CENTER SHIV MANDIR A BAGDIGI 05NO UNDER LODNA AREA | 3.367 | Welfare Building |
| 29. | DISTEMPARING,W/WASH, C/WASH,PAINTING AT COMMUNITY CENTER(shivmandir)BAGAN DHOWRAH BARAREE UNDER LODNA AREA | 55.651 | Welfare Building |
| 30. | W/WASH,C/WASH,PAINTING,ROOF REPARING AND RENOVATION OF CHABUTRA AT DURGA MANDIR AT P.G.PAHARI NT OCP | 11.792 | Welfare Building |
| 31. | W/WASH, C/WASH, PAINTING OF COMMUNITY OF | 3.845 | Welfare Building |

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| | COMMUNITY CENTER D/M AT BHAGA UNDER LODNA AREA. | | |
| 32. | W/WASH,C/WASH,PAINTING AND MISC CIVIL WORK AT BY QRT COMMUNITY CENTER (SHIV MANDIR)AT LODNA COLLIERY UNDER LODNA AREA. | 31.125 | Welfare Building |
| 33. | W/WASH, C/WASH, PAINTING OF COMMUNITY CENTER (D/M) AT BHAGA UNDER LODNA AREA. | 3.845 | Welfare Building |
| 34. | W/WASH, C/WASH, PAINTING AND RENOVATION OF NOORANI MASJID UNDER LODNA AREA. | 184.104 | Welfare Building |
| 35. | W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK at panchdeo mandir noonudih under Lodna Area. | 39.539 | Welfare Building |
| 36. | REPARING AND MAINTANCE OF COMMUNITY CENTER SHIV MANDIR HANUMAN MANDIR ATTACHAKI, ALAKDIHA. | 1.630 | Welfare Building |
| 37. | W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK AT SANTOSHI MANDIR AND SHIV MANDIR 04NO BHAGA PIRKUBANDH UNDER LODNA AREA. | 37.857 | Welfare Building |
| 38. | W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK AT 3S CLUB BHAGA UNDER LODNA AREA. | 20.716 | Welfare Building |
| 39. | WORK OF W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK WITH WIRING AT COMMUNITY CENTER BURHA BABA MANDIR AT JOYRAMPUR COLLY. | 177.656 | Welfare Building |

| Sl. No. | Name of work | Amount (Rs.) in Thousand | Head |
|---|---|---|---|
| 1 | W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK AT 3S CLUB BHAGA UNDER LODNA AREA. | 10.973+0 | Other welfare works |
| 2 | WASH, C/WASH, PAINTING AND MISC CIVIL WORK AT BARAREE MASJID UNDER LODNA AREA. | 234.736 | Other welfare works |
| 3 | W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK WITH WIRING AT COMMUNITY CENTER (BURA BABA MANDIR) AT JOYRAMPUR COLLIERY UNDER LODNA AREA. | 69.974 | Other welfare works |
| 4 | W/EASH, C/WASH, PAINTING AND MISC CIVIL WORK AT SHAHID SAMARAK BAGDIGIH UNDER LODNA AREA. | 35.612 | Other welfare works |
| 5 | Work of W/Wash C/Wash painting and misc. Civil work at Panchdeo Mandir noonudih under Lodna Area. | 74.649 | Other welfare works |
| 6 | Community Centre Shiv Mandir Bararee / Denobili More Under Lodna Area. | 3.243 | Other welfare works |

**Financial Year 2018-19**

| Sl. No. | Name of work | Amount (Rs.) in Thousand | Head |
|---|---|---|---|
| 1 | C/WASH, PAINTING AND MISC. CIVIL WORK AT COMMUNITY CENTER (SHIV MANDIR AND HANUMAN MANDIR) AT DUMARITAND NEWCOLONY UNDER LODNA AREA. | 92.8 | welfare Building |
| 2 | REVALIDATION OF W/WASH, C/WASH, PAINTING AND MISCE CIVIL WORK AT SONTOSHI MANDIR AND SHIV MANDIR 04NO AT PIRKUBANDH BHAGA UNDER LODNA AREA. | 63.431 | welfare Building |

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| 3 | W/WASH, C/WASH, PAINTING REPAIRING AND MISC WORK AT COMMUNITY CENTER(S/M) AT MOCP COLONY SECTOR-1 UNDER LODNA AREA. | 203.453 | welfare Building |
| 4 | W/WASH,PAINTING AND MISCE CIVIL WORK AT COMMUNITY CENTER (SHIV MANDIR)AT SOUTH TISRA NEAR OLD VTC JEENAGORA UNDER LODNA AREA. | 18.96 | welfare Building |
| 5 | W/WASH,PAINTING AND MISCE CIVIL WORK AT COMMUNITY CENTER (SHIV MANDIR) AND HANUMAN MANDIR ATTACHAKKI,MORE ALAKDIHA TOP,WEIGH BRIDGE LODNA AREA. | 246.628 | welfare Building |
| 6 | W/WASH, PAINTING ETC OF COMMUNITY CENTER (SHIV MANDIR) BAGDIGI NO-5 UNDER LODNA AREA. | 27.939 | welfare Building |
| 7 | REPAIRING/MAINTANCE OF MAZDOOR SMRITI MACE AT NOONUDIH PLAY GROUND UNDER LODNA AREA. | 82.569 | welfare Building |
| 8 | REPAIRING AND MAINTENANCE OF JAMUNA SAHAY SIMIRITI COMMUNITY CENTER LODNA COLLIERY UNDER LODNA AREA | 253.425 | welfare Building |
| 9 | PROVIDING OF COVERING OF NTC MIDDLE SCHOOL BY BRICK WALL GRILL AND GATE AT PG PAHARI UNDER LODNA AREA. | 178.979 | welfare Building |
| 10 | W/WASH C/WASH, PAINTING AND MISCE CIVIL WORK AT COMMUNITY CENTER (SHIV MANDIR) ATBYE QRT LODNA AND EST BARAREE JEENAGORA UNDER LOPDNA AREA. | 56.366 | welfare Building |
| 11 | W/WASH C/WASH,PAINTING AND MISCE CIVIL WORK AT COMMUNITY CENTER (SHIV MANDIR) NEAR DURGA MANDIR BAGDIGI COLLIERY UNDER LODNA AREA. | 24.306 | welfare Building |
| 12 | W/WASH C/WASH,PAINTING AND MISCE CIVIL WORK AT RAKSHA KALI MANDIR N.S LODNA UNDER LODNA AREA. | 268.562 | welfare Building |
| 13 | W/WASH C/WASH, PAINTING AND MISCE CIVIL WORK AT NOORANI MASZID BENIAHIR NEW COLONY UNDER LODNA AREA. | 138.821 | welfare Building |
| 14 | Grading front side pcc with chequred tile snowsenand painting and etc wrok at mocp sector-111 community center (d/m) under lodna area. | 140.488 | welfare Building |
| 15 | REPARING MAINTENANCE OF MANDIR OF PG PAHARI Buildings SHIFTING OF STC SHIV MANDIR AT PG PAHARI UNDER LDNA AREA. | 177.364 | welfare Building |
| 16 | REPAIRING/MAINTENANCE (WHITE WASH)OF CENTRAL WORK SHOP JEALGORA UNDER LODNA AREA | 36.742 | welfare Building |
| 17 | REPAIRING OF COMMUNITY CENTER NEAR D TYPE BLOCK AT MOCP UNDER LODNA AREA | 152.109 | welfare Building |
| 18 | REPAIRING SHIV MANDIR SULUNGA JEENAGORA UNDER LODNA AREA | 156.611 | welfare Building |
| 19 | DISTEMPERING, W/WASHING, PAINTING AND MISC CIVIL WORK OF COMMUNITY CENTER (D/M) OF MOCO SCETOR-1, SCETOR-11 AND PG PAHARI UNDER LODNA AREA. | 44.28 | welfare Building |
| 20 | REPAIRING DRAIN AND GARBAGE CLEANING NEAR JEALGORA 07 PIT DURGA MANDIR UNDER LODNA AREA. | 116.91 | welfare Building |
| 21 | REPARING/ MAINTENANCE INCLUDING ROOF REP AT JEENAGORA KALI THAN CLUB UNDER LODNA AREA. | 62.561 | welfare Building |

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| 22 | W/WASH, C/WASH, PAINTING AT COMMUNITY CENTER (DURGA MANDIR) AT JOYRAMPUR UNDER LODNA AREA. | 27.715 | welfare Building |
| 23 | W/WASH, C/WASH, PAINTING AT COMMUNITY CENTER (DURGAMANDIR) AT JEENAGORA UNDER LODNA AREA. | 19.238 | welfare Building |
| 24 | W/WASH, C/WASH, PAINTING AT MISC CIVIL WORK AT MANAS MANDIR JEALGORA UNDER LODNA AREA. | 134.789 | welfare Building |
| 25 | W/WASH, C/WASH, PAINTING AT COMMUNITY CENTER (durga mandir)AT BHAGA UNDER LODNA AREA. | 18.580 | welfare Building |
| 26 | Revised Estimate of Shree Raksha Kali Dham NS LODNA | 18.340 | welfare Building |
| 27 | PIPE LINE HADI PATTI TO LALAH HIGH SCHOOL LODNA UNDER LODNAAREA | 57.251 | welfare Building |
| 28 | W/WASH,C/WASH,PAINTING AND MISC CIVIL WORK WITH ROOFGRADING AT COMMUNITY CENTER BURHA BABA MANDIR AT JOYRAMPUR COLLIERY UNDER LODNA AREA. | 182.718 | welfare Building |
| 29 | CLEANING AND REPAIRING OF DRAIN AT LODNA MORE SHANTOSHI MANDIR UNDER LODNA AREA. | 263.932 | welfare Building |
| 30 | RREVISED ESTIMATE OF COMMUNITY CENTER D TYPE BLOCK AT MOCP UNDER LODNA AREA. | 12.859 | welfare Building |
| 31 | W/WASH,C/WASH,PAINTING AT COMMUNITY CENTER DURGA MANDIRAND KALI MANDIR AT BAGDIGI COLLIERY UNDER LODNA AREA. | 10.778 | welfare Building |
| 32 | REPARING OF DAMAGED CHHAT GHAT AND STEP AT JOYRAMPUR COLLIERY UNDER LODNA AREA | 44.036 | welfare Building |

| Sl. No. | Name of work | Amount (Rs.) in Thousand | Head |
|---|---|---|---|
| 1. | SPECIAI REPARING AND MAINTENANCE OF J.L.N STADIUM JEALGORA INCLUDING MAINTENANCE OF VARANDAH, MODLE ROOMAND V.I.P ROOM AT GUEST HOUSE. | 354.20 | Other Welfare Work |
| 2. | BCCL KE LAL LADLI CENTRE OF LA TO BE INCURRED DURING MONTH FROM MARCH 2018 TO JULY 2018. | 7.700 | Other Welfare Work |
| 3. | GRANT OF RS-15000/=TO MEET THE EXPAND OF SHRI SHRI DURGA PUJA AT BARAREE COLLY THE 2018. | 5.00 | Other Welfare Work |
| 4. | W/WASH,C/WASH,PAINTING OF COMMUNITY CENTER (DURGA MANDIR AND KALI MANDIE) ATCHHATA DHOWRAH BARAREE AND NOONUDIH UNDER LODNA AREA. | 25.215 | Other Welfare Work |
| 5. | W/WASH,C/WASH,PAINTING OF COMMUNITY CENTER (DURGA MANDIR AND KALI MANDIR)AT BAGDIGI COLLERY UNDER LODNA AREA. | 46.607 | Other Welfare Work |
| 6. | Payment of rs- 20000/= Lodna Colly puja committee. | 10.00 | Other Welfare Work |
| 7. | W/W C/W PAINTING OF N S LODNA WORK SHOP KALIMANDIR AND COMPOUND WALL AT LA. | 19.567 | Other Welfare Work |
| 8. | W/WASH, C/WASH, PAINTING NG AND MISC CIVIL WORK AT GOKUL PARK NTC UNDER LODNA AREA. | 29.670 | Other Welfare Work |
| 9. | REPAIRING OF DAMAGED CHHAT AND STEP AT JOYRAMPUR COLLIERY UNDER LODNA AREA. | 53.120 | Other Welfare Work |
| 10. | CLEANING AND REPARING OF WALL AT ALINDI TOLLA SULUNGA JEENAGORA UNDER LODNA AREA. | 33.500 | Other Welfare Work |
| 11. | W/W C/W PAINTING OF COMMUNITY CENTER KALIMANDIR KT SECTION JEEN AND OLD WORK | 23.716 | Other Welfare Work |

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| | SHOP UNDER LA. | | |
| 12. | ADMN APPR EST OF CHHAT TALAB STEP AT MALLAH PATTI UNDER LODNA AREA. | 109.248 | Other Welfare Work |

## Financial Year 2019-20

| Sl. No. | Name of work | Amount (Rs.) in Thousand | Head |
|---|---|---|---|
| 1. | REVISED ESTIMATE OF REPAIRING AND MAINTANANCE OF JAMUNA SAHAY SMRITI COMMUNITY CENTER LODNA COLLIERY UNDER LODNA AREA. | 20.819 | Welfare Building |
| 2. | REPAIRING AND MAINTENANCE OF CHHAT TALAB STEP AT MALLAH PATTI UNDER LODNA AREA. | 83.094 | Welfare Building |
| 3. | CLEANING AND REPARING OF DRAIN AT LODNA MORE TO SANTOSHI MANDIR UNDER LODNA AREA. | 482.731 | Welfare Building |
| 4. | COMMUNITY CENTER (SHIV MANDIR)AT BAGAN DHOWRAH BARAREE,BARAREE OFFICE AND DENOBOLI MORE DIGWADIH NEAR BHULI TYPE QRT UNDER LODNA AREA | 215.664 | Welfare Building |
| 5. | CLEANING AND REPAIRING OF WALL AT KALINDI TOLLA SULUNGA JEENAGORA UNDER LODNA AREA | 63.248 | Welfare Building |
| 6. | W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK AT GOKUL PARK NTC UNDER LODNA AREA. | 58.817 | Welfare Building |
| 7. | W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK AT NOORANI MASZID BANIAHIR NEW COLONY UNDER LODNA AREA. | 13.258 | Welfare Building |
| 8. | REPARING AND MAINTANANCE OF J.L.N STADIUM JEALGORA. | 34.425 | Welfare Building |
| 9. | W/WASH, C/WASH, PAINTING AT COMMUNITY CENTER (DURGA MANDIR) AT BHAGA UNDER LODNA AREA. | 35.517 | Welfare Building |
| 10. | REVALIDATION OF DISTEMPRING, W/WASH, PAINTING AND MISC CIVIL WORK OF COMMUNITY CENTER D/M OF MOCO SECTOR-1, SECTOR-11 AND P.G PAHARI LODNA AREA. | 68.281 | Welfare Building |
| 11. | REPARING AND MAINTENANCE OF RAKSHA KALIDHAM AT N.S.LODNA UNDER LODNA AREA | 391.236 | Welfare Building |
| 12. | C/WASH, PAINTING, AND OTHERS MISC CIVIL WORK OF COMMUNITY CENTER ATBARAREE MASJID UNDER LODNA AREA. | 375.834 | Welfare Building |
| 13. | W/WASHING, C/WASHING, PAINTING AND OTHER CIVIL MISC WORK OF COMMUNITY CENTER(S/M) AT MOCP SECTOR-1 NTC UNDER LODNA AREA. | 82.663 | Welfare Building |
| 14. | REPAIRING OF WELL WATER TANK AND PROVIDING OF PIPE LINE FROM MAIN MINE PIT WATER PIPE TO WATER TANK AT NEARSOUTH TISRA RAILWAYGATE LODNA AREA. | 133.718 | Welfare Building |
| 15. | REVISED ESTIMATE OF CLEANING AND REPAIRING OF DRAIN AT LODNA MORE TO SONTOSHI MANDIR UNDER LODNA AREA. | 47.611 | Welfare Building |
| 16. | W/WASH,C/WASH,PAINTING AND MISC CIVIL WORK AT MANAS MANDIR JEALGORA UNDER LODNA AREA | 335.451 | Welfare Building |

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| 17. | ROOF AND CCEQUREWD TILES WORK OF COMMUNITYCENTER (D/M$K/M) AT MOCP SECTOR-1 UNDERLODNA AREA. | 356.493 | Welfare Building |
| 18. | REPARING/MAINTENANCE OF COMMUNITY CENTENR NEAR 7 PIT JEALGORA UNDER LODNA AREA. | 127.10 | Welfare Building |
| 19. | W/WASHING,C/WASHING,PAINTING AT COMMUNITY CENTER(DURGA MANDIR AND KALI MANDIR)AT CHHOTTO DHOWRAH BARAREE AND NOONUDIH UNDER LODNA AREA. | 30.738 | Welfare Building |
| 20. | W/WASH,C/WASH,PAINTING AND MISC CIVIL WORK OF COMMUNITY CENTER(SHIV MANDIR)BAGDIGI 05NO UNDER LODNA AREA | 41.202 | Welfare Building |
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| **Sl. No.** | **Name of work** | **Amount (Rs.) in Thousand** | **Head** |
| 1. | Repairing and maintenance of chhat talab step at Mallah patti under LA. | 199.815 | Other Welfare Work |
| 2. | C/W PAINTING AND MISC CIVIL WORK AT COMMNIITY SHAD AT LODNA COLLY AND COMMINITY CHABUTRA BHAGA. | 17.327 | Other Welfare Work |
| 3. | SNOWCEM DISTEMPER PAINTING ETC IN MAHABIR MANDIR AT JOYRAMPUR COLLY UNDER LA. | 12.11 | Other Welfare Work |
| 4. | W/WASH,C/WASH,PAINTING AND MISCE CIVIL WORK OF SHAHID SMARAK (LAL MAIDAN) BARAREE UNDER LODNA AREA. | 90.491 | Other Welfare Work |
| 5. | REPAIRING AND MAINTENANCE OF COMMUNITY CENTER (KALI MANDIR) JOYRAMPUR B.R COMPANY UNDER LODNA AREA. | 58.39 | Other Welfare Work |
| 6. | REPAIRING AND MAINTENANCE OF SHIV MANDIR AT BHAGA NO-5 MAHABIR STHAN UNDER LODNA AREA. | 28.889 | Other Welfare Work |
| 7. | REPAIRING AND MAINTENANCE OF COMMUNITY CENTER AT PIRKU BANDH BANIAHIR UNDER LODNA AREA. | 35.581 | Other Welfare Work |
| 8. | PROVIDING OF COMPOUND WALL AND HOORING WORK OF COMMUNITY CENTER (D/M) AT STC UNDER LODNA AREA. | 143.099 | Other Welfare Work |
| 9. | BCCL KE LAL AND BCCL KI LADLI CENTER OF LA TO BE FROM MAY 2019 TO AUG 2019. | 11.132 | Other Welfare Work |
| 10. | PCC ROAD APPROACH OF KALI MANDIR AT GOKUL PAEK,NT-ST UNDER LODNA AREA. | 232.851 | Other Welfare Work |
| 11. | W/WASHING,C/WASHING,PAINTING,AND MISCE CIVIL WORK ATCOMMUNITY CNTER (SHIV MANDIR) ATTA CHAKKI MORE AND ALEKDIHA O.P JOYRAMPUR UNDER LODNA AREA. | 73.313 | Other Welfare Work |
| 12. | PROVIDING OF PAVER BLOCK IN THE FRONT SIDE OF KALI MANDIR AT GOKUL PARK NTC UNDER LODNA AREA. | 223.400 | Other Welfare Work |
| 13. | REVISED ESTIMATE PROVIDING OF COMPOUND WALL AND FLOORING WORK OF COMMUNITY CENTER D/MAT STC UNDER LODNA AREA. | 11.468 | Other Welfare Work |

## Financial Year 2020-21

| Sl. No. | Name of work | Amount (Rs.) in Thousand | Head |
|---|---|---|---|
| **1.** | RENOVATION OF KALI MANDIR SHIFTED FROM DB ROAD AT GOKUL DHAM NEAR NTC OLD WORKSHOP UNDER LODNA AREA | 183.871 | Welfare Building |
| **2.** | For W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK OF COMMUNITY CENTER SHIV MANDIR | 69.524 | Welfare Building |

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| | BAGDIGI 05 NO UNDER LODNA AREA. | | |
| **3.** | For W/WASH, C/WASH, PAINTING AND MISC CIVIL WORK AT SHIV MANDIR AND HANUMAN MANDIR AT DUMARIYATAND NEW COLONY UNDER LODNA AREA. | 73.564 | Welfare Building |
| **4.** | FOR REPAIRING AND MAINTENANCE OF SHIV MANDIR AT BHAGA NO-5 MAHABIR STHAN UNDER LODNA AREA. | 46.021 | Welfare Building |
| **5.** | FOR W/WASH, C/WASH PAINTING ETC AT MANAS MANDIR JEALGORA UNDER LODNA AREA. | 141.836 | Welfare Building |
| **6.** | FOR W/WASH, C/WASH PAINTING AND MISC CIVIL WORK AT COMMUNITY CENTER (SHIV MANDIR) AT SHIV SHAKTI NAGAR BANIAHIR DAV UNDER LODNA AREA. | 241.599 | Welfare Building |
| **7.** | FOR W/WASH, C/WASH PAINTING AND MISC CIVIL WORK OF PANCHANAN TEMPLE AT GOKUL DHAM. | 55.914 | Welfare Building |
| **8.** | FOR REPAIRING AND MAINTENANCE INCLUDING WHITE WASH,COLOUR WASH,AND PAINTING ERC AT COMMUNITY CENTER(SHIVMANDIR AND KALI MANDIR)AT SAIT KOTHI JEENAGORA. | 101.80 | Welfare Building |
| **9.** | FOR W/WASH, C/WASH PAINTING AND MISC CIVIL WORK AT COMMUNITY CENTER SHIV MANDIR ATTACHAKKI MORE AND ALAKDIHA OP JOYRAMPUR UNDER LODNA AREA. | 73.313 | Welfare Building |
| **10.** | FOR REPAIRING AND MAINTENANCE RAKSHA KALIDHAM AT N.S LODNA UNDER LODNA AREA. | 164.704 | Welfare Building |
| **11.** | FOR W/WASH,C/WASH, PAINTNG AT COMMUNITY CENTER DURGA MANDIR AND KALIMANDIR AT CHHATA DHOWRA BARAREE AND NOONUDIH UNDER LODNA AREA. | 61.660 | Welfare Building |
| **12.** | FOR REPAIRING AND MAINTENANCE OF COMMUNITY CENTER PIRKUBANDH BANIHIR UNDER LODNA AREA. | 65.488 | Welfare Building |
| **13.** | FOR REPAIRING AND MAINTENANCE OF COMMUNITY CENTER NEAR 07 PIT JEALGORA UNDER LODNA AREA. | 172.628 | Welfare Building |
| **14.** | FOR W/WASH, C/WASH, PAINTNG AND MISC CIVIL AT COMMUNITY CENTER DURGA MANDIR LODNA COLLIERY UNDER LODNA AREA. | 55.820 | Welfare Building |
| **15.** | FOR W/WASH, C/WASH, PAINTNG OF COMMUNITY CENTER SHIV MANDIR AT LODNA BAZAR, 40NO DHOWRAH, KHAPRA DHOWRA AT LODNA COLLIERY UNDER LODNA AREA. | 140.672 | Welfare Building |
| **16.** | FOR REPAIRING DAMAGED WALL FOR ASH PIT AND Buildings GARBAGE CLEANING NEAR GUEST HOUSE JEALGORA UNDER LODNA AREA. | 49.089 | Welfare Building |
| **17.** | FOR REPAIRING AND MAINTENANCE OF KALI MANDIR JEENAGORA RAILWAY CROSSING PAHALWAN DHOWRAH UNDER LODNA AREA. | 45.413 | Welfare Building |
| **18.** | FOR W/WASH,C/WASH,PAINTING ETC WORK AT COMMUNITY CENTER HANUMAN MANDIR AT EAST BARAREE JEENAGORA COLLIERY UNDER LODNA AREA. | 25.106 | Welfare Building |
| **19.** | FOR/WASH,C/WASH,PAINTING AND MISC CIVIL WORKS AT SHAHID SMARAK BAGDIGIH UNDER LODNA AREA. | 40.536 | Welfare Building |
| **20.** | FOR /WASH,C/WASH,PAINTING OF COMMUNITY CENTER DURGA MANDIR AND KALI MANDIR AT BAGDIGI COLLIERY UNDER LODNA AREA. | 57.009 | Welfare Building |

| | | | |
|---|---|---|---|
| **21.** | FOR COLOUR WASHING, PAINTING, WALL TILES AT 1ST FLOOR INCLUDING PARTIAL PORTION WIRING AT NOORANI MASZID NEW COLONY BANIAHIR UNDER LODNA AREA. | 164.780 | Welfare Building |
| **22.** | FOR CLEANING AND REPAIRING OF DRAIN AT BYE QRT NEAR SHIV MANDIR LODNA UNDER LODNA AREA. | 148.513 | Welfare Building |
| **23.** | FOR /WASH,C/WASH,PAINTING AND MISC CIVIL WORK AT COMMUNITY CENTER(SHIVMANDIR) BYE QRT LODNA COLLIERY UNDER LODNA AREA. | 33.230 | Welfare Building |
| **24.** | FOR W/WASH, C/WASH, PAINTING AND OTHER MISC CIVIL WORK OF SHIV MANDIR AT MOCPSECTOR-1 NTC UNDER LODNA AREA. | 13.317 | Welfare Building |
| **25.** | FOR PROVIDING OF B/WALL AND SHED AT HANDLOOM CENTER AT JHARCRAFT NTC UNDER LODNA AREA. | 230.938 | Welfare Building |
| **26.** | FOR W/WASH, C/WASH, PAINTING AND OTHER MISC CIVIL WORK AT JEENAGORA PEHADIGORA MANDAL DHOWRA (shiv mandir) UNDER LODNA AREA. | 24.532 | Welfare Building |
| **27.** | FOR REPAIRING/MAINTENANCE OF COMMUNITY CENTER NEAR 07 PIT JEALGORA UNDER LODNA AREA. | 13.316 | Welfare Building |
| **28.** | FOR RENOVATION OF KALI MANDIR (SHIFTED FROM DB ROAD) AT GOKULDHAM NEAR NTC OLD WORKSHOP UNDER LODNA AREA. | 194.00 | Welfare Building |
| **29.** | FOR REVALIDATION OF PROVIDING OF PAVER BLOCK IN THE FRONT SIDE OF KALI MANDIR AT GOKUL PARK NTC UNDER LODNA AREA. | 326.878 | Welfare Building |
| **30.** | FOR W/WASH, C/WASH, PAINTING OF SHIV MANDIR AT PIRKUBANDH NEAR LODNA MORE UNDER LODNA AREA. | 10.027 | Welfare Building |
| **31.** | FOR PROVIDING OF PAVER BLOCK IN THE FRONT FACE OF TOILET AT GOKUL PARK UNDER LODNA AREA. | 26.659 | Welfare Building |
| **32.** | FOR C/WASH, PAINTING, AND OTHERS MISC CIVIL WORK OF COMMUNITY CENTER (H/M) AT MOCP SECTOR-11 UNDER LODNA AREA. | 23.407 | Welfare Building |
| **33.** | FOR REPAIRING AND MAINTENANCE OF J.L.N STADIUM JEALGORA FOR THE URGENT FUNCTION SCHEDULE TO BE HELD IN THE STADIUM UNDER LODNA AREA. | 243.496 | Welfare Building |
| **34.** | FOR W/WASH,C/WASH,PAINTING ETC OF SHIV MANDIR BHAGA NO-2 UNDER LODNA AREA. | 12.017 | Welfare Building |
| **35.** | FOR DISTEMPARING, PAINTING ETC OF TEMPLE SITUATED NEAR COLLIERY OFFICE BAGDIGI UNDER LODNA AREA. | 15.919 | Welfare Building |

| **Sl. No.** | **Name of work** | **Amount (Rs.) in Thousand** | **Head** |
|---|---|---|---|
| **1.** | Payment for fooding and lodging arrangement of Work migrate labour returning to Jharkhand from other States as directed by State and district admn. | 220.150 | Welfare Work |
| **2.** | Payment for fooding and lodging arrangement of Work migrate labour returning to jharhand from other states as directed by State & district administration authorities. | 250.613 | Welfare Work |
| **3.** | FOR W/WASH,C/WASH,PAINTING OF SHIV MANDIR AT LODNA BARAREE 40NO DHOWRAH KHAPRA DHOWRAH AT LODNA COLLIERY UNDER LODNA AREA. | 34.633 | Welfare Work |
| **4.** | FOR W/WASH,C/WASH,AND PAINRING AT COMMUNITY CENTER DURGA MANDIR | 34.633 | Welfare Work |

| | | | |
|---|---|---|---|
| | LODNA COLLIERY UNDER LODNA AREA. | | |
| **5.** | Repairing and Maintenance of Raksha Kali Dham at NS Lodna Area. | 194.350 | Welfare Work |
| **6.** | FOR W/WASH, C/WASH, PAINTING AND OTHER MISC CIVIL WORK OF KALI MANDIR AT SOUTH TISRA KT OF JEENAGORA RAILWAY PHATAK UNDER LODNA AREA. | 15.632 | Welfare Work |
| **7.** | FOR W/WASHING, C/WASHING AND PAINTING OF SHIV MANDIR AT PG PAHARI UNDER LODNA AREA. | 25.226 | Welfare Work |
| **8.** | TCR for the work rep of damaged dran at PG pahari NT ST Work under lodna. | 58.045 | Welfare Work |
| **9.** | FOR C/WASH, PAINTING AND OTHER CIVIL WORK OF COMMUNTY CENTER (H/M) AT MOCP SECTOR-11 UNDER LODNA AREA. | 9.100 | Welfare Work |

## Financial Year 2021-22

| Sl. no | Name of the work | Amount | Head |
|---|---|---|---|
| 1. | R/M of 03 Nos Shiv Mandirs under Lodna Area | 49.055 | Welfare Building |
| 2. | R/M of Shiv Mandir at Paharigora, under Lodna Area | 7.539 | Welfare Building |
| 3. | R/M of raksha kali dham Lodna Area | 82.919 | Welfare Building |
| 4. | R/M of Hari Mandir @ Jeenagora under Lodna Area | 41.709 | Welfare Building |
| 5. | R/M 3 Nos Community Centre Dumariyatand under Lodna Area | 32.539 | Welfare Building |
| 6. | R/M of temple at Bagdigi under Lodna Area | 14.781 | Welfare Building |
| 7. | R/M of Kali Mandir at Gokul Park under Lodna Area. | 14.797 | Welfare Building |
| 8. | R/M of Shiv Mandir at alakdiha OP under Lodna Area | 19.559 | Welfare Building |
| 9. | R/M of Hanuman Mandir at Gokul Dham under Lodna Area | 40.864 | Welfare Building |
| 10. | R/M of Shiv Mandir Bhaga No. 2 under Lodna Area | 9.012 | Welfare Building |
| 11. | R/M of Shiv Mandir @ PG Pahari under Lodna Area. | 12.415 | Welfare Building |
| 12. | Rep. of Shiv Mandir @ jeenagora under Lodna Area | 33.474 | Welfare Building |
| 13. | R/M of Mandir at Noonudih & Bararee under Lodna Area. | 20.540 | Welfare Building |
| 14. | R/M of Lodna Masjid under Lodna Area | 258.224 | Welfare Building |
| 15. | R/m of durga kali mandir @ MOCP Sect 1 under Lodna Area. | 44.745 | Welfare Building |
| 16. | R/M of Burha Baba Mandir under Lodna Area. | 44.938 | Welfare Building |
| 17. | Misc. civil works of toilet @ Gokul Park under LOdna Area. | 29.917 | Welfare Building |
| 18. | R/m of Jeenagora weigh bridge under Lodna Area. | 32.620 | Welfare Building |
| 19. | R/M of Shiv Mandir b@ PIrkubandh under Lodna Area. | 8.333 | Welfare Building |
| 20. | R/M of durga Mandir @ Bhaga under Lodna Area. | 15.118 | Welfare Building |
| 21. | R/M of Shiv Mandir @ Baniahirunder Lodna Area. | 68.479 | Welfare Building |
| 22. | R/M of Kali Mandir and Durga mandir under lodna Area | 36.467 | Welfare Building |
| 23. | R/M Durga Mandir @ Lodna Colliery under Lodna Area. | 36.820 | Welfare Building |
| 24. | R/M of Durga Mandir at MOCP Sector 1 under Lodna Area | 25.373 | Welfare Building |

## 4. Water Supply:

Treated mine water is being supplied through water pipelines and water tankers to the nearby villagers, from the different collieries of Lodna Area under Cluster IX.

Apart from this colliery have their own water treatment plants as well to supply the water to nearby villagers. Details of villages, where water is being supplied and corresponding nos. of beneficiaries (Family) are given below:

| Sl. No. | Colliery name | Water supplied to nearby villages (Cum./day) | Name of beneficiary villages |
|---|---|---|---|
| 1. | Amal. Joyrampur Colliery | 10839 | Parga, Mukunda, Surunga, Nunudih Basti, Bazar Dhowra, Lodna Bazar |

**Mine water being used by nearby public for domestic purposes Chatt Talab**

**CSR Expenditure:**

Details of CSR expenditure of Cluster IX for different activities for last two years is given below:

| Name of Activity | Year (Expenditure in lakhs) | | |
|---|---|---|---|
| | 2019-20 | 2020-21 | 2021-22 |
| Expenditure on Filter Plants and Domestic water supply | 51.61 | 50.16 | 14.16 |
| MADA water supply | 725.26 | 693.80 | 444.00 |
| Hospital | 8.03 | 14.25 | 30.09 (including medicine and surgical equipment) |
| For the use of Community Centres/Auditoriums | 27.57 | 30.24 | 4.88 |
| Stadium and Sports | 18.29 | 6.51 | 10.58 |
| Handloom Centre | 3.5 | 1.98 | |
| Other Misc. Work | 2.62 | 6.2 | |

**Details of CSR expenditure of whole BCCL**

CSR Budget & Expenditure Summary from 2015-16 to 2020-21

| Sl. No. | Fin. Yr. | Obligation as per CSR Policy of Company (₹ in crores) | Expenditure (₹ in crores) |
|---|---|---|---|
| 1 | 2015-16 | 51.21 | 50.67 |
| 2 | 2016-17 | 28.89 | 11.87 |
| 3 | 2017-18 | 9.00 | 2.74 |
| 4 | 2018-19 | 6.52 | 1.47 |
| 5 | 2019-20 | 6.21 | 6.01 |
| 6 | 2020-21* | 5.54 | 2.99 |

*Unaudited provisional expenditure for the FY 2020-21

## Details of CSR expenditure of whole BCCL for FY 2021-22

| FY 2021-22 | | |
|---|---|---|
| Sl No | Particulars | Expenditure incurred(in Rs. Lakh) |
| 1 | Depository mode Financial assistance to D.C., Dhanbad for combating COVID-19 situation in Dhanbad | 100.00 |
| 2 | Depository mode Financial assistance to Jharkhand State Disaster Mitigation Fund for distributing home isolation kits to COVID-19 patients | 25.00 |
| 3 | Procurement of masks & hand wash/ sanitizers for distribution amongst public for combating COVID-19 | 0.72 |
| 4 | Fooding through Administration department for Doctors and Frontline workers at Covid Ward, CHD, Dhanbad and other miscellaneous COVID-19 expenditure like temporary contract of doctor etc. | 36.45 |
| 5 | Additional financial liability on submission of fresh bills for the work "Boarding and lodging of doctors and paramedical staff engaged in COVID-19 Hospital, CHD" | 22.62 |
| 6 | Cleaning and sanitization of temporary quarantine centres for doctors and paramedic staff engaged in treatment of COVID 19 | 2.15 |
| 7 | Training of Youths in Various Plastic Engineering Courses through Central Institute of Plastics Engineering and Technology (CIPET) | 14.00 |
| 8 | Development of 500 Nos. of Aanganwadi Centres in Dhanbad | 75.00 |
| 9 | SVA Survey Expenditure (All Areas) | 6.96 |
| 10 | Distribution of blankets during winter season | 3.58 |
| 11 | Submission of fresh bills for project "Training of mining sirdar for SC/ST PAPs" by PB Area | 3.26 |
| 12 | Submission of fresh bills for "Operation of COVID quarantine centre" by Bastacolla Area | 3.80 |
| 13 | Upgradation of public toilets and approach road in Central Hospital, Dhanbad | 3.15 |
| 14 | Submission of final bills for "Gymnasium at Ambedkar Academy, Dhanbad" | 2.35 |
| 15 | Reversal of Financial Liablity (medical camps) | (8.52) |
| 16 | Amount for Aanganwadi deposited in Unspent CSR Account | 188.50 |
| 17 | Amount for CIPET deposited in Unspent CSR Account | 14.00 |
| | **Total** | **493.02** |

# REHABILITATION AND RESETTLEMENT PLAN

The cluster of mines will be dovetailed with the approved Jharia A**ction Plan for** dealing with fire, subsidence and rehabilitation of people. **Master Plan** for dealing with fire, subsidence and rehabilitation within the leasehold area of BCCL has already been approved by Government of Jharkhand & Government of India.

As per EC granted to Cluster IX, R&R of 12246 nos. of PAFs are involved. They should be rehabilitated to safe areas at the cost of Rs 126092.027 Lakhs as per the approved Jharia Action Plan.

## Following will be the R&R package that will be given to affected families as per approved Master Plan

A very attractive R&R package, for the affected people who are to be shifted from endangered areas, has been proposed in the Master plan and has been approved both by Govt. of Jharkhand and Govt. of India. **But no employment will be offered for any rehabilitation under this Master Plan.**

It may be noted that this R&R package is offered for safety of the people living in endangered areas and not for project implementation and mining of coal and thereby gaining any type of profit.

## R&R package for non-BCCL authorized families:

### a) Land Compensation:

Head of every displaced house shall be given compensation for his land at the market rate.

### b) House Compensation:

Every head of displaced house will get replacement value for his house and other structures over the homestead land, the value of which shall be estimated on the basis of PWD civil rates. (Pucca house: Rs. 4.8 lakhs/unit and for Kutcha house: Rs. 1.37 lakhs/unit).

### c) Other Benefits:

Head of each house will be provided a plot of 100 sq.m land at the proposed township. In case his requirement of land is more than 100 sq.m, additional land may be provided, on payment basis as per market rate if land is available. If this offer is not acceptable, head of each house shall be provided a constructed flat of around 40 m2 as super built up area in a triple storied building. A house owner not opting for a plot will be offered equivalent cash compensation in lieu of free plot.

### d) Basic amenities:

Each township will be provided with all basic amenities and infrastructural facilities like Primary school, High school, Bank, Post office, Community centre, Shopping centre, Hospital, Playground, Children Park, Water supply, Sewage disposal & sanitation, Road, Culverts & Drains, and Power Supply etc.

### e) Income generation benefit:

Head of each house shall be paid 250 days/year wage as per State Govt.'s minimum wage rate for a period of 2 years.

### f) Shifting Allowance:

The head of every house is proposed to be paid 0.10 lakhs as shifting allowance from their present living places to the resettlement sites.

## R&R package for non-BCCL unauthorized families (encroachers):

**a)** No compensation will be paid to the house owner having no home stead land (Unauthorized). Instead the following benefits will be provided to them.

**b)** Head of each house will be provided a constructed house on 27 sq.m land as super built up area in triple storey building in resettlement site with all basic amenities like Primary school, High school, Bank , Post office, Community centre, Shopping centre, Hospital, Play ground & children park, Water Supply, Sewage disposal & sanitation, Road, Culverts & Drains, Power Supply etc.

**c)** **Income generation benefit**: Head of each house shall be paid 250 days/year wage as per State Govt.'s minimum wage rate for a period of 2 years.

**d)** **Shifting Allowance:** The head of every house is proposed to be paid 0.10 lakhs as shifting allowance from their present living places to the resettlement sites.

## R&R package for BCCL families:

**a)** BCCL families from the endangered areas to be rehabilitated in satellite townships in non-coal bearing areas outside JCF with all basic infrastructural facilities.

**b)** For each BCCL house 160 sq.m (including for all amenities) resettlement land has been proposed.

# Coal Transportation Plan

Coal produced in the coal face in the different mines of Lodna Area is first dumped in the different coal dumps of the concerned colliery at the surface. From the individual coal dump, coal is then shifted to either railway siding of Amal. NT-ST-JG Colliery for rail dispatch or directly sent via road sell to power plants/steel plants.

- Rly. Siding (GOL 6 & 9)

Distance from coal dumps of NT-ST-JG Colliery to Railway Siding: **1-2 km**

| Production Details | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S. No** | **Name of Mine** | **Normative (MTY)** | **Peak (MTY)** | **Leasehold Area (Ha.)** | **2015-16 (Tonn.)** | **2016-17 (Tonn.)** | **2017-18 (Tonn.)** | **2018-19 (Tonn.)** | **2019-20 (Tonn.)** | **2020-21 (Tonn.)** | **2021-22 (Tonn.)** | **2022-23 (upto sept.) (Tonn.)** |
| 1. | Amal. NT-ST-JG Colliery | 6.0 | 7.8 | 755.15 | **3826689** | **3839054** | **3192316** | **2484642** | **2534760** | **2264372** | **3813224** | **2548384** |

## Coal Transportation in Cluster-IX

### Coal Dispatched by Rail & Road in FY 2016-17

| Colliery Name | Dispatch by Rail (Te) | Dispatch by Road (Te) | Total Dispatch (Rail + Road) (Te) |
|---|---|---|---|
| Amal. NT-ST-JG Colliery | 0 | 2965 | 2965 |

### Coal Dispatched by Rail & Road in FY 2017-18

| Colliery Name | Dispatch by Rail (Te) | Dispatch by Road (Te) | Total Dispatch (Rail + Road) (Te) |
|---|---|---|---|
| Amal. NT-ST-JG Colliery | 6311 | 12806 | 19117 |

### Coal Dispatched by Rail & Road in FY 2018-19

| Colliery Name | Dispatch by Rail (Te) | Dispatch by Road (Te) | Total Dispatch (Rail + Road) (Te) |
|---|---|---|---|
| Amal. NT-ST-JG Colliery | **1776382** | **1068535** | 2844917 |

**Coal Dispatched by Rail & Road in FY 2019-20**

| Colliery Name | Dispatch by Rail (Te) | Dispatch by Road (Te) | Total Dispatch (Rail + Road) (Te) |
|---|---|---|---|
| Amal. NT-ST-JG Colliery | 1885804 | 699044 | 2584848 |

**Coal Dispatched by Rail & Road in FY 2020-21**

| Colliery Name | Dispatch by Rail (Te) | Dispatch by Road (Te) | Total Dispatch (Rail + Road) (Te) |
|---|---|---|---|
| Amal. NT-ST-JG Colliery | 1006475 | 954089 | 1960564 |

**Coal Dispatched by Rail & Road in FY 2021-22**

| Colliery Name | Dispatch by Rail (Te) | Dispatch by Road (Te) | Total Dispatch (Rail + Road) (Te) |
|---|---|---|---|
| Amal. NT-ST-JG Colliery | 3343480 | 679293 | 4022773 |

**Coal Dispatched by Rail & Road in FY 2022-23 (upto sept.)**

| Colliery Name | Dispatch by Rail (Te) | Dispatch by Road (Te) | Total Dispatch (Rail + Road) (Te) |
|---|---|---|---|
| Amal. NT-ST-JG Colliery | 2307976 | 425418 | 2733394 |

Linkage: Coal produced in Lodna Area is dispatched to different organization like- power plants, steel plants etc.

Details of some of the Power/Steel/Fertilizer Plant which are supplied coal from Railway Siding and by road sale are as follows:

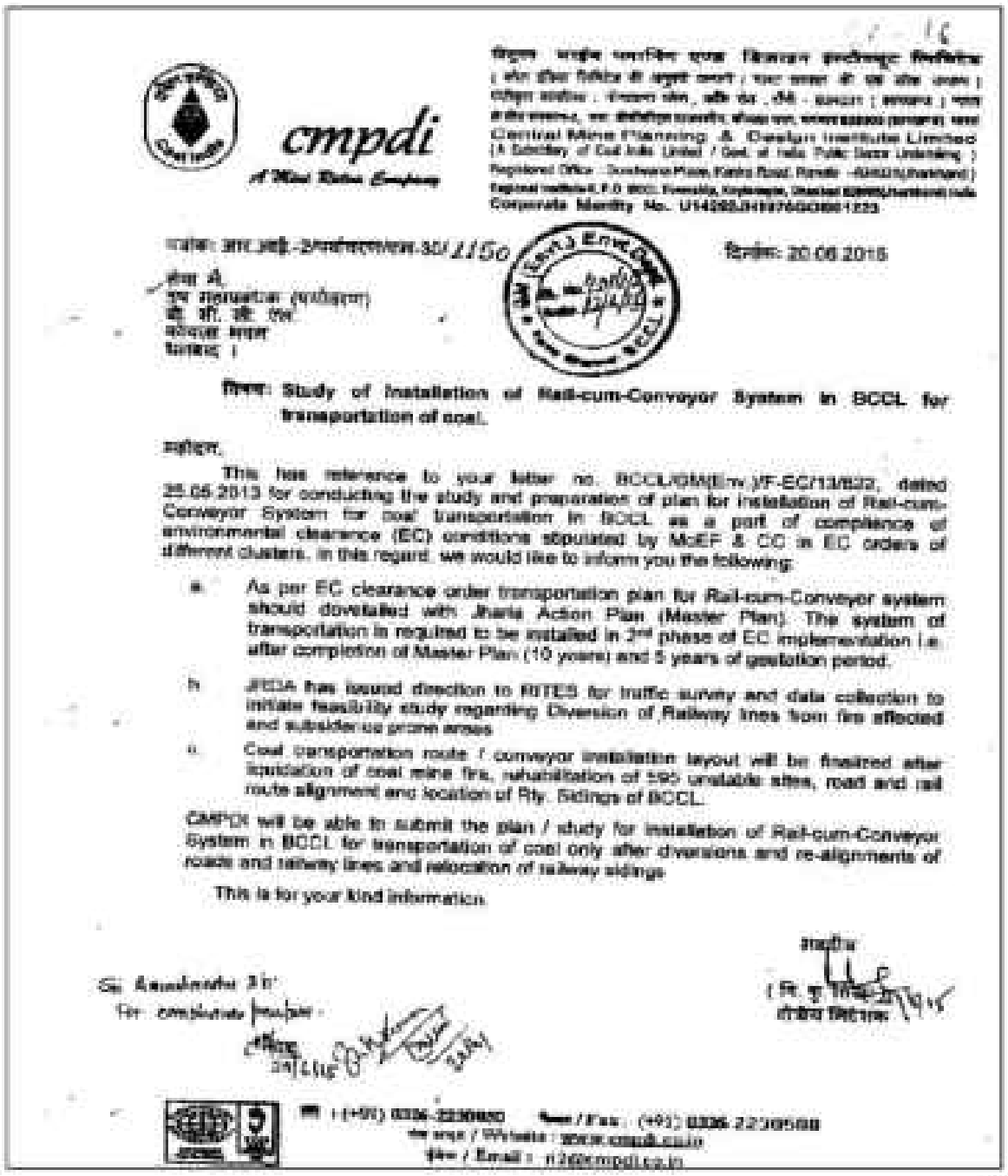
- Maithon Power Limited
- Patherdih Washery
- Steel Plant
- DVC
- Fertilizers
- RTPS
- Haldia
- APNL
- Others

## Transportation Plan:

Action has been taken for formulating adequate transportation plan for conveyor-cum-rail system of dispatch. CMPDIL has been requested to prepare the plan. However, CMPDIL had submitted that such transportation plan can be completed only after implementation of Master Plan and dousing of the fire. The copy of the reply submitted by CMPDI is attached.

Transportation is being done by covering vehicle with tarpaulin cover and it is made mandatory in Transportation contracts.

Transportation Plan for Conveyor



cmpdi

Central Mine Planning & Design Institute Limited

Corporate Identity No. U14292JH1975GOI001223

दिनांक: 20.06.2015

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

महोदय,

This has reference to your letter no. BCCL/GM(Env.)/F-EC/13/822, dated 25.05.2013 for conducting the study and preparation of plan for installation of Rail-cum-Conveyor System for coal transportation in BCCL as a part of compliance of environmental clearance (EC) conditions stipulated by MoEF & CC in EC orders of different clusters. In this regard, we would like to inform you the following:

a. As per EC clearance order transportation plan for Rail-cum-Conveyor system should dovetailed with Jharia Action Plan (Master Plan). The system of transportation is required to be installed in 2nd phase of EC implementation i.e. after completion of Master Plan (10 years) and 5 years of gestation period.

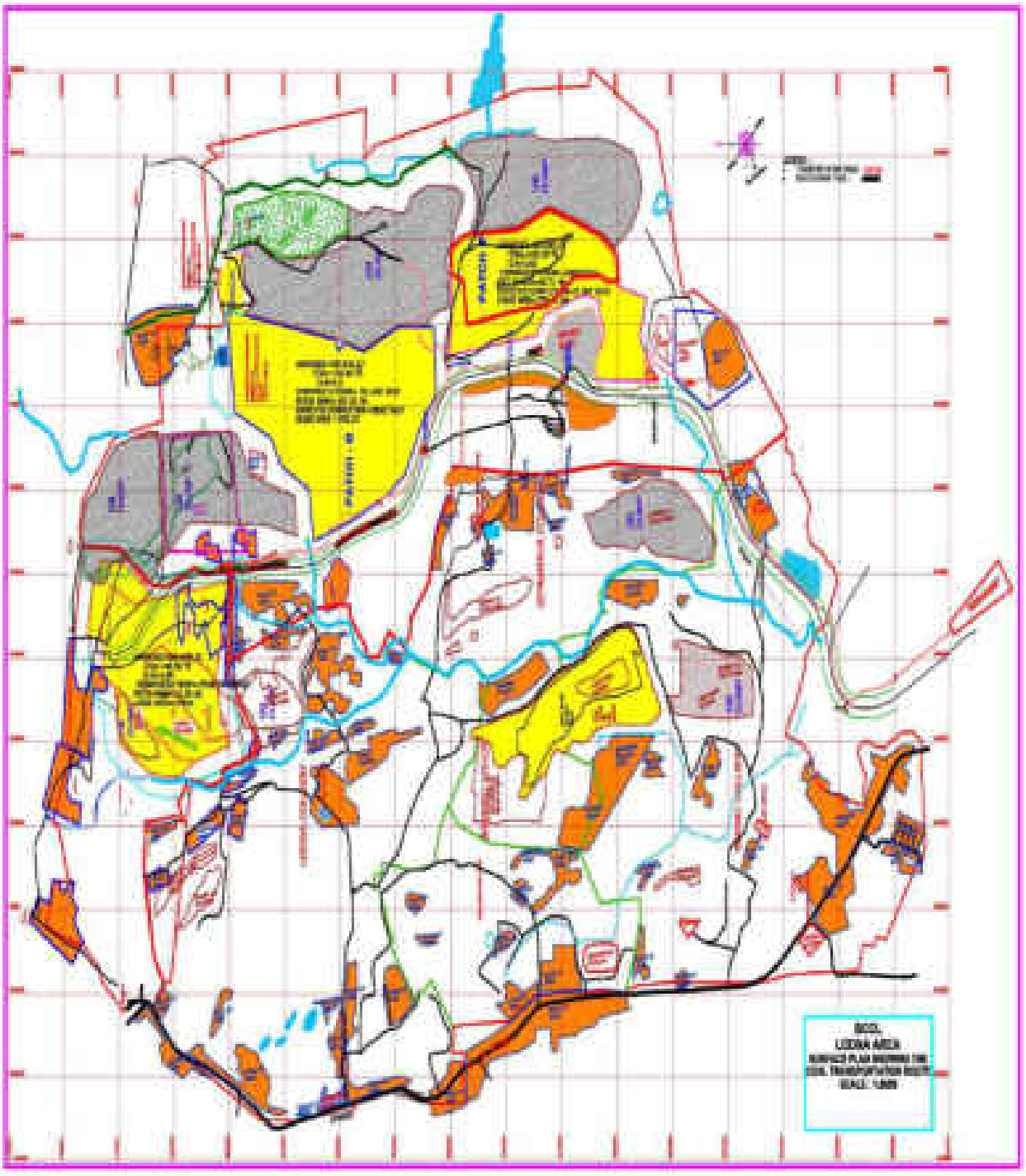
b. JFCCA has issued direction to RITES for traffic survey and data collection to initiate feasibility study regarding Diversion of Railway lines from fire affected and subsidence prone areas.

c. Coal transportation route / conveyor installation layout will be finalized after isolation of coal mine fire, rehabilitation of 595 unstable sites, road and rail route alignment and location of Rly. Sidings of BCCL.

CMPDI will be able to submit the plan / study for installation of Rail-cum-Conveyor System in BCCL for transportation of coal only after diversions and re-alignments of roads and railway lines and relocation of railway sidings.

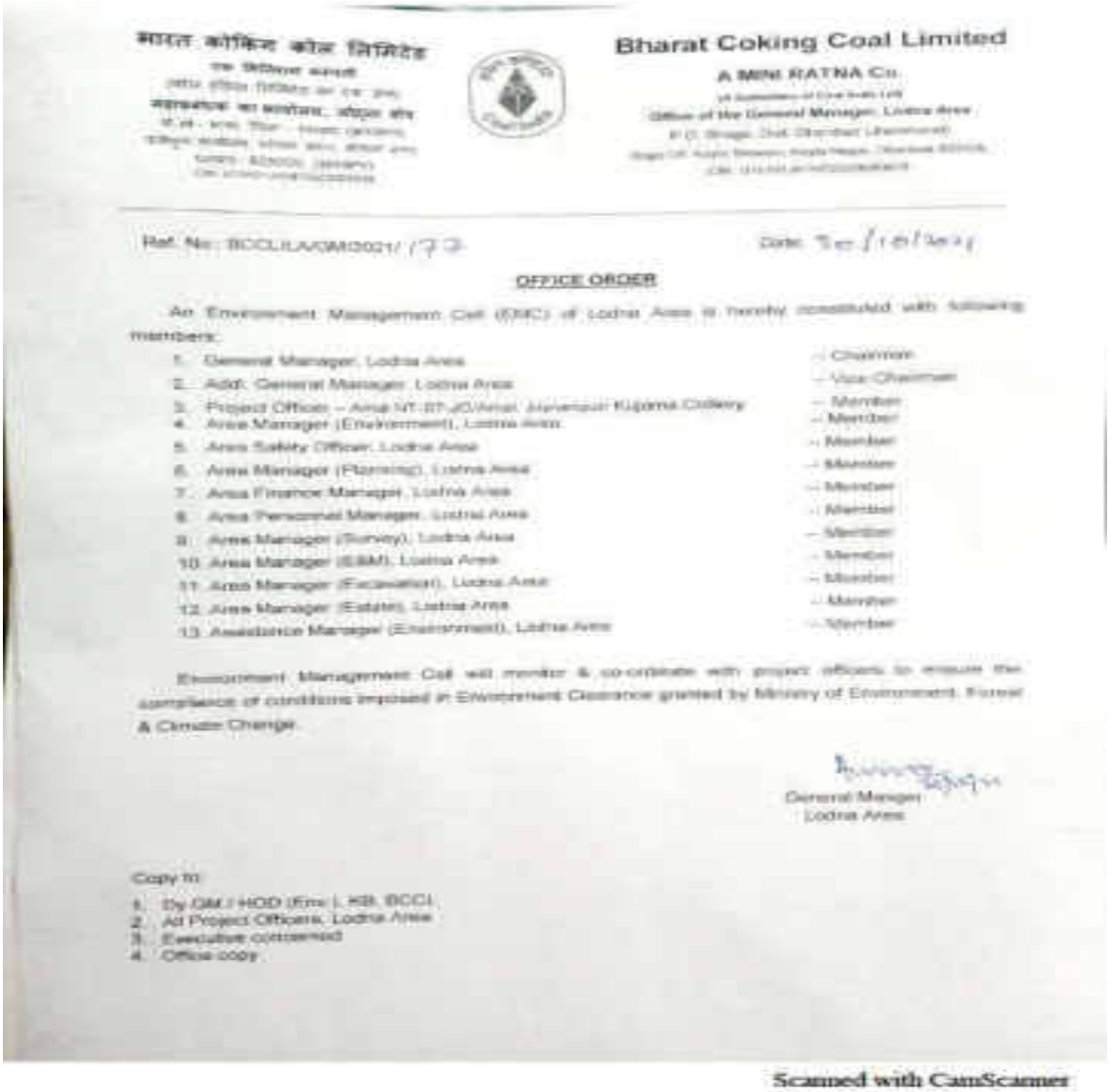
This is for your kind information.

Phone: (+91) 0326-2230830 Fax: (+91) 0326-2230568
Website: www.cmpdi.co.in
Email: rl2@cmpdi.co.in



## Environment Action Plan:

Sustainable coal production is the main objective of Lodna Area, BCCL i.e. meeting the energy demand of the nation while protecting and preserving the environment and ecology as well. For taking care of environment; cluster-IX has given full efforts to comply the conditions of Environmental clearance granted with cluster-IX group of mines. An Environment Management Cell has been formed under the chairmanship of General Manager, Lodna Area for ensuring the compliance of the conditions laid down in EC.



भारत कोकिंग कोल लिमिटेड

Bharat Coking Coal Limited

A MINI RATNA Co.

OFFICE ORDER

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

1. General Manager, Lodna Area — Chairman
2. Addl. General Manager, Lodna Area — Vice-Chairman
3. Project Officer – Area VI, IX, XI (Incharge) Kujama Colliery — Member
4. Area Manager (Environment), Lodna Area — Member
5. Area Safety Officer, Lodna Area — Member
6. Area Manager (Planning), Lodna Area — Member
7. Area Finance Manager, Lodna Area — Member
8. Area Personnel Manager, Lodna Area — Member
9. Area Manager (Survey), Lodna Area — Member
10. Area Manager (E&M), Lodna Area — Member
11. Area Manager (Excavation), Lodna Area — Member
12. Area Manager (Estate), Lodna Area — Member
13. Assistance Manager (Environment), Lodna Area — 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.

General Manager
Lodna Area

Copy to:
1. Dy GM / HOD (Env.), HQ, BCCL
2. All Project Officers, Lodna Area
3. Executive concerned
4. Office copy

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Apart from the above Environment Management Cell, dedicated workforce is being engaged in various environment protection work such as biological reclamation of stabilized OB dumps,

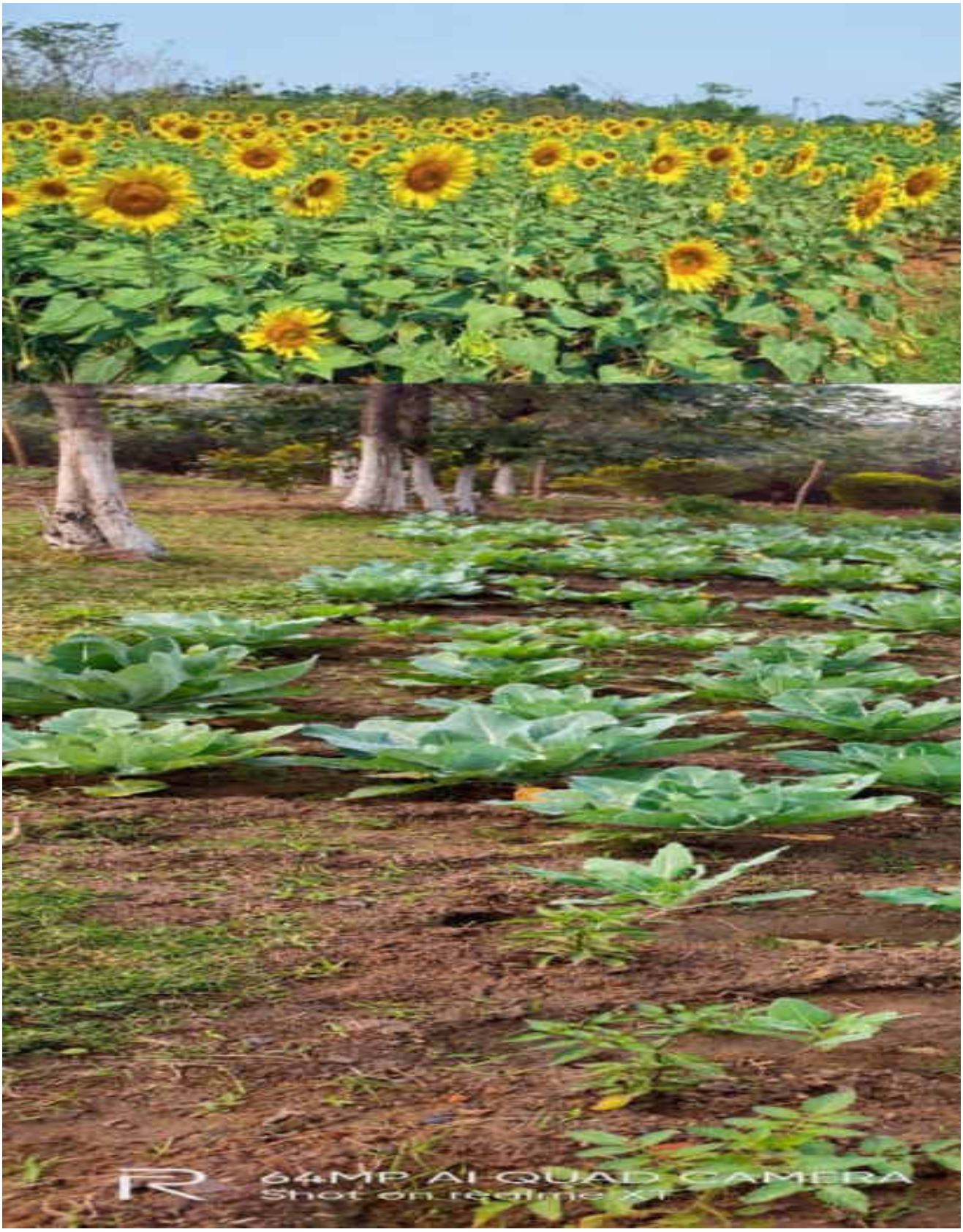
Block plantation, Avenue plantation along the roads, development of Herbal garden and Sneha Smriti Upavan etc.
Details of officials in Environment Department, Lodna Area is as follows:
Executive: 02
Non-Executives: 15

## Eco restoration work in Lodna Area:

Lodna Area is committed to enhance the bio diversity/green cover in Area by regularly taking up eco restoration work on stabilized OB dumps, Avenue plantation, and block plantation etc.

In LODNA Area, In order to restore degraded mined out area, different activities has been started like uprooting of weeds, roots and its disposal, pit digging, spreading of top soil and cow dung, grass seed balls, etc. Under this activity, 10 Ha. Of Land at NT-ST OCP dump of Lodna area has been ecologically developed using three tier plantation as "GOKUL PARK". The park has been developed in collaboration with the FRI, Dehradun.

This noble initiative of BCCL has been well accepted and praised by the local inhabitants in and around. Everyday about 300-400 people visit the park. Another 5 Ha. Of degraded mined out area is earmarked around GOKUL PARK for plantation purpose during the year 2016-17. Again 7 Ha. Of degraded area developed in 3rd stage. Total 22 Ha. Area has been ecologically re-stored at Gokul Park.


64MP AI QUAD CAMERA

**Sneha Smriti Upavan:** A garden of fruit bearing plants is being developed as Sneha Smriti Upavan in the memory of ancestors at NT-ST-JG Colliery.

It was inaugurated by General Manager, Lodna Area, BCCL.

**Pictures of Sneha smriti upavan**

# Jharkraft in Lodna Area:

REELING AND SPINNING TRAINING PROJECT: This is a skill Development cum employment generation project under "*Swaavlambee* Project" of BCCL targeting groups of unemployed and willing to work women from *Mukunda, Alakdiha, Gareia , Panchmohali* and *Nootangram* villages belonging to Dhanbad District. These villages were chosen because they are located in the command area of BCCL, a project was estimated to generate employment for a group of thirty women from a village. For this purpose, BCCL and JHARCRAFT entered into an agreement for implementation of the project.

**Objectives of the project**

1. Skill enhancement through Training and shortening the learning curve of skilled and semi-skilled women.

2. Self-Employment generation and enhancing employability of women groups in the villages.

As per the agreement with CIL, TISS was entrusted the responsibility to undertake the work of generating data through a baseline survey in the peripheral villages of BCCL. Accordingly TISS conducted a sample survey in 42 villages in and around BCCL in the year 2013 to assess community needs that could be addressed through CSR initiatives.

Based on the results of the baseline survey, a skilled development and employment generation project was envisioned for unemployed women of these villages. In order to facilitate the identified groups of women of these villages with employment opportunities, initiatives have been taken to take the help of JHARCRAFT, a Government of Jharkhand undertaking. Five groups of women each group comprising of thirty (30) women were identified at Mukunda, Alakdiha, Gareria, Panchmohali and Nootangram village.

**Mukunda Training Centre**

The centre was inaugurated in the month of January, 2016 and training started from the month of March, 2016. The facility was provided in the adjoining centre of Mukunda Hospital operated by BCCL. The centre is spacious to facilitate trainings and store needful logistics like raw material, equipment & finished products.

Twenty-five women have been trained and are participating in the process of manufacturing at the Mukunda Centre. They reside in the radius of five kilometers from the centre and are between twenty-five to thirty-five years old. Most are either illiterate or barely educated, only one was reported to be a graduate. The women largely belong to Other Backward Classes, Scheduled Caste and Scheduled Tribe and monthly average income ranges from Rs. 15000 to Rs. 30000 per month. According to the beneficiaries, they are currently not employed anywhere else other than the training centre. None of them have started a self-employment venture as a result of the reeling and spinning training because according to the beneficiaries, the handlooms are unaffordable for them.

The beneficiaries explained that they were uninitiated to the workings of the handloom craft and thus were hesitant to join the training and commit two years for the same. Since the beneficiaries had not contributed to the household income prior to this initiative, their family members were uncertain about the viability of the project as well. It was only after the detailed information dissemination by the „*mukhiya*" and the BCCL personnel that the women decided to join the training. The beneficiaries were also assured an increase in income as a consequence of the training program. The beneficiaries noted that their main motivation for engaging with this program was to gain a unique skill which could be used for income generation at any time in the future.

The training was conducted in a facility adjoining the Mukunda hospital operated by BCCL. The centre was found to be spacious enough to facilitate trainings and store resources. The facility houses 20 large handlooms along with a storage room for raw materials such as thread, needles, parts of the handlooms and also the finished materials. The women spent approximately five to six hours a day at the facility weaving fabrics. Even though the agreement between BCCL and Government of Jharkhand states that JHARCRAFT will be solely responsible for the purchase of the finished products and will also bring business for the beneficiaries evidence from secondary research conducted and perspectives from KIIs on the field, indicate that JHARCRAFT has been unable to uphold this aspect of the agreement in its totality. Nevertheless, JHARCRAFT has been instrumental in providing training to the beneficiaries and the trainer is still involved with the production of fabric so that he can provide assistance to the beneficiaries when required.

According to secondary research, JHARCRAFT is, however, not able to provide the optimum market for the produce of the centre. Handloom is learnt over many years whereas these women had spent only two years practicing the craft. Consequently the quality of the product was not at par with market standards On the other hand, the women expected get gainful employment after the completion of the project. Resulting in uncertainty due to the lack of it. This is also breach of contract as they agreed to sale the output of the centre. The beneficiaries unanimously noted that the trainer was a highly skilled professional trainer who had been integral in the growth of their artisan skills. They were well aware of the procedures of the agreement and the roles of JHARCRAFT and BCCL officials. In addition, they were found to have successfully grasped intricate concepts from their syllabus. They also mentioned that post the initial training period, they practiced the nuances of handloom reeling and spinning and are still in the process of honing their craft. They express their gratitude to the involved parties to help them work on the handloom machines post the training.

Apart from facilitation in acquiring a new skill, the reeling and spinning training project has also helped in self-esteem boost, development of entrepreneurship andenhancement in quality of life. The beneficiaries shared that they had never gone out of their house without a male companion but now are able to access the banking services without any assistance post the training program. They also shared instances of realizing the importance of quality education after exposure to myriad of delegates and officials from the well renowned organisations such as BCCL and their partners. The beneficiaries have now tried to chart out a plan to provide quality education to their children and hope this training program will aid them in contributing to the increase in their household income.

As regards to achievement of stated milestones, disappointment was expressed by beneficiaries, as there have been no financial gains to the women in spite of working for more than five hours a
day for twenty days in the month. They earn a bare minimum income of INR 350- INR 600 per month which is less than minimum wages and far less than the benefit promised to them. Conclusively, there is a marginal increase in the household incomes as reported by the beneficiaries. Corrective measures for the same are yet to be taken from the all the stakeholders.

**Pictures of jharcraft, Lodna Area**

**List of Environmental measure works which is being done at cluster-IX regularly**

1. Air, Water and Noise monitoring by CMPDIL regularly and taking proper measures for controlling Air, Water and Noise pollution.
2. Coal Production based on calendar plan.
3. Regular Water Sprinkling for dust suppression within mine and on the main transportation road.
4. Developing green belt by avenue plantation as well as block plantation.
5. 3 tier Ecological restoration.
6. Rain water harvesting.
7. Making of embankment and toe wall.
8. Analysis of Pollution load reduction by CMPDI.
9. Tarpaulin Covered coal transportation.
10. Fire delineation study by IIT (ISM) Dhanbad and CMPDI.
11. Subsidence management.
12. Implementation of Mine Closure Plan prepared by CMPDI.
13. Conducting PME/IME of workers engaged in mining activities regularly.
14. Source Apportionment Study by NEERI Nagpur.

**Annexure IX**

सेन्ट्रल माईन प्लानिंग एण्ड डिजाईन इन्स्टीच्यूट लिमिटेड
(कोल इण्डिया लिमिटेड की अनुषंगी कम्पनी / भारत सरकार का एक लोक उपक्रम)
गोण्डवाना प्लेस, कांके रोड, रांची - 834 031, झारखंड (भारत)
Central Mine Planning & Design Institute Limited
(A Subsidiary of Coal India Limited / Govt. of India Public Sector Undertaking)
Gondwana Place, Kanke Road, Ranchi - 834 031, Jharkhand (INDIA)
CORPORATE IDENTITY NUMBER – U14292JH1975GOI001223

Letter No.: पर्यावरण/22/BCCL/

पर्यावरण प्रभाग
Environment Division
क्रम संख्या
Sl. No. 17.
दिनांक
Date: 08/2/22

Dated: 08/02/2022

सेवा में,

उप महाप्रबन्धक (पर्यावरण)
बी. सी. सी. एल.
कोयला भवन
धनबाद-826005

विषयः Revised Report of Cluster IX group of Mines on "**Study to analyze the Extent of Reduction of Pollution Load every year by reducing coal transportation by Road**".

(Your Email dated 12th Jan 2022)

महोदय,

Please find attached soft copy of the Revised report on "Study to analyze the Extent of reduction of pollution load every year by reducing coal transportation by Road" for the **cluster IX:**

| Sl. No. | Name of the Cluster | Peak Production (MTY) |
|---|---|---|
| 1. | Cluster – IX | 8.512 |

सधन्यवाद,

संलग्नकः यथोक्त

भवदीय

8/2/22

(Abhijit Sinha)
महाप्रबन्धक (पर्यावरण)

प्रतिलिपि:
1. क्षेत्रीय निदेशक, आर.आई- II, कोयला भवन, धनबाद- For Kind information.

फोन नम्बर /Phone No. : +91 651 2230055 फैक्स नम्बर / Fax No : +91 651 2231447
ई मेल /e-mail: gmenv.cmpdi@coalindia.in, gmenv.cmpdi@gmail.com;
वेबसाईट / Website Address: www.cmpdi.co.in

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# Study to Analyze the Extent of Reduction of Pollution Load Every Year by reducing Coal Transportation by Road

# CLUSTER IX GROUP OF MINES

**(NT/ST Expan. OCP, Amalgamated Joyrampur OC,)**

**Peak Production : 8.512 MTPA**
**Lease Hold Area : 1942.12 Ha**

## Bharat Coking Coal Limited

**(February, 2022)**

## Prepared by


## Environment Division

## Central Mine Planning & Design Institute Limited

## CMPDI (HQ)

## Gondwana Place

## Kanke Road, Ranchi-834008

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| II | FUGITIVE DUST GENERATION DUE TO MOVEMENT OF COAL | 9-14 |

# Chapter – I

# Introduction

## 1.1 Genesis:

MOEF provided Environmental Clearance to the various mines of the Cluster EC granted vide.J-11015/307 / 2010 -IA.II(M) ; dated 21st May 2013, Amended vide J-11015/307 / 2010 -IA.II(M) dated 01.03.2018 .

As per the Environmental Clearance Conditions given by the Ministry of Environment & Forest "A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport of coal". Therefore the present study has been carried out to quantify the pollution load due to coal transportation.

## 1.2 Methodology:

In order to find out the pollution load due to coal transportation a Questionnaire was developed by the Environment Division of CMPDI Headquarter and Regional Institute –II, Dhanbad. The Questionnaire was circulated to the various mines of BCCL for collection of the requisite inputs for this study. The quantification of pollution load for PM-10 has been carried out on the basis of the field visit, data provided by BCCL officials and interaction with them.

## 1.3 General Information about the Cluster:

### 1.3.1 Brief Description:

Cluster-IX group of mines of BCCL is a group of nine mines consisting of opencast and underground mines. BCCL is the proponent of the cluster and it is under the administrative control of Coal India Limited. Coal India Limited is a Public Sector Undertaking of Government of India and functioning under the Ministry of Coal, Govt. of India.

The history of coal mining in Jharia Coalfield was started since eighteenth century. The only energy source during those years, the mining was carried out through manual and semi-manual methods resulting into large scale degradation of land, forests and environment. The unscientific mining resulted into large scale mine

fires, subsidence and land degradation. The mines of Jharia Coalfield were taken over mines by BCCL from the erstwhile private mine owners. Most of the mines had their history from pre-nationalization period.

During the takeover of the mines in 1972 in BCCL from private mine owners, the data like leasehold area, underground mine planning, production capacity were unknown. However, most of the mines were further reorganized.

BCCL is the proponent of the cluster and it is under the administrative control of Coal India Limited.

### 1.3.2 Nature and Size of the Cluster:

The details of the mines showing normative/ peak productions, lease hold areas and life are given in Table no. 1.1.

**Table 1.1: Details of the Mines of Cluster – IX**

| Sl No | Name of Mine | Production Capacity (MTY) | | Lease Hold Area (Ha) |
|---|---|---|---|---|
| | | Normative | Peak | |
| 1 | Amalgamated Joyrampur Colliery (OC) | 2.512 | 3.25 | 1186.97 |
| 2 | NT-ST Expansion OCP | 6.0 | 7.8 | 755.15 |
| | Total | | 8.512* | 1942.12 |

### 1.3.3 Impact of Fire Control on Ambient Air Quality:

Due to unscientific mining prior to nationalization there are unstable sites identified in the BCCL. Out of 595 unstable sites identified in the Master Plan, 98 sites affected area of 2.246 Km2 consisting of 12246 no. of houses/families are affected. The affected families will be rehabilited in adjacent non coal bearing area at a cost of Rs. 126092.027 lakhs.

### 1.3.4 Impact of Resettlement on Ambient Air Quality:

As per Jharia Action Plan (JAP) household will be shifted for implementation of master plan. The reduction in number of households within the leasehold area of Cluster will lead to reduction in generation of air pollutants due to reduction in movement of man & materials apart from decrease in consumption of coal as a domestic fuel.

## 1.4 Meteorological Data

The meteorological data recorded during the monitoring period is very useful for proper interpretation of the baseline information and it provides an input for prediction models of air quality dispersion. The transport and diffusion of the pollutants in the atmosphere are governed by meteorological factors. Factors like wind velocity, wind direction and atmospheric stability are known as primary/basic meteorological parameters since the dispersion and diffusion of pollutants depend mainly on these factors. Factors like ambient temperature, humidity, rainfall, atmospheric pressure, etc. are known as secondary meteorological parameters as these factors control the dispersion of the pollutants indirectly by affecting the primary factors. Thus, to assess the air pollution impact it becomes essential to collect data of the above mentioned meteorological parameters in the study area.

### 1.4.1 METHODOLOGY

Data of micrometeorological and microclimatic parameters were recorded by installing an Automatic Weather station at the roof of Moonidih Project Office (inside the premises of existing Moonidih washery) to represent the prevailing micrometeorological aspects of the study area. Automatic Weather station (Make: Ecotech & Model: WM-721) was used to record Ambient temperature, Relative humidity, atmospheric pressure, Cloud cover, Rainfall, wind speed and direction continuously during the study period.

During the study period, hourly reading of wind velocity, wind direction, temperature, relative humidity, cloud cover and rainfall data were recorded and reported.

### 1.4.2 DATA PRESENTATION

Wind Rose diagram during the study period has been in the Fig. 1.1 for the period from 09th December 2020 to 09th March 2021.

### 1.4.3 DATA COLLECTION AND ANALYSIS

Meteorological data collected at meteorological station representing the study area during the study period (09th December 2020 to 09th March 2021) reveals the following status:

**(i) <u>Wind Speed/Direction</u>**

Generally, moderate winds prevailed throughout the season. Moderate Winds prevailed 33.23 % times. Generally, during the night time calm conditions were observed. Wind speed readings throughout the season were ranging from ≤ 0.5 m/sec to 10.3 m/sec. The seasonal average wind speed was observed to be 0.63 m/sec. The wind pattern of the study period is presented below:

The analysis of wind pattern during the season showed that the predominant wind directions were from South South West (SSW) & followed by South West having frequencies 9.30 %, & 6.40 % respectively.

The calm conditions prevailed 50.58%. The analysis of wind speeds during the study period indicated that the low speed of 0.50 - 1.50 m/sec occupied 33.23% while wind speed of 1.50 - 3.50 m/sec occupied 15.69 % and > 3.50 m/sec were recorded as 0.46 % of the total occupancy respectively.

### (ii) Temperature

Temperature values ranged between 6.5 $^{O}$C to 40.3$^{O}$C. The seasonal average temperature value during this period was found to be 22.20 $^{O}$C.

### (iii) Relative Humidity

The daily average relative humidity values were in the range of 12.1 to 94.1%. The seasonal average humidity value was found to be 58.9 %.

### (iv) Cloud Cover

Mostly clear sky was predominant during the study period.

### (v) Atmospheric Pressure

The average atmospheric pressure value has been found to be around 750.12 mm Hg.

### (vi) Rainfall

Total 20 mm rainfall was recorded during the study period. The maximum daily rainfall observed during the season was found to be 4 mm.

## 1.4.3 SUMMARY

The sky was mostly clear during the study period. The readings of wind velocity were ranging from ≤ 0.5 m/sec to 10.3 m/sec. Predominant wind was blowing from South South West (SSW) direction. The seasonal average wind speed was observed to be 0.63 m/sec. The maximum temperature recorded was 40.3$^{O}$C and the minimum is 6.5 $^{O}$C. The daily average relative humidity values were in the range of 12.1 to 94.1%. %.

**Table 1.2: SEASONAL WIND DISTRIBUTION (DEC'2020 -MARCH' 2021)**
**Period: 09th December '2020 –09th March '2021**

| | Directions / Wind Classes (m/s) | 0.50 - 1.50 | 1.50 - 3.50 | >= 3.50 | Total (%) |
|---|---|---|---|---|---|
| 1 | N | 0.55 | 0.23 | 0.00 | 0.78 |
| 2 | NNE | 0.51 | 0.14 | 0.00 | 0.64 |
| 3 | NE | 0.83 | 0.28 | 0.00 | 1.10 |
| 4 | ENE | 0.55 | 0.14 | 0.00 | 0.69 |
| 5 | E | 0.97 | 0.23 | 0.00 | 1.20 |
| 6 | ESE | 0.64 | 0.41 | 0.00 | 1.06 |
| 7 | SE | 1.38 | 0.60 | 0.05 | 2.02 |
| 8 | SSE | 3.31 | 1.66 | 0.00 | 4.97 |
| 9 | S | 4.46 | 1.56 | 0.00 | 6.03 |
| 10 | SSW | 6.30 | 2.85 | 0.14 | 9.30 |
| 11 | SW | 4.00 | 2.25 | 0.14 | 6.40 |
| 12 | WSW | 3.22 | 2.44 | 0.14 | 5.80 |
| 13 | W | 2.16 | 1.15 | 0.00 | 3.31 |
| 14 | WNW | 1.43 | 0.60 | 0.00 | 2.02 |
| 15 | NW | 1.33 | 0.74 | 0.00 | 2.07 |
| 16 | NNW | 1.56 | 0.41 | 0.00 | 1.98 |
| | Sub-Total | 33.23 | 15.69 | 0.46 | 49.38 |
| | Calms | | | | 50.5752 |
| | Missing/Incomplete | | | | 0.04602 |

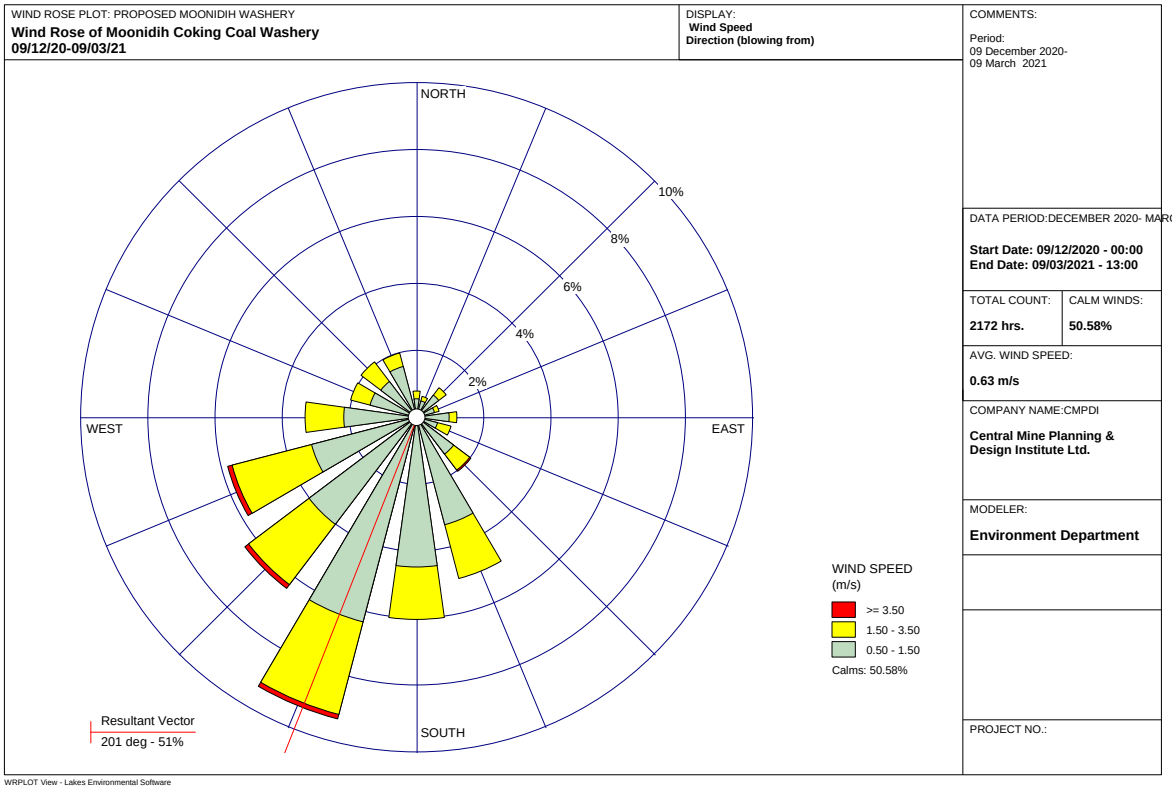



Figure No.-1.1 Wind Rose diagram for the period 9th December 20 to 9th March 2021

# Chapter – II

## Fugitive Dust Generation Due To Movement of Coal

### 2.1 Introduction

The coal produced moves to the consumers via Road & Rail. Coal from the mine face is brought to the surface dumps and bulk of it goes to the nearby railway sidings for further movement to the consumer- end through rail. The journey from the mine face to the railway siding is covered by road. A portion of the coal produced by the mine directly goes to the consumers via road. Transportation of coal by rail is an environmentally better option than the road transportation. Road Transportation results in generation of fugitive dust from road surface apart from other pollutants released due to consumption of Diesel.

The fugitive dust generated due to coal transportation through road depend upon the following factors:

1. Speed and Weight of the moving vehicles.
2. Silt Content of the Road Dust (Particles less than 200 mesh size is considered as silt)
3. Silt loading of the road dust ($Kg/m^2$).
4. Moisture Content of the dust lying on the road surface.
5. Ambient Temperature, Humidity & wind velocity.

The dust generation will be lower if the quantity of dust (silt loading) lying on the road surface is minimum and the moisture content of the loose material lying on the road surface is high.

### 2.2 Movement of Coal

Distance travelled by coal and subsequent release of fugitive dust during its journey towards the consumer end has been described and dust load has been worked out.

### 2.2.1 Dust Generation :

**Table: 2.1 Dust Generation (Kg/day)**

| | Dust generated per day (Kg/Day) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sl No.** | **Name of the Mine** | **Year** | **Location** | **Distance from Face to Siding (Km)** | **Coal Transferred (Te)** | **Daily Coal Production (Te/Day)** | **Capacity of the Dumper** | **Vehicle Kilometre Travelled** | **Emission Rate for PM 10 ( kg/VKT)** | **Pollution Load * Dust Generated Per Day (Kg/day)** | **Dust generated Kg/per tonne** |
| 1 | **NT-ST(Exp.) OCP** | 18-19 | 6/9 no. siding | 3.5 | 2484642 | 7529.21818 | 20.00 | 2635.23 | 0.53 | 1396.670 | |
| | | | **Total for 18-19** | | | **7529.22** | | | | **1396.670** | 0.19 |
| | | 19-20 | 6/9 no. siding | 3.5 | 2534760 | 7681.09091 | 20.00 | 2688.38 | 0.53 | 1424.842 | |
| | | | **Total for 19-20** | | | **7681.09** | | | | **1424.842** | 0.19 |
| | | 20-21 | 6/9 no. siding | 3.5 | 2264372 | 6861.73333 | 20.00 | 2401.61 | 0.53 | 1272.852 | |
| | | | **Total for 20-21** | | | **6861.73** | | | | **1272.852** | 0.19 |

* In terms of PM 10 expressed as kg/day **Average distance has been considered **Emission rate for $PM_{10}$ has been taken from the S&T work (funded by MoC) carried out by CMPDI during 2002-2007.

## 2.3 Optimum Coal Transportation scheme in the Present Scenario:

**Phase – I (for 10 + 05 Years)**

As suggested by the Environmental Appraisal Committee, it is proposed to continue the existing Road–Rail transport network system in view of the implementation of the Jharia Action Plan (JAP) for 10 years and another 05 years gestation period after the completion of the JAP for consolidation of the backfilled dug out fire areas and unstable areas is required. Thus the period of 15 years, make the Phase – I. All mitigation measures like covered trucks, green belting on either side of the road, enhanced water sprinkling, proper maintenance of roads, removal of spilled materials etc shall be adopted for 15 years with the existing road – rails transport system.

## 2.4 Conceptual Plan of Proposed Integrated Coal Transportation Network for the Cluster:

**Phase – II (after 15 Years):**

As suggested by the EAC Members, BCCL shall implement conveyor –cum-rail transport to avoid movement of trucks within the cluster for coal transportation in Phase –II. Loading of coal by pay–loaders shall be discontinued.

During 2020-21, the combined daily coal production of the Cluster was 6862 tones resulting in 1273 kg of daily fugitive dust generation. The dust (PM-10) generation rate at present is 0.19 kg/te.

As a result of replacement of existing road transportation of coal by Conveyor to railway siding will result in reduction of fugitive dust generation to the extent of 4785 kg/day for daily coal production of 25794 tonnes (8.512 MTY) during Phase –II.

## Table 2.2: Proposed Infrastructure for Coal Transportation (phase – II)

| Cluster | Mines in Operation in Phase - II | Production Capacity (MTY) | Proposed Transport Infrastructure in Phase – II |
|---|---|---|---|
| IX | **Amalgamated Joyrampur Colliery (OC) | 3.25 | **Coal transport by Conveyor to Railway Siding** |
| | NT-ST Expansion OCP | 7.8 | |
| | | 8.512* | |

*Peak of the cluster will remain same, as peak of individual will be achieved in different year. ** Mining is not in operation

### 2.5 Conclusion:

On the basis of the study undertaken to assess the impact of coal transportation on pollution load, the followings may be concluded:

**Phase – I :( 2020-21 to 2028 -29):**

1. During Phase – I, business as usual (BAU) scenario will prevail and the existing road cum rail transport network system will be used for coal dispatch to the consumers. During 2020-21, the combined daily coal production of the Cluster was 6862 tones resulting in 1273 kg of daily fugitive dust generation. The dust (PM-10) generation rate at present is 0.19 kg/te.
2. The generation of fugitive dust due to transportation of coal by road can be further reduced by enforcing covering of loaded trucks, periodical removal of loose materials lying on the road surface and black topping of coal transportation roads.
3. Avenue plantation, effective wetting of the road surface and proper maintenance of roads will further result in mitigation of the impact of road generated dust on ambient air quality.
4. Better road condition, by the use of Mechanical Sweeper or vacuum cleaner dust generation may be minimized.

**Phase – II :( From 2029-30 Onwards):**

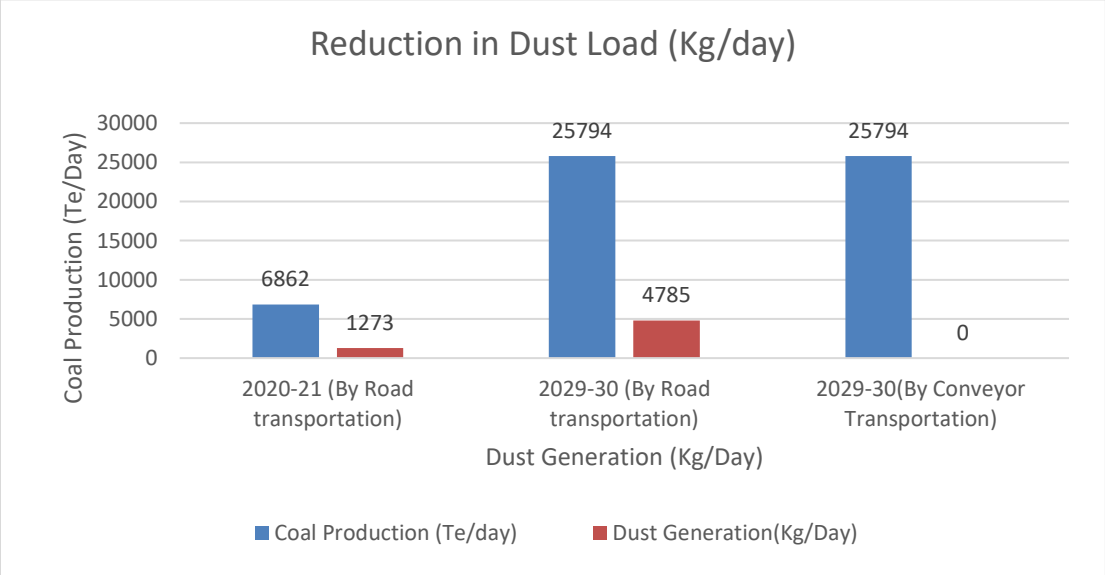
1. As a result of replacement of existing road transportation of coal by Conveyor to railway siding will result in reduction of fugitive dust generation to the extent of 4785 kg/day for daily coal production of 25794 tonnes (8.512 MTY) during Phase –II.
2. During Phase –II, dust load will further reduce due to quenching of mine fire and domestic coal consumption after resettlement of general population dwelling within the command area of cluster, as a result of implementation of Jharia Action Plan. It will result in significant improvement in ambient air quality.

3. **Coal Production Vs. Dust Generation due to Road Transportation is presented below:**

**Table2.3: Coal Production Vs. Dust Generation due to Road Transportation**

| Year | Coal Production (Te/day) | Dust Generation(Kg/Day) |
|---|---|---|
| 2020-21 (By Road transportation) | 6862 | 1273 |
| 2029-30 (By Road transportation) | 25794 | 4785 |
| 2029-30(By Conveyor Transportation) | 25794 | 0 |

**Figure 2.1:** Presentation of reduction in dust generation due to replacement of Road transportation by Conveyor system.



**Annexure X**

भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, लोदना क्षेत्र
पो.ओ.- भागा, जिला - धनबाद (झारखण्ड)
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, Lodna Area
P.O Bhaga, Dist Dhanbad (Jharkhand)
Regd Off: Koyla Bhawan, Koyla Nagar, Dhanbad-825005,
CIN: U10101JH1972GOI000918

Ref. No.: BCCL/LA/GM/2021/ 177 Date: 30/10/2021

**OFFICE ORDER**

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

| | |
|---|---|
| 1. General Manager, Lodna Area | -- Chairman |
| 2. Addl. General Manager, Lodna Area | -- Vice Chairman |
| 3. Project Officer – Amal NT-ST-JG/Amal. Joyrampur/ Kujama Colliery | -- Member |
| 4. Area Manager (Environment), Lodna Area | -- Member |
| 5. Area Safety Officer, Lodna Area | -- Member |
| 6. Area Manager (Planning), Lodna Area | -- Member |
| 7. Area Finance Manager, Lodna Area | -- Member |
| 8. Area Personnel Manager, Lodna Area | -- Member |
| 9. Area Manager (Survey), Lodna Area | -- Member |
| 10. Area Manager (E&M), Lodna Area | -- Member |
| 11. Area Manager (Excavation), Lodna Area | -- Member |
| 12. Area Manager (Estate), Lodna Area | -- Member |
| 13. Assistance Manager (Environment), Lodna Area | -- 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.

30/10/21
General Manger
Lodna Area

Copy to:

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

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**Annexure XI**

(7)

Ph: 0326-2204933

झारखण्ड राज्य प्रदूषण नियंत्रण पर्षद्
Jharkhand State Pollution Control Board
HIG-1, Housing Colony, Dhanbad-826001

Letter No....2650 Dated ....6/7/13....

From,

Regional Officer,
Dhanbad

To,

HOD (Envt.),
M/s. B.C.C.L.,
Koyla Bhawan, Koyla Nagar,
Dhanbad.

Sub: **Fixing up monitoring station/Sampling location of Air, Water & Noise.**

Sir,

With reference to you letter no. GM(Env.)/F-JSPCB/2013/783, dt. 06.07.2013 We have approved Air, Water & Noise monitoring Station/Sampling location after verification and return a copy of the map.

Encl-A/a.

Your's faithfully,

6/7/13

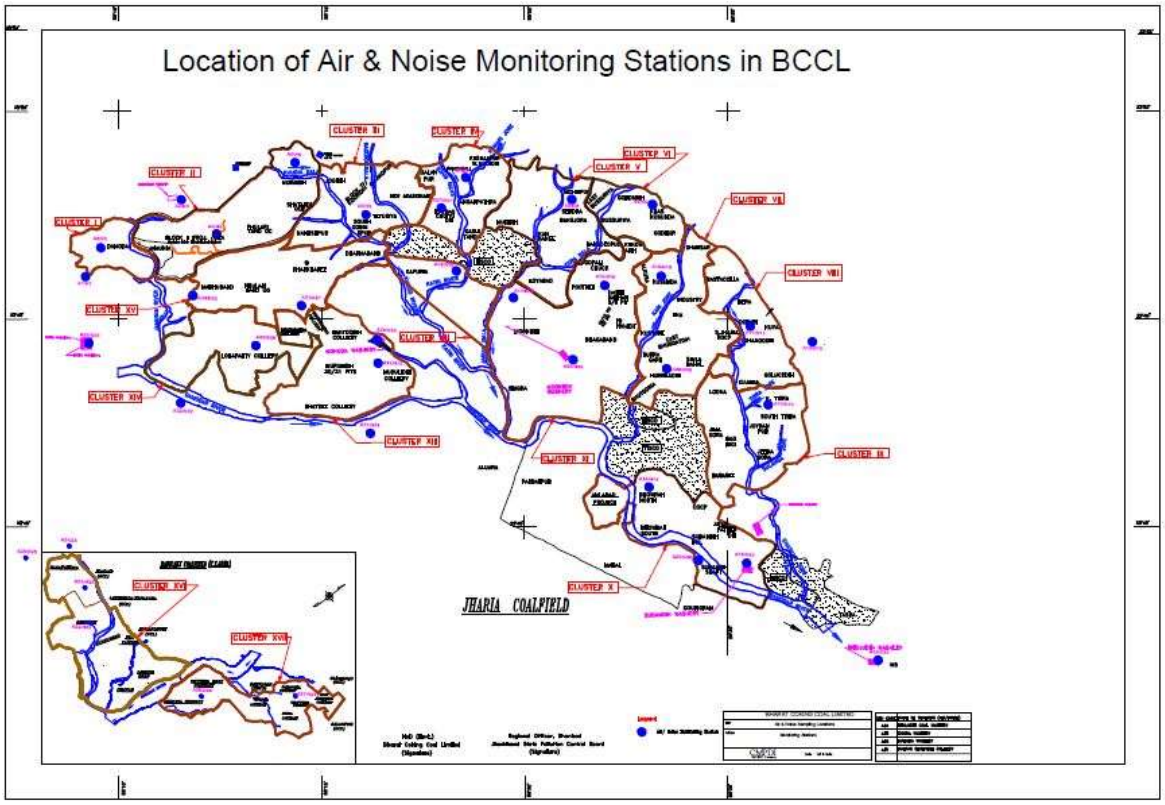
**( Dinesh Prasad Singh)**
Regional Officer.

Memo..... Dhanbad, dated.....

Copy to: The Member Secretary, Jharkhand State Pollution Control Board for information & enclose a copy of the map for necessary action.

Encl-A/a.

**(Dinesh Pd. Singh)**
Regional Officer.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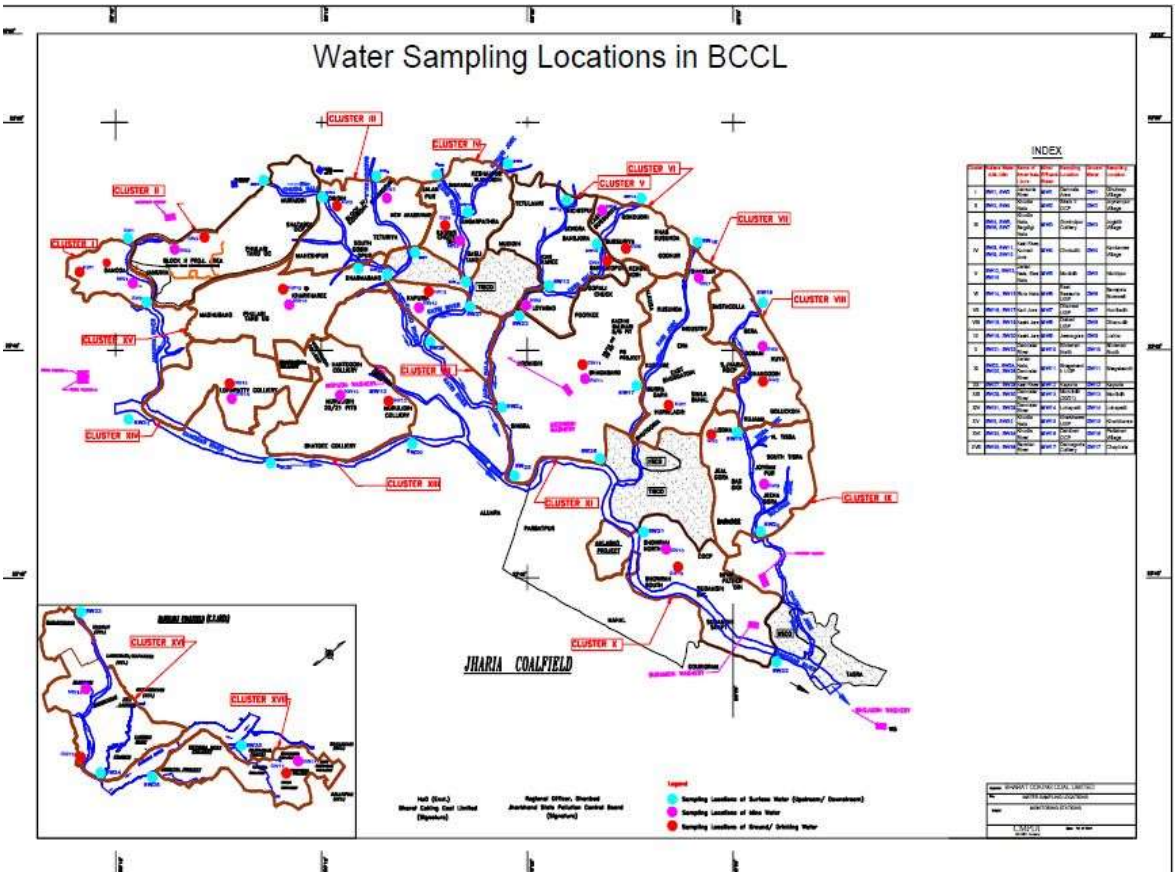
CLUSTER XVII
JHARIA COALFIELD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JHARIA COALFIELD

**ANNEXURE 12**

# “Source apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand”

Sponsor

Bharat Coking Coal Limited (BCCL)

CSIR-National Environmental Engineering

Research Institute, Nagpur

April 2022

**Principal Investigator**

Dr. Rajesh Biniwale
Senior Principal Scientist
CSIR-National Environmental
Engineering Research Institute
Nagpur-440020, Maharashtra
rb_biniwale@neeri.res.in

**Scientific Team**

Dr. Yogesh Pakade
Er. S.A. Praveen
Dr. Rakesh Kadaverugu
Dr.Anirban Middey
Dr. A. D. Bhanarkar

**Project Team**

Mr. Pankaj Kaware

Mr. Ariz Ahmed

Ms. Anshu Pandey

Ms. Samiksha Ashtikar

Ms. Shruti Pande

Ms. Punam Bagde

Ms. Pratiksha Thombre

Mr. Mohit Mahurkar

Mr. Rahul Pawar

Ms. Smita Aditya

Mr. Ankush Rai

Mr. Vijay Selvaraj

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# Chapter 1 Introduction

Jharia Coalfield (JCF) is one of the oldest coalfields of India and has been subjected to coal exploitation for more than 100 years. JCF is one of the significant coal-producing areas in the country and occupies an important place in India's industrial and energy scenario by virtue of prime coking coal and is an essential source of coal. Jharia coalfield is crucial and a large coalfield situated in Dhanbad and Bokaro district, Jharkhand. Geographically the JCF is bounded by latitude 23°38' N to 23°49' N and longitude 86°09'E to 86°30'E and encompassing a total area of about 450sq km (Figure 1.1). Jharia is the largest coal producer in India and has an estimated reserved of 19.4 billion tonnes of coking coal. The coalfield contributes to the local economy and directly or indirectly employs the local population.

Bharat Coking Coal Limited, a subsidiary of Coal India Limited, has been operating the majority of the coal mines in the Jharia coalfield regions since its inception in 1972. Jharia, one of the eight blocks in Dhanbad and the main source of metallurgical coal in India can be termed as the country powerhouse since its mines are the only source for the best quality coking coal required by the steel industries and others in the country.

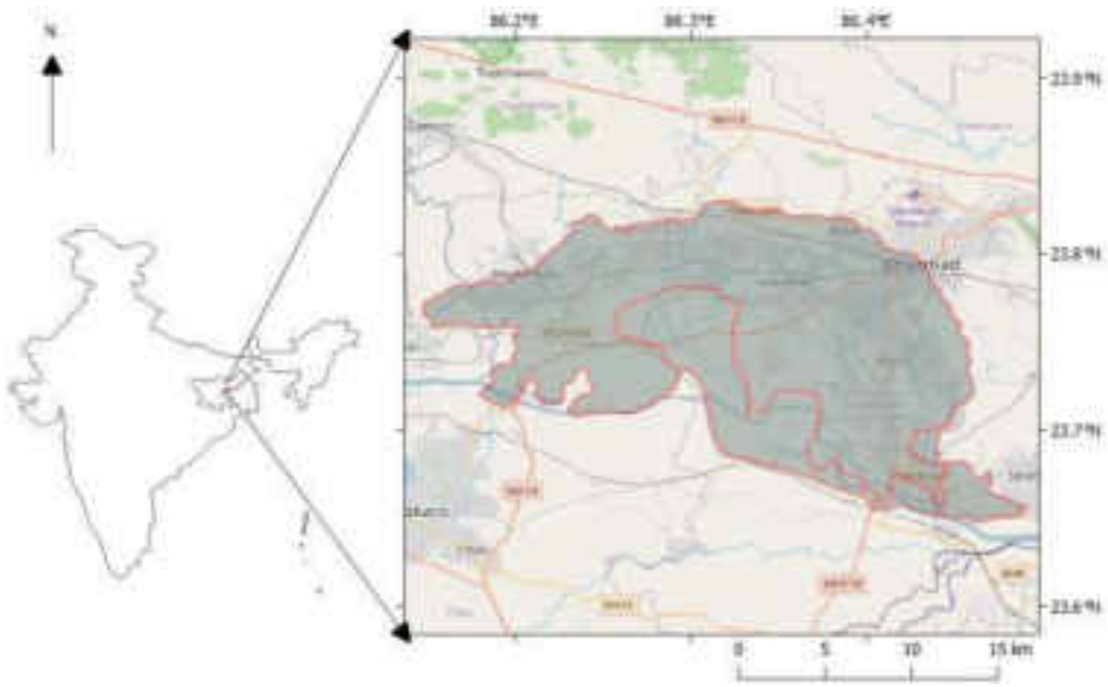



Figure 1.1: Geographical location of Jharia Coalfield in India

### 1.1. Climate

Dhanbad lies 236 m above the mean sea level and experiences the tropical climate. When compared with the winter, the summers have much more rainfall. The Köppen-Geiger climate classification is Aw (Tropical wet-dry climate) and experiences an average temperature of 25.9 °C and 1203 mm of precipitation falls annually. The driest month is December. There is 3 mm of precipitation in December. In July, the precipitation reaches its peak, with an average of 321 mm. With an average of 32.5 °C, May is the warmest month. At 18.4 °C on average, January is the coldest month of the year. The windrose for the March-June months is presented in Figure 1.2.

### 1.2. Land use & Land cover

In the present investigation, the Jharia coalfield area (2827.43 sq km) has been undertaken to study the Land use land cover (LULC), For this study, Sentinel-2A satellite image is used in the month of 17 February 2019 having a minimum cloud. These images were downloaded from the United States Geological Survey (USGS) Earth Explorer. Each Sentinel 2A satellite imagery band was geo-referenced to the WGS_84 datum and Universal Transverse Mercator Zone 45 North coordinate system. The Sentinel 2A satellite image stacking of the band-2, band-3, band-4 and band-8 of 10 m resolution was performed on the ArcGIS 10.5 software for studying the LULC of the Jharia coalfield.

For LULC classification, supervised classification was carried out in the study area. Thus allocations of each classified area in sq. km and its percentages are tabulated in Table 1.1. The percentage of areas as classified as; agriculture (74.5%), barren land (7.45%) built-up areas (5.14%), mining (2.64%), vegetation (9.40%) and water body (0.86%) (Figure 1.2).

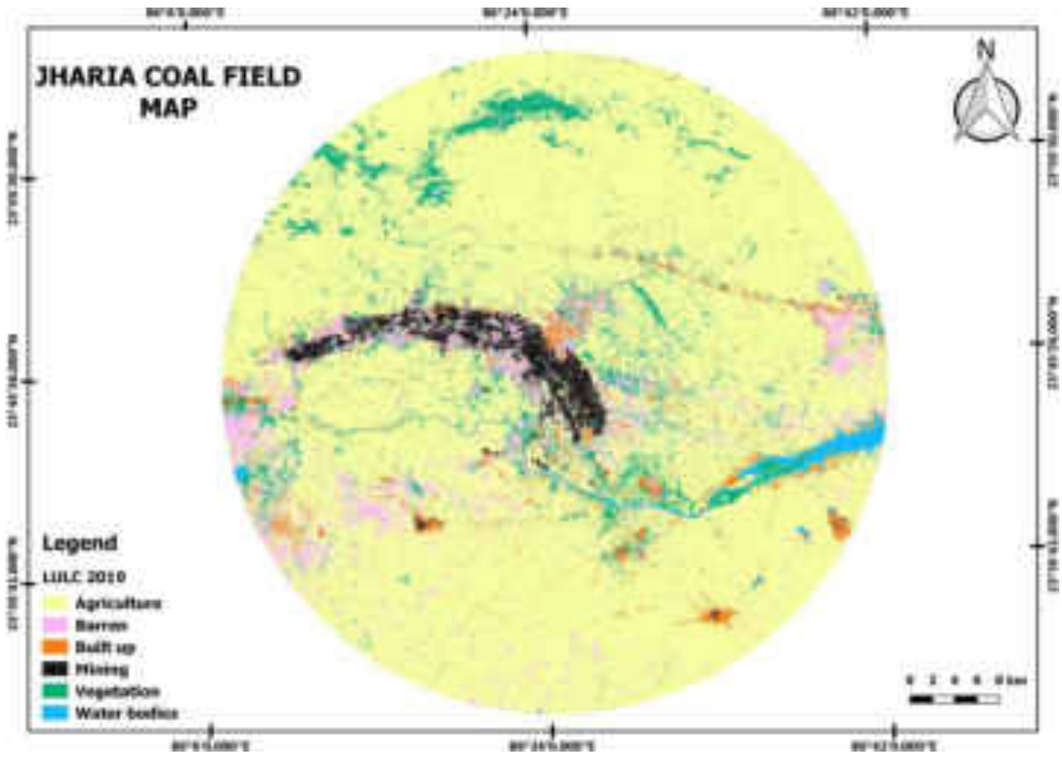



Figure 1.2: Land Use land cover map of Jharia coal field area

Table 1.1: LULC classification of Dhanbad study area

| Sr. No | Name | Area in sq. km | Area in % |
|---|---|---|---|
| 1. | Agriculture | 2106.7 | 74.51 |
| 2. | Barren | 210.64 | 7.45 |
| 3. | Built up | 145.31 | 5.14 |
| 4. | Mining | 74.67 | 2.64 |
| 5. | Vegetation | 265.74 | 9.40 |
| 6. | Water bodies | 24.37 | 0.86 |
| **Total** | | **2827.43** | **100** |

### 1.3. Population

The study area covers four district boundaries; namely Dhanbad (1710.2sq km), Bokaro (620.43sq km), Giridih (29.8sq km) in Jharkhand and Puruliya (465.85sq km) district in West Bengal state. The Dhanbad district covers the maximum study area and the population is around 23, 94,434 in the year 2001 and is around 26,84,487 in 2011. The Bokaro district total population is in 2001 is 17, 75,961 and in 2011 it is 20, 62,330. The Giridih district total population is 19, 01,564 in 2001 and is 24,45,474 in 2011. The Puruliya district in West Bengal state total population is in 2001 is 25, 35,233 and in 2011 are 29, 30,115.

Based on the covered study area the total population in the study area is tabulated in Table 1.2. The total population in the study area based on Census book 2001 is 25,32,195 and 2011 is 28,62,600.

Table 1.2: Population in the study area as per 2011 census

| District Name | District Area Covered by Study Area | % of Area Covered of District by Study Area | Population of 2001 | Population 2001 in Study Area | Population of 2011 | Population 2011 in Study Area |
|---|---|---|---|---|---|---|
| Bokaro | 620.43 | 21.50 | 17,75,961 | 3,81,791 | 2,062,330 | 4,43,353 |
| Dhanbad | 1710.2 | 81.51 | 23,94,434 | 19,51,645 | 2,684,487 | 21,88,060 |
| Giridih | 29.8 | 0.59 | 19,01,564 | 11,275 | 2,445,474 | 14,500 |
| Puruliya | 465.85 | 7.40 | 25,35,233 | 1,87,484 | 2,930,115 | 2,16,686 |
| Total | 2826.28 | | Total Population 2001 | 25,32,195 | Total Population 2011 | 28,62,600 |

### 1.4. Purpose of Study

Urban air pollution is a notable concern across the world. Inferring to the rapid rates of industrialization and urbanization in Indian cities, polluted air quality is considered a key factor in crumbling the quality of life with an adverse effect on the human being. Hence air quality gained a significant role in recent decades since it is worsened by emission from major pollutants including particulate matter ($PM_{10}$ and $PM_{2.5}$), $NO_2$, $SO_2$ and $O_3$ were found to exceed the national ambient air quality standard (NAAQS) limits.

Particulate pollution is a major concern in the field of air pollution. The particulate matter in the air result from dispersion of dust from industrial (mining and non-mining) and allied activities, transportation, local vehicular movement and domestic fuel (Coal, wood-burning etc.) burning. Assessment of the air quality can provide useful insight for the development of the air quality management plan. The database developed on air quality also helps the regulatory agency identify the locations where natural resources and human health could be at risk.

Jharia coal mines having low ash content and high calorific value coals are subjected to intensive mining activities because of the easy availability of coal at shallow depths in thick seams. Therefore, they are often used directly in iron and steel plants for metal oxide reduction after washing. Although these coal mines are highly-priced for their high-quality coal, they are notorious for their mine fires, which cause a lot of fugitive gaseous and PM emissions. Hence, the Jharia region has been under scrutiny by various public authorities and the common public with a vision to improve the ambient air quality.

Various sources contribute to high particular matter concentration in the Jharia region: vehicles, mining activities, re-suspended dust, fugitive emissions, fuel oils, household LPG. The percentage contribution of these factors in the ambient depends exclusively on a particular region‟s economic activities. To improve the existing ambient air quality, the major sources of PM emissions first need to be identified.

Hence, the environmental clearance committee of MoEFCC has directed BCCL to conduct a source apportionment study for particulate matter. In this context, BCCL has approached CSIR-NEERI to conduct a source apportionment study of ambient air particulate matter in the Jharia coalfields region to quantify the various sources of PM emissions and suggest an effective environmental management plan.

The study's major objective 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 includes the entire Jharia Coalfield and an area up to 10 Km from the periphery/boundary of BCCL mines.

The detailed objectives are as follows:

i. Ambient Air Monitoring

- Monitoring of ambient air quality at selected receptor locations for pollutants including $PM_{10}$, $PM_{2.5}$(limited), $SO_x$, $NO_x$, PAHs to establish the status of the air quality in Jharia Coalfields and an 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 validate dispersion modelling predictions using measured air quality parameters
- To draw supportive data through the 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 micrometeorological conditions of the Jharia Coalfields

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

ii. 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
- Source apportionment
- To identify and apportion the pollution load at receptor level to various sources in the Jharia Coalfields along with an 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 periods of the day and day-of-the-week.
- Any other item in consensus between both BCCL/CIL & NEERI evolved during the study.

### 1.5. Approach of study

The study approach has many components, each one of them having its importance and interdependence as shown in Figure 1.3. The ultimate objective is source apportionment of ambient air of JCF that primarily requires knowledge of ambient air quality status, sources and emission load. These three objectives were achieved by monitoring air pollutants at 13 locations in Jharia Coalfield using various instruments and multiple analyses. These locations were selected based on land use and activity profile. All monitoring was carried out using varied instruments and all attributes were analysed using standards methodologies. The study"s methodology of the study was divided into three parts namely ambient air quality monitoring, sources emission inventory and source apportionment analysis.

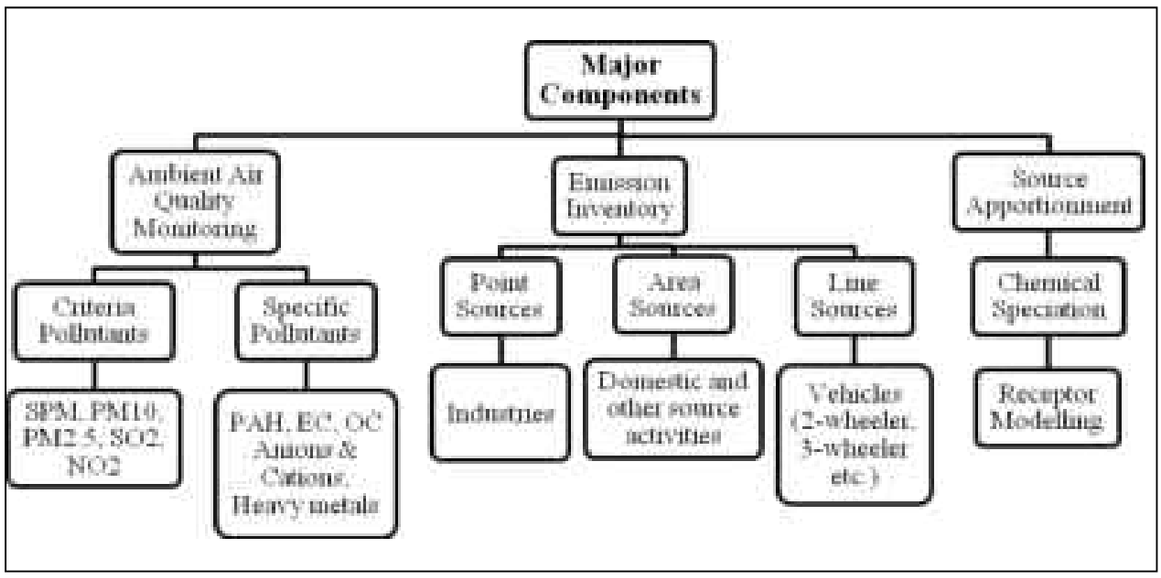



Figure 1.3: Air quality Monitoring & emission source apportionment studies

# Chapter 2 Emission Inventory

This section consists of all methodologies that have been applied for the emission inventory and dispersion modelling in the Jharia Coalfield. The emission inventory is the process to identify the possible source and its contribution. Emission inventory and dispersion modelling are based on the primary data collection to calculate emission load from a particular source. It provides fundamental information for air quality modelling and air pollution control strategy development. In the coal mining area, mining, non-mining, industrial, vehicular and other sources are contributing. Air quality monitoring includes the suitable location selected based on the metrological conditions, chemical characterization for identification of the source, CMB model to estimate the source apportionment to $PM_{2.5}$.

Air pollutant emission inventory is a process to identify the possible sources and their contribution. It provides fundamental information for air quality modelling and air pollution control strategy development. Mining, non-mining, industrial, vehicular and other sources are contributing to critical coal mining zone like JCF, India. According to possible emission sources, sources are divided into three categories like point sources, area sources and line sources. The inventory of these sources is important to make a proper source profile.

## 2.1. Inventory of Point Sources

A point source of pollution is a single identifiable source that is responsible for significant pollution load in the study area, like thermal power stations. A comprehensive list of different point-like industries in the study area was obtained from the regional office of the Jharkhand State Pollution Control Board (JSPCB), at Dhanbad. The industries specific information of includes production capacities, raw material used, manufacturing process, fuel consumption, etc. also collected from the regional office by the CSIR-NEERI team.

## 2.2. Inventory of Area Sources

Area sources are sources of pollution that emit a substance or radiation from a specified area. Mining activities, domestic/hotel fuel (coal) burning, garbage burning, etc. are the major contributor to area sources. In order to assess the fuel consumption in the study area, the necessary information was collected through surveys at petrol pumps, hotels and restaurants, bakeries, open eat out and crematoria. Also, surveys collected data on the seasonal implication of fuel used particularly wood and coal. The data on trash burning and solid waste generated in the study were collected from Municipal Corporation Dhanbad.

## 2.3. Inventory of Line Sources

Vehicles contribute a whole range of HCs besides contributing $SO_x$, $NO_x$ (as $NO_2$), HC and lead. Diesel vehicles are the primary source of smoke and $NO_x$ in addition to CO and HCs. However, CO and HCs per litre of fuel consumed by diesel vehicles in relatively low compared to gasoline-powered vehicles. In gasoline-powered vehicles, the exhaust is the major source of pollution that contributes 100 % CO and $NO_x$ and 80% of HCs emitted to the atmosphere. The remaining 20% of HCs are emitted from crankcase blow-by and evaporative emissions. In the

two-stroke engine, the crankcase blow-by is absent. The exhaust emissions are the principal sources of pollutants emitting about 40% of fuel supplied without burning due to short circulating, contributing high concentration of HCs. In diesel vehicles, practically all pollutants are emitted through exhaust gases and the contribution to crankcase blow-by and evaporative fuel emission are negligible.

Though the quantity of pollutants emitted by the vehicles is directly proportional to the number of vehicles playing on the road, the intensity of pollution potential depends on several contributory factors such as a geographical location, unplanned development of central business areas, inadequate and ill-maintained road as well as the type of vehicle, unplanned traffic management, meteorological conditions, and non-availability of adequate emission control technology.

Vehicle activity data were collected during the field campaign at 12 road networks in the study area, and the daily average vehicular activity is presented in Table 2.1.

Table 2.1a: Daily average vehicle activity on different road network considered during the fieldsurvey

| Label | Road Network | HDV | LMV | 3W | 2W | Total |
|---|---|---|---|---|---|---|
| **L1** | Jharia to Lodna -5 km | 1254 | 1385 | 3640 | 9560 | 15839 |
| **L2** | Pathardih to Sindri -7 km | 1539 | 5356 | 4362 | 15633 | 26890 |
| **L3** | Bastacola to Pathardih -13km | 2153 | 8325 | 3678 | 10233 | 24389 |
| **L4** | Bhuli to Bankmore - 6km | 1475 | 13832 | 12965 | 18241 | 46513 |
| **L5** | Katras to Harina–12.5 km | 1802 | 7290 | 3156 | 15329 | 27577 |
| **L6** | Bankmore to Kusunda -5 km | 658 | 2685 | 1896 | 10235 | 15474 |
| **L7** | Kusunda to Katras - 10 km | 1306 | 4521 | 5327 | 15689 | 26843 |
| **L8** | Monidih to Kusunda -7 Km | 1208 | 7659 | 3985 | 14698 | 27550 |
| **L9** | Lohpiti to Mahuda Area Colony - 8 km | 1535 | 4523 | 2235 | 6356 | 14649 |
| **L10** | Mahuda to Parasia Chowk -7 km | 1223 | 4023 | 1759 | 5623 | 12628 |
| **L11** | Parasia Chowk To Moonidih - 3 km | 269 | 2159 | 236 | 2347 | 5011 |
| **L12** | Bhowra to Parbatpur - 13 Km | 2135 | 7856 | 4258 | 14578 | 28827 |

Table 2.1b: Average vehicle speed of different categories of vecle in the road network

| | | Average vehicle speed* | | | |
|---|---|---|---|---|---|
| **Label** | **Road Network** | **HDV** | **LMV** | **3W** | **2W** |
| **L1** | Jharia to Lodna -5 km | 20 | 35 | 30 | 40 |
| **L2** | Pathardih to Sindri -7 km | 20 | 40 | 35 | 40 |
| **L3** | Bastacola to Pathardih -13km | 20 | 40 | 35 | 40 |
| **L4** | Bhuli to Bankmore - 6km | 15 | 30 | 30 | 30 |
| **L5** | Katras to Harina–12.5 km | 20 | 35 | 30 | 40 |
| **L6** | Bankmore to Kusunda -5 km | 15 | 30 | 20 | 30 |
| **L7** | Kusunda to Katras - 10 km | 20 | 40 | 30 | 40 |
| **L8** | Monidih to Kusunda -7 Km | 20 | 35 | 30 | 40 |
| **L9** | Lohpiti to Mahuda Area Colony - 8 km | 20 | 40 | 30 | 40 |
| **L10** | Mahuda to Parasia Chowk -7 km | 15 | 30 | 20 | 30 |

| | | | | | |
|---|---|---|---|---|---|
| **L11** | Parasia Chowk To Moonidih - 3 km | 20 | 35 | 35 | 40 |
| **L12** | Bhowra to Parbatpur - 13 Km | 20 | 40 | 30 | 40 |

*** Average travel speed on the road network is considered during traffic surveys and input form Traffic police and vehicle drivers**

The vehicle utilization factors (km travelled per day per vehicle type) were adapted from the Auto Fuel Policy Report (Table 2.2). Two-to-four-wheelers Emission factors were taken from various project reports conducted by CPCB and Indian Clean Air Programmed (ICAP) (CPCB 2010; ARAI 2007). The percentage distribution of various types of vehicles moving on the road network considered during the field survey is presented in Fig 2.1. It shows that major numbers of vehicles moving in the considered Road network are two-wheelers (51%), followed by light motor vehicles (26%), three-wheeler (17%) and heavy-duty diesel vehicles (6%).

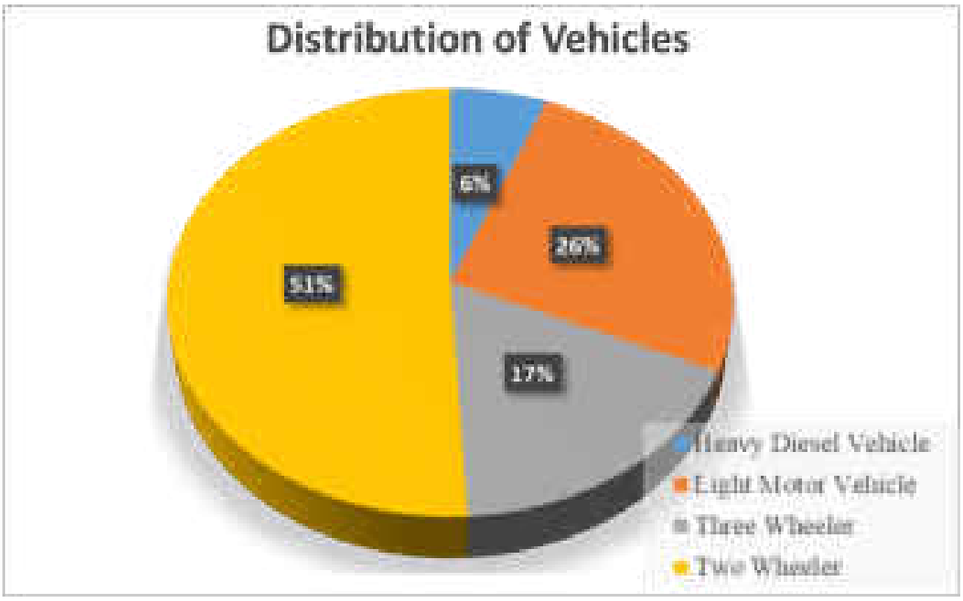



Figure 2.1 Percentage of different types of vehicle surveyed on the road network during the field survey

Table 2.2: Utilization Factors for different types of vehicle

| Vehicle Type | km per day |
|---|---|
| LMV (Car Jeep) | 52.6 |
| LMV (Taxi) | 77.89 |
| 2 Wheeler | 25.1 |
| 3 Wheeler (Auto) | 97.72 |
| HDV | 45.5 |

### 2.4. Methodology

The following method is adopted to estimate the emission load due to vehicles

$$E_i = N_v \times VKT \times E_f \quad (2.1)$$

Where, $E_i$ is the emission from a particular type of vehicle

$N_v$ is the number of vehicles of a particular type

VKT is the vehicle km travelled

$E_i$, km is the emission factor for a specific vehicle

Table 2.3a: Emission estimate for road transport

| Label | Road Network | Emission (kg/day) | |
|---|---|---|---|
| | | $PM_{10}$ | $PM_{2.5}$ |
| L1 | Jharia to Lodna -5 km | 230.12 | 113.08 |
| L2 | Pathardih to Sindri -7 km | 379.07 | 180.37 |
| L3 | Bastacola to Pathardih -13km | 632.21 | 451.98 |
| L4 | Bhuli to Bankmore - 6km | 331.41 | 187.69 |
| L5 | Katras to Harina–12.5 km | 719.42 | 415.63 |
| L6 | Bankmore to Kusunda -5 km | 308.69 | 194.34 |
| L7 | Kusunda to Katras - 10 km | 576.31 | 277.95 |
| L8 | Monidih to Kusunda -7 Km | 317.83 | 114.25 |
| L9 | Lohpiti to Mahuda Area Colony - 8 km | 360.24 | 151.99 |
| L10 | Mahuda to Parasia Chowk -7 km | 241.56 | 148.24 |
| L11 | Parasia Chowk To Moonidih - 3 km | 94.26 | 57.23 |
| L12 | Bhowra to Parbatpur - 13 Km | 592.82 | 379.80 |

Re-suspension of the unpaved and paved roads depends on the „silt loading" factor and „vehicles weight" roaming on the road (Table 2.4). The silt loading ($S_L$) is the mass of the silt-sized material per unit area of the road surface. The amount of dust produces by vehicles movement on paved (eq. 2.2a) and unpaved (eq. 2.2b) roads can be appraised by the following equations (adapted from US-EPA, AP-42):

$$E = k. (SL/2)^{0.65} . (W/3)^{1.5} \quad (2.2a)$$

$$E = [k. (SL/12).(S/30)^{0.5} (W/3)^{1.5}]/(M/0.5)^{0.2} \quad (2.2b)$$

Where, „E" = emission rate of PMs (Table 2.3);

SL is silt load (g/m2);

W is the average weight of the vehicle (Tons);
M is the surface moisture content (%)

k is constant (the function of particle size) in g $VKT^{-1}$ (Vehicle Kilometer Travel)

Table 2.3b: Surface silt load in paved and unpaved road

| Label | Road Network (Paved: 97.4%; Unpaved: 2.6%) | Surface Silt load (g/m2) | |
|---|---|---|---|
| | | unpaved | paved |
| L1 | Jharia to Lodna -5 km | 102.3 | 18.2 |
| L2 | Pathardih to Sindri -7 km | -- | 16.8 |
| L3 | Bastacola to Pathardih -13km | 63.2 | 12.1 |
| L4 | Bhuli to Bankmore - 6km | -- | 17.5 |
| L5 | Katras to Harina–12.5 km | 92.8 | 12.6 |
| L6 | Bankmore to Kusunda -5 km | -- | 18 |
| L7 | Kusunda to Katras - 10 km | -- | 17.3 |
| L8 | Monidih to Kusunda -7 Km | 56.5 | 12.8 |
| L9 | Lohpiti to Mahuda Area Colony - 8 km | -- | 15.5 |
| L10 | Mahuda to Parasia Chowk -7 km | -- | 19 |

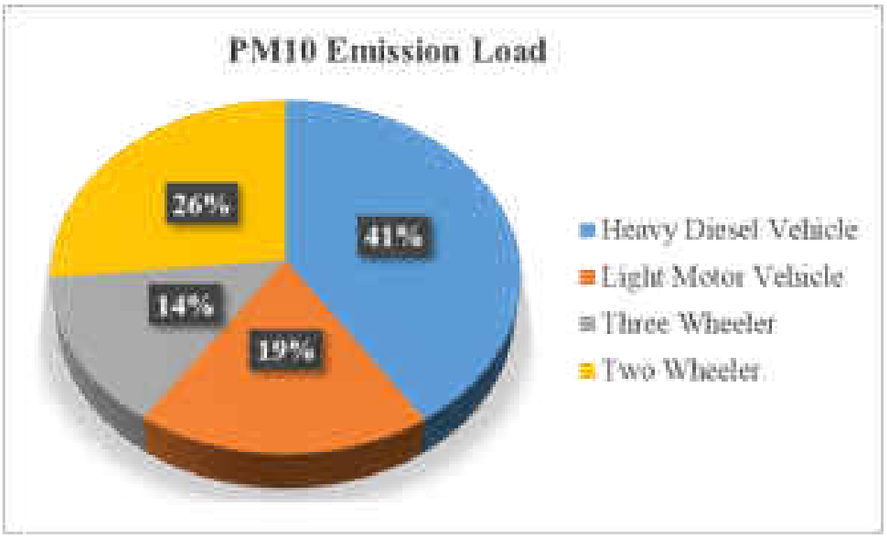



Figure 2.2 $PM_{10}$ emission load for different categories of vehicle

It is observed that 41% of PM10 emission is contributed by the Heavy-duty diesel vehicles followed by two-wheelers (26%), Light motor vehicles (19%) and three-wheelers (14%) in the considered road network during the study period. The particle size multiplier (k) in the equations 2.2a and 2.2b varies with aerodynamic size range as shown in EPA technical document (13.2.1_paved_roads.pdf (epa.gov)).

Table 2.4: Emission rate for the paved and unpaved road

| | **Emission Rate** | |
|---|---|---|
| Emission Sector | **$PM_{10}$ (kg/day)** | **$PM_{2.5}$ (kg/day)** |
| Re-suspension dust from Paved & Unpaved Road | 1756 | 843 |

## 2.5. Results

### 2.5.1. Industrial Emission

Emission inventory estimates are determined based on considering available industrial activity information, emission factors (Table 2.5) and observations. For the current study, industrial and mining information was collected for emission inventory development. Emission inventory information for industries was collected from the regional office of JSPCB. In Dhanbad, the major industries are the power plant and the coking industry. Other

than those are coal mines, thus coal as a fuel is majorly used in industries and households. Emission loads by point source are depicted in Table 2.6 as per emission inventory.

Table 2.5: Emission factor for coal mining activities

| EF | TSP | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ |
|---|---|---|---|---|---|
| **g/Mg Coal** | 1914 | 1864 | 1176 | 420 | 820 |

Table 2.6: Emission load from Industrial sector in JCF

| Sr. No | Name of Industry | Type of Fuel | Fuel consumption | Unit | TSP (Ton/ yr) | $PM_{10}$ (Ton/ yr) | $PM_{2.5}$ (Ton/ yr) | $SO_2$ (Ton/ yr) | $NO_2$ (Ton/ yr) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | M/s Mahalaxmi Industries | Coal | 4 | MT/Oven/ cycle (24hrs) | 2.79 | 2.72 | 1.72 | 0.61 | 1.20 |
| 2 | GEETEE Hard Coke Traders | Coal | 100 | TPD | 69.86 | 68.04 | 42.92 | 15.33 | 29.93 |
| 3 | M/s Shree Gopal Coke Industries | Coal | 77.4 | TPD | 54.07 | 52.66 | 33.22 | 11.87 | 23.17 |
| 4 | M/s Laxmi Hard coke Manufacturing Company | Coal | 102 | TPD | 71.26 | 69.40 | 43.78 | 15.64 | 30.53 |
| 5 | M/s - Sanjay Hard Coke Industries | Coal | 70 | TPD | 48.90 | 47.63 | 30.05 | 10.73 | 20.95 |
| 6 | M/s Inder Hard Coke Industries | Coal | 36 | TPD | 25.15 | 24.49 | 15.45 | 5.52 | 10.77 |
| 7 | M/s Shiv Shakti Coke Industries | Coal | 80 | TPD | 55.89 | 54.43 | 34.34 | 12.26 | 23.94 |
| 8 | Khetawat Coke Manufacturing Company | Coal | 4.5 | MT/ Oven/ Batch (24hrs) | 3.14 | 3.06 | 1.93 | 0.69 | 1.35 |
| 9 | M/s Pawan Hard Coke Industries | Coal | 100 | TPD | 69.86 | 68.04 | 42.92 | 15.33 | 29.93 |
| 10 | M/s Ganapati Udyog | Coal | 135 | TPD | 94.31 | 91.85 | 57.95 | 20.70 | 40.41 |
| 11 | M/s Aman Soft Coke Industries | Coal | 29.76 | TPD | 20.79 | 20.25 | 12.77 | 4.56 | 8.91 |

### 2.5.2. Area/Distributed source

An area source emission inventory estimates the pollutant loads emanating from several small but numerous individual sources in a specific geographic area and which cannot be included underline no point sources.

Area sources considered for emission inventory for JCF region are:

- Cooking operations in households: Slum and non-slum
- Cooking operations in hotels, restaurants, open eat-outs and bakeries
- Crematoria

The following sections will detail the methodology adopted for estimating emissions from each of the above-mentioned sources and the results thusobtained.

- **Emission load from mining activities**

The emission loads from coal mine activities are depicted in Table 2.7. The emission load is calculated based on the secondary data collected from the BCCL mines covered in the study. The data includes coal and overburden quantity handled per day during loading and unloading, transfer from pit to stockyard through haul road and conveyor, vehicular movement frequency and diesel consumption for HEMM and DG sets. Emission factors from EEA air pollutant emission inventory guidebook 2019 were considered for the estimations of TSP and PM load.

Table 2.7: Emission load from coal mine activities in Jharia coalfield region

| Mine | Area ($m^2$) | $PM_{10}$ (Tone/y) | $PM_{2.5}$ (Tone/y) |
|---|---|---|---|
| ABOCP | 2355283 | 156.1 | 78.0 |
| ADI Colliery | 1444818 | 47.9 | 23.9 |
| ASP Colliery | 19540 | 27.7 | 13.8 |
| Bhowra south | 78079 | 26.9 | 13.4 |
| Block IV Govindpur | 432827 | 22.5 | 11.2 |
| DBOCP | 605747 | 64.7 | 32.4 |
| East Bassuriya Colliery | 576494 | 24.3 | 12.2 |
| Gopalichuck Colliery | 37573 | 3.7 | 1.9 |
| Jeenagora OCP | 2079123 | 208.0 | 104.0 |
| Kuya OCP | 1134723 | 90.1 | 45.1 |
| NAKC | 245205 | 78.3 | 39.1 |
| NGK | 261847 | 126.0 | 63.0 |
| Nichitpur colliery | 791140 | 61.4 | 30.7 |
| Phularitand colliery | 335887 | 84.1 | 42.1 |
| Rajapur OCP | 1170784 | 90.4 | 45.2 |
| Sendra Bansjora | 472760 | 63.0 | 31.5 |
| Shatabdi colliery (Muraidhih) | 34270 | 77.0 | 38.5 |
| Tetulmari | 876320 | 23.3 | 11.7 |
| **Total** | | **1275.4** | **637.7** |

- **Cooking operations in non-slum household**

A survey of 20 non-slum household areas was conducted in randomly selected areas of Dhanbad to understand which fuels are being used in these households and their quantities. The survey results indicated that Liquefied Petroleum Gas (LPG) was the fuel of choice in all the households and that each household used about 1 cylinder per month on average. It was assumed that LPG use remains the same for all 365 days of the year. The results obtained are presented in Table 2.8.

Table 2.8: Emissions from the use of LPG in non-slum households in Dhanbad

| LPG Pollutant | $PM_{10}$ | $SO_2$ | $NO_2$ | CO | HC |
|---|---|---|---|---|---|
| **Emission Factor (g/kg)** | 2.1 | 0.4 | 1.8 | 0.25 | 0.07 |
| **Emission (T/Year)** | 0.00575 | 0.0011 | 0.0049 | 0.0007 | 0.0002 |

- **Cooking operations in slum households**

A survey of 15 areas having slum households was conducted, spread in Jharia Coalfield which was known to have significant slum populations, to understand which fuels are being used in these households and their quantities. It was seen that a majority of the slum households use coal as a cooking fuel (Table 2.9).

Table 2.9: Emission from coal as fuel

| Pollutant | SPM | $SO_2$ | $NO_2$ | CO | HC |
|---|---|---|---|---|---|
| **Emission Factor (g/kg)** | 20 | 13.3 | 3.99 | 24.92 | 0.5 |
| **Emission (T/Year)** | 28.354 | 18.856 | 5.657 | 35.330 | 0.709 |

- **Emissions from crematorium**

In order to calculate emission from crematoria data were obtained from crematoriums in Dhanbad. Emission from the burning of bodies using woods mainly produces $PM_{10}$, CO and HC majorly as depicted in Table 2.10.

Table 2.10: Emission from Crematoria using Wood as fuel

| Pollutant | $PM_{10}$ | $SO_2$ | $NO_2$ | CO | HC |
|---|---|---|---|---|---|
| **Emission Factor (g/kg)** | 17.3 | 0.2 | 1.3 | 126.3 | 114.5 |
| **Emission (T/Year)** | 28.88 | 0.033 | 0.216 | 20.99 | 19.03 |

- **Emissions from bakeries**

Data were collected from 34 bakeries operating in Dhanbad in which 12 bakeries were using electrical ovens. The emissions from such bakeries were not considered. All the other bakeries were using coal as fuel. Emissions from such bakeries are given in Table 2.11.

Table 2.11: Emission from Bakeries using Coal as fuel

| Pollutant | SPM | $SO_2$ | $NO_2$ | CO | HC |
|---|---|---|---|---|---|
| **Emission Factor (g/kg)** | 20 | 13.3 | 3.99 | 24.92 | 0.5 |
| **Emission (T/Year)** | 6.26 | 4.16 | 1.25 | 7.80 | 0.16 |

- **Emissions from hotels and restaurants**

Data were collected from 35 hotels in Dhanbad city. It has been found that most hotels/restaurants were using a combination of coal and LPG as cooking fuel. Emission

from coal and LPG were calculated and depicted in Table 2.12 and 2.13.

Table 2.12: Emission from Hotel & Restaurants using Coal

| Pollutant | SPM | $SO_2$ | $NO_2$ | CO | HC |
|---|---|---|---|---|---|
| **Emission Factor (g/kg)** | 20 | 13.3 | 3.99 | 24.92 | 0.5 |
| **Emission (T/Year)** | 81.10 | 5.393 | 1.618 | 10.105 | 0.203 |

Table 2.13: Emission from Hotel & Restaurants using LPG

| Pollutant | $PM_{10}$ | $SO_2$ | $NO_2$ | CO | HC |
|---|---|---|---|---|---|
| **Emission Factor (g/kg)** | 2.1 | 0.4 | 0.8 | 0.25 | 0.07 |
| **Emission (T/Year)** | 0.136 | 0.026 | 0.117 | 0.016 | 0.005 |

- **Emission from open eat-outs**

From the survey it has been observed that most of the open eat-outs were using coal as cooking fuel, only a few were using LPG (Table 2.14).

Table 2.14: Emission loads from open eat-outs

| Pollutant | SPM | $SO_2$ | $NO_2$ | CO | HC |
|---|---|---|---|---|---|
| **Emission Factor (g/kg)** | 20 | 13.3 | 3.99 | 24.92 | 0.5 |
| **Emission (T/Year)** | 140.7 | 9.36 | 2.81 | 17.54 | 0.35 |

### 2.5.3. Grid wise emission inventory

The grid-wise particulate emission inventory maps were prepared from the primary and secondary data collected during the field surveys and the information received from the open cast mines, respectively. The PM emissions from restaurants, eat-outs, domestic chullahs, vehicles, crematoria, etc. were estimated based on the primary data obtained from the filed campaigns, whereas, the emissions from the mine operations were estimated based on the data received from the mines and the emission factors reported in the literature. Once the emissions rates were estimated, the cumulative emissions (including all types of sources like line, point, and area) were calculated falling under the grid defined (shown in Figure 2.3 and Figure 2.4). From the figures, it can be interpreted that the PM emissions are high on the northeast side of the study area. Whereas, the actual transport and dispersion of these emissions can be interpreted through the dispersion modelling carried out using the AERMOD model.

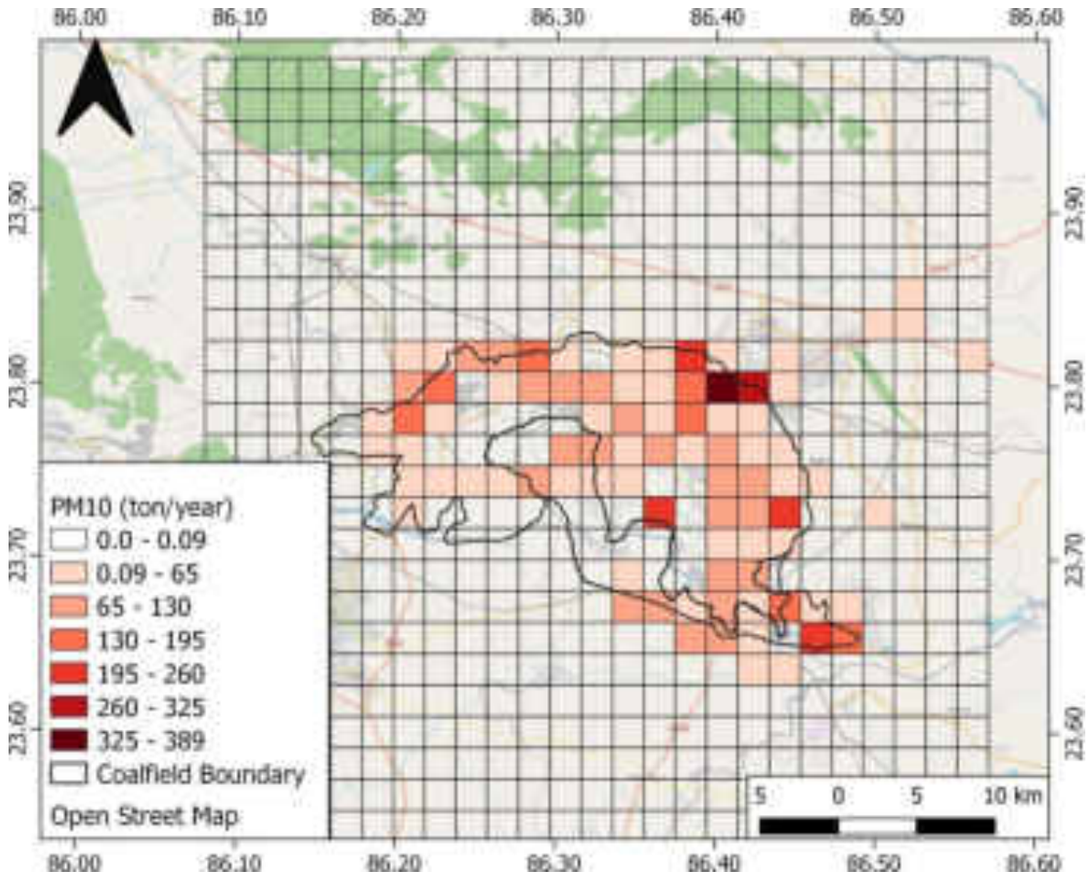



Figure 2.3 Grid-wise emission inventory of $PM_{10}$ in tons/year over the study area

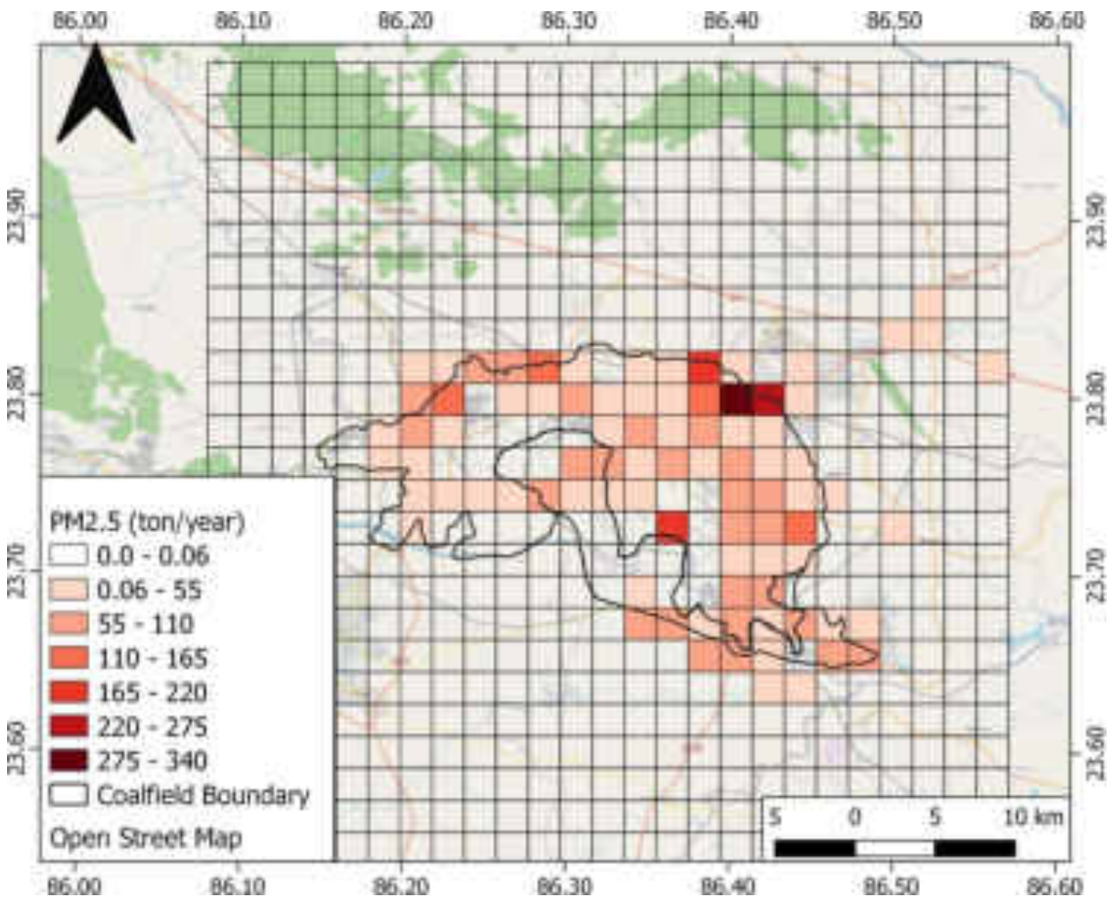
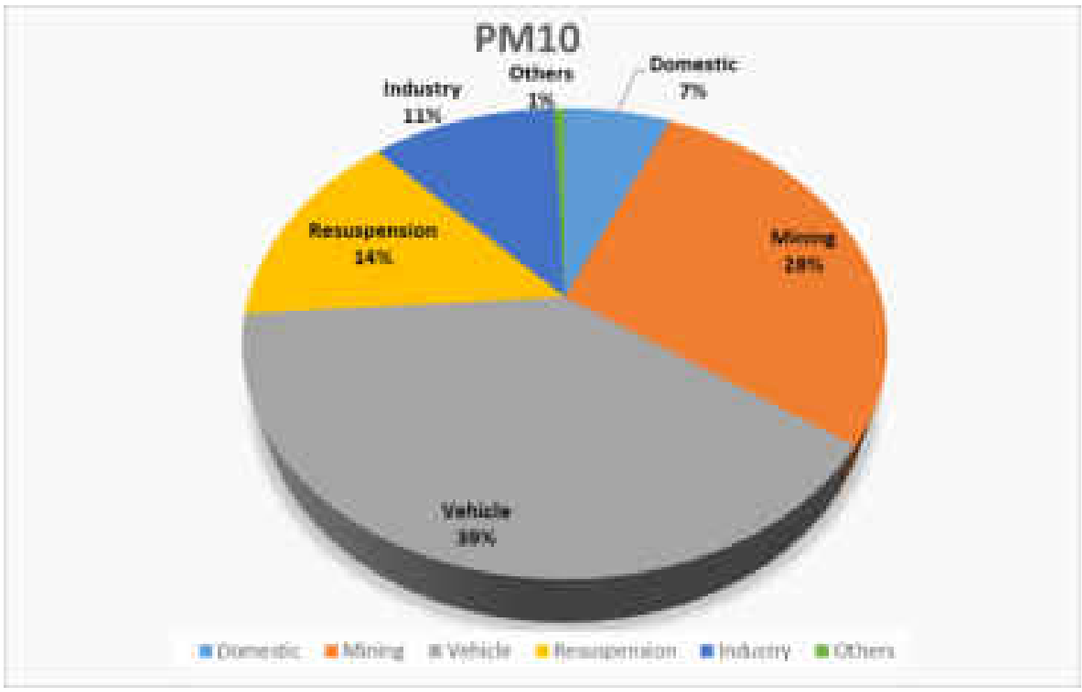


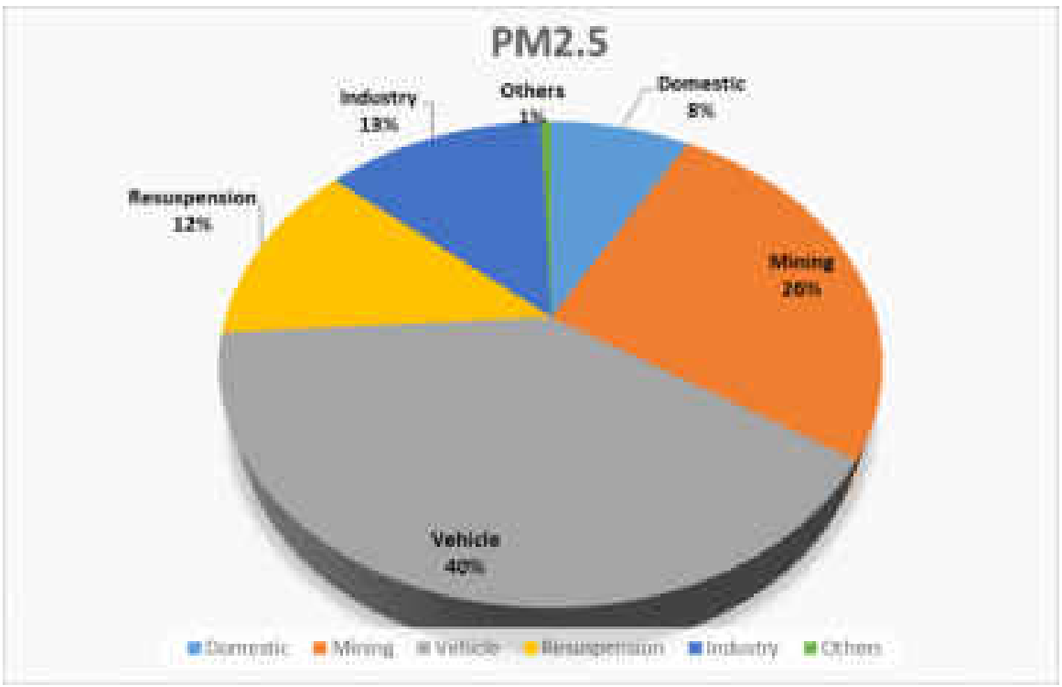

Figure 2.4 Grid-wise emission inventory of PM2.5 in tons/year over the study area

The respective share of various emission sources is represented through pie diagrams shown in Figure 2.5. Data shows that $PM_{10}$ emissions are contributed mostly from vehicular emissions

followed by emissions from the mines whereas, $PM_{2.5}$ emissions are contributed mostly from vehicular emissions, domestic burning and mine activities. The grid-wise emission inventory maps and the information on the pollution sources provide the basis for the policymakers to target the hotspots of pollution generation in order to take effective mitigation actions.




(a)




(b)

Figure 2.5 (a) and (b) represents emission load from various sectors over JCF region for $PM_{10}$ and $PM_{2.5}$ respectively

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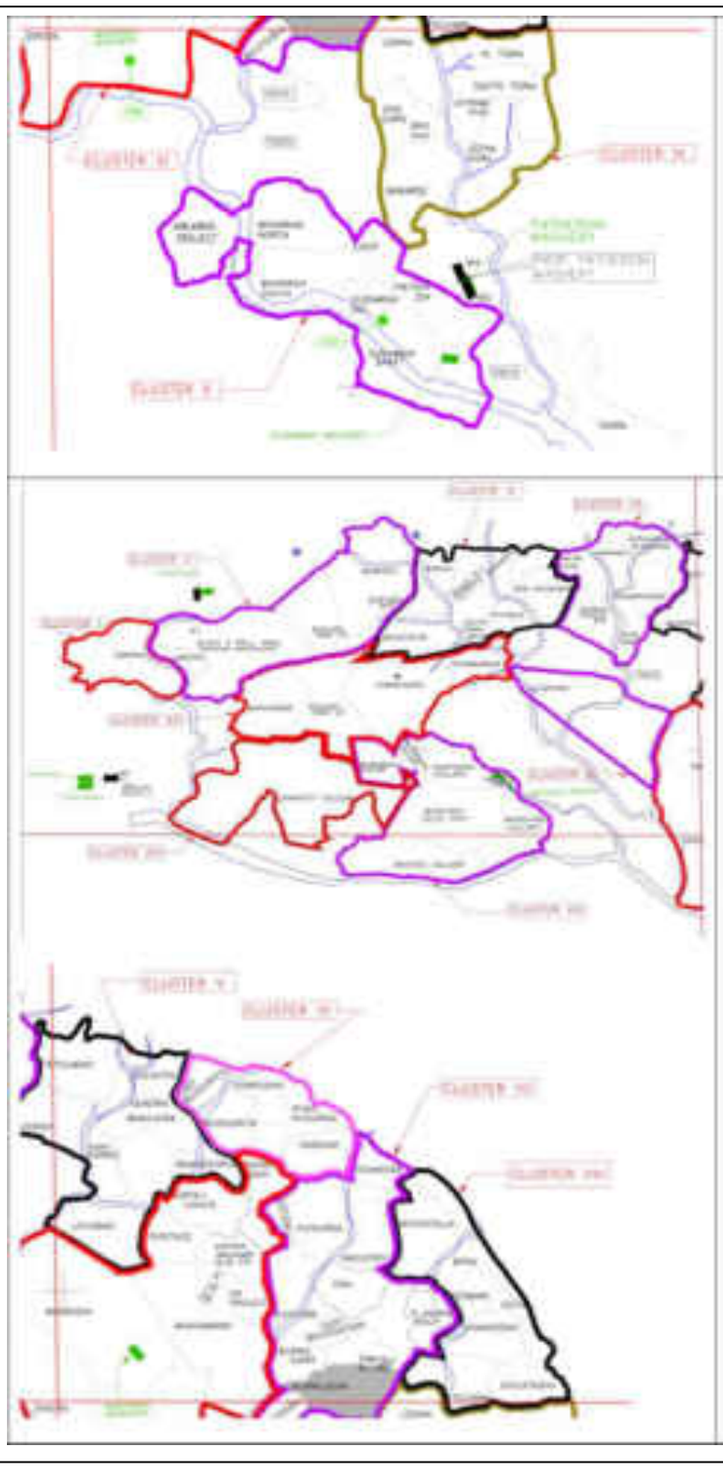
## Chapter 3 Air Quality Monitoring and Receptor modelling

BCCL environmental department provided the map of the Jharia region. The site visit was carried out with assistance from BCCL‟s team. The 15 Jharia mines coal fields were segregated into three parts. The details of the visit and mine cluster names are given in Table 3.3.1. The Entire Jharia Coal Field (JCF) is divided into 16 clusters. Both open cast and underground mines are operational in JCF. Standard mining operations like drilling, blasting, hauling, accumulation, and transfer are the major sources of emissions and air pollution. Apart from that, a typical emission source, mine fire, is prevailing at JCF. Besides, JCF encompasses large non-mining regions with their emission sources like vehicular emission in congested traffics, road dust, Power Plant emission, other industrial emissions (coke oven plants, brick kilns, stone crushers, etc.), crematoria, domestic burning, open burning, etc.

Table 3.3.1: The details of mine cluster in Jharia Coalfield



| | |
|---|---|
| | Day 1: Cluster I, II, III, IV, XII, XIII, XV and XIV |
| | Day 2: Cluster V, VI, VII, and VIII |
| | Day 3: Cluster IX, X and XI |

Based on preliminary field visit by NEERI Scientists along with BCCL staffs, the following locations (Figure 3.1) were selected for the establishment of Air Quality Monitoring Stations for source apportionment study;

- **Core Zone**

1. Cluster XIV Lohapatty– nearby sources: Chandrapura Thermal Power Plant
2. Cluster VII Mine rescue station- nearby sources: Coal Mine, Industry
3. Cluster V- Katras
4. Cluster IX Lodhna
5. Cluster XI Moonidih nearby sources: Coal Mine
6. Cluster X Patherdih: nearby sources: Coal Mine, Steel Industry
7. Cluster VIII Bastacola nearby sources: Coal Mine

- **Buffer Zone**

8. Bank More
9. Harina
10. Bhuli
11. Sindri
12. Parbatpur Electro steel/ Bhaga
13. Background

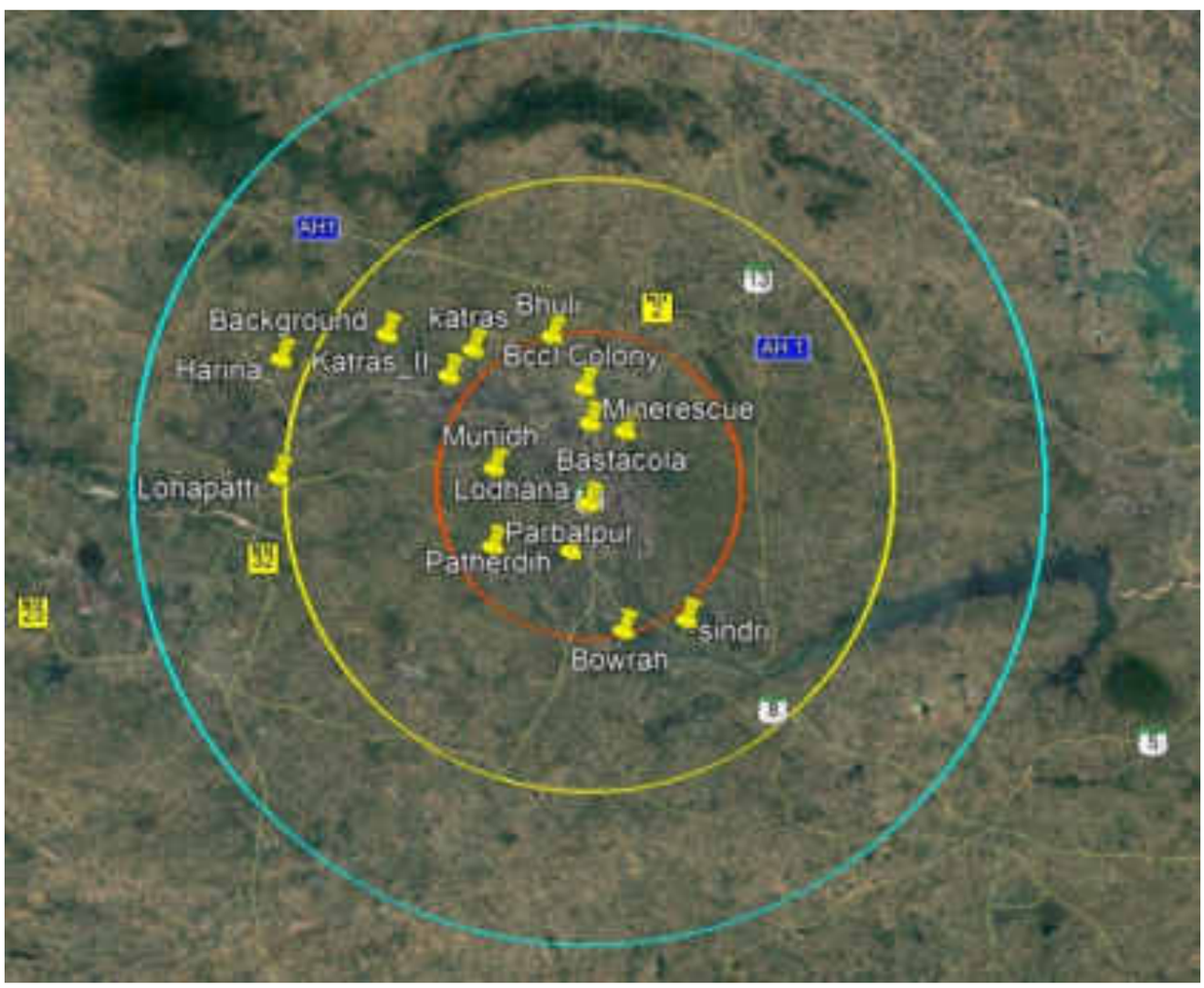



Figure 3.1: Air monitoring sites under 30 km buffer area

### 3.1. Sampling Method and Schedule

The $PM_{10}$ and $PM_{2.5}$ sampling for Jharia Coalfields was done at all the 13 sampling sites for the period of 24 h using low volume respirable suspended particulate matter samplers (Instrumax, ARA and Envirotech) on Quartz and polytetrafluoroethylene (PTFE) filter paper of 47 mm diameter. Samplers at a flow rate of 16.67 LPM were used. The filter papers were desiccated before and after sampling for 24h at a temperature of 27 ± 3°C and at a relative humidity (RH) of 55 ± 2% to remove the moisture present in them. The $PM_{10}$ and $PM_{2.5}$ field samples were collected periodically throughout the sampling period. The sampling frequency and types of equipment used for monitoring are described in Table 3.3.2 and 3.3.3. The national Ambient quality and Standards for Coal Mines (Stipulated by Ministry of Environment and Forests are depicted in Table 3.3.4. and Table 3.3.5.

Table 3.3.2: Frequency of Air pollutants sampling in Jharia Coalfields

| Parameter | Number of Days | Change of Filter/ absorbing media | Reporting |
|---|---|---|---|
| $PM_{10}$ | 10 | 24 hourly,<br>Teflon: 5 Days<br>Quartz: 5 Days | 24 hourly |
| $PM_{2.5}$ | 10 | 24 hourly<br>Teflon: 5 Days<br>Quartz: 5 Days | 24 hourly |
| $NO_2$ | 10 | 8 hourly | 8 hourly |
| $SO_2$ | 10 | 8 hourly | 8 hourly |

Table 3.3.3: Ambient Air Quality Sampling/Analysis Methodology for Target Pollutants

| Particulars | Parameters | | | |
|---|---|---|---|---|
| | **$PM_{10}$** | **$PM_{2.5}$** | **$NO_2$** | **$SO_2$** |
| **Sampling Instrument** | INSTUMEX and ARA-N-FRM Sampler | INSTUMEX and ARA-N-FRM Sampler | APM sampler | APM sampler |
| **Sampling Principle** | Cyclonic Flow Technique | Cyclonic Flow Technique | Chemical absorption in suitable media | Chemical absorption in suitable media |
| **Flow rate** | 16.7 LPM | 16.7 LPM | 0.5 LPM | 0.5 LPM |
| **Sampling Period** | 24 hourly | 24 hourly | 8 hourly | 8 hourly |
| **Sampling Frequency** | 7 days continuous, Teflon and quartz on alternate days | 7 days continuous, Teflon and quartz on alternate days | 7 days continuous | 7 days continuous |
| **Analytical Instrument** | Electronic Micro Balance | Electronic Micro Balance | Spectrophotometer | Spectrophotometer |
| **Analytical Method** | Gravimetric | Gravimetric | Modified Jacob and Hochheiser method | Colorimetric Improved West & Gaeke Method |
| **Minimum reportable value** | 5µg/$m^3$ | 5µg/$m^3$ | 9µg/$m^3$ | 4µg/$m^3$ |

Table 3.3.4: National Ambient Air Quality Standards (2009)

| Sr. No. | Pollutant | Time Weighted Average | Concentration in ambient Air (in µg/m$^3$) Industrial, Residential Rural & Other Areas | Concentration in ambient Air (in µg/m3) Ecologically Sensitive Area | Concentration In ambient Air (in µg/m$^3$) Methods of Measurement |
|---|---|---|---|---|---|
| 1 | Sulphur Dioxide ($SO_2$) | Annual* | 50 | 20 | Improved West & Geake, Ultraviolet fluorescence |
| | | 24Hours** | 80 | 80 | |
| 2 | Nitrogen Dioxide ($NO_2$) | Annual* | 40 | 30 | Modified Jacob & Hochheiser (Na-Arsenite) Chemiluminescence |
| | | 24Hours** | 80 | 80 | |
| 3 | Particulate matter (Size less than 10µm) or $PM_{10}$ | Annual* | 60 | 60 | Gravimetric, TOEM, Beta attenuation |
| | | 24Hours** | 100 | 100 | |
| 4 | Particulate matter (Size less than 2.5µm) or $PM_{2.5}$ | Annual* | 40 | 40 | Gravimetric, TOEM, Beta attenuation |
| | | 24Hours** | 60 | 60 | |
| 5 | Ozone ($O_3$) | 8 Hours* | 100 | 100 | UV photometric, Chemiluminescence chemical method |
| | | 1 Hour | 180 | 180 | |
| 6 | Lead (Pb) | Annual* | 0.5 | 0.5 | ASS / ISP method after sampling on EPM 2000 or equivalent filter paper ED-XRF using Teflon filter |
| | | 24Hours** | 1 | 1 | |
| 7 | Carbon Monoxide (CO) | Annual* | 0.2 | 0.2 | Non-dispersive Infra-Red (NDIR) Spectroscopy |
| | | 24Hours** | 0.4 | 0.4 | |
| 8 | Ammonia ($NH_3$) | Annual* | 100 | 100 | Chemiluminescence, Indo-phenol‟s blue method |
| | | 24Hours** | 400 | 400 | |
| 9 | Benzene ($C_6H_6$) | Annual* | 0.5 | 0.5 | Gas Chromatography based continuous analyzer. Adsorption and description followed by GC analysis |
| 10 | Benzo (a) Pyene (BaP)-particulate phase only | Annual* | 0.1 | 0.1 | Solvent extraction followed by HPLC / GC analysis |
| 11 | Arsenic (As) | Annual* | 0.6 | 0.6 | AAS/ ICP method after sampling on EPM 2000 or equivalent filter paper |
| 12 | Nickel (Ni) | Annual* | 20 | 20 | |

Table 3.3.5 Standards for Coal Mines (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)

| Pollutant | Time weighted Average | Concentration in Ambient Air | |
|---|---|---|---|
| | | New Coal Mines (commenced after 25.09.2000) | Existing Coal Mines (commenced prior to 25.09.2000) |
| **Suspended Particulates Matter (SPM)** | Annual Average<br>24 hours | 360µg/m3<br>500µg/m3 | 430µg/m3<br>600µg/m3 |
| **Respirable Particulate Matter (size less than 10 µm) (RPM)** | Annual Average<br>24 hours | 180µg/m3<br>250µg/m3 | 215µg/m3<br>300µg/m3 |
| **Sulphur Dioxide ($SO_2$)** | Annual Average<br>24 hours | 80µg/m3<br>120µg/m3 | 80µg/m3<br>120µg/m3 |
| **Oxides of Nitrogen as $NO_2$** | Annual Average<br>24 hours | 80µg/m3<br>120µg/m3 | 80µg/m3<br>120µg/m3 |

### 3.2. Chemical Analysis

#### 3.2.1. Gravimetric analysis

The exposed filters were analysed by gravimetric technique using a weighing balance for $PM_{10}$ particles and using a microbalance for $PM_{2.5}$ particles with a precision of 5µg with automatic (internal) calibration.

#### 3.2.2. Elemental analysis

$PM_{10}$ samples collected on glass fibre filters were digested in a microwave digester. The samples were made up to 50ml using deionized distilled water. Similarly, the exposed filters containing $PM_{2.5}$ particles were cut equally into 2 halves. A part of the exposed filter was used for ions analysis. Whereas, the other half was cut into tiny fragments and digested and made up to 15mL using distilled deionized water. The obtained samples (both $PM_{10}$ and $PM_{2.5}$) after digestion were stored in vials and refrigerated at 4°C until further analysis. These samples were later subjected to estimate the elemental composition using ICP-OES (Thermo Scientific, USA).

#### 3.2.3. Analysis of $SO_2$ and $NO_2$

$SO_2$ analysis: Modified West and Gaeke method was followed for sampling and analysis of Sulfur dioxide in ambient air. $SO_2$ from the air is absorbed in a solution of potassium tetracholo-mercute (TCM). A dichlorosulphitomercurate complex, which resists oxidation by the oxygen in the air was formed. Once formed, that complex was stable to strong oxidants such as ozone and oxides of nitrogen and therefore, the absorber solution may be stored for some time prior to analysis. The complex was made to react with pararosaniline and formaldehyde to form the intensely colored pararosanline methylsulphonic acid. The absorbance of the solution was measured by means of a suitable spectrophotometer.

$NO_2$ analysis: Modified Jacobs and Hochheiser method was followed for sampling and analysis of $NO_2$ in ambient air. Ambient $NO_2$ was collected by bubbling air through a solution of sodium hydroxide and sodium arsenite. The concentration of nitrite ion produced during sampling was determined calorimetrically by the nitrite ion reaction with phosphoric acid, sulphanilamide, and N-(1-napthyl)-ethlylenediamine di-hydrochloride (NEDA) and the absorbance of the highly colored azo dye was measured at 540nm.

### 3.2.4. Ion analysis

The filter papers containing both $PM_{10}$ and $PM_{2.5}$ samples were extracted and subjected to ion analysis as per standards. The filter papers were divided into tiny fragments and moistened with isopropanol slightly before extraction since the filters are hydrophobic. Further 25 mL of deionized distilled water was added and sonicated using an ultrasonic bath for 60 min at 60°C. The samples were then kept overnight after sonication. Furthermore, the samples were then filtered using nylon filter discs (25mm, 0.45mm) and were refrigerated at 4°C until further analysis. The extracted samples were subjected to IC to analyse the ions (anions and cations) present in them.

### 3.2.5. Polycyclic Aromatic Hydrocarbons (PAH) analysis

Filter papers were cut into pieces using scissors and transferred to a 100 ml beaker and 50 ml of Dichloromethane (DCM) (GC/HPLC grade) was added. The samples were extracted with DCM using an ultrasonic bath for about 30 minutes. The extracted samples were filtered with Whatman filter paper containing 2gm Anhydrous Sodium Sulphate. After filtration, the filtrate is concentrated using a rotary vacuum evaporator to 2ml final volume. Solid-phase extraction may be used to clean up the impurities of the sample and re-concentrated in a rotary evaporator. The samples were analyzed through GC with conditions as injector 300°C and FID temperature 320°C.

### 3.2.6. EC & OC analysis

This is a thermal/optical-transmittance (TOT) method that speciates carbon in particulate matter collected on a quartz-fiber filter into OC, EC, and CC. In the first (or non-oxidizing) heating stage, organic and carbonate carbon is thermally desorbed from the filter under a flow of helium with controlled temperature ramps. The oven is then partially cooled, and the original flow of helium is switched to an oxidizing carrier gas ($He/O_2$). In the second (or oxidizing) heating stage, the original elemental carbon component plus pyrolyzed organic carbon formed during the first heating stage are oxidized/desorbed from the filter with another series of controlled temperature ramps. All carbon evolved from the sample is converted to $CO_2$ in an oxidizing oven immediately downstream from the desorption oven, and the $CO_2$ is converted to methane ($CH_4$) by a methanator oven before being measured with a flame ionization detector (FID). (https://www3.epa.gov/ttnamti1/files/ambient/pm25/spec/RTIOCECSOP.pdf)

### 3.3. Results

#### 3.3.1. Mass concentration of $PM_{10}$ and $PM_{2.5}$

In summer monitoring, the mean mass concentrations of $PM_{10}$ particles in all 13 sampling sites were found to be in the range of 74-184µg/$m^3$ with the highest concentration of 184µg/$m^3$ at mine rescue site and lowest concentration of 74µg/$m^3$ at Bastacola site. Also, the mean mass concentration of $PM_{2.5}$ particles was found in the range of 49-117µg/$m^3$ with the highest concentration of 117µg/$m^3$ and the lowest concentration of 49µg/$m^3$ recorded at Harina and Lohapatti site respectively.

The average concentrations of $PM_{10}$ and $PM_{2.5}$ in two seasons are described in Table 3.6 and 3.7. Results revealed that the average concentrations of $PM_{10}$ are within the prescribed limits of MoEF notification guidelines for coal mine areas. In the case of $PM_{2.5}$, there is no Govt. notified standard for mining areas but in the case of buffer zones, National Ambient Air Quality Standard, NAAQS, 2009 may be applicable. The highest $PM_{10}$ and $PM_{2.5}$ concentrations were found in Mine rescue and Harina (Figure 3.2 and 3.3).

Table 3.6: Average concentration of $PM_{10}$ and $PM_{2.5}$ in Summer of Jharia Coalfield

| **Monitoring Sites** | | **Average Concentration (µg/$m^3$)-Summer** | |
|---|---|---|---|
| | **Site Description** | **$PM_{10}$ (µg/$m^3$)** | **$PM_{2.5}$ (µg/$m^3$)** |
| Lohapatti | Core Zone | 133.7 | 49.42 |
| | | (83-203) | (44-83) |
| Mines Rescue | Core Zone | 184.8 | 83.43 |
| | | (124-255) | (55-205) |
| Katras | Core Zone | 141.4 | 80.01 |
| | | (100-216) | (42-150) |
| Lodhna | Core Zone | 156.8 | 63.98 |
| | | (100-303) | (32-99) |
| Moonidih | Core Zone | 118.4 | 62.84 |
| | | (80-153) | (34-94) |
| Patherdih | Core Zone | 94.7 | 67.22 |
| | | (50-119) | (37-91) |
| Bastacola | Core Zone | 104.32 | 93.27 |
| | | (154 -316) | (64-158) |
| BCCL colony | Buffer Zone | 157.35 | 74.37 |
| | | (113-222) | (47-103) |
| Harina | Buffer Zone | 177.7 | 117.3 |
| | | (73-265) | (42-175) |
| Bhuli | Buffer Zone | 141.7 | 105.89 |
| | | (85-243) | (44-161) |
| Sindri | Buffer Zone | 122.2 | 76.05 |
| | | (82-139) | (18-127) |
| Parabatpur | Buffer Zone | 122.4 | 110.98 |
| | | (86-171) | (70-150) |
| Background | Buffer Zone | 144.4 | 57.13 |
| | | (24-255) | (23-97) |

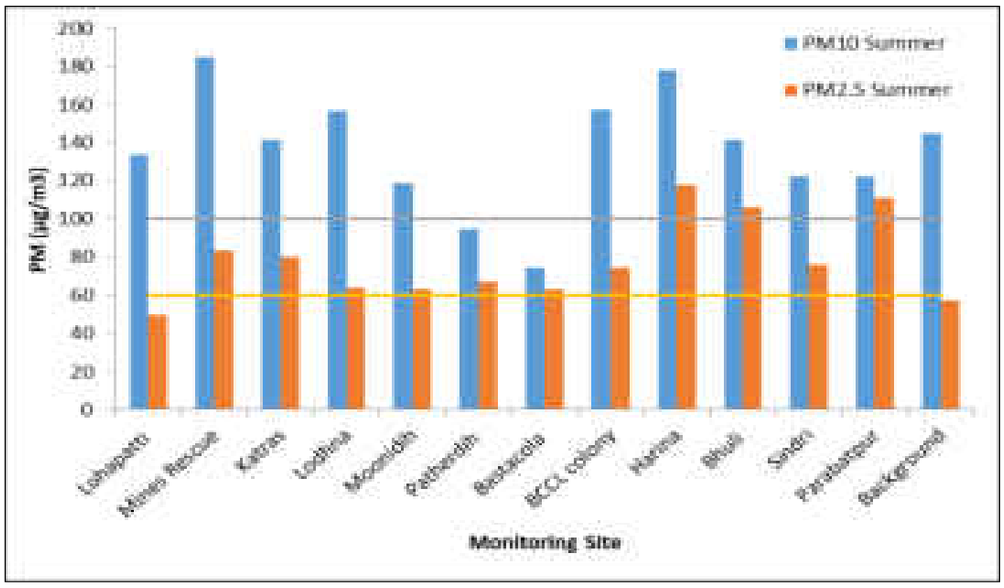



Figure 3.2: Average concentration of $PM_{10}$ and $PM_{2.5}$ in JCF region in summer compared to NAAQS (2009)

Table 3.7: Average concentration of $PM_{10}$ and $PM_{2.5}$ in winter of Jharia Coalfield.

| **Monitoring Sites** | **Site Description** | **Average Concentration (µg/m$^3$)-Winter** | |
|---|---|---|---|
| | | **$PM_{10}$ (µg/m$^3$)** | **$PM_{2.5}$ (µg/m$^3$)** |
| Lohapatti | Core Zone | 174.28 | 139.59 |
| | | (122-241) | (114-236) |
| Mines Rescue | Core Zone | 303.49 | 176.97 |
| | | (175-350) | (114-233) |
| Katras | Core Zone | 230.06 | 50.87 |
| | | (134-332) | (24-78) |
| Lodhna | Core Zone | 322.8 | 112.17 |
| | | (243-412) | (98-209) |
| Moonidih | Core Zone | 300.16 | 188.27 |
| | | (128-728) | (64-600) |
| Patherdih | Core Zone | 222.71 | 113.23 |
| | | (182-246) | (111-167) |
| Bastacola | Core Zone | 332.05 | 176.48 |
| | | (251-663) | (54-425) |
| BCCL colony | Buffer Zone | 219.98 | 128.79 |
| | | (155-300) | (94-175) |
| Harina | Buffer Zone | 130.73 | 42.93 |
| | | (65-215) | (44-98) |
| Bhuli | Buffer Zone | 174.75 | 151.66 |
| | | (150-200) | (89-180) |
| Sindri | Buffer Zone | 171.82 | 167.07 |
| | | (81-210) | (142-184) |
| Parabatpur | Buffer Zone | 228.76 | 148.16 |
| | | (75-660) | (101-192) |
| Background | Buffer Zone | 233 | 121.18 |
| | | (195-254) | (63-170) |
| Katras II | | 107.13 | 98.42 |
| | Core Zone | (128-181) | (94-104) |

Whereas in winter monitoring, the highest $PM_{10}$ mass concentration was found to be 332µg/m$^3$ at Bastacola site (exceeding the prescribed limit of **GSR 742(E)**) along with other core mining zones like Mines Rescue, Moonidih. The lowest average concentration of $PM_{10}$ was found in Katras II (Table 3.7).

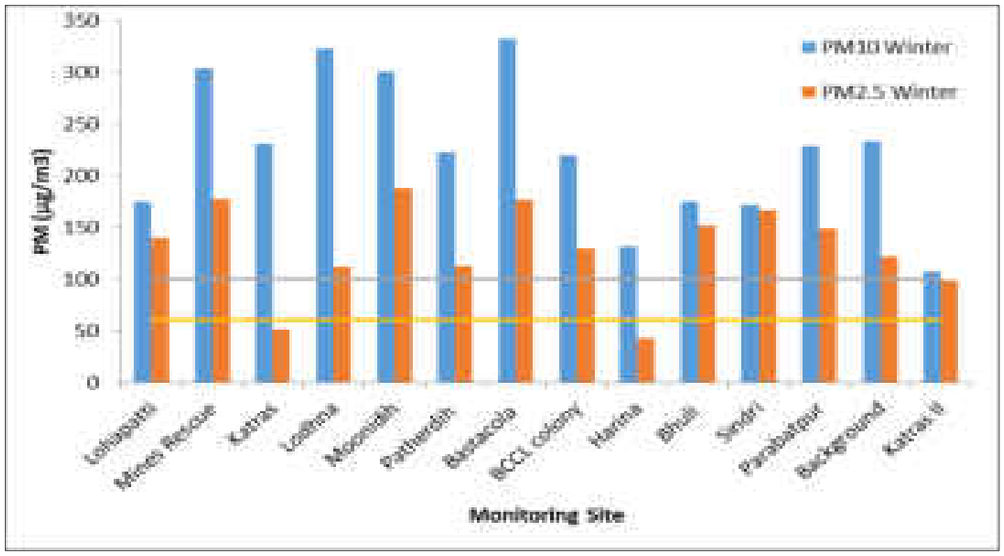



Figure 3.3: Average concentration of $PM_{10}$ and $PM_{2.5}$ in JCF region during Winter compared to NAAQS (2009)

### 3.3.2. Elemental concentration of $PM_{10}$ and $PM_{2.5}$ in summer

The digested samples of $PM_{10}$ and $PM_{2.5}$ particles from all the 13 sampling sites were subjected to estimate the elemental composition using ICP-OES. The analysis of $PM_{10}$ particles yields 11 different elements such as Al, As, Cd, Co, Cu, M, Ni, Pb, Zn, Fe and Cr. Similarly, the samples containing $PM_{2.5}$ particles revealed the same elements as $PM_{10}$. It was observed that Al and Fe were found to be higher for both $PM_{10}$ and $PM_{2.5}$ particles. Al is the most abundant element. The concentration of Al was detected in the range of 6.32-14.62µg/m$^3$. Maximum Al concentrations were found at BCCL colony, Parbatpur, Harina and Background. The concentrations of Fe and Cr were estimated as 0.78-7.74µg/m3 and 0.075-1.32µg/m3 respectively. The highest concentrations of both Fe (7.74µg/m3) & Cr (1.32µg/m3) were found at the Bastacola site Figure **3.4.** Similarly, in the case of PM2.5 particles the concentrations of Al (4.87-14.47µg/m3), Fe (0.44-11.77µg/m3) and Cr (0.066-2.17µg/m3) were found higher than other elements. For PM2.5 particles, maximum concentrations of Fe (11.77µg/m3) and Cr (2.17µg/m3) were obtained at the Mine Rescue site and Al (14.47µg/m3) at Katras. Since, the elements such as Al, Fe and Cr possess higher concentrations in the PM10 elemental composition, Al would have been emitted from road dust, whereas Fe would have been emitted from the re-suspension of dust containing deposits from the emissions of vehicular and other anthropogenic activities Figure 3.5.

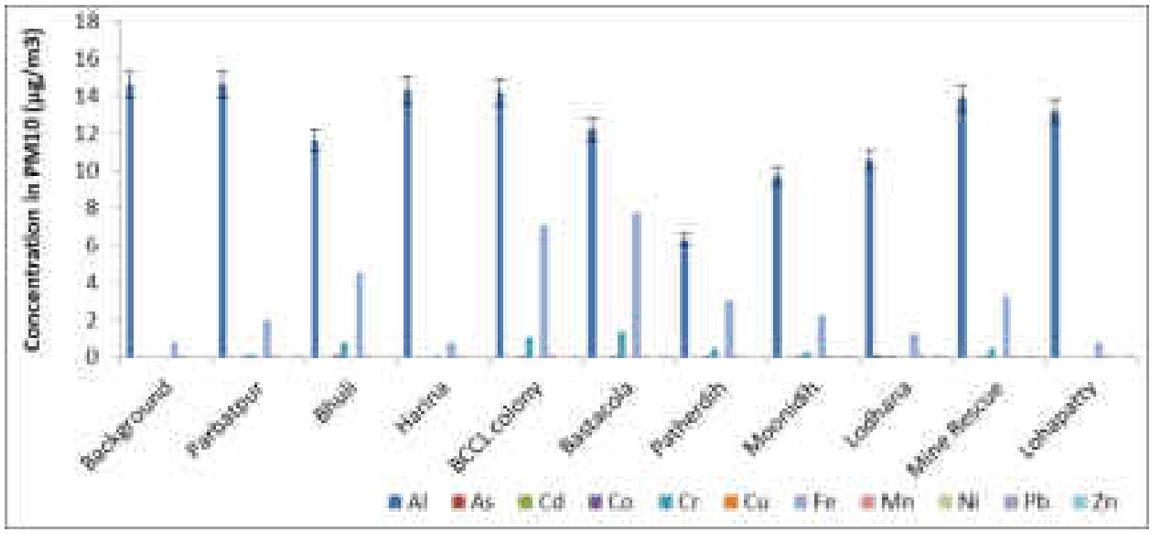



Figure 3.4: Metal concentration of $PM_{10}$ in the summer season

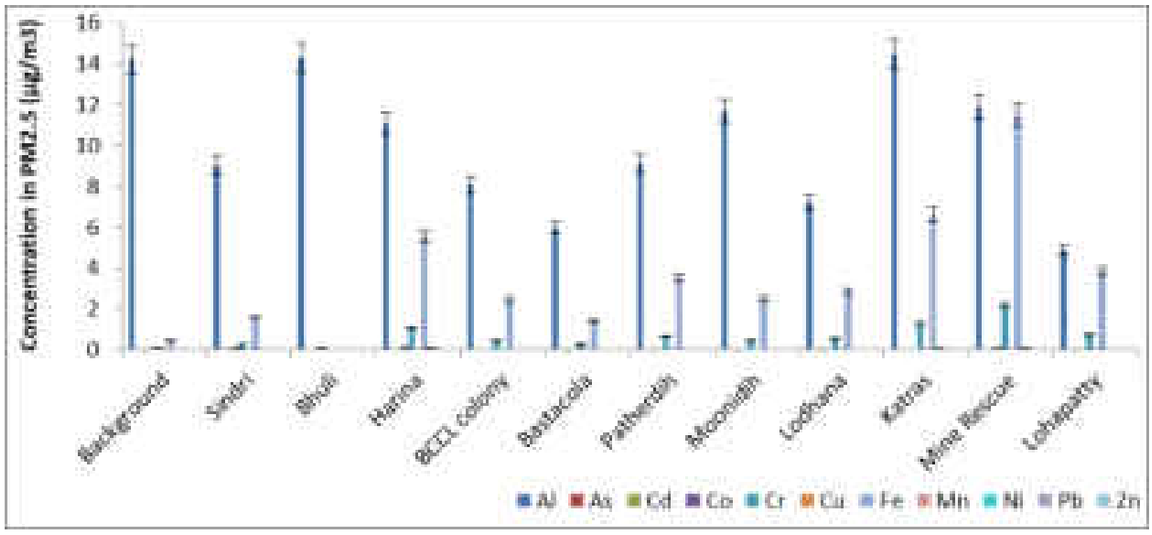



Figure 3.5: Metal concentration of $PM_{2.5}$ in the summer season

### 3.3.3. Elemental Concentration of $PM_{10}$ and $PM_{2.5}$ in Winter

The elemental analysis was performed using inductively coupled plasma optical emission spectroscopy (ICP-OES). For the air quality assessment, the concentrations of 11 elements i.e. Al, As, Cd, Cr, Cu, Fe, K, Mn, Ni, Pb, and Zn in $PM_{10}$ and $PM_{2.5}$ samples, were measured. Among all the elements, Al, Fe, and K concentrations were found considerably higher for $PM_{10}$ samples in the winter season. Al was observed in the range of 2.02-10.77µg/m3 followed by Fe (0.79-9.26µg/m3) and K (0.90-4.19µg/m3). Maximum Al concentration (10.77µg/$m^3$) was observed at the BCCL colony, followed by Lodhna (10.29µg/$m^3$). The Highest Fe concentration (9.26µg/$m^3$) was observed at Bastacola while K (4.19µg/$m^3$) at the Lodhna site. This may be due to vehicular emissions, paved roads, construction dust, coal combustion, soil dust, etc. The concentration of As, Ni, Pb was found within the limits of CPCB standards. The remaining elements i.e. Cd, Cr, Cu, Mn, and Zn were found very low (Figure 3.6).

Similarly, in the case of $PM_{2.5}$ samples concentrations of Al, Fe and K were detected higher than other elements. The concentration of Al, Fe, and K was obtained as 0.11-2.91µg/$m^3$, 0.05-1.93µg/$m^3$ and 0.08-2.12µg/$m^3$. For $PM_{2.5}$ particles, maximum Al and K were found at the Munidih site, which were 2.91µg/$m^3$ and 2.12µg/$m^3$ respectively. The highest concentration of

Fe i.e. 1.93µg/m$^3$ was detected at Lodhna site. The concentrations of all other analysed elements were low (Figure 3.7).

From the elemental analysis of the summer and winter seasons, it was observed that the average Al concentration obtained was more in the summer season than in the winter season. In contrast, the average concentration of Cr was more in the winter season.

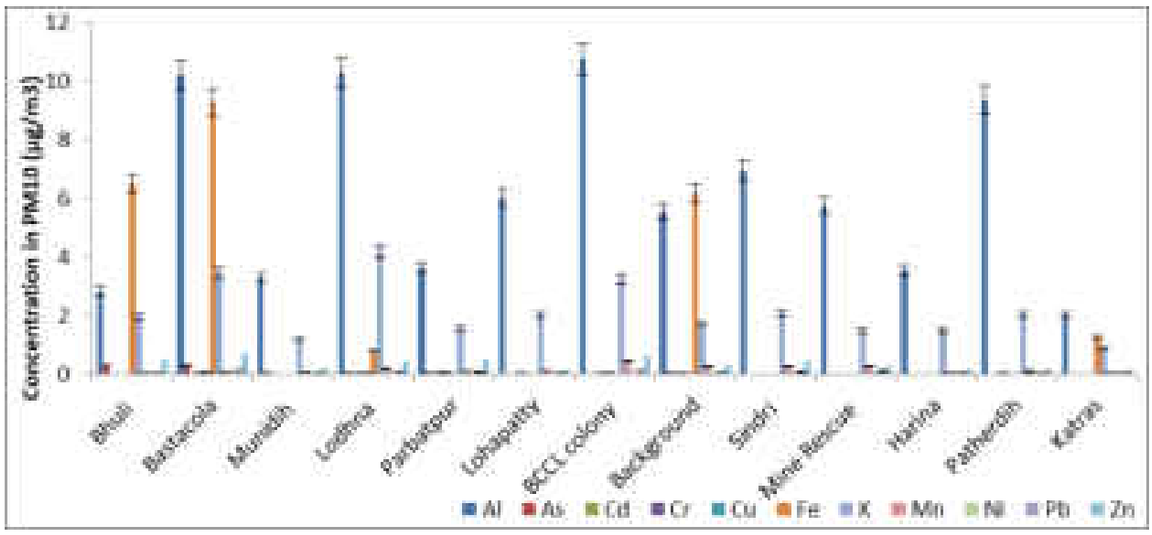



Figure 3.6: Metal concentration of $PM_{10}$ in winter season

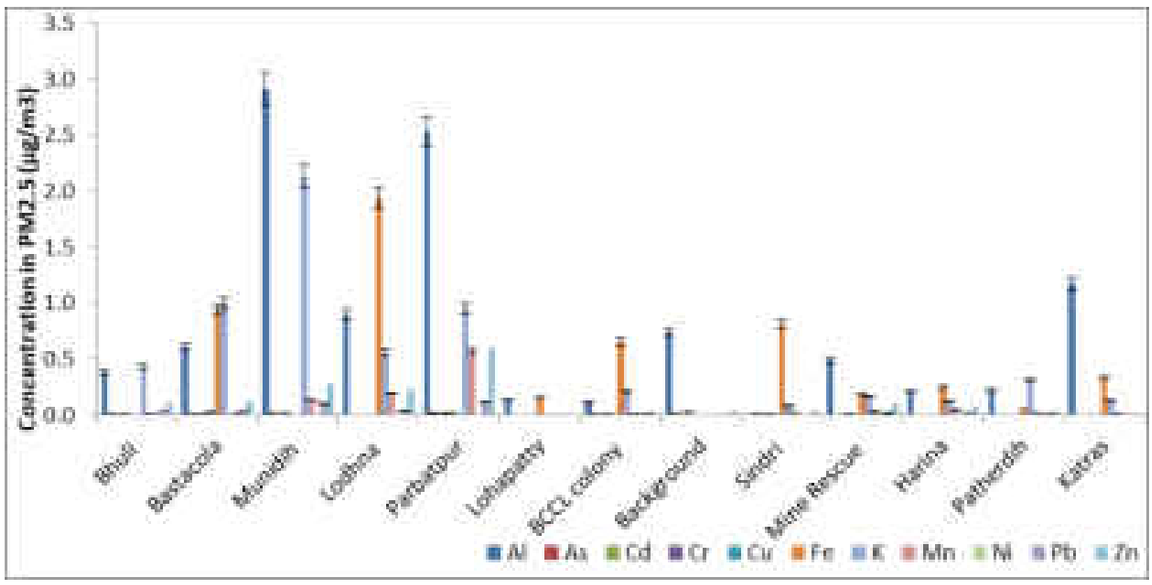



Figure 3.7: Metal concentration of PM 2.5 in winter season

### 3.3.4. $SO_2$ and $NO_2$ concentration in ambient air in the Summer season

The mean average $SO_2$ concentration in the summer season among all the monitoring stations ranged between 11µg/m$^3$ (Harina & Bastacola) and 24.5µg/m$^3$ (Moonidih), being well below the threshold limits of 80µg/m$^3$ (residential or industrial). The 8-hour average $NO_2$ concentrations were between 10.3µg/m$^3$ (Background) and 40.9µg/m$^3$ (Lodhana), well within the standard limits of 80µg/m$^3$ (residential or industrial) Figure 3.8. The $SO_2$ in the residential areas may be received from the open burning of raw coal and other domestic and commercial activities.

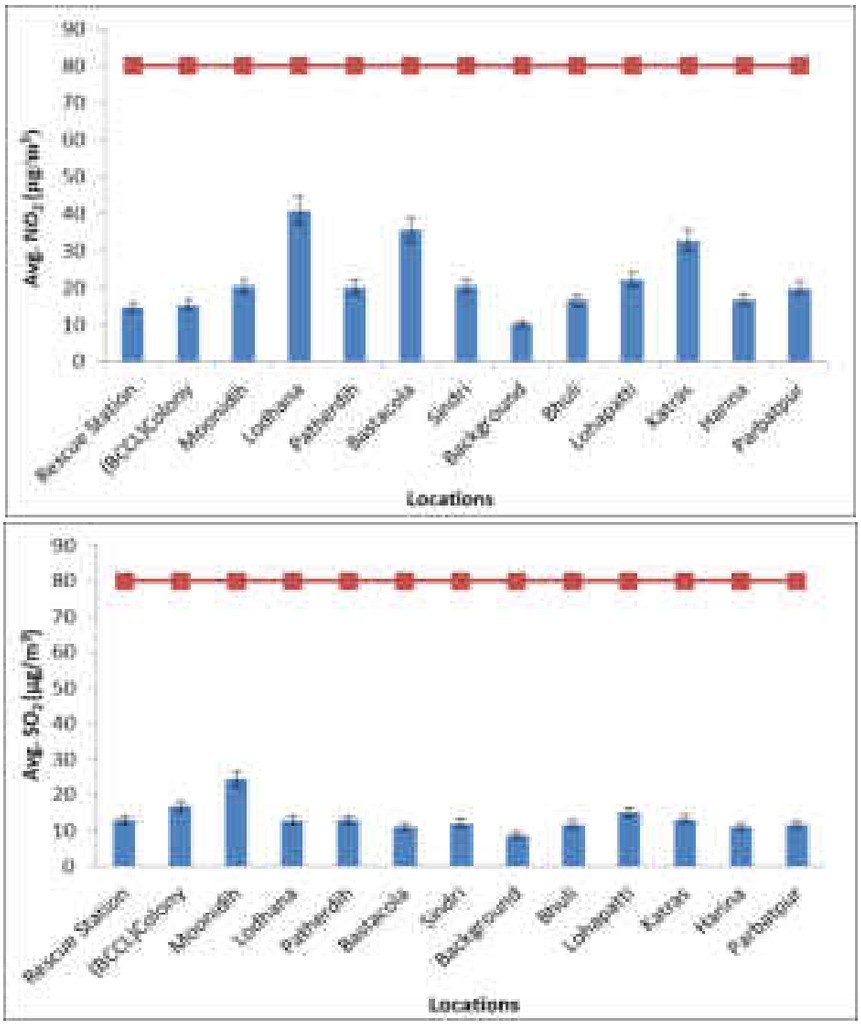



Figure 3.8: $NO_2$ and $SO_2$ Concentration of all monitoring sites in summer season

### 3.3.5. $SO_2$ and $NO_2$ concentration in ambient air in Winter season

The mean concentration of $NO_2$ and $SO_2$ in the winter season was found below the threshold limit i.e. 80µg/m$^3$. The concentration of $SO_2$ was below 10µg/m$^3$ in Katra, BCCL colony, Mine Rescue, Bastacola, Lodhana and Munidih. Bastacola and Bhuli site has a $NO_2$ concentration above 10µg/m$^3$ (Figure 3.9). It has been observed that the concentration of $NO_2$ and $SO_2$ in the winter and summer seasons were below the standard limit. But the average concentration of $NO_2$ and $SO_2$ in the summer season was higher than in the winter season.

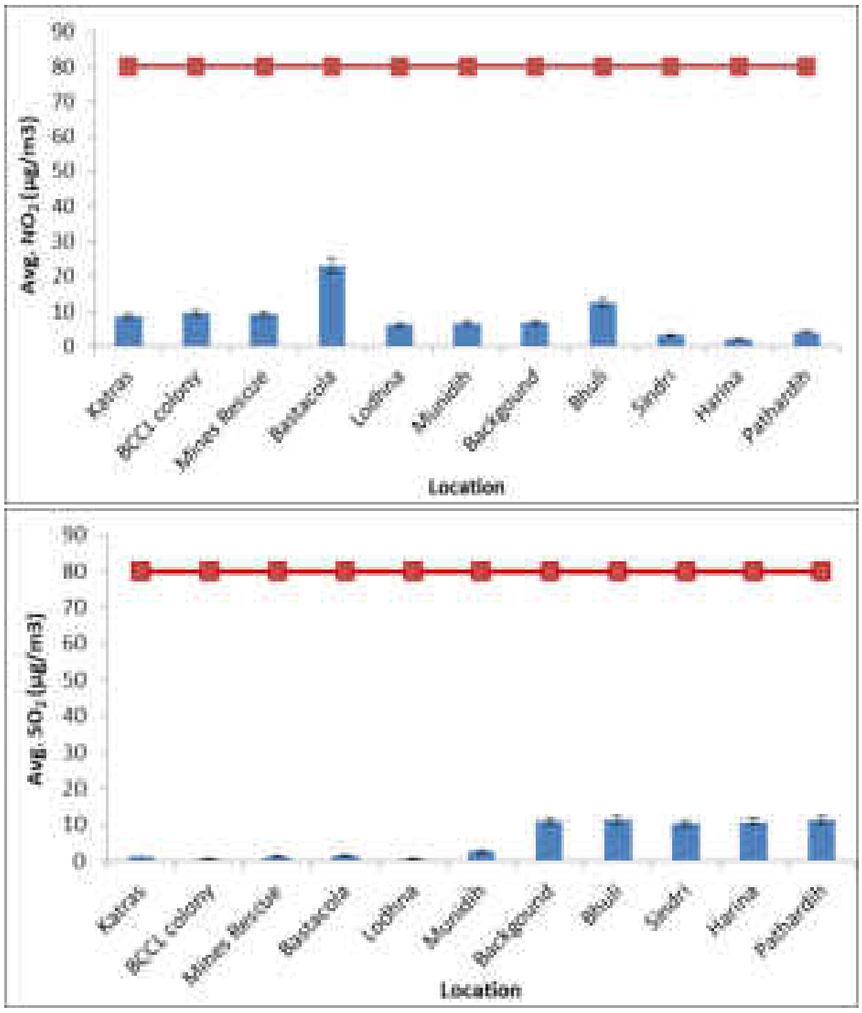



Figure 3.9: $NO_2$ and $SO_2$ Concentration of all monitoring sites in Winter season

### 3.3.6. Carbonaceous Aerosol/EC & OC in Summer

Data were obtained for four OC fractions (OC1, OC2, OC3 and OC4 in He atmosphere at 140, 280, 480 and 580°C, respectively) and three EC fractions (EC1, EC2, and EC3 in a 2% O2/98% He atmosphere at 580, 740 and 840°C, respectively). The IMPROV protocol defines OC as OC1 + OC2 + OC3 + OC4 and EC as EC1 + EC2 + EC3. The mass concentration of organic matter (OM) in the atmosphere was estimated by multiplying OC by 1.6 (conversion factor for urban aerosol). The total carbonaceous aerosol (TCA) was calculated as the sum of OM and EC. The highest concentration of OC and EC in $PM_{2.5}$ was found in the BCCL colony site i.e. 37.85 and 42.33µg/$m^3$, respectively, and the lowest OC concentration was 15.36µg/$m^3$ and EC was 13.08µg/$m^3$ in Sindri site. In comparison, the concentration of OC (67.35µg/m3) and EC (81.67µg/$m^3$) in $PM_{10}$ were higher in the BCCL colony among all the sites. The lowest OC concentration as 17.95µg/$m^3$ was in Bastacola and EC in Parbatpur i.e. 15.44µg/$m^3$ (Figure 3.10).

### 3.3.7. Carbonaceous Aerosol/EC & OC in winter

The mass concentration of EC and OC in $PM_{10}$ and $PM_{2.5}$ are more significant than 100µg/$m^3$ and 70µg/$m^3$, respectively in Bastacola, Katras, Mine Rescue, Background, and Sindri. The highest concentration of EC in $PM_{10}$ and $PM_{2.5}$ was observed in the Sindri site, whereas OC was found higher in Sindri and Bastacola. OC contributing to $PM_{10}$ mass concentration was lowest in

Harina followed by Lohapatti and Patherdih. In the case of $PM_{2.5,}$ Parbatpur was found to have the lowest concentration among other sites.

The higher mean concentration of EC and OC in winter were likely related to the influence of emissions from residential heating (in addition to traffic source) and, on the other hand, to the unfavourable meteorological conditions leading to more excellent dispersion of pollutants in the atmosphere during this season. Elemental carbon is emitted directly into the atmosphere during incomplete combustion emissions, such as motor vehicle exhaust, fuel burning, and biomass burning (Figure 3.11).

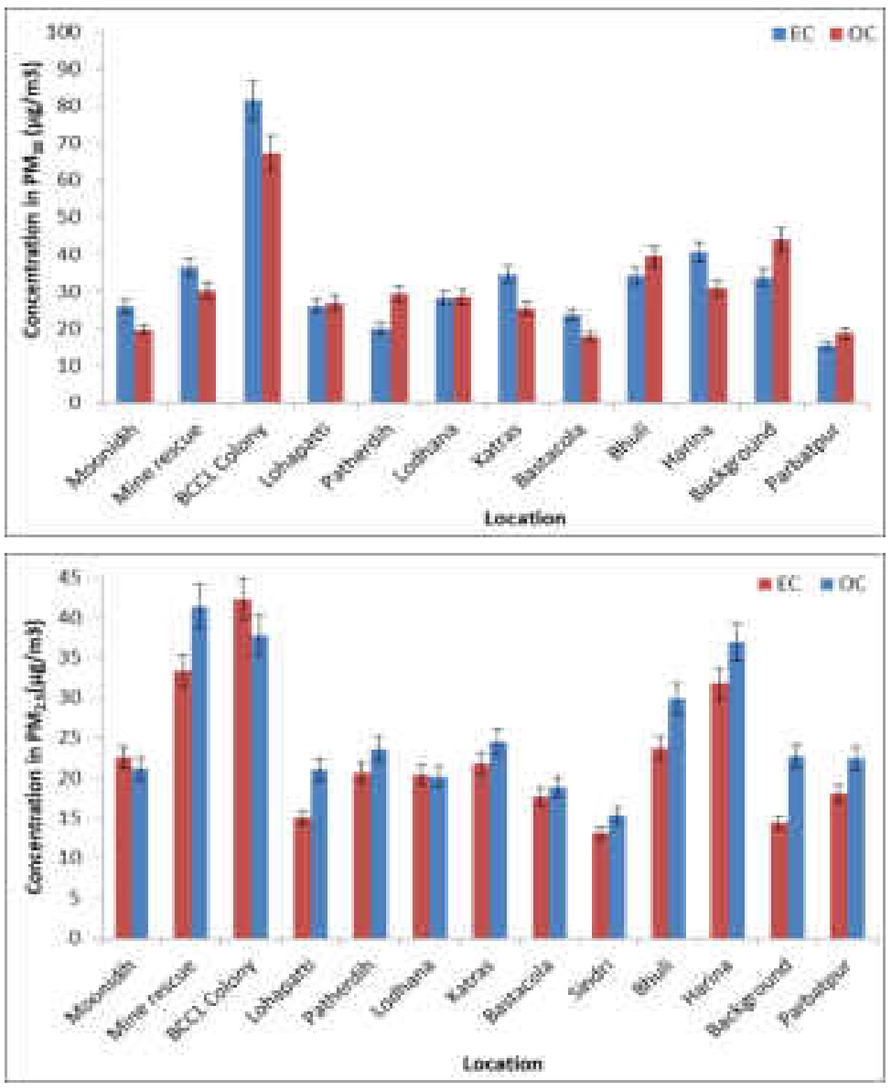



Figure 3.10: EC & OC concentration in $PM_{10}$ and $PM_{2.5}$ in Summer season

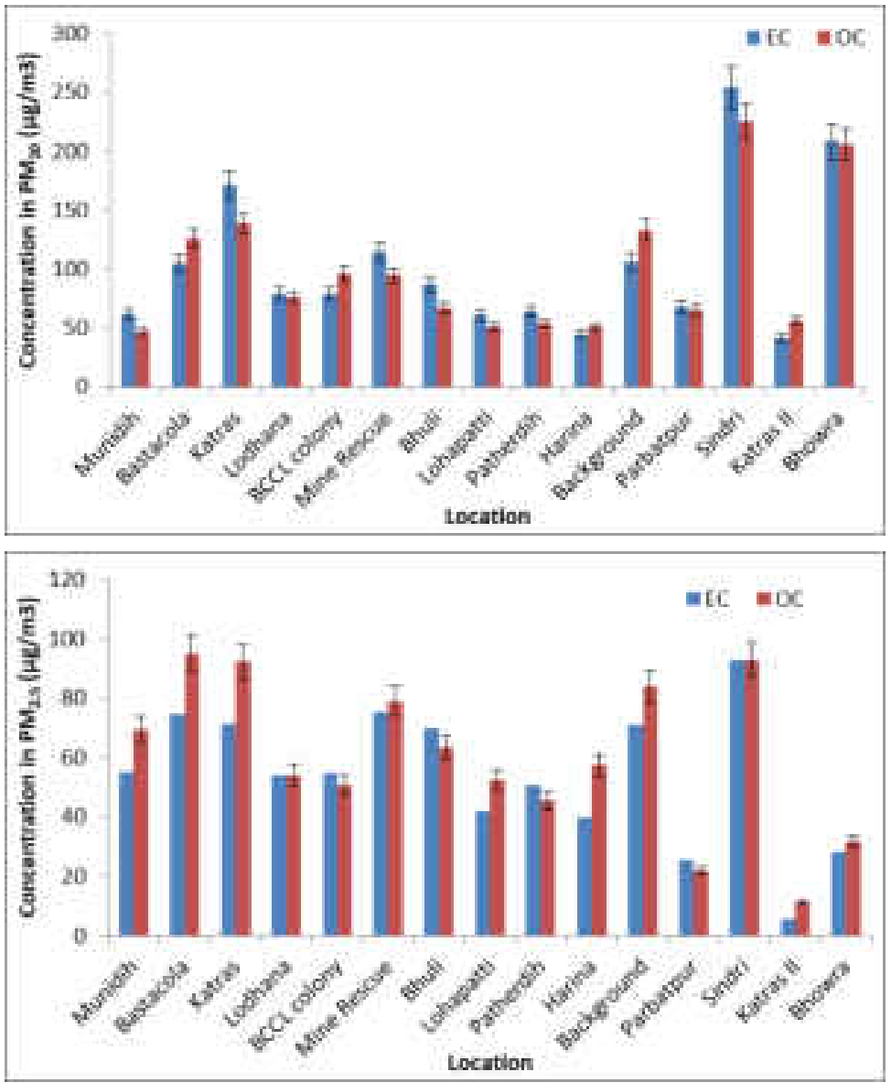



Figure 3.11: EC & OC concentration in $PM_{10}$ and $PM_{2.5}$ in Winter Season

### 3.3.8. Ionic composition of $PM_{10}$ and $PM_{2.5}$ in Summer season

The anions ($SO_4^{2-}$, $NO_3^-$ and $Cl^-$) and cations ($NH_4^+$, $Na^+$, $Ca^{2+}$, $K^+$) are the water-soluble inorganic ions found in abundance. In summer, the mass concentration of $SO_4^{2-}$ in $PM_{10}$ was in the range of 1.06-20.17µg/m$^3$ where a higher concentration was observed in Harina, BCCL colony, and Lodhana sites. Likewise, $NO_3^-$ was in the range of 0.32-19.2µg/m$^3$ with the highest in the Harina site. $PO_4^{3-}$ and $Cl^-$ concentration was highest in Harina and < 2µg/m$^3$ in other locations. $NH_4^+$ was in the range of 0.75-16.24µg/m$^3$, Harina with the highest concentration, and Bastacola with the lowest concentration. $Na^+$ concentration (0.18-8.6µg/m$^3$) was highest in Harina followed by BCCL colony and less than 2µg/m$^3$ in remaining sites. $Ca^{2+}$ concentration (1.5-11.77µg/m$^3$) was highest in Lohapatti and BCCL colony while lowest in Katras. $K^+$ ion was also observed in the Harina site with a concentration of 5.85µg/m$^3$ (Figure 3.12).

The mass concentration of $SO_4^{2-}$ in $PM_{2.5}$ was highest in Patherdih with a concentration of 15.13µg/m$^3$ and lowest in Bhuli. In Bastacola site, the concentration of $NO_3^-$ (2.85µg/m$^3$), $Cl^-$ (2.04µg/m$^3$), $K^+$ (1.84µg/m$^3$) were the highest among the other sites. $Ca^{2+}$ (6.17µg/m$^3$) and $Mg^{2+}$ (0.57µg/m$^3$) concentration was highest in Lohaptti site (Figure 3.13).

### 3.3.9. Ionic composition of $PM_{10}$ and $PM_{2.5}$ in Winter season

$PM_{10}$ ions concentration in Bastacola and Background were highest among all the monitoring

sites which followed the increasing order of $Na^+ < Mg^{2+} < F^+ < K^+ < Ca^{2+} < Cl^- < NH_4^+ < SO_4^{2-} < NO_3^-$. It has been observed that $SO_4^{2-}$, $NO_3^-$ and $NH_4^+$ ions were present in abundant in $PM_{10}$ mass concentration, and concentration of $NO_3^-$ in these sites contributes majorly to $PM_{10}$. Ions concentration in Katras, Lohapatti, and Bhuli sites were observed having lower ionic concentration Figure 3.14.

The ionic composition of $PM_{2.5}$ comprises mainly of $SO_4^{2-}$, $NO_3^-$, $Cl^-$, $NH_4^+$, $Ca_2^+$ and $K^+$ ions. Locations such as Bastacola and Parbatpur have higher concentration of ions compared to remaining sites in following order: $Mg^{2+} < Na^+ < Ca^{2+} < K^+ < Cl^- < NH_4^+ < SO_4^{2-} < NO_3^-$. The same trend has been observed i.e. $SO_4^{2-}$, $NO_3^-$ and $NH_4^+$ ions contribute mainly in $PM_{2.5}$ mass concentration. The average concentration of $SO_4^{2-}$ and $NO_3^-$ in winter was higher than in summer.

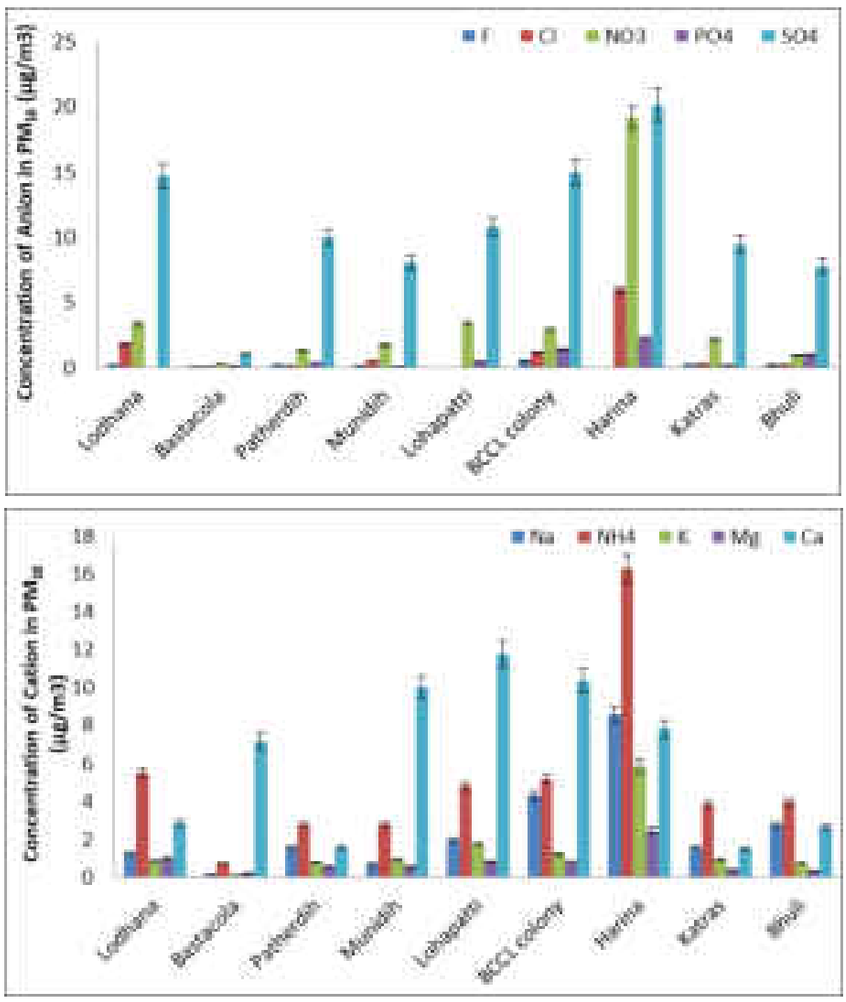



Figure 3.12: Anion and Cation concentration in $PM_{10}$ in summer

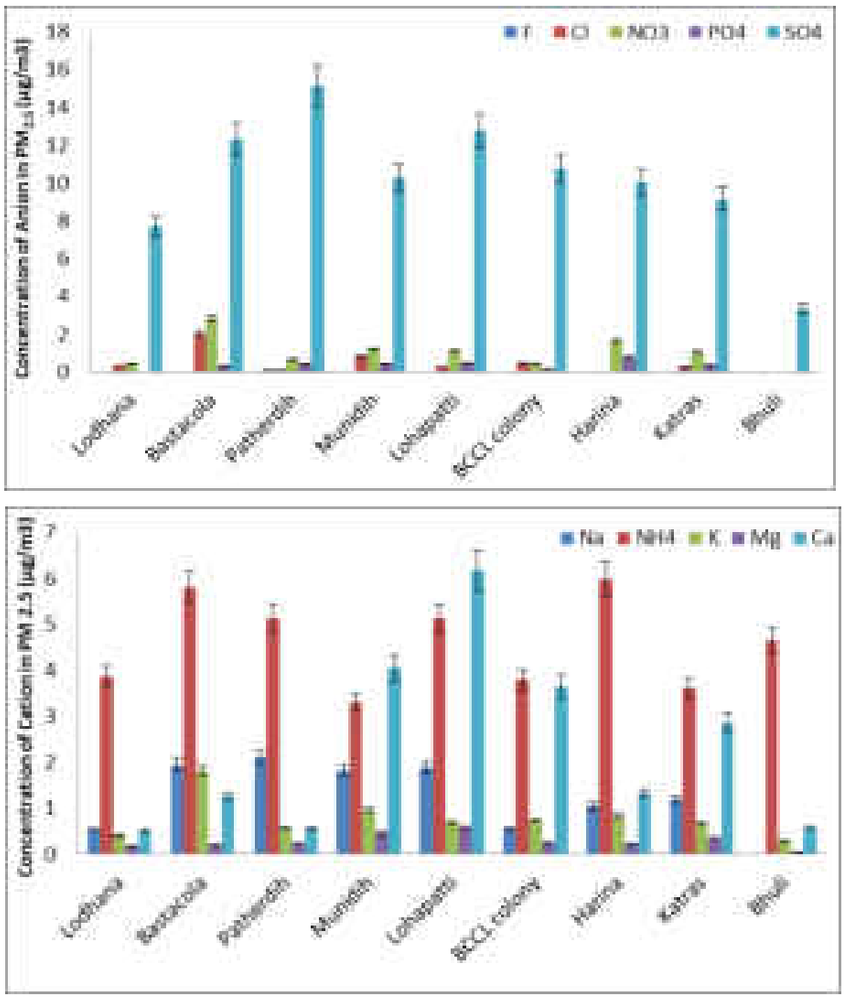



Figure 3.13: Anion and Cation concentration in $PM_{2.5}$ in summer

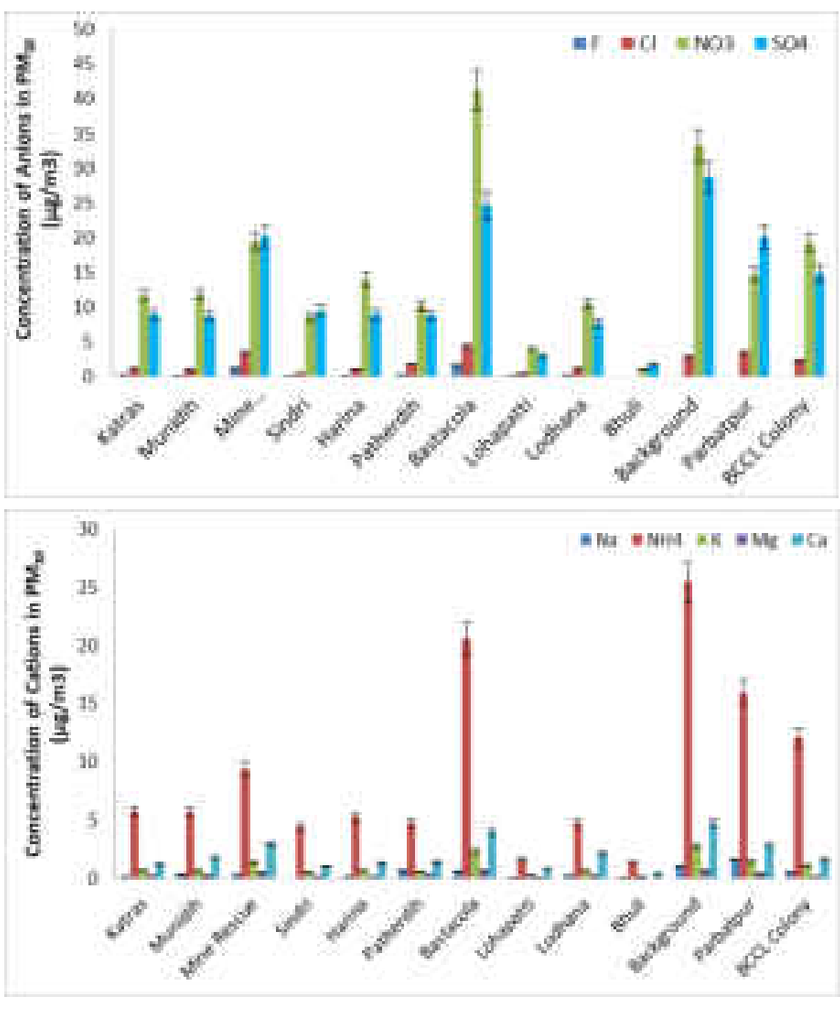



Figure 3.14: Anion and Cation concentration in $PM_{10}$ in winter

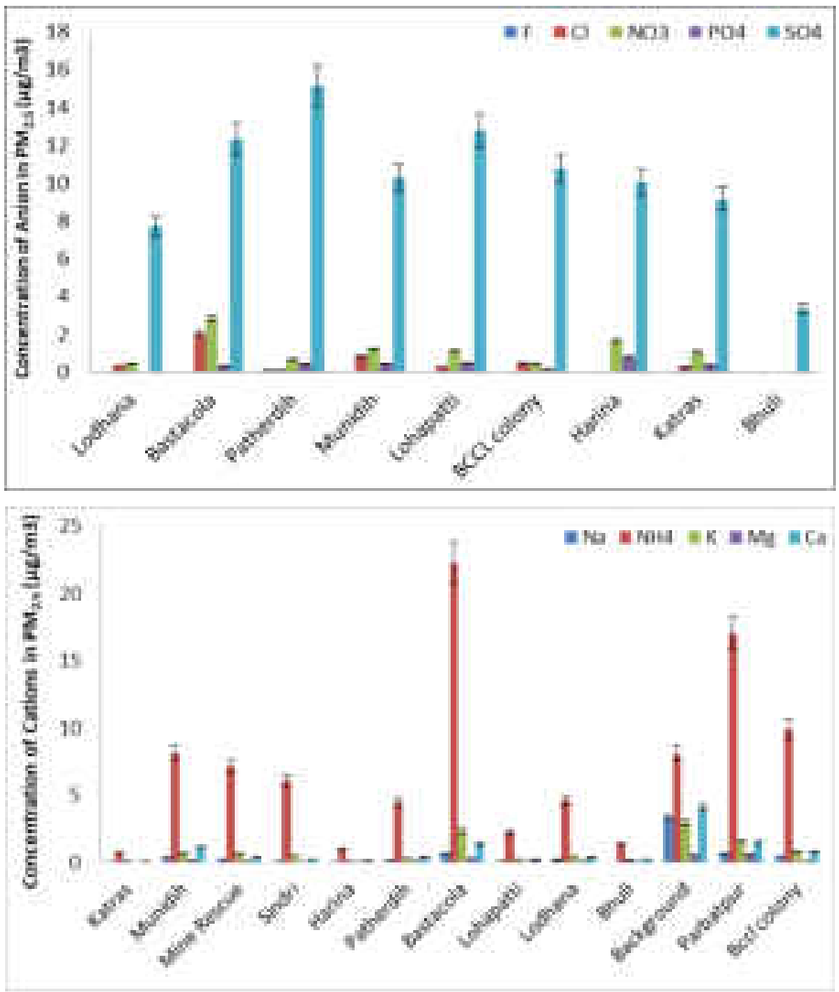



Figure 3.15: Anion and Cation concentration in $PM_{2.5}$ in winter

# Chapter 4 Receptor modelling

## 4.1. Source Apportionment

The source apportionment study was carried out to identify the potential sources contributing to the particulate matter of aerodynamic size less than 10 µm in the Jharia coalfield (JCF) using a receptor modelling approach. In receptor modelling, the particulate matter ($PM_{10}$) characterization in terms of metal, ions, elementary and organic carbon profiles is statistically matched with that of various source profiles in the study area. For the source apportionment study of JCF, the area is divided into various zones (buffer, core and background zone). And the ambient $PM_{10}$ characterization obtained from the multiple monitoring locations in the study area is conflated and compared with source profiles viz. industrial (mining and non-mining) and allied industrial activities, transportation, local vehicular movement and domestic fuel (coal wood burning, etc.). The chemical mass balance (CMB) model EPA-CMB v8.2 is one of the several receptor models and is most trusted for coarse and fine particulate matter source apportionment. The CMB model estimates source contributions by determining the best linear combination of emission source profiles and the chemical composition of ambient particulate, aerosol, and volatile organic compound samples. The study is studying the apportionment of particulate matter is considered owing to the nature of high particulate matter pollution in the study area. The source apportionment study is useful for devising an effective action plan for abatement of emission load in the region; thereby the region‟s overall air quality can be improved.

Jharia is one of the eight blocks in Dhanbad and is the main source of metallurgical coal in India, and is termed as the powerhouse of the country owing to its best quality coking coal, which is required by the steel and other industries in India. Dhanbad lies between 23°37‟3” N and 24°4‟ N latitude and between 86°6‟30” E and 86°50‟ E longitude with an average elevation of 222 m. Its geographical length, extending from North to South, is 43 miles and width 47 miles, stretching across East to West. It shares its boundaries with West–Bengal in the Eastern and Southern parts, Dumka and Giridih in the North, Bokaro in the west. It is the administrative headquarter of the district and Dhanbad Municipal Corporation (DMC).

The air quality status is determined by dividing the study area into background, core, and buffer zones. Thirteen sites were selected to represent various regions, including two references or background sites. The sampling locations are shown in Figure 3.1.

### 4.1.1. Chemical Mass Balance (CMB)

A mass balance equation can be written to account for all the chemical species in the samples as contributions from independent sources:

$$C_i = \sum_j m_j X_{ij} a_{ij} \qquad 4.1$$

$C_i$ is the concentration of species i measured at a receptor site (derived from the chemical analysis), $X_{ij}$ is the $i^{th}$ elemental concentration measured in the $j^{th}$ sample, and $m_j$ is the airborne mass concentration of material from the $j^{th}$ source contributing to the $j^{th}$ sample. The term $a_{ij}$ is

included as an adjustment for any gain or loss of species i between the source and receptor. The term is assumed to be unity for most of the chemical species.

The CMB 8.2 software (USEPA 1997) is used in this study. It is windows-based software that requires input data on ambient (at receptor locations) and source profiles of PM characterization. The model runs multiple iterations to provide optimum goodness of fit among the sources and receptors and verifies the model with various checks viz. Chi-square statistic, t-tests, mass percentage, and correlation coefficient. The following assumptions should be understood before proceeding with the CMB analysis.

The CMB model assumptions are:

- The concentration of emissions sources is constant throughout ambient and source sampling;
- Chemical species do not react with each other (i.e., they add linearly);
- All sources with potential for contributing to the receptor have been identified and have had their emissions characterized;
- The number of sources or source categories is less than or equal to the number of species;
- The source profiles are linearly independent of each other; and
- Measurement uncertainties are random, uncorrelated, and normally distributed.

The following steps are followed for running the CMB model:

- Identification of the contributing emission source types based on primary survey and emission inventory data collected around the monitoring sites.
- The selection of chemical species to be included in the CMB modelling calculation is based on the Central pollution control board (CPCB) guidelines.
- The source profiles with the fraction of each chemical species and uncertainty are withdrawn from the SPECIATE 5.1 database. SPECIATE 5.1 is US-EPA‟s repository of organic gas and particulate matter (PM) speciation profile of air pollution sources.
- Estimate ambient concentration (ambient data) is based on chemical analysis of the PM samples collected at the respective site during monitoring. The uncertainty of the chemical species is mainly based on the instrument uncertainty.
- The CMB 8.2 model run provides the solution of the chemical mass balance equation.

For source apportionment of $PM_{10}$, CMB 8.2 software (USEPA 1997) provides many goodness‟s of fit tests to verify the accuracy of the model. The normal checks, as specified in the manual by USEPA (1997) to accept the model are; t-statistics i.e., source contribution divided by the error of source contribution should be greater than 2, $\chi^2$ (chi-square) is the weighted sum of squares of the differences between calculated and measured fitting species concentrations divided by the effective variance and the degrees of freedom, it should be less than 4. The weighting is inversely proportional to the squares of the precision in the source profiles and ambient data for each species. Ideally, $\chi^2$ would be zero, there would be no difference between calculated and measured species concentrations. The $\chi^2$ less than one indicate a very good fit for the data. Values greater than 4 indicate that one or more of the fitting species concentrations are

not well-explained by the source contribution estimates (SCE). The source contribution estimate approximates the total mass concentration which is a convenient check on the %mass explained value. When the SCE is less than its standard error, the source contribution is undetectable. Two or three times the standard error may be taken as the upper limit of the SCE in this case. Assuming that the errors are normally distributed, there is about a 66% probability that the true source contribution is within one standard error and about a 95% probability that the true concentration is within two standard errors of the SCE.

$R^2$ is determined by the linear regression of the measured versus model-calculated values for the fitting species. $R^2$ ranges from 0 to 1. The closer the value is to 1.0, the better the SCEs explain the measured concentrations. When $R^2$ is less than 0.8, the SCEs does not explain the observations very well with the given source profiles. The percentage mass explained should be between 80% and 120%, the ratio of the computed and the measured concentration of each element (C/M ratio) should be close to 1 and R/U ratio, i.e., the ratio of residuals to uncertainty should be less than 2. As the model requires the source contribution estimates and receptor concentrations in ambient air, the significant sources in the area need to be identified first. The investigation of sources of $PM_{10}$ to be accounted for in the CMB model is carried out using emission inventory studies.

### 4.1.2. Source profiling

The Chemical profile needs to be developed for the air-polluting source as input to the receptor-oriented source apportionment models like CMB8.2 (chemical mass balance). The U.S Environmental Protection Agency‟s (EPA) SPECIATE database and several studies carried out in other parts of the world provide an extensive collection of source profiles. The source profiles required in this study are extracted from SPECIATE5.1 the database.

The source of the particulate matter in JCF accompanies various coal handling activities such as opencast coal mining and its associated activities, thermal power stations, automobiles, generator sets fuel burning, construction activities, domestic coal, cooking gas burning, etc. and even the background contribution of natural dust (crustal origin) cannot be ruled out, particularly, in the zones having loose topsoil (Roy and Singh 2014). So, the sources profiles considered here are coal dust, coal combustion, road dust, heavy vehicle diesel, light vehicle gasoline, etc.

### 4.1.3. Ambient profiling

As discussed in Chapter 3**,** the samples collected from the sampling location undergo chemical characterization. The species obtained from the chemical analysis used in ambient profile structuring and the uncertainty is based on the instrument.

The overall methodology used in the source apportionment study is depicted by the flow diagram as follows:

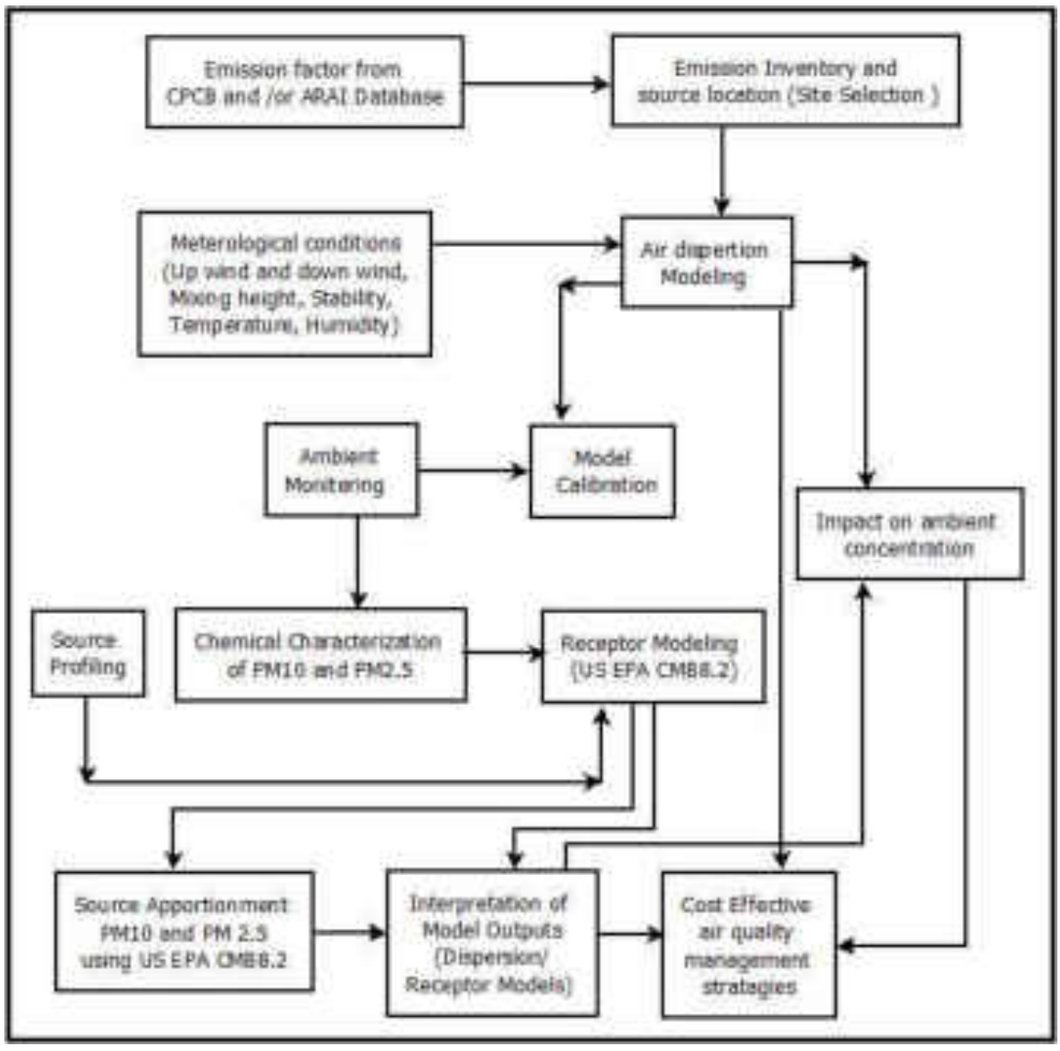



Figure 4.1: General methodology followed in the source apportionment studies

### 4.2. Results of the Chemical Mass Balance

CMB8.2 is performed for all the air quality monitoring locations. The significant sources in the area are identified first based on the field surveys. The general category of sources included in the model for all the sites are composites of all the vehicular sources, domestic combustion, road dust, agricultural waste burning, Industries, etc (Summary of relevant air quality studies from major Indian cities is given in Table 4.1). However, the choice of sources varies concerning the activities prevailing in the area and CMB model performance. A similar approach also applies to the selection of species. Efforts were made to include as many species in the model as possible. The choice was, however, restricted based on model performance. The source contributions are shown in the following Figures 4.3. The CMB model performance with respect to various sources is shown in Annexure 1.

#### 4.2.1. Domestic combustion

In the summer season, the foremost emission source was domestic combustion for $PM_{10}$ and $PM_{2.5}$. The domestic combustion percentage was observed at 22% and 25% for $PM_{10}$ and $PM_{2.5}$ in the summer season. In the winter season, domestic combustion contribution was the second most percentage contributor for $PM_{10}$ and $PM_{2.5}$. The $PM_{10}$ percentage was 23% while the $PM_{2.5}$

percentage contribution was 28% in this season. The higher concentration of $Cl^-$, $F^-$, Cr, and Br. $Cl^-$ and $F^-$ are the markers of coal-burning and wood-burning (Jain et al., 2020). High Br along with $Cl^-$ suggests the contributions from coal combustion.

### 4.2.2. Industrial Emission

The industrial combustion percentage contribution observed 16% in $PM_{10}$ and 13% in $PM_{2.5}$ in the summer season. In the winter season, contribution to industries is determined to be 15% in $PM_{10}$ and 24% in $PM_{2.5}$. The abundances of elements like As, Zn, Fe, Cu, Cr, Pb, and S indicate the industrial source's emissions. Kumar et al. (2001) used Cu, Mn, and Ni as tracers for industrial emissions in Mumbai; Sharma et al. (2014b) used Cu, Cr, Mn, Ni, Co, and Zn as industrial emission tracers for metal manufacturing plants in Delhi; Kulshrestha et al. (2009) used a combination of Ni, Cu, Fe, and Cr as a marker for construction activities in Agra; and Karet al. (2010) used Zn, Cu, and Ni as tracers of galvanizing, metallurgy, and electroplating industries while Cr from tannery industry in Kolkata.

### 4.2.3. Coal Mining

Opencast coal mining activity comprises heavy-duty diesel vehicle usage, blasting, Coal handling and overburden management. During the summer season, the coal mining activity in $PM_{10}$ and $PM_{2.5}$ is observed to be 8% and 7% respectively while in the winter season it contributes somewhat 6% and 5% in $PM_{10}$ and $PM_{2.5}$ respectively.

### 4.2.4. Transportation

The overall transportation contribution is 25% for $PM_{10}$ and 32% for $PM_{2.5}$ in the summer season. In the winter season, the transportation emission contribution is examined at 16% for $PM_{10}$ and 18% for $PM_{2.5}$. The OC/EC ratio is a convenient diagnostic tool for investigating the sampling site and its emission sources. In the present study, the OC/EC ratio shows significant seasonal variations for a coarser fraction of PM than for a finer fraction. It is well established that OC/EC ratio values between 1.4 and 4 indicate emissions from gasoline catalyst vehicles and 0.3 to 1 suggest diesel vehicle emissions (Amato et al., 2016; Cesari et al., 2018). Assessing the ratio of nss-K+/EC is another diagnostic check for estimating the relative loading of vehicular emissions, where nss-K+ is a non-sea-salt water-soluble potassium ion (calculated as K+- 0.129Na+) (Andreae and Merlet, 2001).

### 4.2.5. Secondary Inorganic Aerosol

During summer, the secondary inorganic aerosol contribution to $PM_{10}$ and $PM_{2.5}$ is about 8% and 16%, respectively. Secondary inorganic aerosols contribution found in winter is about 14% and 17%, respectively for $PM_{10}$ and $PM_{2.5}$. The secondary inorganic aerosol source is a high concentration of nitrate ($NO_3^-$), sulphate ($SO_4^{2-}$), and ammonium (($NH_4^-$). These secondary products are formed in the atmosphere, being emitted either by natural or anthropogenic sources. The oxidation of $NO_x$ forms the secondary nitrate. It is favoured by low temperature (Li et al.2004), while high temperature and strong solar radiations favour the formation of secondary sulfates through photochemical reactions (Seinfieldand Pandis, 2016). Secondary inorganic aerosol formation from precursors ($SO_2$ and $NO_2$) enhances the pollution burden over the

vicinity. Biomass burning, the presence of metal traces (Fe, Al, Mn, Zn, Cr etc.) from vehicular or industrial emission play a key role to neutralise the oxides of nitrogen and sulphur and thus raises the amount of secondary inorganic aerosols in the atmosphere.

### 4.2.6. Agriculture

The agriculture contribution observed that 5% for $PM_{10}$ and 2% for $PM_{2.5}$ in the study period during the summer season. In the winter season, the contribution is 3% and 2% for $PM_{10}$ and $PM_{2.5}$ respectively. Agricultural activities contribute ammonium to the atmosphere (Pant and Harrison, 2012; Jain et al., 2019). The OC and EC are also significant agricultural activity sources (Ram and Sarin 2011; Sharma et al.2016a).

### 4.2.7. Open burning

The contribution of open burning in the summer season is 5% for both $PM_{10}$ and $PM_{2.5.}$ In winter, the garbage burning contribution is 6% and 2% for $PM_{10}$ and $PM_{2.5}$ respectively during study time. The abundance of tracers like $K^+$, Pb, Br and consider-able $Cl^-$ marks this garbage/biomass burning source. $K^+$ and levoglucosan are globally employed as biomass burning markers. Biomass consists of residential and agricultural wastes, post-harvest residue, cow dung, dry leaves, fuelwood, and wildfires (Almeida et al., 2006; Khare and Baruah, 2010; Shridhar et al., 2010). The OC and EC are also traced insignificant amounts along with K+, indicating the biomass burning emanations (Cesari et al., 2018; Sharma et al., 2014; Jain et al., 2018).

### 4.2.8. Road Resuspension dust

The re-suspension dust is a significant contributor to $PM_{10}$. The contribution of resuspension dust is during the summer season 12% while in the winter season the emission contribution is 10% for $PM_{10}$. In the summer season, resuspension dust's contribution is higher because of the high wind velocity and dry condition. The lower percentage contribution of road dust to fine particulate matter is attributed to substantial road dust particulates in coarse mode, found in other studies (Gupta et al., 2007; Masri et al., 2015). Crustal elements are significant constituents of airborne soil and re-suspension road dust. Generally, they contribute to coarse aerosols, including Al, Si, Ca, Ti, Mg, Fe, and Na used as tracers for soil dust or crustal re-suspension (Lough et al.2005; Begum et al. 2011). The marker elements that have been used in India for the identification of soil dust include Al, Si, Ca, Ti, Fe, Pb, Cu, Cr, Ni, Co, and Mn (Sharma et al., 2017). Cu, Zn, and Ba are associated with road dust/re-suspension dust due to the release of these marker elements from cars and non-exhaust sources.

### 4.2.9. Other emission Contribution

Other area sources contributed in the summer season is 12% for $PM_{10}$ and 7% for $PM_{2.5}$ during the study period. In the winter season, emission contribution is 14% for $PM_{10}$ and 9% for $PM_{2.5}$.

### 4.3 Inferences

The receptor modelling (CMB) results (Figure 4.3) revealed that the transport sector and domestic combustion are the predominant emission sources contributing to the receptor levels. During the summer season, the contribution of the transport sector was found maximum in both $PM_{10}$ (23%) and $PM_{2.5}$ (30%) followed by the contribution of domestic combustion (17% and 23% for $PM_{10}$ & $PM_{2.5}$ respectively). While in the winter season, the contribution of domestic combustion outruns the contribution of the transport sector. During the winter season, domestic combustion has contributed 22% ($PM_{10}$) and 28% ($PM_{2.5}$) whereas the transport sector has contributed 16% ($PM_{10}$) and 21% ($PM_{2.5}$) of the total emission.

After transport sector and domestic combustion, Industrial emission (12% of $PM_{10}$ emission) and Road Resuspension (12% of $PM_{10}$ emission) followed by Coal mining activity and secondary inorganic aerosol formation (both 8%) are contributing majorly to $PM_{10}$ emission at receptor during the summer season.

In $PM_{2.5}$ source contribution, secondary inorganic aerosol formation contributed majorly (16% & 15% in summer and winter seasons respectively) after domestic combustion and transport sector. Secondary inorganic aerosol formation from precursors ($SO_2$ and $NO_2$) enhances the pollution burden over the vicinity. Biomass burning, the presence of metal traces (Fe, Al, Mn, Zn, Cr etc.) from vehicular or industrial emission play a key role to neutralise the oxides of nitrogen and sulphur and thus raises the amount of secondary inorganic aerosols in the atmosphere.

Industrial activity contributed 12% and 11% of total $PM_{10}$ load in summer and winter respectively but in the case of finer dust ($PM_{2.5}$), it contributed 17% in the winter season at the receptor level. This may be due to the calm winter conditions that allow finer dust ($PM_{2.5}$) to settle near to ground than that of summer conditions that allow more turbulence mixing in the atmosphere.

Road re-suspension of dust contributes significantly in $PM_{10}$ load at receptor both in summer (12%) and in winter (8%). As these are larger and heavier particles, they contribute to $PM_{10}$ fraction and are not found in $PM_{2.5}$ fraction at the receptor.

After the contribution of the industrial sector, coal-mining activity contributed around 8% and 6% of the total $PM_{10}$ receptor dust load during summer and winter respectively. In the case of $PM_{2.5}$ dust load at the receptor, coal-mining activity contributed 7% and 5% during summer and winter respectively.

From the results and analysis of receptor modelling, it can be summarised that mitigation and abatement of the emissions from domestic combustion and transport sector alone may reduce receptor dust load by 40% (approx.).

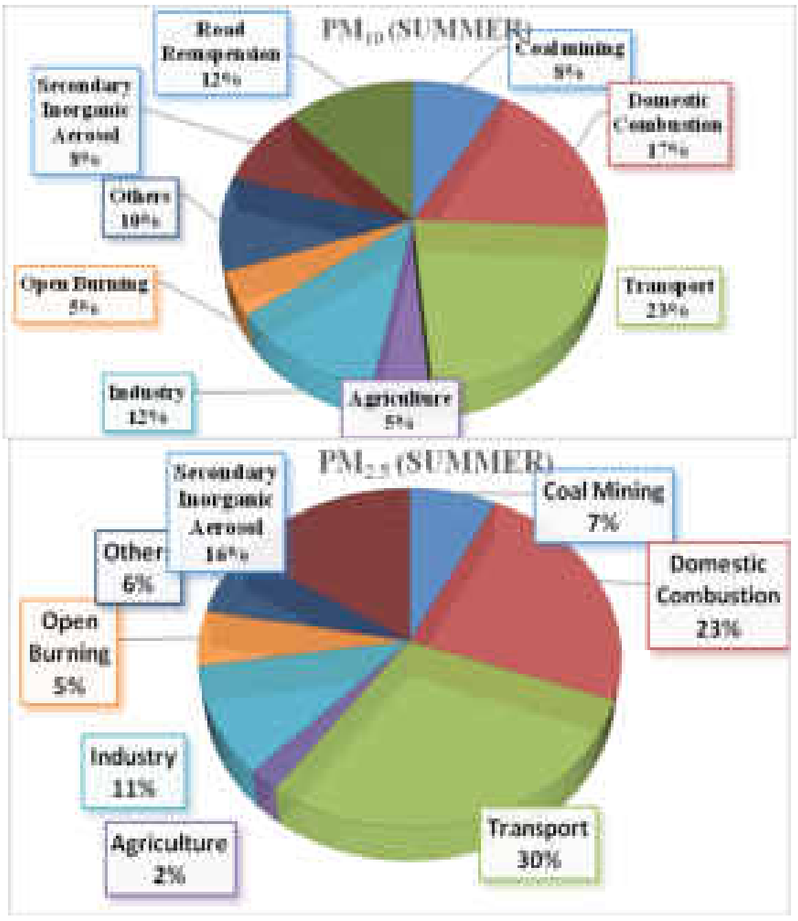



Figure 4.2: Source contribution at receptor locations of $PM_{10}$ and $PM_{2.5}$ in summer

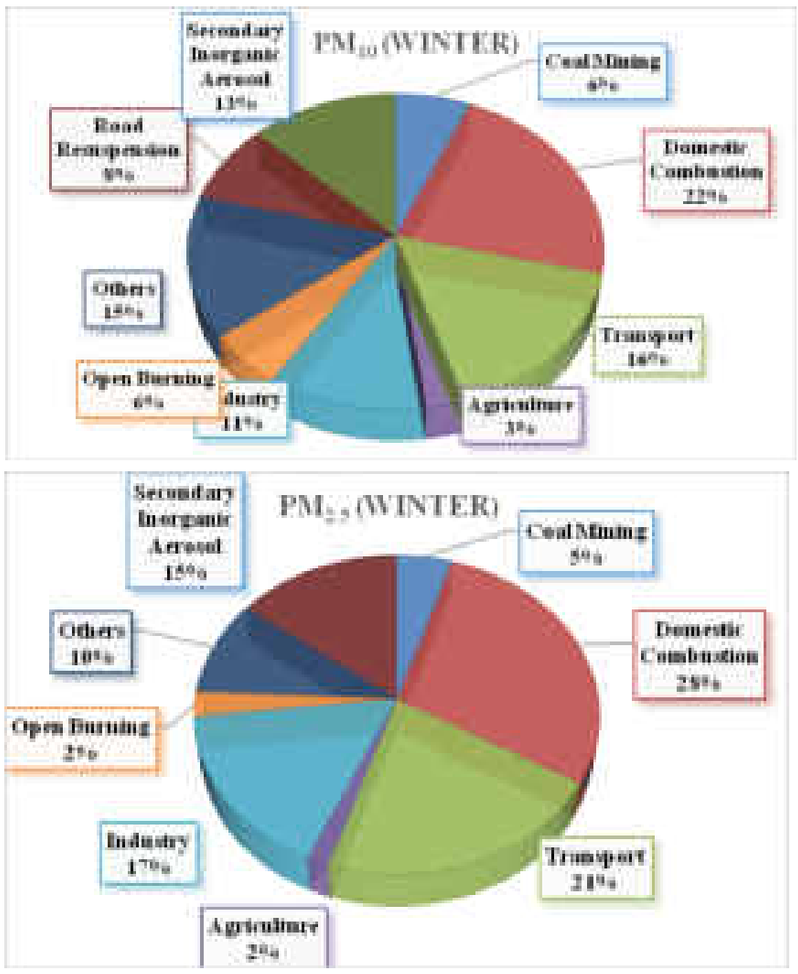



Figure 4.3: Source contribution at receptor locations of $PM_{10}$ and $PM_{2.5}$ in winter

Table 4.1: Summary of relevant air quality studies from major Indian cities.

| **Area/Location** | **Particle size** | **Sources** | **Elements and Ions** | **References** |
|---|---|---|---|---|
| Delhi | $PM_{10}$ and $PM_{2.5}$ | Secondary Nitrate, Secondary Sulfate, Vehicular emission, Biomass burning, Soil dust, Fossil fuel combustion, Sodium and magnesium salt, Industrial emission | Al, Mg, Ca, Ti, Fe, Cr, Mn, Zn, As, Pb, Br, M, $F^-$, $Cl^-$, $NO_3^-$, $SO_4^{2-}$, $K^+$, $NH_4^+$, and $Na^+$ | Jain et. Al., 2020 |
| Mangalore | $PM_{10}$ and $PM_{2.5}$ | Construction dust, Diesel generator, Tyre wear emission, Brake lining emission, Sand dust emission, gasoline vehicle emission, Diesel vehicle emission, Unpaved and paved road emission, Biomass burning, LPG stove emission, Solid fuel emission, Ferrous and steel industries emission, Fabrication and welding emission, Kerosene stove emission | As, Ba, Cd, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sr, Zn, $F^-$, $Cl^-$, $NO_3^-$, $PO_4^{3-}$, $SO_4^{2-}$, $Na^+$, $K^+$, $Mg^{2+}$ and $Ca^{2+}$ | G. Kalaiarasan et al. 2018 |
| Delhi NCR | $PM_{10}$ and $PM_{2.5}$ | Dust construction, Vehicle emission, Biomass Burning, Industrial emission, Secondary Pollutants, DG sets emission, | Al, Si, P, S, Cl, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ca, $F^-$, $Cl^-$, $NO_3^-$, $Br^-$, $NO_2^-$, $SO_4^{2-}$, $Na^+$, $K^+$, $Mg^{2+}$ and $Ca^{2+}$ | Report No. ARAI/16-17/DHI-SA-NCR/Final Report August 2018 |
| Delhi | $PM_{2.5}$ | Secondary Aerosol, Vehicular emission, Biomass burning, Soil dust, Fossil fuel combustion, Sea salt, Industrial emission | Al, Mg, S, Si, Cl, K, Ca, Ti, Cu, Mn, Fe, Zn, Br, Cr, As, Pb, $F^-$, $Cl^-$, $NO_3^-$, $SO_4^{2-}$, $K^+$, $NH_4^+$, and $Na^+$ | Jain et. Al., 2017 |
| Nagpur | $PM_{2.5}$ | DG sets, biomass burning, resuspended dust, secondary aerosol and mobile sources. | Al, Ba, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb, Si, Zn. $F^-$, $Cl^-$, $NO_3^-$, $PO_4^{3-}$, $SO_4^{2-}$, $Na^+$, $K^+$, $Mg^{2+}$ and $Ca^{2+}$ | Pipalatkar et al., 2014 |
| Raipur | $PM_{2.5}$ | Brick kiln process, steel re-rolling mills, steel processing industries, biomass burning, metallurgical industrial emissions and coal burning | Al, As, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, S, Sb, Se, V, Zn, $Na^+$, $K^+$, $Mg^{2+}$ $NH_4^+$, $F^-$, $Cl^-$, $NO_3^-$, $SO_4^{2-}$, and $Ca^{2+}$ | Matawle et al., 2014 |
| Hyderabad | $PM_{10}$ and $PM_{2.5}$ | Vehicles exhaust, resuspension of dust, secondary sulfates, secondary nitrates, biomass | Na, Mg, K, Al, Si, Ca, Fe, Cl, $SO_4^{2-}$, $NO_3$, $NH_4^+$ | Guttikunda et al., 2013 |

| | | | | |
|---|---|---|---|---|
| | | burning, coal burning. | | |
| Pune | $PM_{10}$ and $PM_{2.5}$ | Vehicles, DG sets, construction dust, solid fuels emissions, resuspended dust | Al, Pb, Cu, Zn, As, Se, Br, Ni, Fe, Mn, Mg, Cr, Ti, Ca, Cd, S, Si, Na, Ba, Sb, Cd, Sr, $Cl^-$, $NO_3^-$, $SO_4^{2-}$, $K^+$, $NH_4^+$ | ARAI, 2010 |
| Kanpur | $PM_{10}$ and $PM_{2.5}$ | Vehicles, open burn, road dust, domestic wood, coal and LPG, metal smelting, DG sets. | $Cl^-$, $NO_3^-$, $SO_4^{2-}$, $K^+$, $NH_4^+$, $Na^+$, $Ca^{2+}$, $Mg^{2+}$ Si, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Cd, Sn, Sb, Pb | CPCB, 2010b |
| Mumbai | $PM_{10}$ and $PM_{2.5}$ | Wood combustion, Fuel oil combustion, kerosene combustion, biomass burning, LPG, ammonium sulfate, ammonium nitrate, heavy duty diesel vehicles emissions, soil dust. | Na, Mg, Al, Si, P, S, Cl, Ca, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ga, Rb, Y, Zr, Pd, Ag, In, Sn, La, Se, Sr, Mo, Cr, Cd, Sb, Ba, Hg, and Pb. $F^-$, $Cl^-$, $Br^-$, $NO_2^-$, $NO_3^-$, $SO_4^{2-}$, $K^+$, $NH_4^+$, $Na^+$, $Ca^{2+}$, $Mg^{2+}$ | CPCB, 2010a |
| Chennai | $PM_{10}$ and $PM_{2.5}$ | Vehicles, DG sets, bakeries, soil dust, construction dust, paved road dust, kerosene and LPG emissions. | As, Ag, Ca, Na, Fe, Mg, Cu, Zn and other metals. $Cl^-$, $NO3^-$, $SO4^{2-}$, $K^+$, $NH_4^+$, $Na^+$, $Mg^{2+}$ | IIT Madras, 2010 |
| Bangalore | $PM_{10}$ and $PM_{2.5}$ | Petrol vehicles, diesel vehicles, secondary particulates, fuel oil burning, wood domestic wood burning, DG set, kerosene generator set, paved road dust re suspension, soil dust. | Na, Mg, Al, Si, P, S, Cl, Ca, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ga, Rb, Y, Zr, Pd, Ag, In, Sn, La, Se, Sr, Mo, Cr, Cd, Sb, Ba, Hg, and Pb. $F^-$, $Cl^-$, $Br^-$, $NO_2^-$, $NO_3^-$, $SO_4^{2-}$, $Na^+$, $K^+$, $Mg^{2+}$ and $Ca^{2+}$ | TERI, 2010 |

DG - Diesel generators; LPG - Liquefied petroleum gas; OC - Organic carbon; EC - Elemental carbon.

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# Chapter 5 Dispersion Modelling

Air quality modeling includes four major processes (a) emission of pollutants, (b) transportation of the pollutants due to mean wind profile (c) chemical transformations and (d) deposition/removal. In the present study the particulate matter emissions, transportation and dispersion are carried out using the AERMOD model, which is developed by USEPA. AERMOD model estimates the spatial profile of pollutants based on the Gaussian plume equation, which is an analytical solution to the steady-state approximation of the advection-diffusion phenomenon. The boundary conditions about the atmospheric mixing height and other thermodynamic vertical profiles for the simulations are derived from the mesoscale model. The model relies on the atmospheric stability classes for deriving the dispersion coefficients across the multiple dimensions with respect to the distance away from the sources. In this study, only the ground level concentrations of the particulate matter are simulated during the study period. The study domain envelops the Jharia Coal Fields situated in the Jharkhand state of India. The methodology followed in the present study is shown in Figure 5.1. The southwest part of the Dhanbad City shares borders with the study area, but the majority of emission load used in the study is included from the JCF.

## 5.1. Wind data analysis

The nearest IMD (India Meteorological Department) observations are at Patna and Kolkata, which are approximate >150km from the study area. Hence, hourly meteorological observations required for the study for the AERMOD dispersion model were simulated through the Weather Research and Forecast, version-3.9 (WRF), which is a meteorological model that dynamically downscales the global NCAR/UCAR meteorological data to the regional level data (www.mmm.ucar.edu). Nested domains of grid resolution 12km and 4km, respectively were laid over the study area for simulation of hourly meteorological variables using the WRF model (Figure 5.2). Hourly meteorological data, including both the surface variables and upper atmosphere variables, were simulated for the study period viz. 23 May to 12 June 2019 and 23 January to 12 February 2020, representing the summer and winter seasons, respectively.

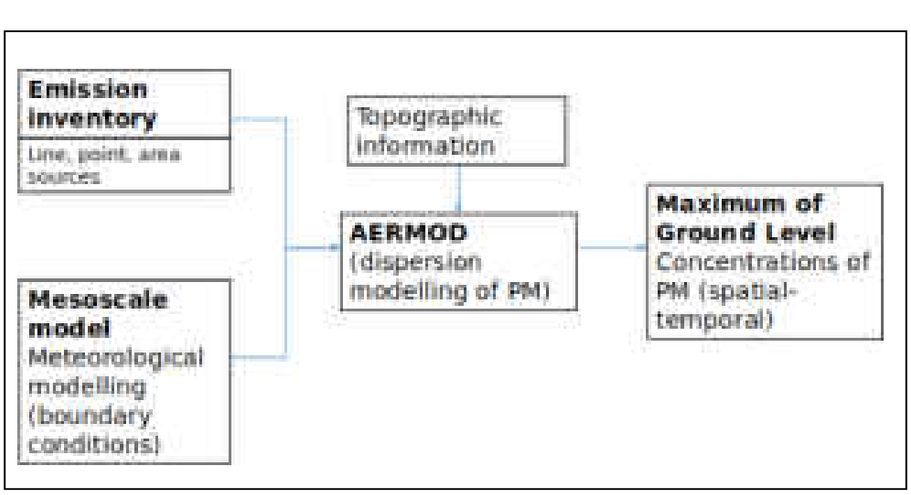



Figure 5.1: Methodology followed in the study.

The mesoscale model interface program MMIF (https://www.epa.gov/) converter tool was used

to convert the inner domain‟s gridded WRF model simulated meteorological data into a format suitable for the AERMOD model. The AERMOD receptor grid covering the study area is shown in Figure 5.3. A Cartesian receptor grid having 21 rows and 21 columns with a resolution of 2000 m was laid for the simulation of particulate matter dispersion /concentration at the receptor locations. Overall there are 20 grids in each direction covering an area of 40 km by 40 km enveloping the JCF.

The spatial pattern of the predominant wind profile over the study area is plotted using the windrose diagrams for the summer (March to May 2019) and winter season (November 2019 to February 2020), shown in Figures 5.2 and 5.3, respectively. Results show that the study area is experiencing the predominant wind (having high frequency) flow from east to west direction followed by north-west to south-east direction during summer, while in winter the predominant wind direction is from north to south. The wind speeds vary in the range of 0.5 to 11.1m/s during the summer predominantly in the range of 2.1 to 3.6m/s whereas wind speeds vary in the range of 0.5 to 8.8m/s during the winter, predominantly in the range of 2.1 to 3.6m/s.

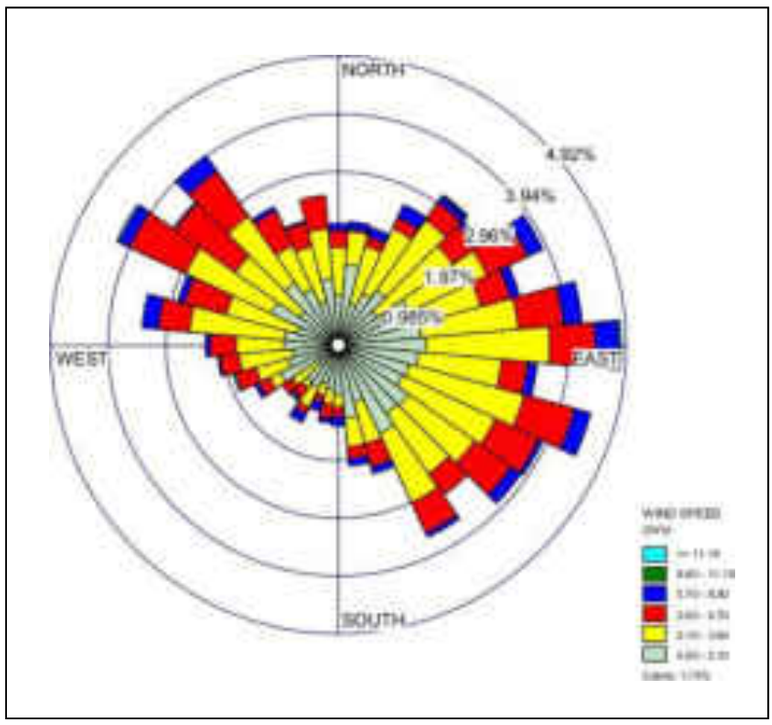



Figure 5.2: Windrose of the study area during March-June, 2019 (wind direction blowing towards the center)

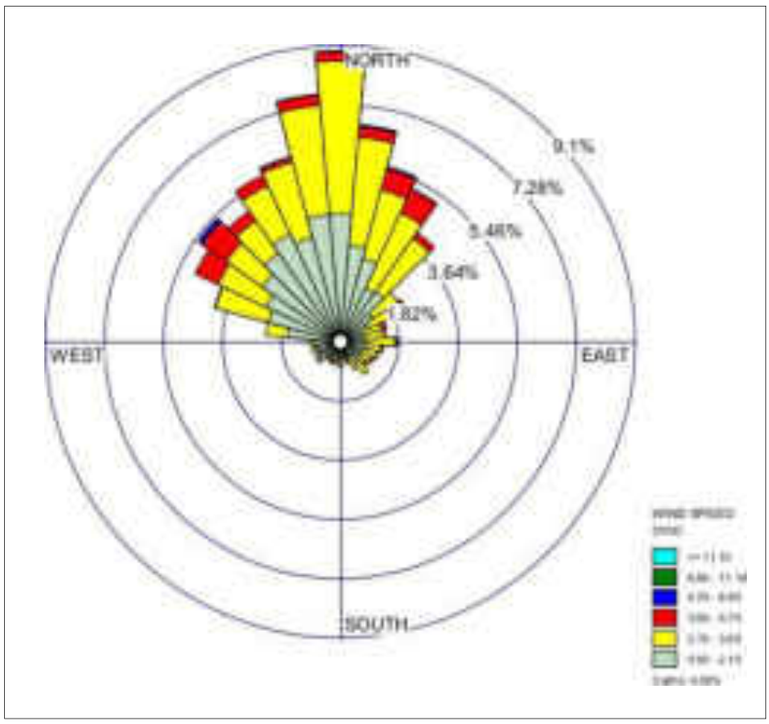



Figure 5.3: Windrose of the study area during November-December 2019 (wind direction blowing towards the centre)

### 5.2. Dispersion of Particulate matter

Spatial profiles of maximum ground-level concentrations of 24-hour average values of $PM_{10}$ and $PM_{2.5}$ were simulated using the AERMOD Gaussian plume model. The emission rates of particulate matter from multiple source types including the point, line, and area were derived from the field monitoring of the emission inventory. Point sources mainly include the emissions from the industries situated in the study area that mainly use coke/coal as the fuel. The line sources include the emissions from the vehicular exhaust. Emission inventory of traffic pollution was carried out in the study area by noting down the vehicular activity. The vehicular activity of different vehicular types such as trucks, light motor vehicles, three-wheeled vehicles, motorbikes, etc. was multiplied by the corresponding emission factors for the estimation of gaseous pollution. The summation of emissions from all vehicle types adds to the overall line sources contributing to the pollution load in the study area. The area sources include emissions from the open cast mining emissions (including all the activities in the mine premises) and domestic burning (including emissions from crematoria, bakeries, open eat-outs, restaurants, chulha burning from the slum, etc.).

The emissions in grams per second were calculated from the emission inventory survey, for the line and point sources. Whereas, the emission rates in $g/s/m^2$ were calculated for the area sources including mining. These emission rates from each source type have been computed in the study area and fed into the AERMOD model domain for the simulation of spatial average concentrations of $PM_{10}$ and $PM_{2.5}$. In the present study, the maximum GLC (ground level concentrations, in $\mu g/m^3$) was simulated at several receptor grid locations in AERMOD domains. The AERMOD model was run during the sampling period in May 2019 and November 2019, representing the pre-monsoon and post-monsoon seasons, respectively.

Analysis of WRF model simulated wind speed and direction data shows that the wind is

predominantly flowing from south-east direction to north-west direction, followed by the reversal in the direction, during the monitoring in summer, representing pre-monsoon conditions (Figure 5.5). The wind speeds during the monitoring period in summer month varied between 0.5 and 8.8m/s. During the monitoring period in winter (post-monsoon), the wind predominantly flowed from the north-east to south-west direction having wind speeds in the range of 0.5 to 3.6m/s (Figure 5.5).

The wind blowing from different directions in the study area determines the direction of pollution dispersion. The Gaussian plume equation used in the AERMOD model estimates the diffusion and advection of the pollutants concerning the emission rates and meteorology (wind speed, direction and atmospheric stability categories). The model simulated maximum ground level concentration of the particulate matter ($PM_{10}$ and $PM_{2.5}$) in the study area covering the JCF is shown through the isopleths. The isopleths (contours connecting the regions with the same ground level concentration in the context of the present study) of maximum GLC of $PM_{10}$ and $PM_{2.5}$ were observed to form a pattern according to the predominant wind directions flowing in different monitoring seasons. It is observed that the line sources in the study area have contributed the maximum to the surface GLC of $PM_{10}$, following the open cast mines. The AERMOD model simulated the value of GLC of $PM_{10}$ due to line sources, open cast mines, and all sources are 927, 286, and 978µg/m$^3$, respectively, for the summer season. The $PM_{2.5}$ maximum GLC contributed by the line sources, open cast mines, and all sources included are 809, 143, and 835µg/m$^3$, respectively. It is evident from the result that the line sources are significantly contributing to the overall particulate pollution in the study area during summer.

The analysis of the $PM_{10}$ and its maximum GLC simulated by the AERMOD model for the winter season also follows a similar pattern as of summer. The contribution of line sources, open cast mines, and all sources included are 1565, 597, and 1679µg/m$^3$, respectively. The $PM_{2.5}$ maximum GLCs during the winter are 1004, 299, 1167µg/m$^3$ as contributed by line, open cast mines, and all sources including, respectively. Based on the emission inventory and the prevailing meteorological conditions during the winter season have in general contributed to the higher particulate matter than that of the summer season.

Pockets of maximum concentrations of $PM_{10}$ (200-1000 µg/m$^3$ and above) are observed in the vicinity to roads nearer to the open cast mines south of Dhanbad City during the winter (Figure 5.5). The localities of the high concentrations of $PM_{10}$ are Sabji Patti road and Sudamdih mine area, which is reflected in the figure. The area covering the Dhanbad city and the mines situated in the southwest have $PM_{10}$ concentrations in the range of 200-900µg/m$^3$. The fringes of the JCF have recorded the $PM_{10}$ concentrations in the range of 100-250µg/m$^3$. In contrast, the $PM_{10}$ concentrations for the summer season have significantly lower and the majority of the study area have $PM_{10}$ < 100µg/m$^3$, however, the area extending from south of Dhanbad City and Sudamdih mine have relatively high $PM_{10}$ concentration in the range of 100-500µg/m$^3$. Baghmara and Sonardih mine area in the west of Dhanbad City have also been observed to have high GLC of $PM_{10}$ in the range of 100-500µg/m$^3$.

A similar pattern of the spatial distribution of $PM_{2.5}$ is reflected as of $PM_{10}$. As the underlying meteorological conditions are the same for both the $PM_{10}$ and $PM_{2.5}$ simulations the

spatial pattern is nearly similar. High concentrations of $PM_{2.5}$ (100-500µg/$m^3$) are observed in the southwest direction of Dhanbad City (Figure 5.6). The maximum GLC of $PM_{10}$ is found to be higher than $PM_{2.5}$ during both the monitoring seasons, and higher concentrations are observed during the winter season. The prevailing winter meteorology in the region has lower wind speeds and mixing heights, which poses an unfavorable situation for the dispersion of particulate matter, hence containing a high chance of accumulation of airborne pollutants. The significant contribution of particulate matter from the line sources is observed in the study area, followed by the area sources (from open cast mining, domestic burning, bakeries, open eat-outs, and restaurants)**.** The locations of the highly polluted can be interpreted from the images shown in Figures 5.6 (a) and 5.6 (b) for devising realistic and grass-root level mitigation strategies.

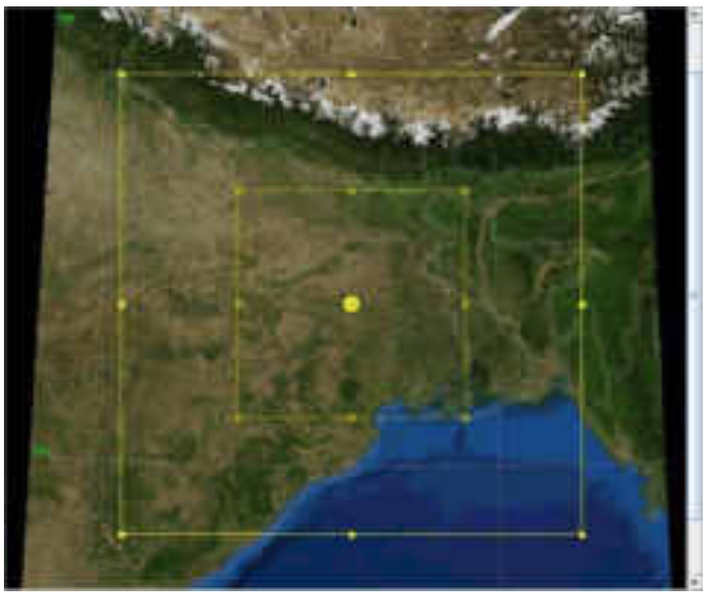


Figure 5.4: AERMOD grid covering the Jharia Coal Fields (JCF). The line, area, and point sources covered in the study are indicated in red color. The UTM coordinates of the left bottom point are x=406111 and y=2603492, and the coordinates of the right top point are x=456248 and y=2653417.

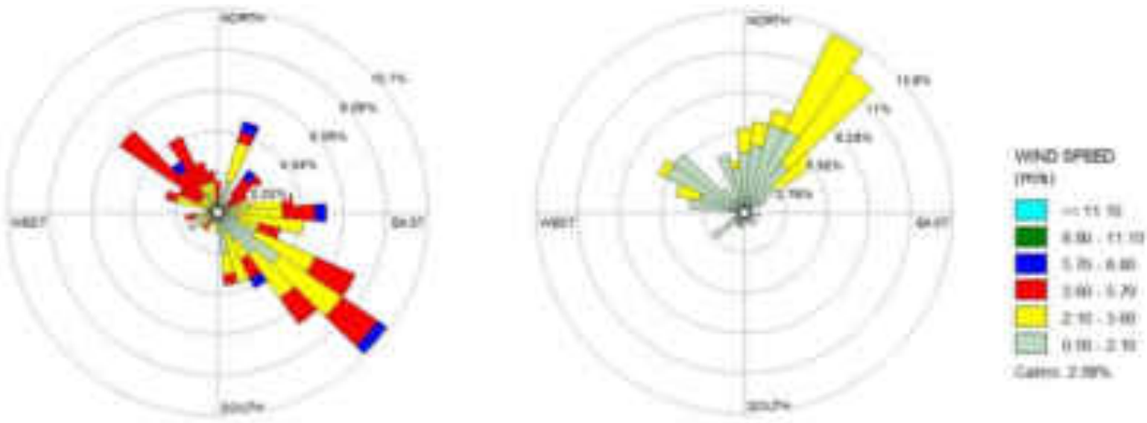
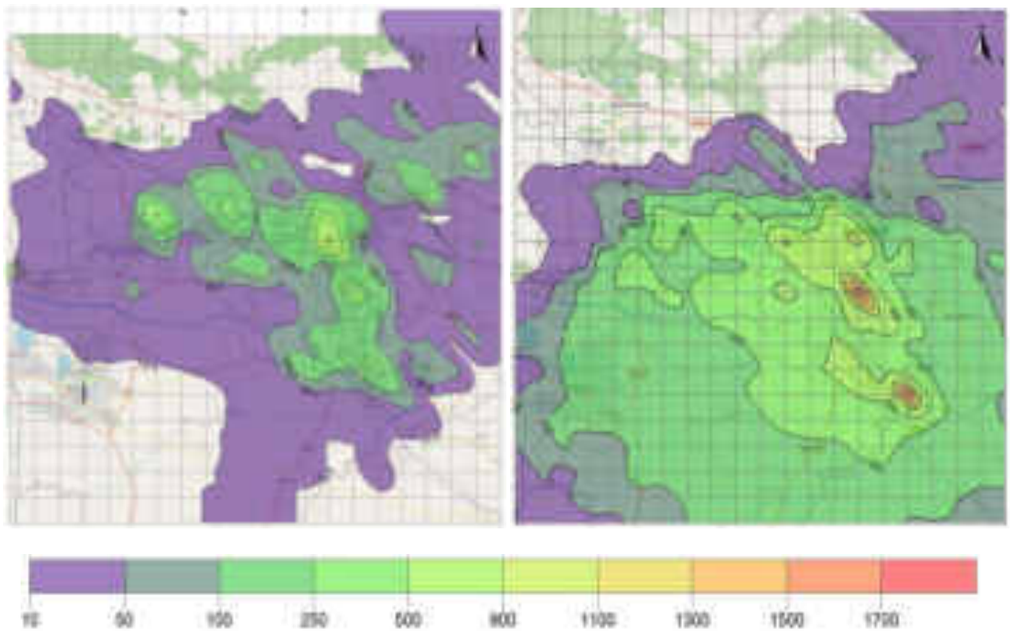
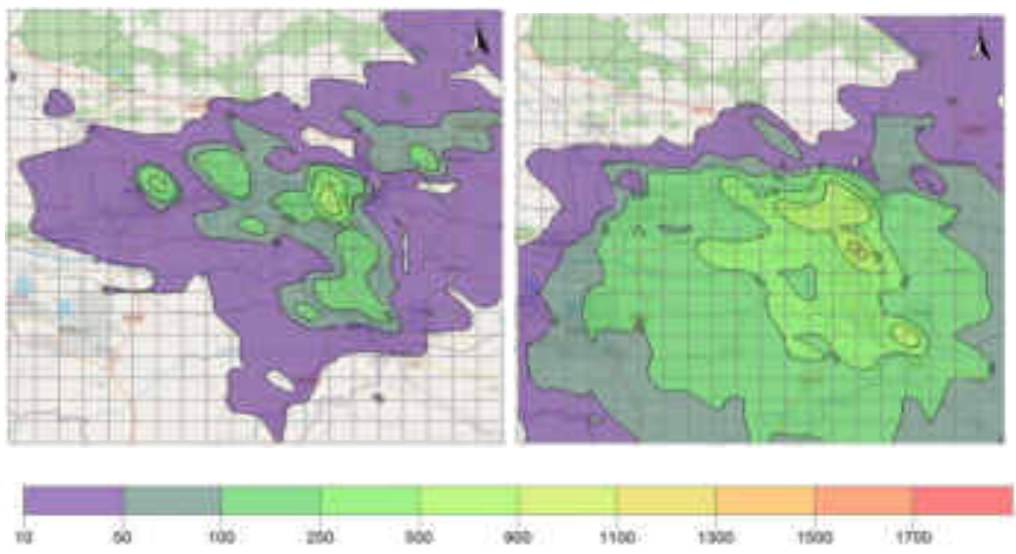



Figure 5.5: Windrose diagram for the summer (left) and winter seasons (right) at Jharia Coal Fields during the sampling period. Wind direction is flowing towards the centre.




(a)




(b)

Figure 5.6: 24-hour average maximum ground level concentration of PM contours in the study area simulated during the study periods in summer (left) and winter (right) seasons (a) $PM_{10}$ ($\mu g/m^3$) and (b) $PM_{2.5}$ ($\mu g/m^3$)

### 5.3 Validation of the model

Comparison between the model simulated period average PM and the measured PM concentrations was made to determine the overall efficiency of the dispersion model. In the present study, the model validation metrics viz. mean bias (MB), normalized mean bias (NMB), mean gross error (MGE), normalized mean gross error (NMGE), and Pearson‟s correlation (r) were calculated for $PM_{10}$ and $PM_{2.5}$ separately including data of both seasons. At some of the monitoring locations like Mines Rescue, Katras, Patherdih, Harina, Lodhna, and Lohapatti the discrepancies between the modeled and observed data were found to be high, for both summer and winter seasons. At remaining locations for both seasons, the results indicate an acceptable/fair degree of model performance in simulating the particulate dispersion. Results show that the correlation coefficient between the measured and modeled $PM_{10}$ is 0.6, which is

fair enough in environmental open systems, similarly, for $PM_{2.5}$ the correlation value is around 0.7 (Table 5.1).

Table 5.1 Performance Stimulation Metric

| Model metric | $PM_{10}$ | $PM_{2.5}$ |
|---|---|---|
| MB | -19.46 | 20.67 |
| NMB | -0.11 | 0.24 |
| NMGE | 0.32 | 0.37 |
| Correlation Coefficient | 0.6 | 0.7 |

The NMB values are observed to be lower for $PM_{10}$ (-0.11) than $PM_{2.5}$ (0.24), which indicates the slight negative bias in $PM_{10}$ simulations (under-prediction of the concentrations) and positive bias in $PM_{2.5}$ (over-prediction of the concentrations). Whereas, the NMGE for both $PM_{10}$ and $PM_{2.5}$ are 0.32 and 0.37, respectively, which indicates the variation in the model simulations deviate around 30% from the mean values on average (which is a result due to some extreme values in the simulations). However, this discrepancy could be minimized if long-term simulations are carried out, which is highly computationally intensive. Nevertheless, the model performance metrics in terms of correlation and normalized mean gross error infer that the model could capture the spatial profile of the particulate matter distribution to a good extent.

# Chapter 6 Recommendation

## 6.1. Mine industries

1. The project proponent might consider installing conveyor systems for transporting the coal from the coal handling plant to the railway siding or to the nearest thermal power plant (if feasible).
2. A sufficient number of plants should be planted around the mine pit to arrest the movement of particulate matter or dust into the surrounding areas.
3. Scientific studies might be necessary to design a green belt with an optimized dimension of plot size and direction as per the prevailing meteorology. Similar studies are required to design a wind barrier for optimized benefits.
4. Adequate dust control measures should be in place, like mechanized sweeping, water sprinkling or mist spraying systems on the haul roads and at loading sites. Long-range misting or fogging canons are also should be in place.
5. Dust suppression measures at all operations of mining should be ensured.
6. Ensuring the complete coverage of the trucks and railway wagons that carry coal with a tarpaulin sheet is necessary.
7. In the long-run mobilization of closed trucks to carry the coal is preferable.
8. The coal transport roads should not be left with open curb sides. End to end covering up of curb side is essential to avoid the re-suspension of coal due to the truck movement.

## 6.2. Area Sources

Area sources are mainly domestic sources of fuel (coal, wood, kerosene, LPG) burning, trash/MSW combustion, bakeries, hotels/restaurants etc. and re-suspension of dust. Based on the survey and assessment, the following recommendations emerge:

1. Construction and demolition of buildings in the urban area give high local dust contribution resulting health problems. These practices need to follow compliance guidelines to reduce emissions.
2. Road and pavement should be well constructed to suppress road dust. The standard specifications and code of practice for road construction should be followed and implemented as per the Indian Road Congress (IRC) guidelines or international standard guidelines.
3. Strategically placed green cover in urban and semi-urban areas can help to improve localair quality.
4. Manage agricultural residues, including strict enforcement of bans on open burning
5. Strictly enforce bans on the open burning of household waste.
6. Use clean fuels – electricity, natural gas, liquefied petroleum gas (LPG) in cities, and LPG and advanced biomass cooking and heating stoves in rural areas; substitution of coal by briquettes
7. Use incentives to improve the energy efficiency of household appliances, buildings, lighting, heating and cooling; encourage roof-top solar installations
8. Promote the use of electric vehicles

9. Encourage centralized waste collection with source separation and treatment, including gas utilization.
10. There is a substantial population that also uses available coal. These houses could be given a combination of improved chulla or free/subsidised power for cooking purposes.
11. Hotels and dhabas need to be educated and compulsorily asked to use LPG for its cooking purposes.
12. The trash and MSW burning is very common. Some of the places contain a mix of plastics and thermocol. The combustion of these materials is very harmful to human health.
13. Coal depot pollution is due to open storage and unregulated buying, selling and transportation. These coal depots are responsible for nearby air pollution peaks. However, the contribution of the same need to be assessed.

### 6.3. Line Source

The vehicular sector in cities has been seen to be a major source of gaseous and fine particulate matter. The action plan for this sector would need a combination of efforts:

1. Vehicle inspection and maintenance: Enforce mandatory checks and repairs for vehicles.
2. Improved public transport: Encourage a shift from private passenger vehicles to public transport.
3. Set up a mechanism of Inspection and Maintenance programme for all vehicles in the district through RTO with automated system assessment.
4. The Inspection & Maintenance (I & M) centre shall also test all vehicles for their inbuilt emission tests.
5. All commercial vehicles should be phased out after 8 years of age or subjected to two years extension after rigorous I&M tests
6. All private vehicles should be subjected to proper assessment and fitness tests through I&M centres.
7. All autos and buses shall also be subjected to I&M tests
8. Dhanbad city does not have a designated place for truck parking and maintenance related activities. A separate designated place should be allocated to prevent illegal parking and repair shops on the roads and kerbside.
9. Dhanbad city does not have a designated place for Auto-rikshaw. A separate designated place should provide to prevent traffic congestion and control vehicle emission.
10. Major haul trucks with heavy loads should not pass through the main city. The plan being made should be implemented in the next 1-1.5 years.
11. Overloading is a common phenomenon in the region resulting in poor road quality. This can be avoided through online checking when vehicles leave industries with a guarantee that the vehicle is not carrying more material than its designated loads.

### 6.4. Others

- There is a need to explore various options for controlling air pollutants to tackle increased emissions in future.
- The local authority should stress sustainable and affordable public transport keeping clean air goals in mind.
- Frequent (time to time) arrangement of campaign/awareness programmes for lawmakers, stakeholders, health professionals, academicians to brainstorm about the future scenario and importance of clean air.
- Strategic installation of continuous air quality monitoring systems at various locations of urban, semi-urban and rural areas to check the existing air quality and information dissemination to the general public.

**Annexure -1**

[A] Cumulative receptor sample of $PM_{10}$ for source profiling with fitting parameters

| **Source contribution estimate** | **Source profiles** | **Std Error** | **R-square** | **Chi-square** |
|---|---|---|---|---|
| 82.7% mass | Unpaved road | 0.056 | 0.96 | 2.41 |
| | Coal combustion | 0.643 | | |
| | Light Duty vehicle | 1.60 | | |
| | Heavy Diesel vehicle | 2.19 | | |
| | Residential combustion | 5.59 | | |
| | Iron and steel industry | 7.16 | | |
| | Agriculture soil dust | 0.212 | | |
| | Solid waste | 1.37 | | |

[B] Cumulative receptor sample of $PM_{2.5}$ for source profiling with fitting parameters

| **Source contribution estimate** | **Source profiles** | **Std Error** | **R-square** | **Chi-square** |
|---|---|---|---|---|
| 88.1% mass | Residential combustion | 3.34 | 0.98 | 2.44 |
| | Coal combustion | 0.094 | | |
| | Light Duty vehicle | 0.30 | | |
| | Heavy Diesel vehicle | 1.91 | | |
| | Agriculture soil dust | 0.10 | | |
| | Flyash | 0.51 | | |

**Annexure -2**

# Emission Inventory Data

Name of Mine:

| S.no | Operation | Quantity Kg/day | Type of fuel & quantity (litre/day) | Moisture content % | Silt content % | Details |
|---|---|---|---|---|---|---|
| **Point source** | | | | | | |
| 1 | Drilling | | | | | Hole dia ---mm & Frequency ---/day |
| 2 | Blasting | | | | | ----/day |
| 3. | Overburden loading | | | | | Drop height ----m; Frequency ------/day |
| 4 | Coal loading | | | | | Drop height ----m; Frequency -----/day |
| 5 | Overburden unloading | | | | | Drop height -----m; Frequency ----/day |
| 6 | Coal unloading | | | | | Drop height ----m; Frequency ------/day |
| 7 | Top soil removal | | | | | |
| 8 | Crushing | | | | | |
| 9 | DG sets | | | | | |
| **Line source** | | | | | | |
| 10 | Transfer of coal through haul road | | | | | Average speed ------- km/hr & frequency -------/day Distance ---- km Width ------m |
| 11 | Transfer of OB through haul road | | | | | Average speed -----km/hr & frequency -------/day Distance -----km |
| 12 | Transport road | | | | | Average speed -----km/hr Distance ------ km |
| 13 | Haul Road length (km) | | | | | -----Km |
| **Area Source** | | | | | | |
| 14 | Stockyard | | | | | Unloading freq. -------/day & Coal Loading ------T/day Area -------- $m^2$ |
| 15 | Workshop ($m^2$) | | | | | Area |
| 16 | Exposed pit ($km^2$) | | | | | |
| 17 | Colony | | | | | Fuel for cooking :----- |

# Project Report

# On

# Delineation of Surface Coal Fire and associated Land Subsidence in Jharia Coalfield (2022-2024), Jharkhand using satellite based remote-sensing techniques

A collaborative project between

**National Remote Sensing Centre (NRSC)**
**Indian Space Research Organisation (ISRO)**
**Hyderabad - 500 037**

**Bharat Coking Coal Limited**
**Koyla Bhawan, Koyla Nagar**
**Dhandbad, Jharkhand**

**May, 2025**

# NATIONAL REMOTE SENSING CENTRE

## REPORT / DOCUMENT CONTROL SHEET

| | | | | | |
|---|---|---|---|---|---|
| 1 | Security Classification | Restricted | | | |
| 2 | Distribution | BCCL and CMPD | | | |
| 3 | Report / Document Version | (a) Issue no. 01 | (b) Revision & Date | -- | |
| 4 | Report / Document Type | Project report | | | |
| 5 | Document Control Number | NRSC-RSA-(DAG-(GMTD-May 2025-TR-0002885-V1.0 | | | |
| 6 | Title | Delineation of Surface Coal Fire and Associated Land Subsidence in Jharia Coalfield (2022-2024), Jharkhand Using Satellite Based Remote Sensing Technique | | | |
| 7 | Particulars of collation | Pages 41 | Figures 19 | Tables 6 | References 18 |
| 8 | Author(s) | Shri Pulak R Jalan, Sc. 'SC', Smt Priyanka Rai, Sc. 'SC', Smt Nivedita Jain, Sc. 'SD', Dr. Tapas Ranjan Martha, Head GMTD | | | |
| 9 | Affiliation of authors | Geosciences Group, RSA-A, NRSC/ISRO | | | |
| 10 | Security mechanism | Compiled by<br>Shri Pulak R Jalan, Sc. 'SC'<br>16/05/25 | Reviewed by<br>Dr. Tapas Ranjan Martha<br>Head,<br>GMTD<br>Dr. T.C.<br>Group Director<br>Geosciences | Approved / Controlled by<br>DD (RSA-A) | |
| 11 | Originating unit | NRSC | | | |
| 12 | Sponsoring / Name and Address | BCCL | | | |
| 13 | Date of Initiation | 18/05/2022 | | | |
| 14 | Date of Publication | 16/05/2025 | | | |
| 15 | Abstract (with keywords): Surface coal fires cause not only economic damage to the countries but also create many working conditions for the mine workers due to prolonged exposure to toxic gases. Along with this, the subsurface fire and underground mining create a void beneath the ground, causing subsidence and affecting land conservation by damaging infrastructure. The present study addresses the estimation of surface coal fires for 2022-2024 and mining induced subsidence (derived with DInSAR) in Jharia with high and medium spatial resolution multi-sensor satellite images were used to identify the anomalous pixels (high temperature) compared to the surrounding area and delineated as coal fire) by the algorithm. Further, ASTER-TAI (142, 2, 1) band combination was used to identify the areas of potential land subsidence owing to underlying coal fire/mining activity due to burning. The coal fire areas were field verified in 2023 and 2024, where the fire areas were classified in terms of area (sq km) as underground mining fires, and the subsidence was verified through ground evidences. The study provides a comprehensive analysis of the dynamics of coal fire areas between the previous studies and the maps generated for 2022 to 2024 and a fundamental understanding of coal fire hazard by both natural (underlying fire) and man-made (mining) activities. The fire area increased from ~1.03 sq km in 2022 to ~4.34 sq km in 2023 and then again increased in 2024 to ~5.20 sq km, which subsequently decreased to ~3.91 sq km in 2024. The spatial distribution of the comparative analysis for individual years is investigated to understand the major contributors to the total fire areas and changes from the previous year. Apart from the subsidence in the old underground mining area of Jharkhand, 2022 was identified and verified during the fieldwork, where the cause of subsidence can be due to the melting of the underground ice. The coal mine fire and subsidence maps of the present study will be of great help in preparing | | | | |

## Acknowledgements

The project team is grateful to Dr. Prakash Chauhan, Director, NRSC for his support at various stages of project execution. We are extremely grateful to Dr. K. Sreenivas, Deputy Director (RSAA), NRSC for his overall guidance and encouragement. We also thank Dr. I C Das, Group Director (GSG), NRSC for providing us with his critical feedback. We also thank Smt B Santhisree, Group Head (SDPEG) and Shri N Raghavender, Scientist-SF (SDPEG), NRSC for providing us the instrument and necessary instructions for smooth operation during the field. We thank BCCL for providing us the opportunity to collaborate for this work. We thank Shri Full Jha, General Manager (JMP), BCCL and Shri Mithilesh Kumar, General Manager (Mining), BCCL in aiding us by providing necessary resources for ease of access to the locations lying within the mines of BCCL. We thank BCCL team Shri Srijan Thakur, Deputy Manager (JMP), Shri Shashi Prakash, Assistant Manager (JMP) and Mushtaq Ahmed, Assistant Manager (Central Survey) for assisting us in navigation during the field visit for coal fire areas and subsidence sites.

# Executive Summary

Surface coal fires cause not only economic damage to the countries but also create harsh working conditions for the mine workers due to prolonged exposure to toxic fumes. Along with this, the sub-surface fire and underground mining create a void beneath the ground, causing subsidence and affecting local communities by damaging infrastructures. The present study addresses the delineation of surface coal fires for 2022-2024 and mining-related subsidence. Thermal and SWIR bands with high and medium spatial resolutions of winter season Landsat-8/9 images were used to identify the anomalous pixels (high temperature) compared to the surrounding area and demarcated as coal mine fire area. Further, ALOS-PALSAR 2, L band microwave data, was used to identify the zone of probable land subsidence (using differential interferometry) due to mining. The identified areas were field verified in 2023 and 2024, where the fire areas were classified in terms of mine fires and overburden dump fires, and the subsidence was verified through ground evidence. The study presents a comparative analysis of the dynamics of coal fire area between the previous studies and the maps generated for 2022 to 2024 and a block-wise distribution of coal fire zones for both classes (mine fire and overburden fire). The fire area increased from ~1.85 sq.km in 2020 to ~4.54 sq.km in 2022 and then again increased in 2023 to ~5.00 sq.km, which subsequently decreased to ~3.91 sq.km in 2024. The cardinal direction-wise comparative analysis for individual years is investigated to understand the major contributors to the total fire areas and changes from the previous year. Apart from this, subsidence in the old overburden dumping area of Nudkhurkee OCP was identified and verified during the fieldwork, where the cause of subsidence can be due to the settling of the dumped materials. The final coal mine fire and subsidence maps of the Jharia coal field is prepared.

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Table 6: Mine-wise area under coal fire classified into two classes of mine fire and Overburden dump fire for 2024 (grey cells in the table indicate the area has no fire or the fire is below detection resolution of satellite).

# *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. 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 dioxide, which are the result of coal burning process, 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 $120^{0}$C, 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 dates 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

Bharat Coking Coal Ltd. (BCCL), a Public Sector Undertaking is engaged in coal mining activities in the area. As a part of its operational activity, BCCL is monitoring the existing fire locations in the area and also their relative movement with time. Additionally, BCCL funds several activities to monitor and map the dynamic nature of the coal fires. In this regard, several satellite-based research works were taken up for mapping the coal fire in last two decades in the area (Chatterjee, 2006; Chatterjee et al., 1996; Martha et al., 2010; Reddy et al., 1993). These projects were funded and supported by BCCL. 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 data for 2001 over Raniganj coalfield, West Bengal. Further another project was executed in 2006, in which coal fire of the Jharia Coalfield was mapped for 2003 and 2006, using ETM+ and ASTER data, respectively. In the last decade, three similar projects were executed by NRSC in 2012, 2017 and 2020 to map the coal fire and land subsidence.

The current project is based on the letter (Ref. no. BCCL/GM(JMP)/File-2022/283) from General Manager (JMP), BCCL addressed to Director, NRSC on the 30 of September 2022 with a request to take up Coal fire and Land Subsidence study of the Jharia Coal Field using space-borne remote sensing techniques and to report the status of the same for the year 2022, 2023 and 2024 (three years). The project was initiated on 18-05-2023.

### 1.2 Objectives

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

- To map the coal fire in the study area based on pixel integrated relative radiant temperature derived Landsat-8/9 Thermal data as on 2022, 2023 and 2024.
- To compare the change in the coal fire distribution in the Jharia coalfield within the period of 2020, 2022, 2023 and 2024.
- To identify the land subsidence zones in Jharia coalfield, Jharkhand using microwave data.

### 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 approximately within latitudes 23° 42' N and 23° 50'N and longitudes 86° 09'E and 86° 30'E.

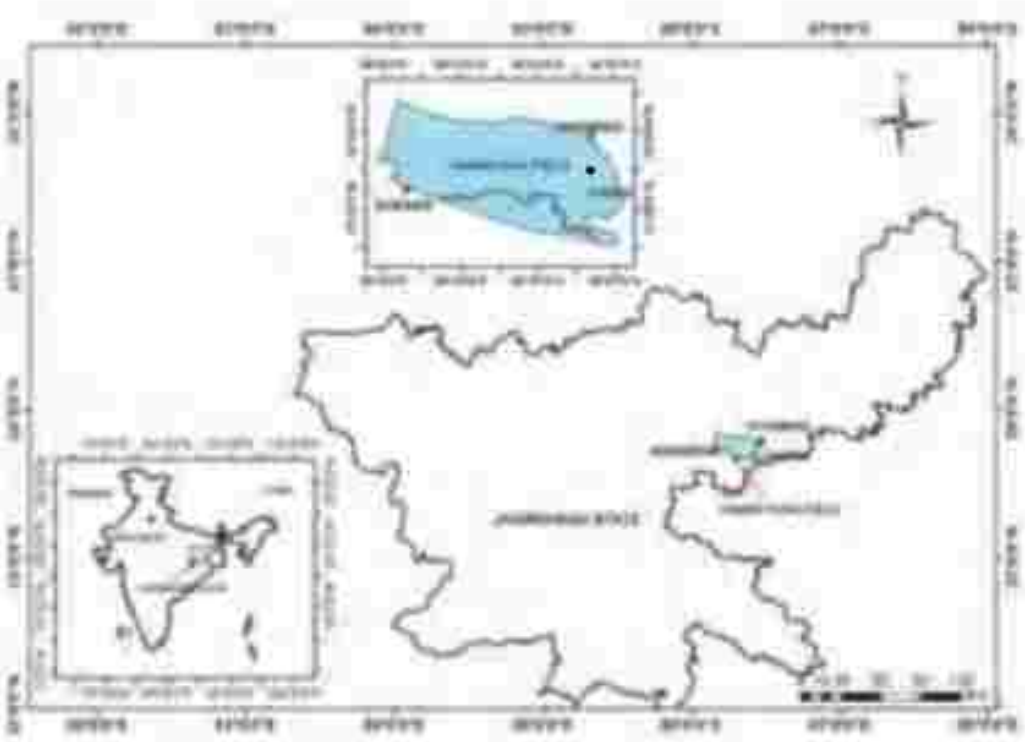

Figure 1: Study area map of Jharia Coalfield, Jharkhand.

# *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 –10° C in the month of December – January and maximum temperature is –50° C in the month of May – June.

### 2.3 General Geology

Gondwana Super Group 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 in and around the northern part of Jharia coalfield. 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.

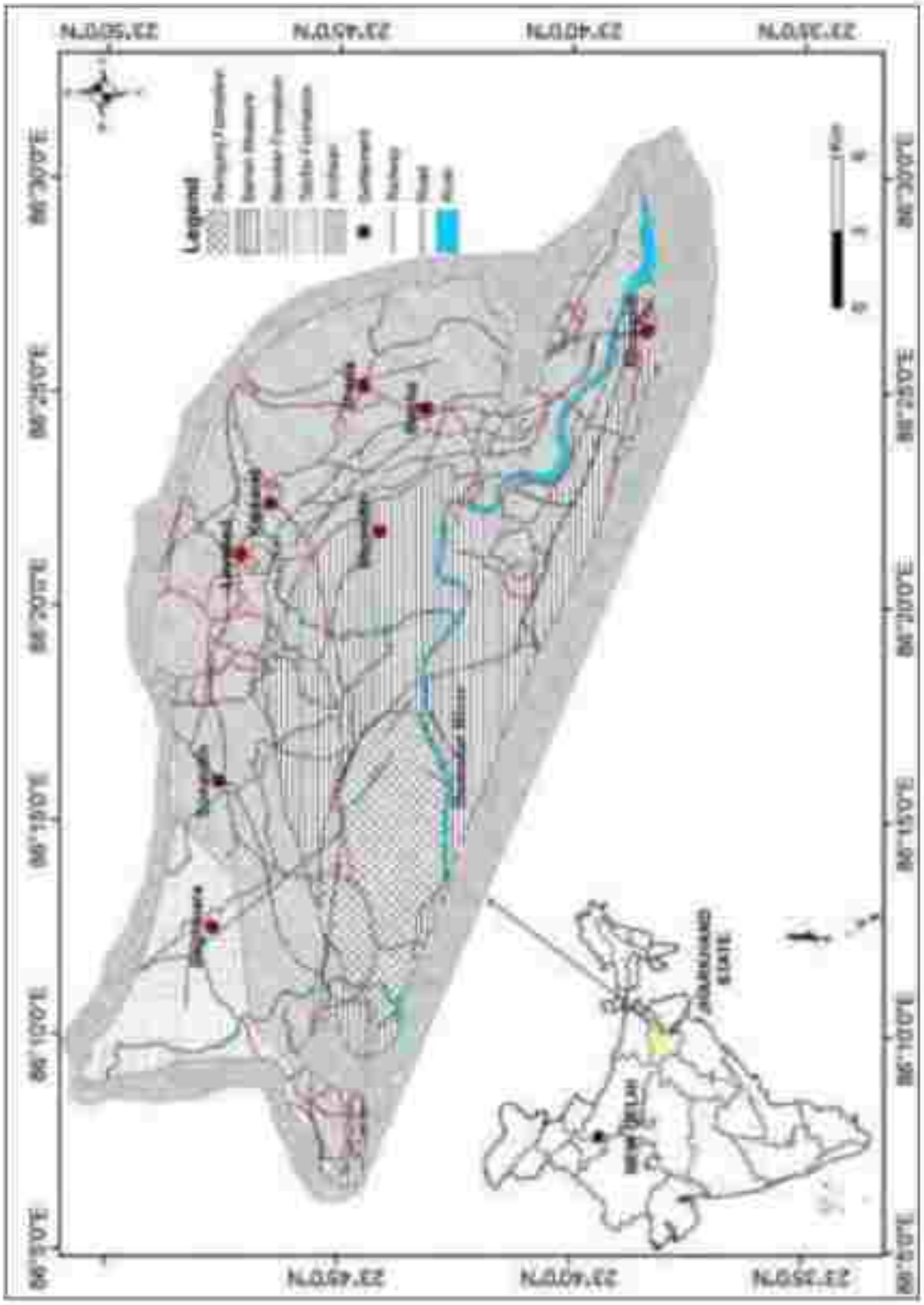


Figure 2 : Geological map of Jharia coal field, Dhanbad, Jharkhand (Source: NGDR).

# *CHAPTER III*

## DATA REQUIREMENTS

### 3.1 Remote Sensing Data

Coal fire map was created from three years period from 2022 to 2024 using Landsat bands details of which are provided in the table 2. A comparative analysis was carried out for each year based on the previous year and 2020 coal fire map prepared by NRSC from the Landsat 8 TIRS bands.

For the land subsidence study, L-band microwave data from ALOS-PALSAR satellite (JAXA) were used. Seven scenes of "Fine Beam mode" SLC data were taken from PALSAR-2 archives over a period from February, 2021 to February, 2024. 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.

| Satellite | Sensor | Resolution | Time | Date | Data source |
|---|---|---|---|---|---|
| Landsat-8 | TIRS 1/2 | 100m | Daytime | 28 November 2022 | USGS, USA |
| Landsat-9 | TIRS 1/2 | 100m | | 12 December 2023 and 03 December 2024 | |
| | NIR | 30m | | | |
| | SWIR 1/2 | 30m | | | |
| ALOS | PALSAR-2 (Fine Beam mode) | 10 m | NA | 27 February 2021 | JAXA, Japan |
| | | | | 11 November 2021 | |
| | | | | 26 February 2022 | |
| | | | | 10 November 2022 | |
| | | | | 25 February 2023 | |
| | | | | 07 December 2023 | |
| | | | | 24 February 2024 | |

| Landsat Satellite Bands | Wavelength (um) |
|---|---|
| NIR | 0.85 – 0.88 |
| SWIR 1 | 1.57 - 1.65 |

| | |
|---|---|
| SWIR 2 | 2.11 – 2.29 |
| TIRS 1 | 10.6 – 11.19 |
| TIRS 2 | 11.5 – 12.51 |
| PALSAR-2 Frequency/ Wavelength: 1.27 Ghz / 23.62cm | |

**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 for fire zones identification and field verification

### 4.1.1 Processing of Landsat TIRS band Data

Since the launch of Landsat 4/5 satellite and subsequent launch of other Landsat 7/8/9 has made space borne thermal data available through its thermal infrared sensor (TIRS) bands. 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-8/9 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 (Gangopadhyay et al. 2012). In present study, band 10 of TIRS sensor with the details of acquisition provided in table 2 has been used for coal fire mapping. 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-8/9 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.

$$L_\lambda = M_L Q_{cal} + A_L \quad \ldots\ldots (1)$$

Where:

$L_\lambda$ = Spectral radiance (Watts/ ($m^2$ * 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 ($L_\lambda$) for Landsat-8/9 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 literature (Gupta, 2003).

$$T_B = K_2 / \ln ((K_1 / L_\lambda) + 1) \quad \ldots\ldots (2)$$

$T_B$ = Radiant (brightness) temperature,

$K_1$ = Calibration constant (1260.56 K),

$K_2$ = Calibration constant (666.09 watts/ ($m^2$ *srad*μm)),

$L_\lambda$ = Spectral radiance

**4.1.2 Thresholding of radiant temperature image**

Once the Landsat-8/9 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-8/9, 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-8/9 data used in this study, the cut-off temperature was determined for individual years from its respective Landsat images which came around 30.5°C for 2023 and 28°C for 2024 as shown in figure 4.

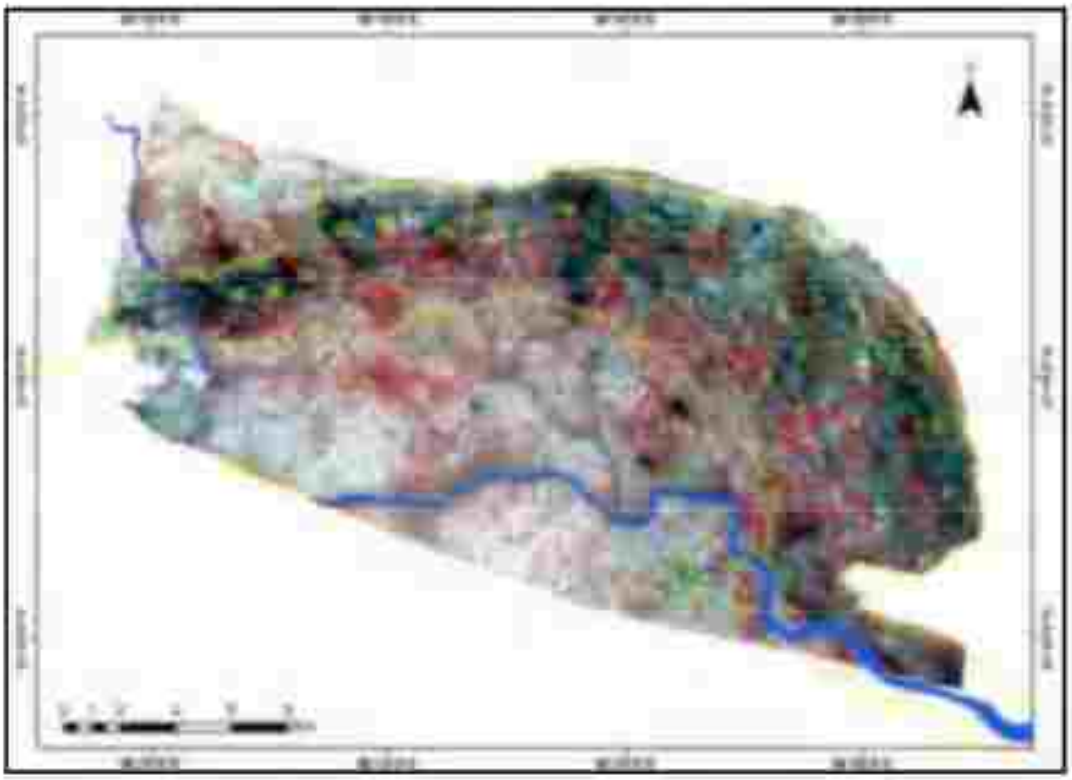

Figure 3. False colour composite image of Jharia Coalfield, with subset blocks (in red boxes) to obtain temperature values (from radiant temperature image) within the Barakar formation across the Jharia coalfield.

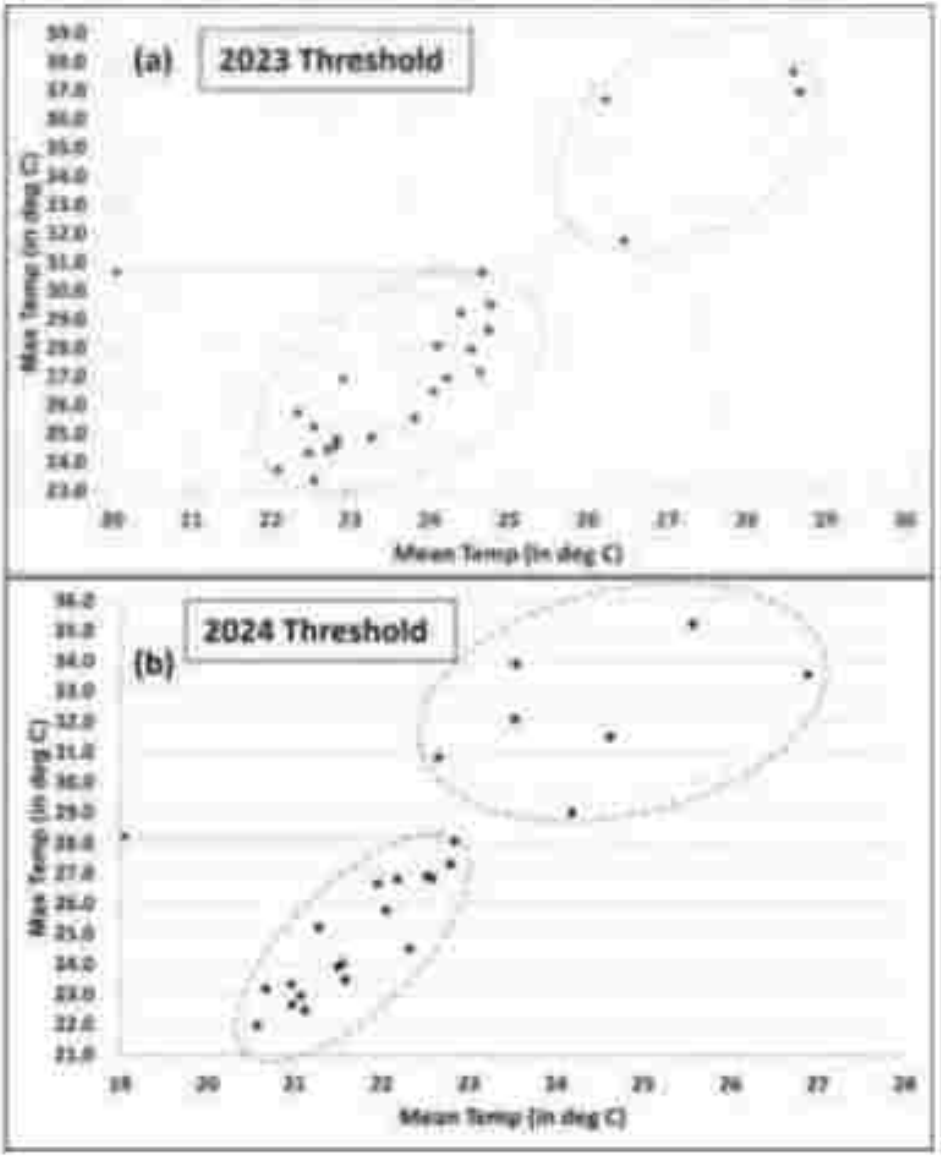


Figure 4. Maximum temperature plotted against mean temperature for various locations for 2023 and 2024; cluster separation observed around (a) 30.5°C for 2023 and (b) 28°C for 2024 (marked with arrow).

**4.1.3 Medium-Resolution SWIR/NIR-based fire area identification.**

The SWIR 1, 2 and NIR bands of Landsat-9 data for the year 2023 and 2024 were considered to detect small size coal fires that weren't identified through the Radiant Temperature as the TIRS band resolution is 100m. Based on Wein's displacement law distribution of energy, particle with higher energy emits radiation with peak at higher wavelengths hence the DN values for SWIR and NIR bands for fire pixels will look darker compared to the surrounding areas and when set to fire colour composite with

SWIR-2, SWIR-1 and NIR combination can be identified as red or orange pixels from the image. The cluster of pixels was then digitized manually.

### 4.1.4 Surface Fire Temperature estimation using Thermal Sensor

The validation of the surface fire temperature estimated from the satellite platforms was carried out using handheld thermal infrared imager which captured heat map of an area and provided approximate surface temperature and temperature difference using inverse square law. Important details of the instrument are given in the table 3.

Table 3: Details of the handheld thermal infrared imager.

| Description | Value |
|---|---|
| Make | Fluke |
| Model | Ti 300 |
| Detection type | Infrared / emitted radiation |
| Operating wavelength | 8-14 µm |
| Field of View (H * V) | 24 * 17 deg |
| Temperature measuring range | -20 to +650 deg C |
| Accuracy | ±1 deg C |

The images are captured by aiming the instrument (Figure 5) at the specific spot and taking a snap of the area. The captured thermal images during the field work were taken by reaching the closest proximity of the pre-field identified areas. The captured image gives details of the fire temperature at that spot. The optical image is also captured by the instrument along with the thermal image of a focused area.

Figure 5: Left image shows the front portion and right image shows the rear portion of the Fluke Ti300 hand held thermal imager.

### 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).

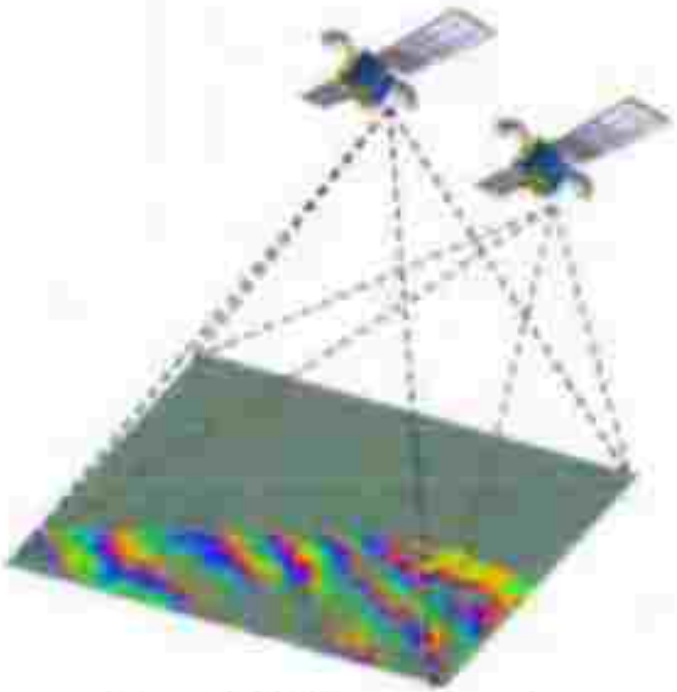

Figure 6. DInSAR acquisition scheme.

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.

$$\Delta\Phi dif = \Phi ErrorTopo + \Phi Mov + \Phi Atm + \Phi Noise \quad (4)$$

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 improvement 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 (Carnec et al., 1996; Bürgmann et al., 2000).

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

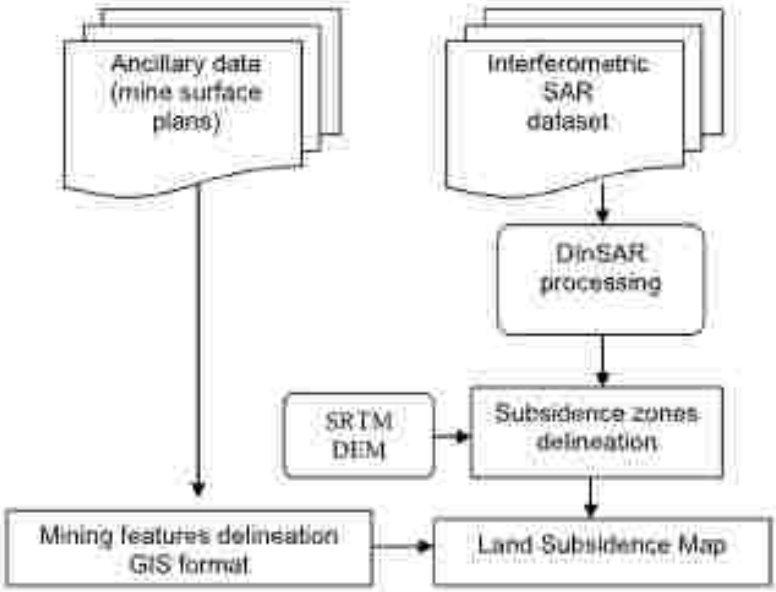


Figure 7. Work flow diagram for generating land subsidence map using DInSAR technique.

**4.2.2 Identification of subsidence zones through processed Interferograms**

In the present study, 7 sets of ALOS-PALSAR L-band microwave data (as mentioned in table 1) were procured. The datasets were paired into master-slave pairs. The interferograms for the long temporal baselines include data pairs of time difference of ~ one year were produced. The short temporal baselines could not be carried out due to satellite offset. The figure 8 shows the interferograms pairs produced.

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

The master-slave pairs of long temporal baseline (approximately one year as shown in figure 8) will incorporate terrain changes due to mining activities as well, as long-term ground subsidence from underground mining, settling of old Overburden dump and subsidence due to mining. The figure 9 shows an example of the identifiable subsidence area through the interferogram.

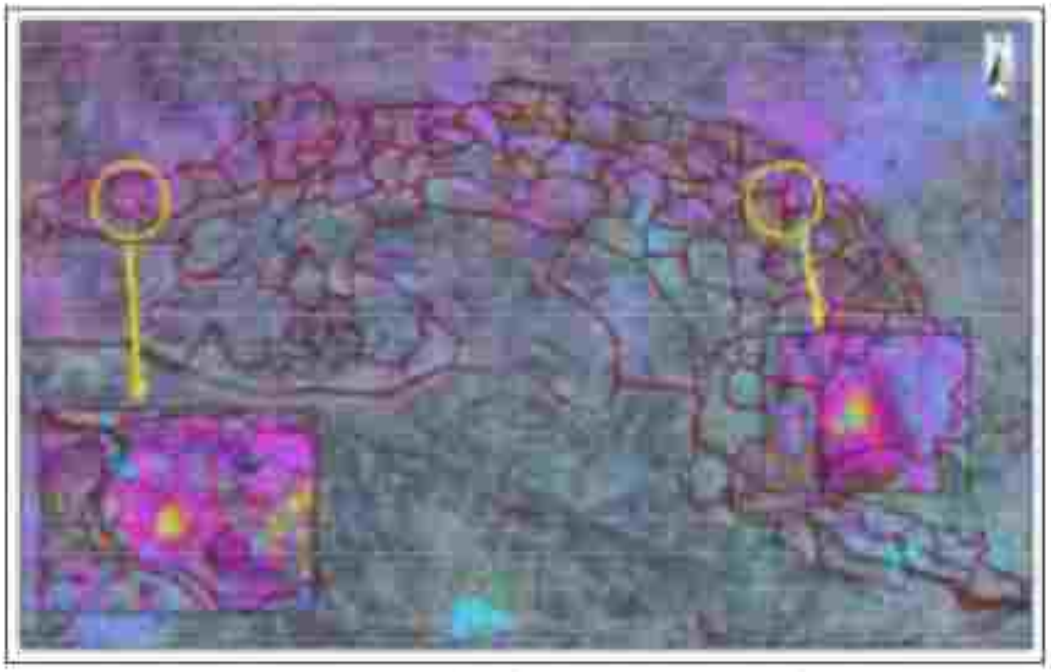

Figure 9: Fringe patterns generated from long baseline processing (e.g. Master: 26 February 2022 Slave: 27 February 2021).

The results from the long 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. Using this, a subsidence map of the Jharia Coalfield was generated.

## *CHAPTER V*

## FIELD WORK

Field work for verification of the coal fire locations for 2023 and 2024 and the subsidence points generated from 2022 to 2024 as identified by the satellite data was carried out from 15 to 18 December 2023 and 22 to 25 February 2025, respectively. NRSC further independently and physically verified both the coal fire and the subsidence locations. A total of 53 coal fire points for 2023, 54 coal fire points and 30 subsidence locations for 2024 were identified from the satellite data analysis (figure 10-11). The surface temperature for the coal fire areas was captured using the handheld sensor. Specific evidence of subsidence around the active mine areas and old Overburden dumps was identified to verify the subsidence map, which is shown in the result section.

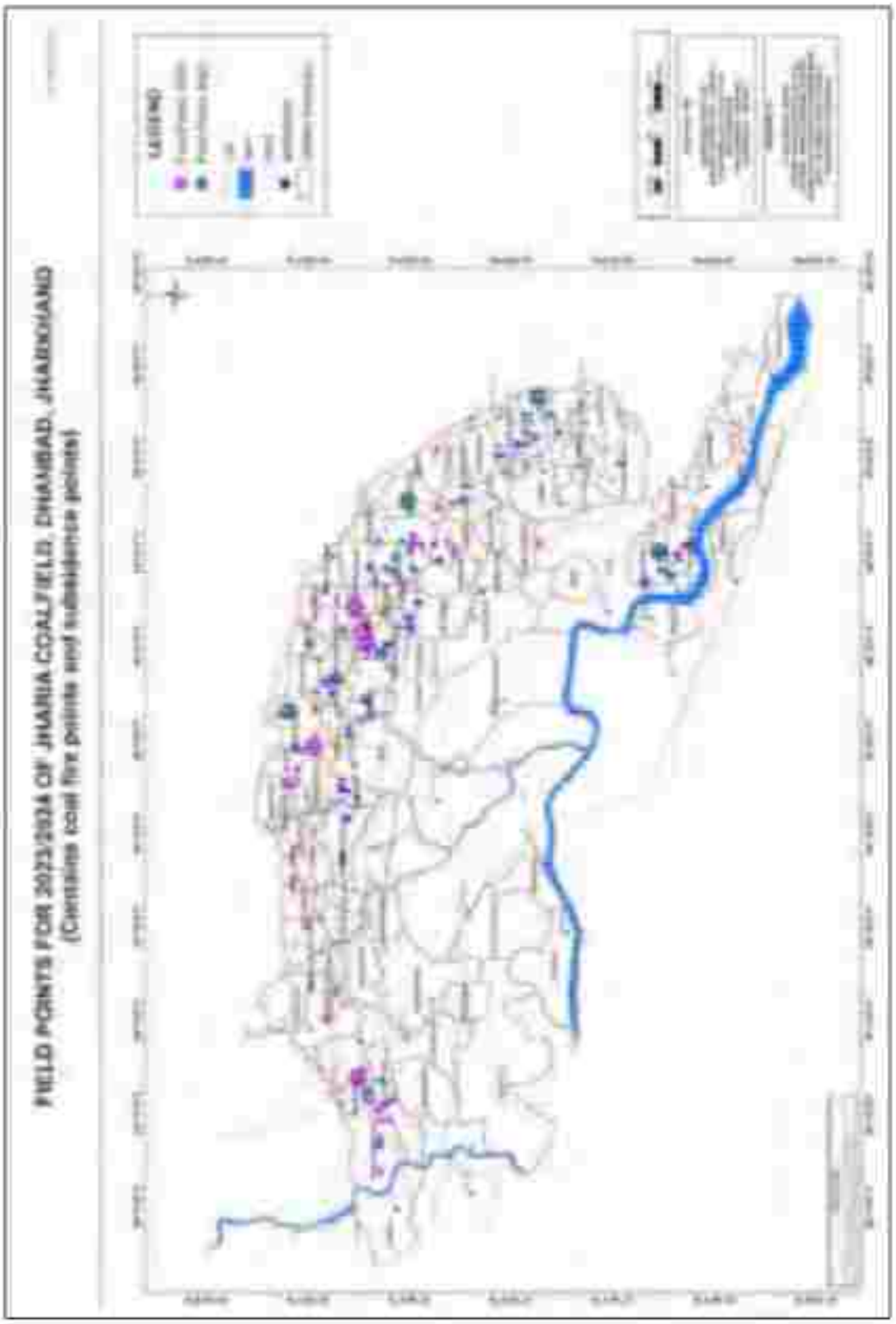


Figure 10. Field data points for coal fire and subsidence (only for 2024) verification for 2023 and 2024.

*Fire location observations:*

1. The 100+ fire locations were visited during the field for 2023 and 2024; all the points were verified and classified as Overburden dump Fire and Active Mine Fire. Accordingly, the polygon associated with the field point was assigned its particular class.
2. Upon physically reaching the fire location, the fire area could easily be identified due to large fissures, cracks, carbonated rocks or through CMB, CO, CO2 gases smell, and by visible blazing fire (burning fire) in the active mining areas. For locations at a distance, the fire could be identified from the change in the refraction due to the emitting gasses or through the handheld thermal sensor.
3. Largely the extent of fire in and around large Overburden dump areas such as Kusunda, Bhowrah, Block-II, Gopalichuck, etc., identified in 2023 and 2024, have remained approximately the same as seen during the field. The blazing fire inside the active mining areas of ENA, Basjuria, Bhowrah, etc, was found only in 2024. The blazing fire locations, such as Benedih/Block-II OCP, Mudidih, etc, identified during the 2023 field visit were still persisting.
4. As shown in the results section, the fire area decreased as compared to 2023 in 2024, while based on the field observation.

*Subsidence location observations:*

1. Subsidence locations identified from the satellite data are difficult to verify in the field unless there are tell-tale signatures like large cracks or fissures on the ground, bending of the trees, or damage to anthropogenic constructions like vertical cracks on building cracks, etc.
2. Out of the 30 identified subsidence locations from the interferograms produced through the ALOS-PALSAR-2 SLC pairs of microwave data. The identified location can be categories into three categories as; old Overburden dump regions, new Overburden dump regions and active mining area or edge of the active mining area.
3. The two main areas of subsidence, as seen from Figure 9, where subsidence is occurring on a pervasive scale, were identified in the old Overburden dump area of Nudkhurkee OCP and the old Overburden dump area of Dhansar,

where the bending / slanting trees due to the slow settling of the dumped material could be observed. Similar features to Nudkhurkee OCP old Overburden dump could be identified in the other regions of old or new Overburden dump areas; a few field photographs are shown in section 6.2.

4. The slanting trees and cracks on the ground could be identified at the edge of the active mine regions, where at one of the identified points in the Kankanee block.
5. Three other locations where subsidence is seen from microwave data fall within the mining lease of TISCO and IISCO and, hence, are not under the purview of BCCL mining authorities.

# *CHAPTER VI*

# RESULTS

## 6.1 Coal Fire Maps and Mine-Wise fire area statistics

The Landsat images of 2022 to 2024 used to prepare the coal mine fire area maps to indicate thermal anomalies as identified through a 100m spatial resolution TIRS band and 30m spatial resolution SWIR 1/2 and NIR band. The anomalies are identified based on the surrounding areas; hence, any small fires through fissures with minor differences in temperature as compared to the surroundings go undetected, or any fire with a size lower than the detectable limit also goes undetected. A few other limitations of the methodology are mentioned in Chapter 8. The Coal fire maps, as shown in Figure 11-13 for 2022 to 2024 in comparison to previous similar studies, show the trend in shift of coal fire zones.

To understand the dynamic spatial extent of the fire pockets, a total fire area comparison between the 2020 block-wise fire area distribution and distribution for the subsequent years is shown in Table 4. The table highlights the year-on-year increment and decrement by assigning a red or green color to the cell. The red indicates an increase in the total fire area for a block as compared to the previous year, and the green indicates a decrease in the total fire area for a block as compared to the previous year. The total fire area was 1.85 sq.km, 4.54 sq.km, 5.00 sq.km, and 3.91 sq.km for 2020,2022, 2023, and 2024 respectively.

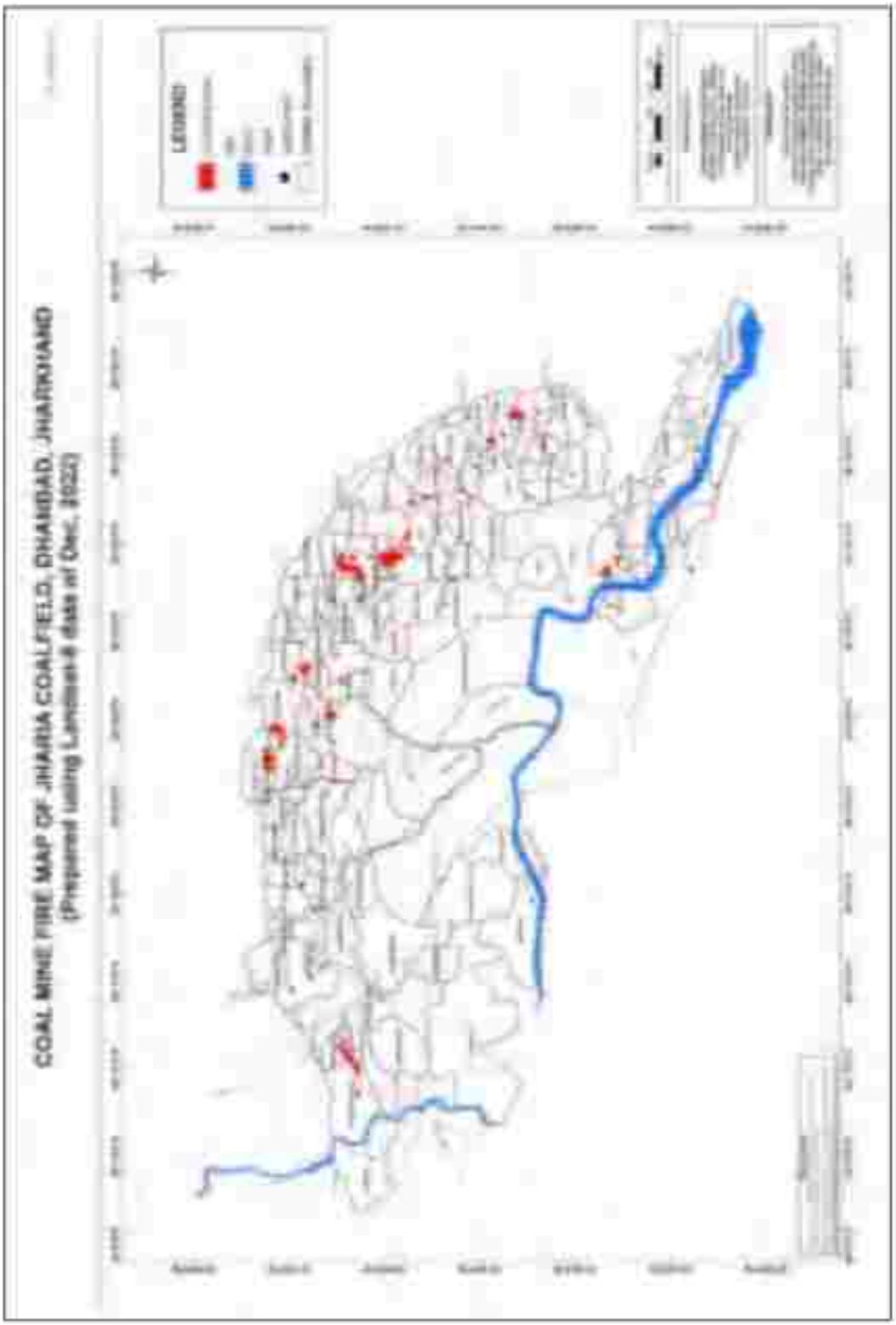


Figure 11. Coal fire map of the Jharia Coalfield (from Landsat-8 Data of Dec 2022)

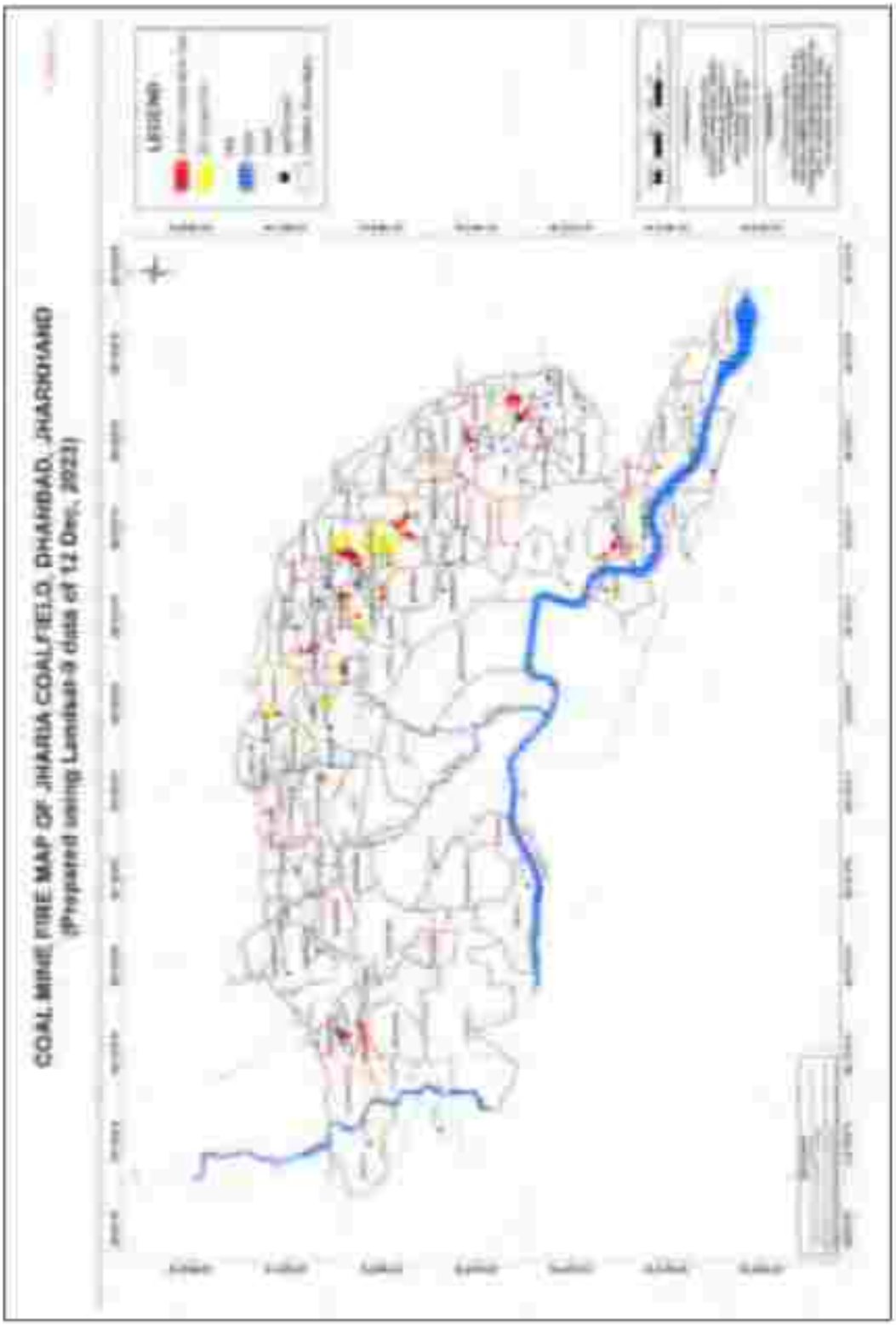


Figure 12. Coal fire map of the Jharia Coalfield (from Landsat-9 Data of Dec 2023)

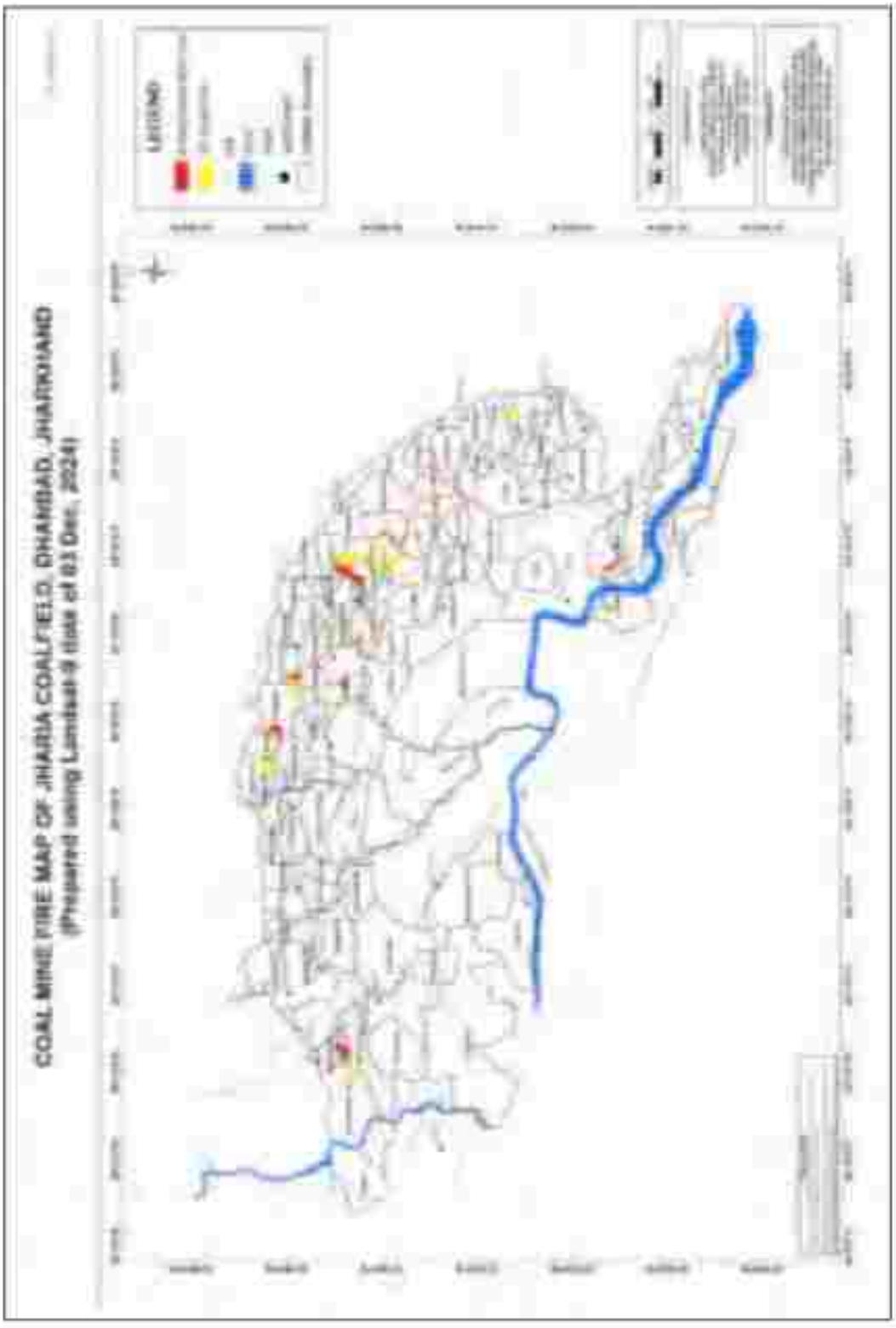


Figure 13. Coal fire map of the Jharia Coalfield (from Landsat-9 Data of Dec 2024)

Based on the figure 11 and 12, cardinal direction-wise fire zones distribution is as follows:

- For the coal fire map of 2023, the eastern side of the covering regions such as Jharia OCP, Kujama, Tisra (North and South), and Bhowrah (North and South) contains large patches of coal fire areas and regions with high increase in fire area in comparison to 2020 and 2022.
- The western side of Nudkhurkee OCP, Block-II OCP, and Benedih OCP, with fire patches covering both the active mine and Overburden dump areas, shows a shift from the northern region to the south region, which may be indicative of a shift in the mining zone. The fire patch area for the western side has remained approximately similar in comparison to 2022 but has primarily increased as compared to 2020.
- The North-Eastern side from Kusunda, Ena, covering Godhar, Alkusa till Basuria and Bansdeopur, etc., is the most significant contributor to the total coal fire area for the Jharia coal mines, with most portions seeing a significant increase in fire patches in comparison with 2022 and a very high increase in regions of Gopalichuck and Kusunda. The portion has remained the largest contributor for the years 2020 and 2022 as well.
- The Northern side from Loyabad to Katras, consisting of areas such as Sendra-Bansjora, Mudidh, Keshalipur, and Katras, sees scattered small to large fire patches of the coal fire area. The total coal fire area has slightly decreased, specifically for West Mudidh and Keshalipur, but the small patches have scattered even further in comparison to 2022.

Table 4: The tables show Year on Year mine wise comparison for total fire area for 2022-2024, where red indicates increase in fire area and green indicates decrease in fire area compared to previous year. Zero indicates no fire or fire is below the detection resolution of Landsat images.

| S.I. | COLLIERY AREA NAME | FIRE AREA 2020 (SQ. KM.) | FIRE AREA 2022 (SQ. KM.) | FIRE AREA 2023 (SQ. KM.) | FIRE AREA 2024(SQ. KM.) |
|---|---|---|---|---|---|
| 1 | AKASH KINARI | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | ALKUSHA | 0.046 | 0.073 | 0.022 | 0.066 |
| 3 | AMLABAD | 0.000 | 0.000 | 0.003 | 0.000 |

| | | | | | |
|---|---|---|---|---|---|
| 4 | ANGARAPATRA | 0.036 | 0.083 | 0.000 | 0.116 |
| 5 | BAGDIGI | 0.000 | 0.000 | 0.000 | 0.000 |
| 6 | BANSDEOPUR | 0.000 | 0.052 | 0.123 | 0.044 |
| 7 | BARAREE | 0.040 | 0.000 | 0.000 | 0.000 |
| 8 | BASTACOLLA | 0.000 | 0.080 | 0.000 | 0.023 |
| 9 | BASURIA | 0.012 | 0.000 | 0.058 | 0.032 |
| 10 | BENEDIH OCP | 0.020 | 0.256 | 0.168 | 0.208 |
| 11 | BERA | 0.000 | 0.000 | 0.000 | 0.000 |
| 12 | BHAGABAND | 0.000 | 0.000 | 0.000 | 0.000 |
| 13 | BHATDIH | 0.000 | 0.000 | 0.000 | 0.000 |
| 14 | BHOWRAH. N | 0.006 | 0.203 | 0.275 | 0.196 |
| 15 | BHOWRAH. S | 0.023 | 0.027 | 0.156 | 0.013 |
| 16 | BHURUNGIA | 0.000 | 0.000 | 0.000 | 0.000 |
| 17 | BLOCK-II OCP | 0.034 | 0.065 | 0.285 | 0.086 |
| 18 | BULLIHARY | 0.000 | 0.003 | 0.000 | 0.000 |
| 19 | BURRAGARH | 0.000 | 0.000 | 0.000 | 0.000 |
| 20 | CHANDAN OCP | 0.000 | 0.000 | 0.000 | 0.000 |
| 21 | DAMODA | 0.000 | 0.000 | 0.000 | 0.000 |
| 22 | DHANSAR | 0.000 | 0.000 | 0.000 | 0.000 |
| 23 | DHARAMABAND | 0.000 | 0.000 | 0.000 | 0.000 |
| 24 | DOBARI | 0.000 | 0.000 | 0.000 | 0.000 |
| 25 | E. BASURIA | 0.000 | 0.000 | 0.000 | 0.000 |
| 25 | E. KATRAS | 0.000 | 0.000 | 0.000 | 0.000 |
| 26 | E.BHUGGATDIH | 0.020 | 0.054 | 0.053 | 0.024 |
| 27 | ENA | 0.004 | 0.115 | 0.335 | 0.203 |
| 28 | GASLITAND | 0.156 | 0.079 | 0.018 | 0.009 |
| 29 | GODHAR | 0.132 | 0.299 | 0.353 | 0.374 |
| 30 | GOLUCKDIH | 0.000 | 0.051 | 0.062 | 0.022 |
| 31 | GONDUDIH | 0.000 | 0.000 | 0.000 | 0.013 |
| 32 | GONHOODIH | 0.001 | 0.029 | 0.000 | 0.000 |
| 33 | GOPALICHUCK | 0.000 | 0.082 | 0.255 | 0.107 |
| 34 | GOVINDPUR | 0.000 | 0.000 | 0.000 | 0.000 |
| 35 | HURRILADIH&STD | 0.000 | 0.000 | 0.000 | 0.000 |
| 36 | IISCO | 0.000 | 0.000 | 0.000 | 0.000 |
| 37 | INDUSTRY | 0.000 | 0.000 | 0.000 | 0.000 |
| 38 | JEALGORA | 0.000 | 0.000 | 0.000 | 0.000 |
| 39 | JEENAGORA | 0.000 | 0.000 | 0.000 | 0.000 |
| 40 | JOGIDIH | 0.000 | 0.000 | 0.000 | 0.000 |
| 41 | JOYRAMPUR | 0.011 | 0.000 | 0.000 | 0.000 |
| 42 | KANKANEE | 0.057 | 0.084 | 0.140 | 0.090 |
| 43 | KATRAS-CHOITUDIH | 0.214 | 0.090 | 0.067 | 0.038 |
| 44 | KENDUADIH | 0.001 | 0.133 | 0.158 | 0.110 |
| 45 | KESHALPUR | 0.134 | 0.232 | 0.040 | 0.177 |
| 46 | KHARKHAREE | 0.000 | 0.000 | 0.000 | 0.000 |
| 47 | KHAS KUSUNDA | 0.000 | 0.000 | 0.000 | 0.000 |
| 48 | KORIDIH BLOCK- | 0.000 | 0.000 | 0.000 | 0.000 |

| | | | | | |
|---|---|---|---|---|---|
| | IV OCP | | | | |
| 49 | KUJAMA | 0.000 | 0.026 | 0.123 | 0.029 |
| 50 | KUSTORE | 0.014 | 0.033 | 0.039 | 0.021 |
| 51 | KUSUNDA | 0.399 | 0.858 | 1.030 | 0.711 |
| 52 | KUYA | 0.000 | 0.000 | 0.000 | 0.000 |
| 53 | LODNA | 0.000 | 0.000 | 0.000 | 0.000 |
| 54 | LOHAPATTY | 0.000 | 0.000 | 0.000 | 0.000 |
| 55 | LOYABAD | 0.000 | 0.006 | 0.003 | 0.000 |
| 56 | MADHUBAND | 0.000 | 0.000 | 0.000 | 0.000 |
| 57 | MAHESHPUR | 0.000 | 0.000 | 0.000 | 0.000 |
| 58 | MOONIDIH PROJECT | 0.000 | 0.000 | 0.000 | 0.000 |
| 59 | MUDIDIH | 0.220 | 0.197 | 0.194 | 0.109 |
| 60 | MURAIDIH OCP | 0.006 | 0.000 | 0.000 | 0.009 |
| 61 | MURULIDIH | 0.000 | 0.000 | 0.000 | 0.000 |
| 62 | MURULIDIH 20/21 PIT | 0.000 | 0.000 | 0.000 | 0.000 |
| 63 | N. TISRA | 0.031 | 0.097 | 0.123 | 0.041 |
| 64 | NICHITPUR | 0.000 | 0.000 | 0.000 | 0.000 |
| 65 | NUDKHURKEE OCP | 0.000 | 0.400 | 0.039 | 0.154 |
| 66 | PATHERDIH | 0.000 | 0.000 | 0.000 | 0.000 |
| 67 | PHULARITAND | 0.000 | 0.000 | 0.000 | 0.000 |
| 68 | POOTKEE | 0.000 | 0.000 | 0.000 | 0.000 |
| 69 | RAMKANALI | 0.000 | 0.011 | 0.000 | 0.016 |
| 70 | S. JHARIA-R. OCP | 0.010 | 0.005 | 0.085 | 0.020 |
| 71 | S. TISRA | 0.021 | 0.210 | 0.367 | 0.157 |
| 72 | S.GOVINDPUR | 0.000 | 0.000 | 0.000 | 0.000 |
| 73 | SALANPUR | 0.000 | 0.000 | 0.000 | 0.000 |
| 74 | SENDRA-BANSJORA | 0.110 | 0.350 | 0.152 | 0.248 |
| 75 | SHATABDI OCP | 0.005 | 0.000 | 0.000 | 0.000 |
| 76 | SIMLABAHAL | 0.000 | 0.000 | 0.000 | 0.000 |
| 77 | SITANALA | 0.000 | 0.000 | 0.000 | 0.000 |
| 78 | SUDAMDIH | 0.000 | 0.000 | 0.000 | 0.000 |
| 79 | TASRA-IISCO | 0.000 | 0.000 | 0.000 | 0.000 |
| 80 | TETULMARI | 0.011 | 0.000 | 0.232 | 0.253 |
| 81 | TETURIA | 0.000 | 0.000 | 0.000 | 0.000 |
| 82 | TISCO | 0.000 | 0.000 | 0.000 | 0.004 |
| 83 | W. GODHAR | 0.000 | 0.000 | 0.000 | 0.002 |
| 84 | W. MUDIDIH | 0.085 | 0.265 | 0.050 | 0.192 |
| | **Total** | **1.85** | **4.54** | **5.00** | **3.91** |

The classification of the coal fire area was based on field observation of whether the fire existed in the open cast mining areas/ old mining areas or the overburden dump of the active mine area. The larger patches of anomalies identified

by the Landsat images were meticulously separated from mine fires or Overburden dump fires after the field. The classified maps of 2023 and 2024 are shown in Figures 12 and 13. The spatial extent statistics and block-wise fire distribution for the separate classes of mine fire and Overburden dump fire for 2023 and 2024 are also shown in Tables 5 and 6, respectively. The bar graph-based statistical figure for block-wise increment and decrement of the fire area of the two classes is shown in Figures 14 and 15.

Table 5: Mine-wise area under coal fire classified in two classes of mine fire and Overburden dump fire for 2023 (grey cells in the table indicate the area has no fire or the fire is below detection resolution of satellite).

| S.L | Mine Area Name | Mine Fire (sq. km) | Overburden Fire (sq. km) |
|---|---|---|---|
| 1 | ALKUSHA | 0.020 | 0.002 |
| 2 | AMLABAD | | 0.003 |
| 3 | BANSDEOPUR | 0.125 | |
| 4 | BASURIA | 0.058 | |
| 5 | BENEJDIH | 0.168 | |
| 6 | BHOWRAH_N | 0.161 | 0.115 |
| 7 | BHOWRAH_S | 0.023 | 0.133 |
| 8 | BLOCK II | 0.242 | 0.043 |
| 9 | E.BHUGGATDIH | | 0.053 |
| 10 | ENA | 0.307 | 0.028 |
| 11 | GASLITAND | | 0.018 |
| 12 | GODHAR | 0.199 | 0.214 |
| 13 | GOLUCKDIH | | 0.062 |
| 14 | GOPALICHUCK | 0.105 | 0.150 |
| 15 | KANKANEE | 0.089 | 0.051 |
| 16 | KATRAS | 0.056 | 0.012 |
| 17 | KENDUADIH | 0.096 | 0.062 |
| 18 | KESHALPUR | | 0.040 |
| 19 | KUJAMA | 0.125 | |
| 20 | KUSTORE | | 0.039 |
| 21 | KUSUNDA | 0.109 | 0.922 |
| 22 | LOYABAD | 0.002 | 0.000 |
| 23 | MUDIDIH | | 0.194 |
| 24 | N. TISRA | 0.015 | 0.107 |
| 25 | NUDKHURKEE | 0.002 | 0.037 |
| 26 | S. JHARIA | | 0.085 |
| 27 | S. TISRA | 0.367 | |
| 28 | BANSJORA | 0.152 | |
| 29 | TETULMARI | 0.013 | 0.219 |
| 30 | W. MUDIDIH | 0.036 | 0.014 |
| | **Total** | **2.41** | **2.60** |

Table 6: Mine-wise area under coal fire classified into two classes of mine fire and Overburden dump fire for 2024 (grey cells in the table indicate the area has no fire or the fire is below detection resolution of satellite).

| S.L | Mine Area Name | Mine Fire (sq. Km) | Overburden Fire (sq. Km) |
|---|---|---|---|
| 1 | ALKUSHA | 0.060 | 0.006 |
| 2 | ANGARAPATRA | | 0.116 |
| 3 | BANSDEOPUR | 0.021 | 0.023 |
| 4 | BASTACOLLA | | 0.023 |
| 5 | BASURIA | | 0.032 |
| 6 | BENEDIH OCP | 0.203 | 0.005 |
| 7 | BHOWRAH. N | 0.127 | 0.069 |
| 8 | BHOWRAH. S | | 0.013 |
| 9 | BLOCK II OCP | 0.040 | 0.046 |
| 10 | E.BHUGGATDIH | | 0.024 |
| 11 | ENA | 0.169 | 0.034 |
| 12 | GASLITAND | | 0.009 |
| 13 | GODHAR | 0.185 | 0.189 |
| 14 | GOLUCKDIH | | 0.022 |
| 15 | GONDUDIH | | 0.013 |
| 16 | GOPALICHUCK | 0.058 | 0.049 |
| 17 | JEENAGORA | | 0.001 |
| 18 | KANKANEE | 0.074 | 0.016 |
| 19 | KATRAS-CHOITUDIH | | 0.038 |
| 20 | KENDUADIH | 0.105 | 0.005 |
| 21 | KESHALPUR | | 0.177 |
| 22 | KUJAMA | 0.029 | |
| 23 | KUSTORE | | 0.021 |
| 24 | KUSUNDA | 0.056 | 0.655 |
| 25 | MUDIDIH | | 0.109 |
| 26 | MURAIDIH OCP | | 0.009 |
| 27 | N. TISRA | 0.012 | 0.028 |
| 28 | NUDKHURKEE OCP | | 0.154 |
| 29 | RAMKANALI | | 0.016 |
| 30 | S. JHARIA-R. OCP | 0.006 | 0.014 |
| 31 | S. TISRA | 0.033 | 0.124 |
| 32 | SENDRA-BANSJORA | 0.157 | 0.091 |
| 33 | TETULMARI | 0.130 | 0.123 |
| 34 | TISCO | | 0.004 |
| 35 | W. GODHAR | | 0.002 |
| 36 | W. MUDIDIH | 0.066 | 0.127 |
| | **Total** | **1.53** | **2.38** |

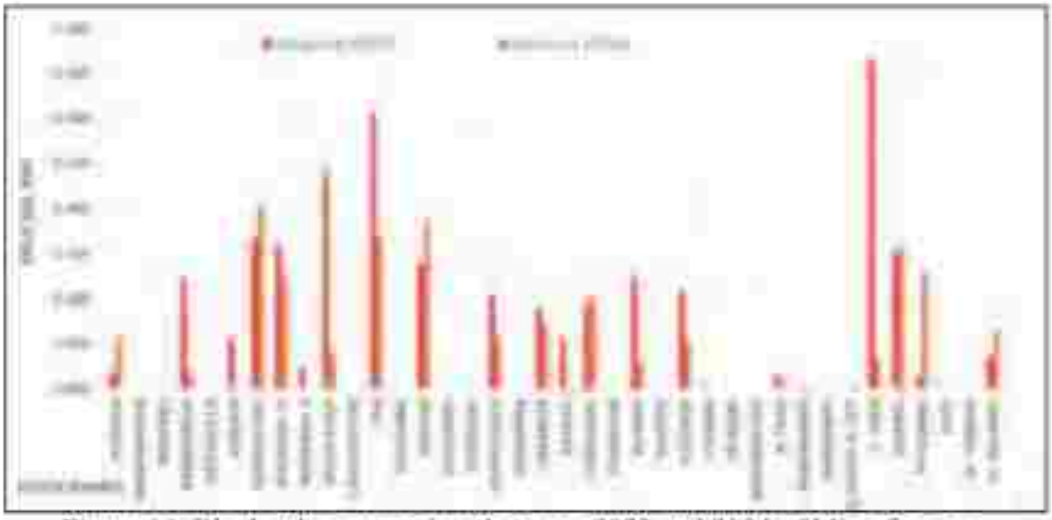

Figure 14. Block-wise comparison between 2023 and 2024 of Mine fire area.

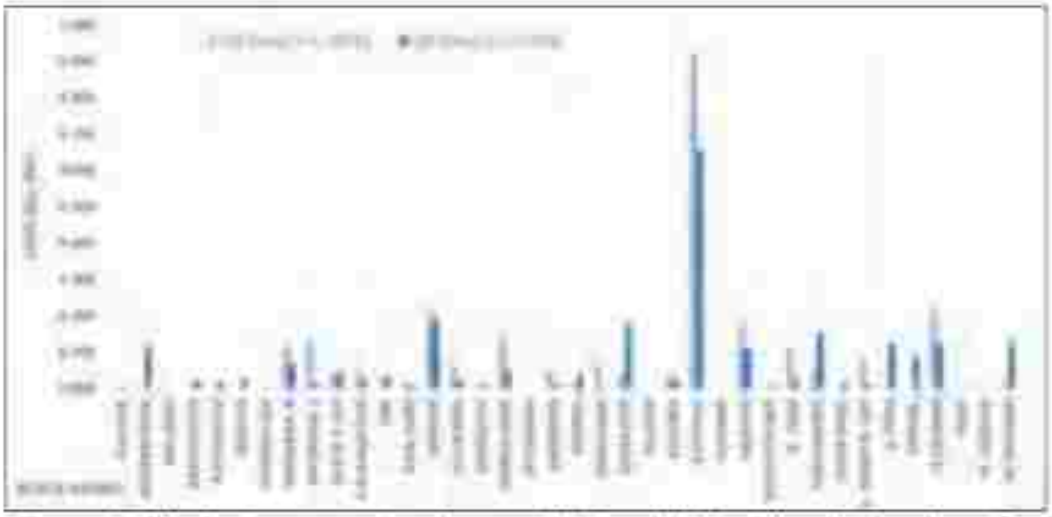

Figure 15. Block-wise comparison between 2023 and 2024 of Overburden dump fire area.

A similar cardinal direction-wise analysis of 2024 in comparison to 2023 provides a larger picture while at the same time allowing for focused analysis of the portions, with further distribution of fire area to two classes enabling us to provide further details on the regions of increasing and decreasing fire which helps the user in area-wise objective specific mitigation strategy.

- The eastern side of the mining extent has seen a significant decrease in overall fire area, number of fire patches, and specifically active mine fire from 2023 to 2024, with a significant decrease in active mine fire area for South Tisra Block, the Bhowrah active mining fire area regions and extent is approximately unchanged from 2023 to 2024.

- The western side has also seen a decrease in total fire area and active mine fire portions but an increase in the Overburden dump fire for the Nudkhurkee OCP block, which is part of a single mining area covering the Benedih OCP and Block-II OCP as well.
- The north-eastern side, while still being the highest contributor to the total fire area, has seen a slight decrease in the extent, specifically in the active mine fire areas due to Basuria and Bansdeopur blocks. At the same time, the Kusunda, Ena, and Gopalichuck portions have remained mainly similar for both classes.
- The northern portion has seen a significant increase in approximately all the parameters about coal mine fires, including the number of blazing fires in active mines; total mining area, and the extent to the two separate classes of mine fire. Although the northern portion was always the second largest contributor to the total mine fire area for the Jharia coalfield, the increase has made its contribution comparable to that of the north-eastern side, which was not observed in previous years—a large portion of Overburden dumps fire in the regions of Keshalpur, West. Mudidh and Angartapatra and the newly identified active mine fire regions of Sendra-Bansjora are the few key changes from 2023. The Overburden dump fire area of Mudidh and the active mine fire area of Kankanee have primarily remained as they were in 2023.

The ground temperature measurements for the fire area were taken for both years using the handheld thermal sensor, and the sensed temperature for a few of the Overburden dump fire and mine fire areas are shown in figures 16 and 17 for 2023 and 2024, respectively with the respective field location shown in figure 10. The surface temperature reading was taken for most of the fire locations using the handheld thermal sensor, where the Overburden dump fire temperature ranged from 100° to 5(80° C degrees. In comparison, the mine fire either contained only fissures/ cracks where the temperature ranged from 300° to 500°C or fissures/cracks along with blazing fire where the temperature was very high, surpassing the detectable limit of 650° C of the temperature for few locations.

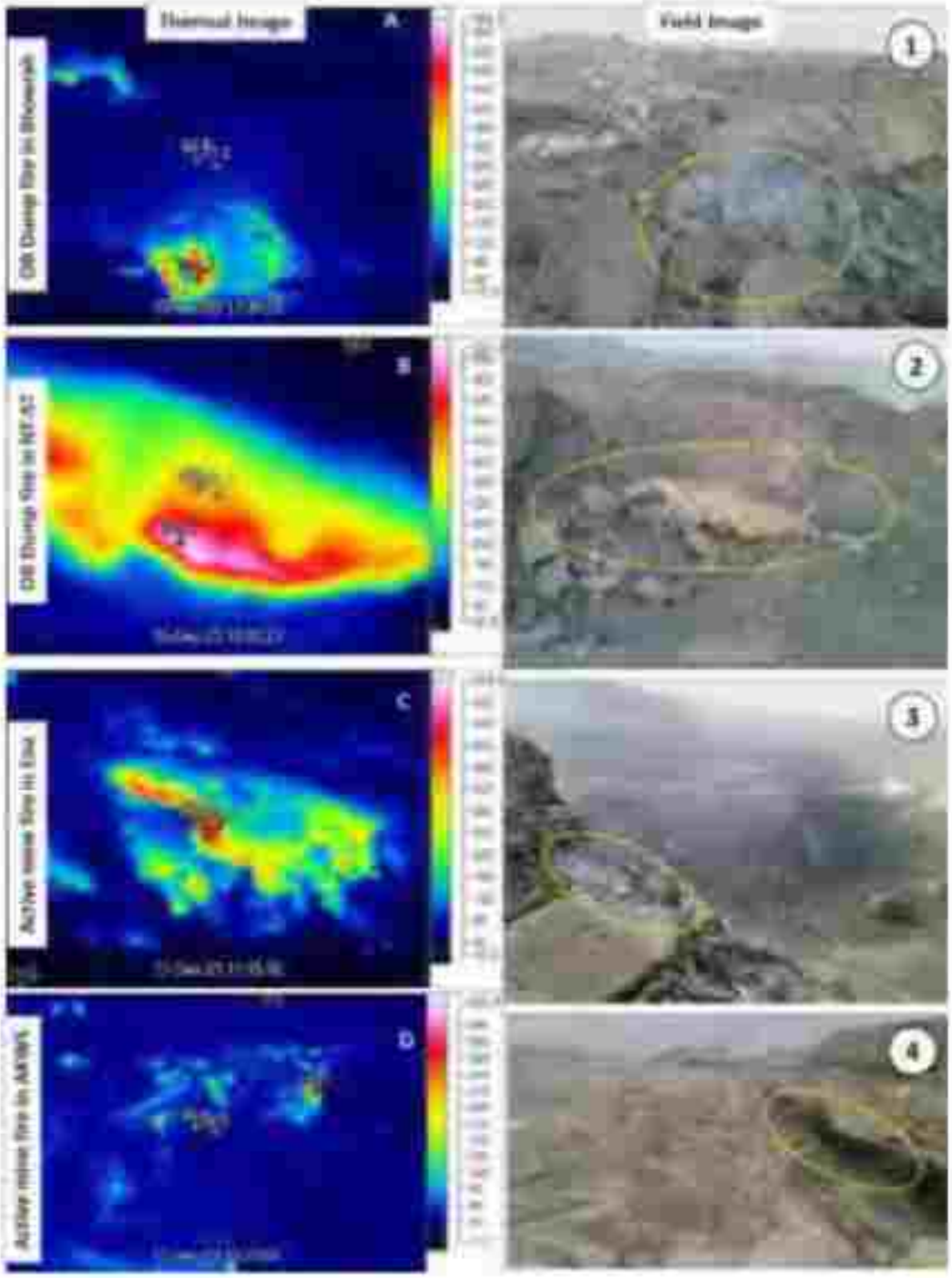


Figure 16. Thermal images and ground photographs from field survey for 2023 (yellow polygon shows the location from where thermal measurements are taken).

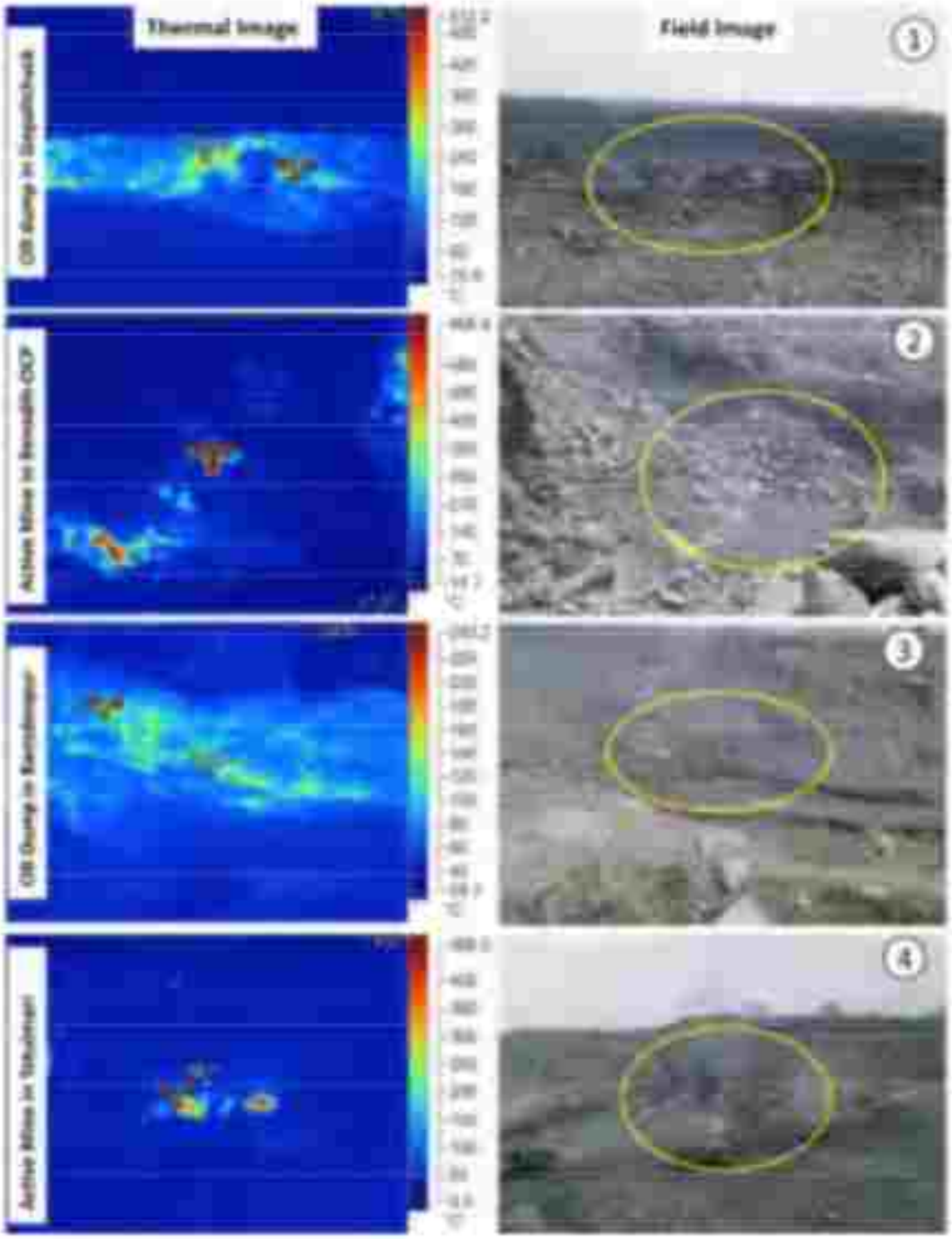


Figure 17. Thermal images and ground photographs from field survey for 2024 (yellow polygon shows the location from where thermal measurements are taken).

### 6.2 Subsidence Maps and Field images

The interferogram pair-by-pair processing for the seven acquired ALOS-PALSAR-2 L Band SLCs was carried out, and through the visual interpretation of the interferograms, the possible subsidence area was identified. The ground-based signature could be identified for the areas of Basuria, ENA, Dobari, and Nudkhurkee OCP as the bending of the treeing at the edge of the mine or settling of old Overburden dump or fall of loose material from Overburden dump areas. A few field photographs are shown in Figure 18, and the Jharia subsidence map is in Figure 19.

Figure 18. Field photographs for identified ground evidence for the subsidence areas for four different locations with (a) showing slanting trees, (b) showing falling of loose material, (c) edge of the mine slanting trees and (d) showing large crack due to mining activities.

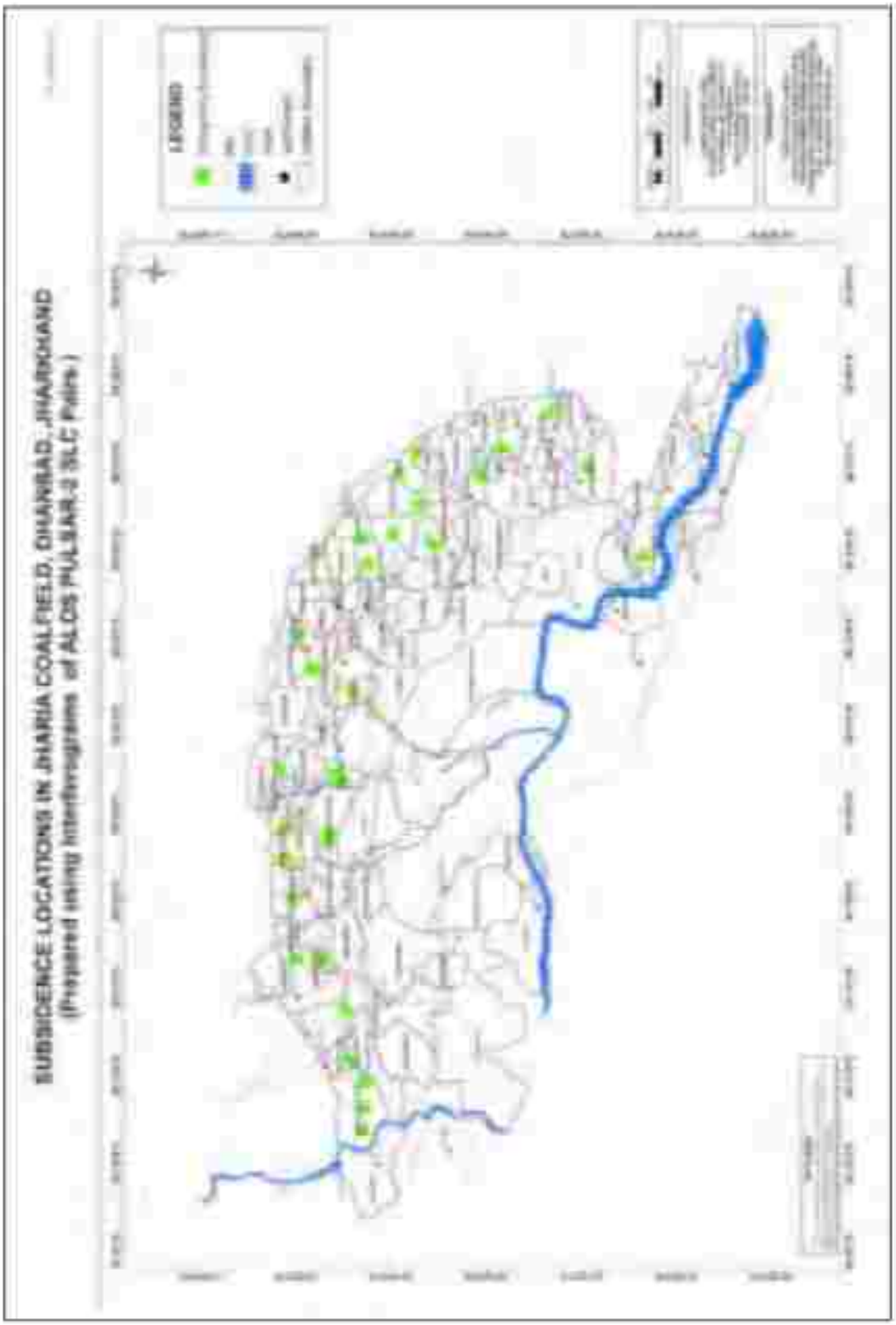


Figure 19. Subsidence map of the Jharia Coalfield (from ALOS PALSAR-2 data)

# *CHAPTER VII*

# DISCUSSION AND CONCLUSIONS

## 7.1 Discussion

### 7.1.1 Coal fire analysis

The present status of the fire in the Jharia Coal Fields for the period of 2022 to 2024 shows an increase in fire area for 2022 in comparison to 2020 (although field verification was not carried out in 2022) and an increase for 2023 in comparison to 2022 in approximately 0.5 sq. km where the cardinal direction-wise fire zones distributions were analysed in section 6.1. The identification of two classes in mine fire areas and overburden dump fire areas allowed for a deeper look into the areas of increment and decrement, which were analysed for the years 2023 and 2024, as shown in Figures 14 and 16. There is a decrease in total fire area of approximately 1.0 sq. km for 2023 and 2024 and a decrease in fire area in the two subclasses as well.

The identification of anomalous pixels from the Landsat images has changed from the previous analysis, where the coarse resolution of 100m x 100m of TIRS bands was solely used by converting it into radiant temperature through Planck's radiation function to using the fire color composite of medium resolutions of 30m x 30m bands of SWIR and NIR bands to identify the bright pixels indicative of fire along with the previous methodology. The change in the strategy has allowed for the identification of areas with fire patches covering smaller spatial extent while validating the identified areas through both methodologies for each other. As the identifiable overall resolution decreased, the total identified areas of coal fires increased, contributing to the increase in overall fire from previous years.

All the fire areas identified were field verified, and the accuracy of identification through satellite imagery is still consistently very high, strengthening the outcomes of the methodology for the identification of fire areas. The Fluke Ti300 thermal sensor provides a temperature estimate of the identified fire zones and a causative relationship between the satellite-measured temperature and the actual surface temperature.

### 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 a differential interferometric technique. Seven scenes of PALSAR-2 data spanning 2021 to 2024 were used to identify the subsidence in the region and separately identify them from the terrain changes due to mining. Verifying 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 identifying a few subsidence areas within the BCCL mine boundary. The two main areas of subsidence lie in the old Overburden dump area of Nudkhurkee OCP and the old Overburden dump area of Dhansar, while the other subsidence point lies in the active mine areas or Overburden dump areas; no subsidence was identified in the human habitation zones. No quantitative estimates of the subsidence have been carried out in the study.

## 7.2 Conclusions

The change in the areal extent of fire as identified by the Landsat images and block-wise distribution calculated for 2023 and 2024 and compared with old data of 2020 and non-verified maps of 2022, where an increase in the fire area for 2023 was majorly contributed by the north-eastern and easter sides and decrease for 2024 was due to eastern side while the central area of focus being the northern side due to substantial increase in the fire area from 2023 to 2024. The persistent coal fire zones from 2022 to 2024 in the North-eastern sides were also identified and verified during the field.

The accuracy of the generated maps, as verified from the field, was very high, and the emissative relationship between the temperature measurement from the handheld thermal sensor and the identified higher fire pixel anomalies was satisfactory, with a higher degree of anomalies relating to the higher measured temperatures on the surface. The results section also discussed the temperature range for Overburden dump areas and active mine fire areas.

No subsidence was observed in the human habitation zones, and the main areas of subsidence do not seem to have consequences of the near settlements, while

the active mining area subsidence and new Overburden dump subsidence can be of concern for the mining area personnel due to constant failure of the loose material

***Note:*** *The minimum mapable unit from satellite image is 30m by 30m or 0.0009 $km^2$. Estimations of fire extent (in terms of sq.km.) for the present study carried out for 2023-2024. They may differ from the actual ground area under fire. These estimations are made for comparative purpose only, to indicate the increase or decrease of areal extent of fire. Hence, they should not be quoted as fire area on the ground.*

## *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 for the fire area composite and 100m x 100m for TIRS bands based radiant temperature (resampled to 30m x 30m spatial resolution) 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. 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 4.1.2, 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 are 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.

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) Considering the precision of DInSAR data for different wavelengths, topographic and atmospheric errors, slow subsidence rates may not be detected. Further, the displacement measured is along the line of sight of the sensor and not vertical displacement.

8) Temporal decorrelation and noise due to adverse land use and land cover may affect DInSAR based detection and monitoring of land subsidence. Changes vegetation pattern over time can cause significant decorrelation between the master and slave image, thus producing a very low coherent output. Under such conditions, subsidence information may not be retrieved

9) 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 need 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.

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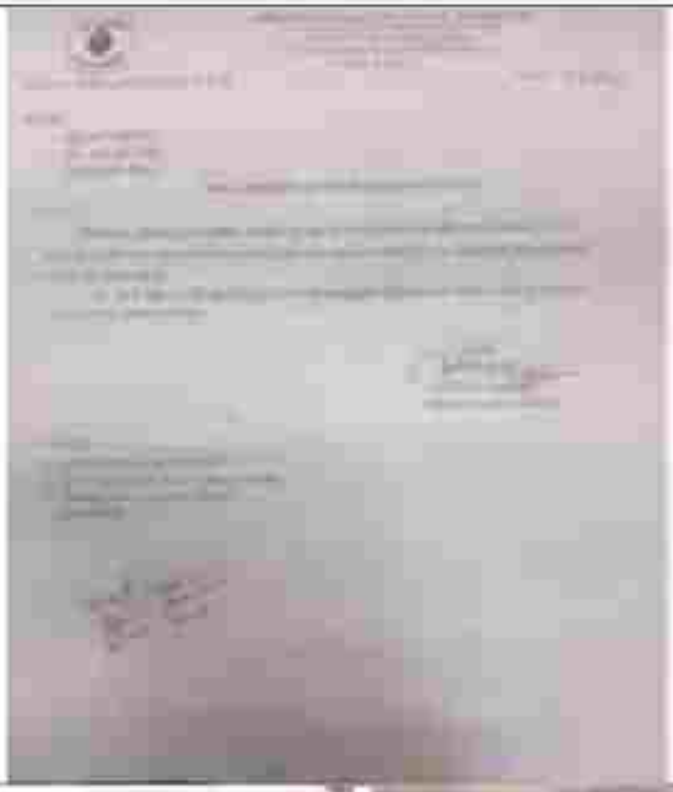
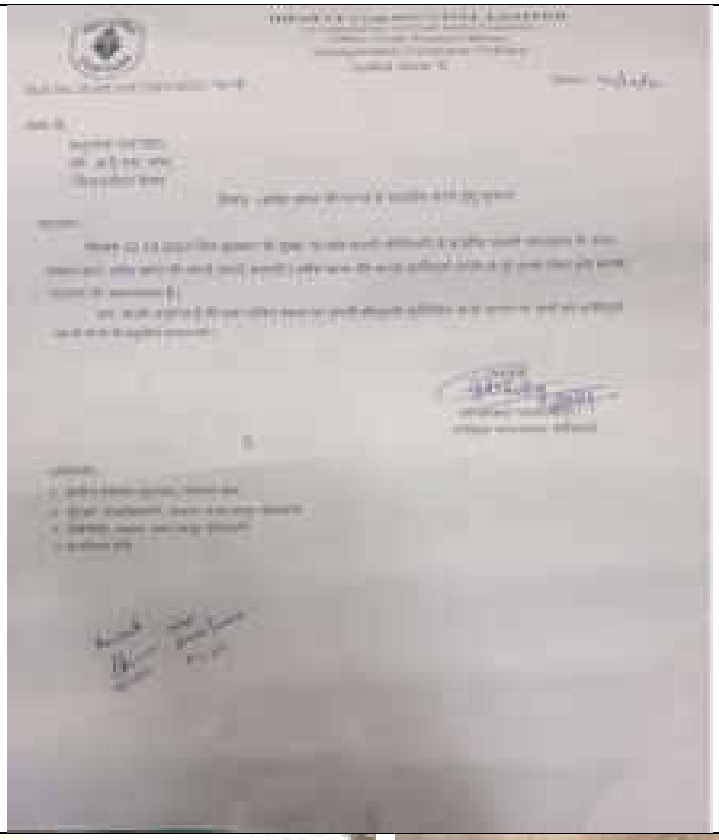
**Annexure XIV**



Water Pool Created on Sajjad Park

**Annexure XIV**



**Water Pool Created on Gokul Park**

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FOR CORPORATE ENTRY

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.

# GROUNDWATER LEVEL & QUALITY REPORT

# FOR CLUSTERS OF MINES, BCCL

**(Assessment year – 2024-25)**

**[CLUSTER – I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XIII, XIV, XV, XVI & XVII 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**

**Geology Department**

**Regional Institute-II**

**CMPDI, Dhanbad**


**MARCH – 2025**

Job no.- 200424005

# PERSONS ASSOCIATED

**Poulomi Baksi**
Manager (Geology)
Geology Department
CMPDI RI-II, Dhanbad

**Jayjit Banerjee**
Dy.Manager (Geology)
Geology Department
CMPDI RI-II, Dhanbad

**Kumar Vaibhav**
Manager (Environment)
Regional Institute - II
CMPDI, Dhanbad

**CMPDIL**
**CENTRAL MINE PLANING & DESIGN INSTITUTE**
HYDROGEOLOGY SECTION, EXPLORATION DEPARTMENT
GONDWANA PLACE, KANKE ROAD, RANCHI, JHARKHAND– 834031

(Accredited Groundwater Professional Institutions by CGWA)

(Accredited as a GWCO by QCI-NABET)

(Accredited by NABL, CMPDI, RI-II, Lab)

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**Annexure – I**

## DETAILS OF THE REPORT

| Sl No. | ITEMS | INFORMATIONS |
|---|---|---|
| 1 | Geographical Area | Jharia Coalfield (JCF): 453.0 sq. km.<br>Raniganj Coalfield (BCCL area): 19.64 sq. km. |
| 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 part. |
| 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.<br>Damodar River, Barakar River is the master drainage of the part of RCF area (CV Area). |
| 4 | Annual Rainfall (IMD-report) | Jharkhand State: 1185.40 mm (year 2024)<br>Rainfall data given in **Annexure-IV**. |
| 5 | Geological Formations | Gondwana Formation<br>(Talchir Formation, Barakar Formation, Barren Measure Formation & Raniganj Formation) |
| 6 | Aquifer System | Unconfined/Phreatic Aquifer – thickness 25 m (Avg.)<br>Semi-confined to confined Aquifer – thickness from 50 m upto 650 m |
| 7 | Hydrogeological properties (Aquifer Pump Test) | Unconfined Aquifer:<br>Hydraulic Conductivity – 0.50 - 0.90 m/day<br>Transmissivity – 10 - 42 $m^2$/day |
| | | Semi-confined to confined Aquifer:<br>Hydraulic Conductivity – 0.0006-1.44 (0.05 avg.) m/day<br>Transmissivity – 0.06 – 15.0 $m^2$/day |
| 8 | Groundwater Level Monitoring Network | Out of total 139 nos. of monitoring stations 73 nos. located within core mining area and rest comes within Buffers zone.<br>55 Nos. of Groundwater monitoring well (Dug Wells) network established by CMPDI to record groundwater level data in and around the Core Zone of JCF and 18 Nos. of Groundwater monitoring well (Dug Wells) in RCF (CV Area). |
| 9 | Groundwater Levels Below Ground Level (bgl) | JCF area:<br>Pre-monsoon – 1.70 to 11.38 m (Avg. 6.33 m bgl) in '2023-24<br>Post-monsoon – 0.60 to 8.03 m (Avg. 3.77 m bgl) in '2023-24<br>RCF area (part):<br>Pre-monsoon – 2.10 to 9.50 m (Avg. 5.22 m bgl) in '2023-24<br>Post-monsoon – 1.50 to 5.18 m (Avg. 3.06 m bgl) in '2023-24 |
| 10 | Groundwater Quality | Potable as per BIS (**Annexure- VIII**) |
| 11 | Piezometers | Piezometers (23 nos.) to monitor impact of coal mining on groundwater regime within the coalfield area (JCF & part of RCF) |
| 12 | Stage of Groundwater Development (CGWB) | Dhanbad District-Safe to Over-exploited category<br>(GWRE 2023-24) |

# GROUNDWATER LEVEL & QUALITY REPORT FOR CLUSTER OF MINES OF BCCL

## 1.0 INTRODUCTION

### 1.1 LOCATION DETAILS AND BRIEF ABOUT THE PROJECT

The 16 nos. Cluster of mines (Cluster-I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XIII, XIV, XV XVI and XVII) of BCCL is located in the Jharia coalfield in Bokaro and Dhanbad districts of Jharkhand and part of Raniganj coalfield in Dhanbad district of Jharkhand.

The area of Jharia Coalfield (JCF) is 453 sq. km. and Raniganj Coalfield (RCF part) is 19.64 sq. km. (CV area). Located about 3.0 km south-west of Dhanbad town and 10.0 km north-east of Bokaro town. The coalfield bounded by Jamunia River in the west, Damodar river in the south, and Metamorphics (hard rock) in the north and east side. **(Plate-I)**

### 1.2 OBJECTIVE OF THE STUDY:

The objective of the report is to conduct hydrogeological study by quarterly monitoring of groundwater level and quality of the Jharia coalfield and Raniganj coalfield (part) within BCCL command area for 16 Cluster of mines. The data collected shall be submitted to the MoEF&CC, CPCB & SPCB within stipulated timeframe. The work is being done yearly and required to be continued as per the specific condition mentioned invariably in Environmental Condition (EC) for all of the Clusters of BCCL.

### 1.3 SCOPE OF THE STUDY:

The following scope has been taken into account for hydro-geological investigation of the study area.

i) To monitor the groundwater levels four times/year during (May, August, Nov and Jan).
ii) To monitor the groundwater quality during May including Arsenic and Fluoride.
iii) To evaluate the status of ground water level condition in the area.
iv) To study the ground water flow direction in the mining areas.
v) To study the depth to ground water level condition in the mining areas.
vi) To study the ground water quality data and interpretation in the mining areas.

File No. 08HSDD/JRR/BCCL/ENV/0003/2018-BD Divn.-CMPDI (Computer No. 68378 )
Receipt No. - 1500852018/C/e-HEAD OF BUSINESS DEVELOPMENT, CMPDI HQ

भारत कोकिंग कोल लिमिटेड
एक मिनी रत्न कम्पनी
(कोल इण्डिया लिमिटेड की अनुषंगी)
Bharat Coking Coal Limited
A Mini Ratna Company
(A Subsidiary of Coal India Limited)
Regd Off: Koyla Bhawan, Koyla Nagar
CIN: U93101JH1972GOI000918
Environment Department

पत्र संख्या: भा.को.को.लि./पर्या./पर्यावरण(एचडी)/जलीय/18/1056-1082(अ) दिनांक : 14.06.2018

प्रेषक,
महाप्रबंधक
(जल्लार विभाग)
भा.को.को.लि. - बरवा टेक्ष तथा टोरी (झा०)-II-

Sub: For work of Ground water level and quality monitoring

महोदय,

This is with reference to earlier letter ref no: BCCL/HOD(Env)/F-Env-11/161 dated 11.02.2014 regarding conducting hydrological study by quarterly monitoring of groundwater level and quality of the study is to carried out by establishing a network of existing wells. The monitoring for quantity shall be done four times a year in pre-monsoon (May), monsoon (August), post-monsoon (November) and winter (January) season and for quality including Arsenic and Fluoride during month of May. Data thus collected shall be submitted to the Ministry of Environment & Forest and to Central Pollution Control Board/SPCB quarterly within one month of monitoring.

The above work is being done yearly and required to be continued as per the specific conditions mentioned invariably in Environment Clearance order of all clusters of BCCL.

This is for your kind information and further necessary action.

भवदीय

14/6/18

(उप-महाप्रबंधक (पर्यावरण))

Copy To:
1 महाप्रबंधक (पर्यावरण), भा.को.को.लि.-II-

## 1.4 TOPOGRAPHY AND DRAINAGE

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

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 southeasterly course and ultimately joins Damodar River - the master drainage. The drainage of the JCF is mainly controlled by Jamuniya River (5th order), Khudia nala (3rd order), Katri River (4th) and Chatkari nala (3rd 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 (***Plate-I***). 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 distributed in and around JCF, out of which one prominent lake is located at Topchanchi in the north-west part. Two reservoirs, Maithon dam on Barakar River and Panchet dam on Damodar River near to Chairch 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.

## 1.5 DETAILS REGARDING WETLANDS

A **wetland** is a distinct ecosystem that gets flooded by water, either permanently or seasonally. The primary factor that distinguishes **wetlands** from other landforms or water bodies is its characteristic vegetation (aquatic plants). Wetland are protective ecosystem as per new guidelines of CGWA & MoEF&CC. There are no Wetlands in and around the area (Jharia coalfield and Raniganj coalfield) as per the list available on official website of MoEF&CC, Govt. of India. The list enclosed as **Annexure-III**.

## 1.6 CLIMATE & 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 up to 45° C and falls between 10° C to 5° C in winter. The maximum rainfall occurs during the period between June and September. Rainfall data of IMD Dhanbad and Mine Rescue Station Dhanbad given in **Annexure-IV**.

In Jharkhand state, Daily Rainfall data from 1989 to 2018 considered for analysis of trend variability and mean rainfall patterns. From the daily rainfall data, monthly rainfall series of each station is computed and then monthly district rainfall series is constructed by considering arithmetic average of all the station rainfall values within the district. The monthly rainfall series of the state is computed by using area weighted rainfall values of all the districts within the state. The objective of the analysis is to:

1. Identify the spatial pattern of the mean rainfall
2. Understand district wise observed rainfall trend and variability in annual and SW monsoon season (June, July, August and September).

Daily station rainfall data is utilized for identification of the mean spatial patterns and rainfall intensity trends. From mean and standard deviation (SD), the coefficient of variation (CV) is calculated using following equation:

Coefficient of variation (CV) = [Standard Deviation / Mean] * 100

The analysis has done in two parts. For identification of the spatial pattern mean rainfall and variability and observed trends we have used district rainfall series and results have been brought out for four southwest monsoon months viz. June, July, August, September, for the southwest monsoon season and also for annual.

Table shows the mean rainfall (mm) and coefficient of variation of the state for the monsoon months, southwest monsoon season and annual during the period 1989-2018. It can be seen that the state gets highest rainfall (31%) of southwest monsoon rainfall in July month while the August month get 28% of the southwest monsoon rainfall. June and September receive 19% and 22% of southwest monsoon rainfall. Also more than 84% of annual rainfall receives during the southwest monsoon season only. The variability of monsoon or annual rainfall is also very less.

**Jharkhand State**

| | June | July | August | September | Sub-total | Annual |
|---|---|---|---|---|---|---|
| **Mean** | 190.3 | 313.9 | 289.2 | 225.7 | 1019.1 | 1211.4 |
| **CV** | 44.4 | 29.0 | 24.8 | 37.0 | 16.7 | 16.9 |

**Dhanbad District**

| | June | July | August | September | Sub-total | Annual |
|---|---|---|---|---|---|---|
| **Mean** | 203.9 | 327.7 | 302.5 | 271.5 | 1105.6 | 1332.2 |
| **CV** | 41.0 | 35.0 | 33.5 | 48.7 | 20.8 | 19.4 |

**Fig. 1 and 2** show the time series of rainfall in mm for the months of June, July, August and September along with southwest monsoon season and annual rainfall. The trend lines are displayed for each of the series. Neither monthly rainfall nor seasonal rainfall shows any significant increasing/decreasing trend while annual rainfall shows significant decreasing trend. The monthly rainfall during June, July, August and September as well as seasonal rainfall show decreasing trend. During the last 30 years, highest rainfall of 390.3 mm was received in June in the year 1994, 492.1 mm was received in July in the year 2017, 431.5 mm was received in August in the year 1997, while highest rainfall of 395.2 in September was received in the year 1995. Highest annual rainfall of 1567.9 mm was received in the year 1999 and highest southwest monsoon rainfall of 1364.8 mm was received in the year 1994 (Climate Research and Services, IMD, Ministry of Earth Sciences, Pune, Jan'2020).

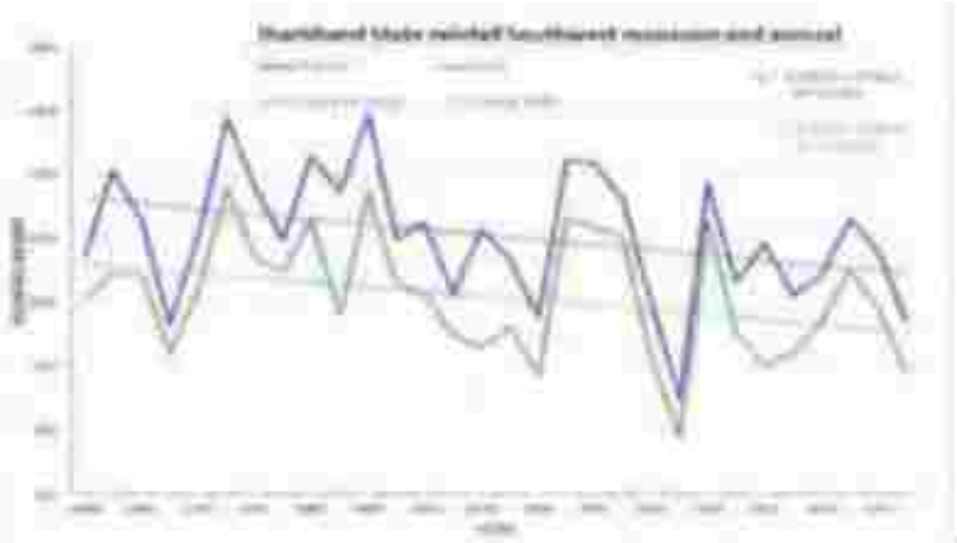


***Fig-1.***

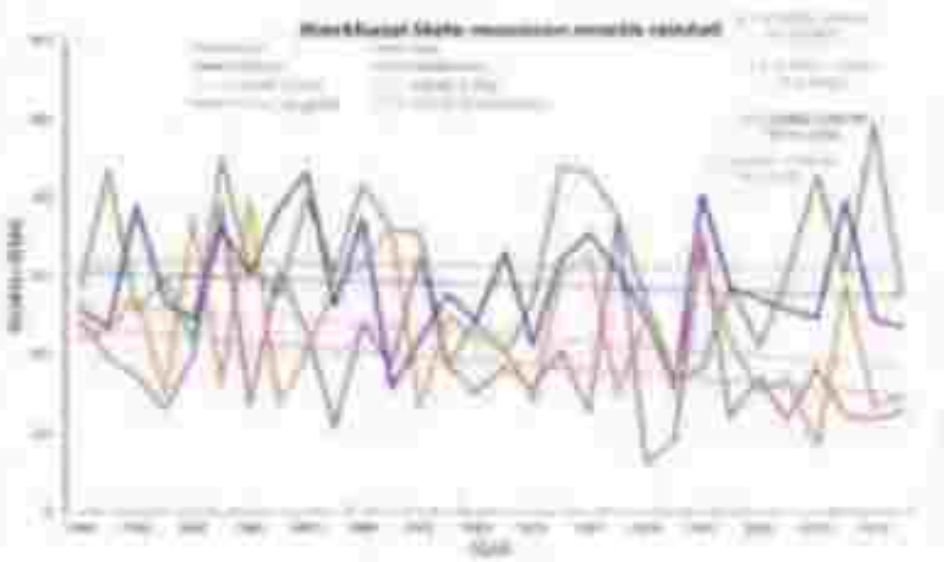


*Fig-2.*

## 2.0 GEOLOGY AND HYDROGEOLOGICAL SETUP OF THE AREA

### 2.1 REGIONAL GEOLOGY

The Jharia Coalfield covering an area of 453 sq. km. is 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 (Coal Bearing horizon) overlies the Talchir and covers the most part of the Jharia Coalfield and have an area of 218 sq. km. This is successively overlain by the non-coal bearing Barren Measures 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-west part of the Coalfield and covers an area of 54 sq. km.

Chanch-Victoria Area is located in the western part of Raniganj Coalfield. The Raniganj coalfield represents the eastern most coal basin in the Damodar Valley Region, located at the border of Dhanbad District of Jharkhand and Bardhaman District of West Bengal. The Coalfield is almost elliptical in shape and covers an area of about 1530 sq. km. Out of this, only 35 sq. km. comes under leasehold area of BCCL within 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 in **Table-1**.

**Table – 1: Regional Geological Succession of Jharia Coalfield**

| Geological Formations | | Age |
|---|---|---|
| Quaternary/Recent | Soil cover/Weathered mantle | Recent |
| Post-Gondwana | Dolerite | Upper Cretaceous |
| | Lamprophyres | Jurassic |
| Damodra Group | Raniganj Formation | Upper Permian |
| | Barren Measures Formation | Middle Permian |
| | Barakar Formation | Lower Permian |
| | Karharbari | |
| | Talchir Formation | Upper Carboniferous |
| Unconformity | | |
| Metamorphics | | Proterozoic |

## 2.2 HYDROGEOLOGICAL SET- UP

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 constitute of fine to coarse grain sandstone having primary porosity of inter-granular void space. The secondary porosity formed due to presence of faults, fracture, joints, etc. Sandstones of Gondwana formation in JCF and RCF are very hard, compact and cemented and form less potential aquifer, particularly in 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 AQUIFERS DESCRIPTION

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 varying from few meters to 50 m. This un-confined aquifer is more potential than semi-confined to confined aquifer.

### SEMI-CONFINED TO CONFINED AQUIFER

The semi-confined to confined aquifer consisting of sandstone bed is sandwiched between coal seams/shale beds and thus, multiple aquifer system developed due to presence of multiple number 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 potentiality.

**Table –2: Generalized Hydrogeological Units developed in the study Area**

| Sl. No. | Type of Aquifer | Depth range (m) | Core zone (within 2 km) | Buffer zone (within 10 km) |
|---|---|---|---|---|
| 1. | Unconfined | 0 – 50 (Avg. 25) | Alluvium, weathered sandstone | Alluvium, weathered sandstone |
| 2. | Semiconfined/ confined | 50 to 650 m | Multiple Sandstone horizons in Barakar formation | Multiple Barakar sandstone, Barren Measure, Raniganj sandstone, Talchir shale and Metamorphics |

## 2.4 GENERAL AQUIFER PARAMETERS

### PHREATIC/UN-CONFINED AQUIFER

The wells 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 to 0.90 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

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 determined by CMPDI in Sitarata Block by conducting aquifer performance test (APT) and also various piezometers within Cluster of mines BCCL during 2022-23. 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.

**Table – 3: Aquifer parameters determined from piezometers constructed in BCCL**

| Sl no. | Piezometer No. | Aquifer / Formation | Depth of the well (Meters) | Aquifer thickness (Meters) | Static Water Level (Meters) | Discharge (LPS) | Test duration (Minutes) | K (m/day) | T ($m^2$/day) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | PZ-1A | Phreatic Aquifer | 40 | 15 | 12.15 | 4.70 | 275 | $9.71 \times 10^{-1}$ | 14.6 |
| 2 | PZ-1B | Barakar Formation (JCF) | 115 | 30 | 27 | 2.85 | 275 | $6.33 \times 10^{-2}$ | 1.9 |
| 3 | PZ-2A | | 87 | 15 | 28.1 | 1.5 | 960 | $5.88 \times 10^{-2}$ | 0.88 |
| 4 | PZ-3A | | 172 | 42 | 17.55 | 3.0 | 157 | $4.04 \times 10^{-2}$ | 1.70 |
| 5 | PZ-4A | | 70 | 18 | 15.55 | 1.65 | 167 | $5.00 \times 10^{-2}$ | 0.89 |
| 6 | PZ-8A | | 140 | 24 | 68.72 | 1.05 | 275 | $6.53 \times 10^{-2}$ | 1.57 |
| 7 | PZ-9B | | 100 | 30 | 34.68 | 2.45 | 390 | $6.66 \times 10^{-2}$ | 2.00 |
| 8 | PZ-10A | | 135 | 30 | 5 | 4.7 | 865 | $1.52 \times 10^{-1}$ | 4.55 |
| 9 | PZ-11A | Barren Measure Formation (JCF) | 300 | 66 | 60.60 | 3.05 | 300 | $3.9 \times 10^{-2}$ | 2.57 |
| 10 | PZ-13A | Raniganj Formation (JCF) | 80 | 24 | 30.9 | 1.75 | 400 | $6.37 \times 10^{-2}$ | 1.53 |
| 11 | PZ-14B | | 162 | 24 | 12.15 | 2.75 | 475 | $7.48 \times 10^{-2}$ | 1.80 |
| 12 | PZ-16A | Barakar Formation (part of RCF) | 90 | 18 | 31.5 | 2.0 | 385 | $5.59 \times 10^{-2}$ | 1.01 |

## 3.0 GROUND WATER LEVEL MONITORING

To collect the representative groundwater levels in the study area, CMPDI has established a monitoring network of total 139 monitoring stations out of which 73 located within core zone and rest falls in Buffer zone. Total 105 nos. dug well within JCF and 34 nos. dug well within RCF (part) area (Details of the Hydrograph stations & water level given in **Annexure-V, VA & VB**) spread over the entire BCCL leasehold area, **Plate-I**. Water level data collection in all monitoring stations has been done on quarterly basis (May'24, Aug'24, Nov'24 and Jan'25).

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 on 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

## 3.1 HISTORICAL GROUNDWATER LEVEL (GWL)

Historical GWL of JCF and part of RCF of CMPDI monitoring stations given from 2005 to 2024 (total 64 stations within Coalfield area). Pre-monsoon and Post-monsoon GWL with Fluctuation has been mentioned below in the table.

## Table – 4: 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 |
| JDF | 2005 | 0.07 | 19.08 | 6.29 | 0.64 | 12.13 | 3.20 | 0.13 | 12.45 | 3.21 |
| | 2007 | 0.40 | 19.27 | 5.66 | 0.35 | 8.21 | 2.57 | 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 | 15.58 | 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 | 15.68 | 3.17 |
| | 2014 | 0.70 | 16.28 | 4.92 | 0.75 | 14.85 | 3.27 | 0.25 | 10.15 | 2.17 |
| | 2015 | 1.38 | 17.20 | 6.05 | 0.45 | 14.58 | 2.82 | 0.28 | 7.62 | 2.15 |
| | 2016 | 0.78 | 16.73 | 5.64 | 0.30 | 12.43 | 3.19 | 0.23 | 6.38 | 2.88 |
| | 2017 | 0.67 | 16.29 | 5.61 | 0.15 | 8.97 | 2.41 | 0.10 | 12.10 | 3.25 |
| | 2018 | 1.20 | 14.58 | 5.55 | 0.40 | 7.17 | 2.63 | 0.20 | 9.45 | 2.68 |
| | 2019 | 0.95 | 15.68 | 5.40 | 0.45 | 5.95 | 2.34 | 0.23 | 13.40 | 3.06 |
| | 2020 | 0.80 | 16.25 | 4.95 | 0.75 | 10.10 | 3.26 | 0.25 | 11.05 | 2.15 |
| | 2021 | 0.62 | 11.26 | 5.23 | 0.05 | 7.62 | 2.28 | 0.15 | 9.03 | 2.94 |
| | 2022 | 0.42 | 11.90 | 5.10 | 0.29 | 11.12 | 2.32 | 0.03 | 7.2 | 1.80 |
| | 2023 | 1.70 | 11.38 | 6.33 | 0.80 | 8.02 | 3.77 | 0.10 | 6.05 | 2.56 |
| | 2024 | 1.95 | 12.50 | 6.73 | 0.65 | 8.22 | 3.80 | 1.30 | 4.28 | 2.93 |
| | | | | | | | | | | |
| RDF (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 | 4.83 | 0.88 | 1.10 | 0.99 |
| | 2011 | 3.57 | 9.02 | 4.98 | 2.50 | 8.21 | 3.75 | 0.55 | 1.90 | 1.23 |
| | 2012 | 3.10 | 7.34 | 4.59 | 1.55 | 7.00 | 3.86 | 0.05 | 2.78 | 0.94 |
| | 2013 | 1.70 | 9.87 | 6.54 | 2.90 | 8.85 | 4.71 | 1.02 | 5.54 | 2.94 |
| | 2014 | 3.27 | 6.48 | 4.57 | 2.13 | 3.02 | 2.63 | 0.54 | 3.46 | 1.94 |
| | 2015 | 3.38 | 9.52 | 5.33 | 2.68 | 8.20 | 5.11 | 1.08 | 1.32 | 1.81 |
| | 2016 | 3.61 | 10.65 | 6.34 | 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 |
| | 2019 | 1.60 | 8.35 | 5.29 | 0.80 | 3.88 | 2.10 | 0.80 | 5.47 | 3.20 |
| | 2020 | 2.30 | 9.70 | 4.30 | 1.75 | 5.50 | 2.70 | 0.40 | 2.75 | 1.60 |
| | 2021 | 2.00 | 8.20 | 3.34 | 1.10 | 5.25 | 2.44 | 0.85 | 0.95 | 0.90 |
| | 2022 | 1.73 | 2.68 | 2.20 | 1.63 | 2.2 | 1.91 | 0.10 | 0.48 | 0.29 |
| | 2023 | 2.10 | 9.50 | 5.22 | 1.50 | 5.18 | 3.06 | 0.60 | 4.32 | 2.16 |
| | 2024 | 2.14 | 10.28 | 5.17 | 1.14 | 7.34 | 3.10 | 1.00 | 2.92 | 2.07 |

## 3.2 DEPTH TO WATER LEVEL & HYDRAULIC GRADIENT

Depth to water level (DTW) range in different formations with respect to mining and non-mining areas is summarized in the Table-5.

**Table – 5: Avg. Depth to water table**

| Formation | Area | DTW (bgl, m) (Year-2024-25) | |
|---|---|---|---|
| | | Pre-monsoon (May'24) | Post-monsoon (Nov'24) |
| Sedimentary (Gondwana Formation / Core Zone) | Non-mining | 1.95-11.90 | 0.65-8.22 |
| | Mining | 1.95-10.6 | 0.65-7.34 |
| Metamorphics (Hard rock) | Peripheral part of the Coalfield | 3.17-12.5 | 1.14-7.77 |

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 JCF and RCF (part) area. The average hydraulic gradient of the water table within mining and non-mining areas is given in Table-6. No significant change in hydraulic gradient is observed. Relatively steep gradient near active opencast mining areas w.r.t. non-mining, underground mines and Metamorphics areas is observed.

**Table – 6: Average hydraulic gradient**

| Sl. No | Formation | Area | Average hydraulic gradient |
|---|---|---|---|
| 1 | Sedimentary (Gondwana Formation / Core Zone) | Non-Mining | $1.0 \times 10^{-3}$ to $2 \times 10^{-3}$ |
| | | Mining | $1.0 \times 10^{-3}$ to $1.5 \times 10^{-3}$ |
| 2 | Metamorphics (Buffer Zone) | Peripheral part of the Coalfield | $1.0 \times 10^{-3}$ to $3.5 \times 10^{-3}$ |

## 3.3 GROUND WATER LEVEL DATA OF THE CLUSTER OF MINES OF BCCL

### A GROUND WATER LEVEL OF CLUSTER-I

Cluster-I (Damuda Group of Mines consisting of Damuda UG, Albion OCP, Proposed BJ Section OCP and Abandoned Gutway OCP) of Barora area, BCCL is located in the western most part of Jharia coalfield in Bokaro district of Jharkhand. The life of the project has been worked out to be up to 15 years considering annual target production of 1.17 MTPA. It is located in the extreme western part of JCF in Bokaro district of Jharkhand (Toposheet no – 73 I/1).

The present leasehold area of Cluster-I is 575.0 Ha. The Damuda block area 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.

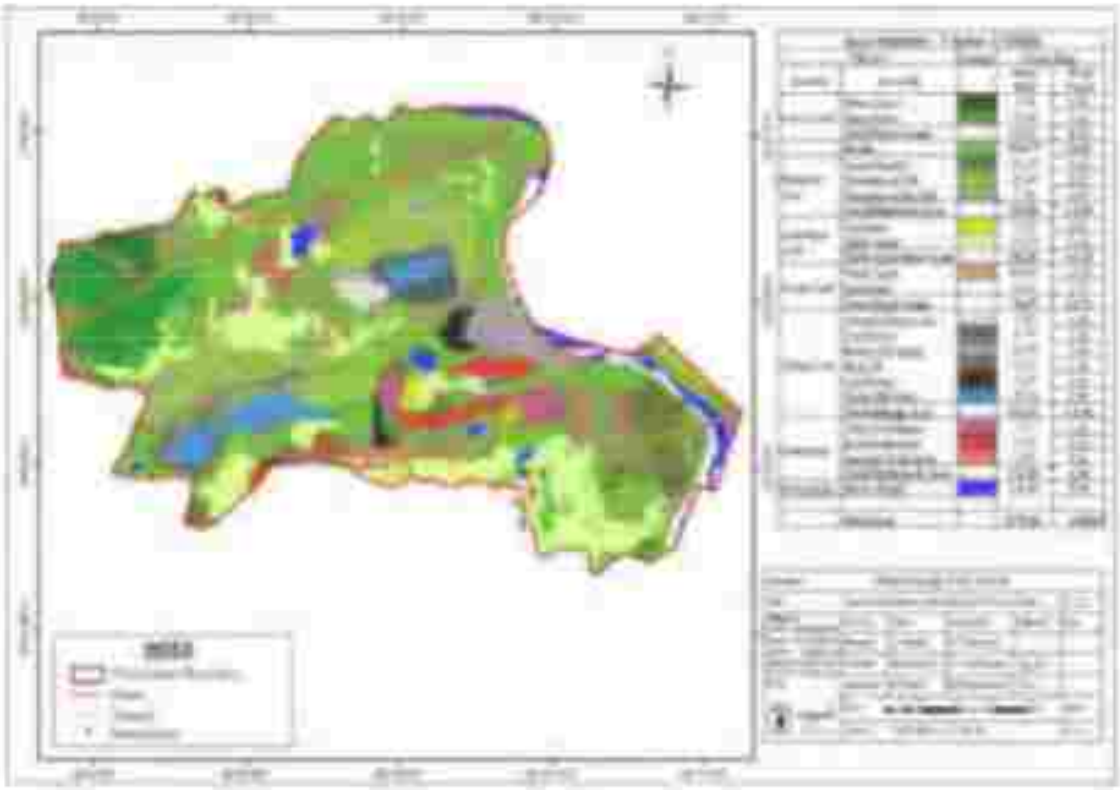
Monitoring stations (**B015, B051 and B053**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl | Well | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No | No | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | B015 | Bera Basti | 3.35 | 0.70 | 0.91 | 1.54 | 3.20 | 0.80 | 1.00 | 2.72 | 3.67 | 0.45 | 1.02 | 2.30 |
| 2 | B051 | Taranga | 6.40 | 2.66 | 4.47 | 5.05 | 5.20 | 2.51 | 4.45 | 4.95 | 5.06 | 0.00 | 4.57 | 2.67 |
| 3 | B053 | Kamatanr | 3.10 | 1.02 | 1.21 | 1.45 | 2.62 | 1.33 | 1.13 | 1.66 | 4.42 | 1.78 | 3.54 | 1.68 |
| ***Average WL (bgl)*** | | | 4.28 | 1.46 | 2.20 | 2.58 | 3.67 | 1.55 | 2.19 | 3.11 | 4.38 | 0.74 | 3.04 | 2.28 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 2.62 m  Max –6.40 m
Post-monsoon GW Level (m): Min – 0.91 m  Max – 4.57 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-I MINES, BCCL



| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 393.69 x $10^4$ | 0.0 | 393.69 x $10^4$ |
| 2 | Open Land | 204.89 x $10^4$ | 0.0 | 204.89 x $10^4$ |
| 3 | Road/ Paved Area | 09.0 x $10^4$ | 0.0 | 09.0 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 14.58 x $10^4$ | 0.0 | 14.58 x $10^4$ |
| 5 | Total | 575.00 x $10^4$ | 0.0 | 575.00 x $10^4$ |

## B. GROUND WATER LEVEL OF CLUSTER-II

Cluster-II consists of seven mines namely; Block II Mixed mines (OCP & UGP), Jamunia OCP, Shatabdi OCP, Muraidih Mixed mines (OCP & UGP), and Phularitand OCP of BCCL is located in the western most part of Jharia coalfield in Bokaro district and Dhanbad district of Jharkhand. The life of the project has been worked out to be up to 30 years considering annual target production of 20.215 MTPA. It is located in the extreme western part of Jharia Coalfield in Dhanbad district of Jharkhand (Toposheet no- 73 I/1 and I/5).

The present leasehold area of Cluster-II is 2260.54 Ha. The Damuda block area 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.

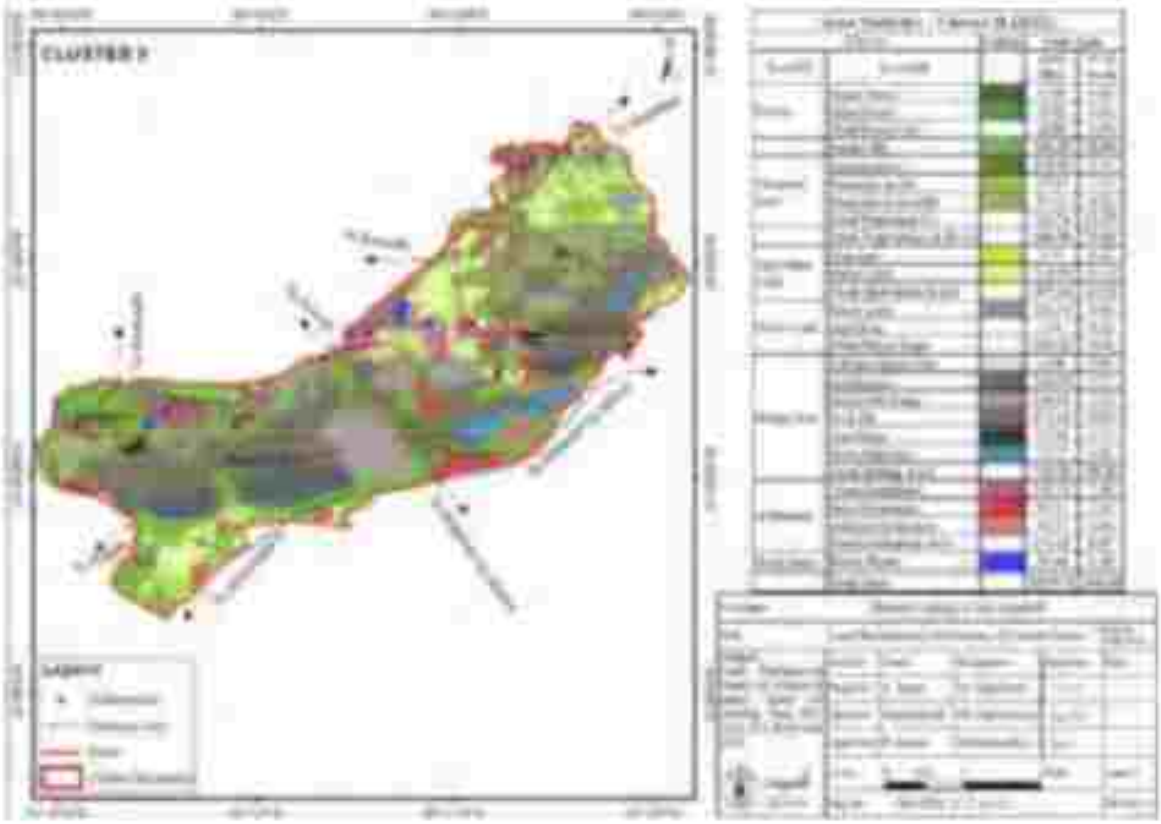
Monitoring stations (**B001, B059, B060 and B062**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl. No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | B001 | Muraidih | 4.12 | 1.82 | 2.58 | 2.83 | 3.22 | 1.25 | 2.45 | 2.7 | 2.1 | 1.65 | 1.91 | 2.73 |
| 2 | B059 | Khodovaliy | 2.98 | 0.50 | 0.65 | 1.12 | 1.88 | 0.5 | 0.7 | 1.12 | 4.5 | 0.44 | 1.14 | 1.04 |
| 3 | B060 | Bahiyardih | 9.10 | 2.70 | 5.77 | 9.04 | 10.73 | 5.31 | 5.73 | 9.51 | 10.53 | 1.08 | 5.8 | 9.38 |
| 4 | B062 | Sadiyardih | 4.97 | 3.01 | 3.19 | 3.80 | 4.8 | 2.35 | 3.1 | 4 | 6.45 | 1.77 | 4.91 | 5.15 |
| ***Average WL (bgl)*** | | | 5.29 | 2.01 | 3.05 | 4.20 | 5.16 | 2.35 | 3 | 4.33 | 5.9 | 1.24 | 3.42 | 4.58 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.88m Max – 10.73 m
Post-monsoon GW Level (m): Min – 0.65 m Max – 5.80 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-II MINES, BCCL



| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 977.33 x $10^4$ | 0.0 | 977.33 x $10^4$ |
| 2 | Open Land | 1072.08 x $10^4$ | 0.0 | 1072.08 x $10^4$ |
| 3 | Road/ Paved Area | 140.32 x $10^4$ | 0.0 | 140.32 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 70.81 x $10^4$ | 0.0 | 70.81 x $10^4$ |
| 5 | Total | 2260.54 x $10^4$ | 0.0 | 2260.54 x $10^4$ |

## C. GROUND WATER LEVEL OF CLUSTER-III

Cluster-III consists of nine mines namely, Jogidih UG, Govindpur UG, Maheshpur UG, Kooridih/Block-IV Mixed Mine, New Akashkinaree Mixed Mine, South Govindpur UG (closed), and Tetulya UG (closed) mines. The life of the project has been worked out to be up to 60 years considering annual production target of 3.60 MTPA. This Cluster of mines is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand (Toposheet no – 73 I/5).

The present leasehold area of Cluster-III is 1552.53 Ha. The area is plain with gentle undulation with RL varying from 160 m to 208.80 m AMSL. The general slope of the area is towards south. Khudia River, Baghdigi Jore, Katri River and its tributaries are controlling the drainage system of the area. The area comes under the watershed of Khudia River.

Monitoring stations (**A025, A029, B014 and B060**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | | | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | A025 | Sindri | 4.85 | 1.39 | 2.65 | 2.98 | 2.93 | 1.09 | 2.6 | 2.7 | 3.31 | 1.33 | 2.08 | 2.51 |
| 2 | A029 | Dharmabandi | 3.06 | 1.01 | 2.80 | 2.88 | 5.6 | 2.1 | 3.2 | 4.08 | 4.6 | 1.2 | 1.15 | 1.12 |
| 3 | B014 | Mathadih | 3.40 | 0.93 | 2.27 | 2.45 | 2.84 | 1.12 | 2.34 | 2.42 | 3.24 | 0.09 | 2.6 | 2.55 |
| 4 | B060 | Sonardih | 9.10 | 2.70 | 5.77 | 9.04 | 10.73 | 5.31 | 5.73 | 9.51 | 10.53 | 1.08 | 5.8 | 9.38 |
| ***Average WL (bgl)*** | | | 5.10 | 1.51 | 3.37 | 4.34 | 5.53 | 2.41 | 3.47 | 4.68 | 5.42 | 0.93 | 2.91 | 3.89 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 2.84 m  Max – 10.73 m
Post-monsoon GW Level (m): Min – 1.15 m  Max – 5.80 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-III MINES, BCCL

| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 560.21 x $10^4$ | 0.0 | 560.21 x $10^4$ |
| 2 | Open Land | 770.61 x $10^4$ | 0.0 | 770.61 x $10^4$ |
| 3 | Road/ Paved Area | 164.97 x $10^4$ | 0.0 | 164.97 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 36.74 x $10^4$ | 0.0 | 36.74 x $10^4$ |
| 5 | Total | 1552.53 x $10^4$ | 0.0 | 1552.53 x $10^4$ |

## D. GROUND WATER LEVEL OF CLUSTER-IV

Cluster-IV consists of six mines namely, Amalgamated Keshalpur & West Muddih colliery, Amalgamated Angarpathra & Ramkanali colliery, Katras-Choitudih Colliery, Salanpur colliery and Gasitand colliery of Katras area, BCCL. It is located in the north-central part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project has been worked out to be more than 30 years considering annual target production of 9.55 MTPA (Toposheet no – 73 I/5).

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

Monitoring stations (**A026, A028 and B065**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl. No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | A026 | Mukherra | 7.00 | 3.18 | 3.72 | 4.35 | 8.4 | 3.87 | 3.83 | 5.5 | 6.42 | 2.83 | 4.31 | 3.82 |
| 2 | A028 | Lakarka | 4.30 | 3.30 | 3.49 | 3.79 | 3.45 | 3.13 | 3.35 | 3.4 | 4.23 | 2.66 | 3.3 | 3.57 |
| 3 | B065 | Jhinjpahari | 10.80 | 2.22 | 2.45 | 4.01 | 8.45 | 1.95 | 2.35 | 4.93 | 7.45 | 0.5 | 2.27 | 3.45 |
| ***Average WL (bgl)*** | | | 7.37 | 2.90 | 3.22 | 4.05 | 6.77 | 2.98 | 3.18 | 4.61 | 6.03 | 2.06 | 3.29 | 3.55 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 3.45 m  Max – 10.80 m
Post-monsoon GW Level (m): Min – 2.27 m  Max – 4.31 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-IV MINES, BCCL

| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 385.15 x $10^4$ | 0.0 | 385.15 x $10^4$ |
| 2 | Open Land | 555.43 x $10^4$ | 0.0 | 555.43 x $10^4$ |
| 3 | Road/ Paved Area | 160.59 x $10^4$ | 0.0 | 160.59 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 22.63 x $10^4$ | 0.0 | 22.63 x $10^4$ |
| 5 | Total | 1123.79 x $10^4$ | 0.0 | 1123.79 x $10^4$ |

## E. GROUND WATER LEVEL OF CLUSTER-V

Cluster-V consists of twelve mines namely: Tetulmari OC & UG mines, Muraidih OC & UG mines, Nichitpur OC mine, Sendra Bansjora OC & UG mines, Bansdeopur OCP (proposed) & UG Mines, Kankanee OC & UG mines and Loyabad UG mine (closed) of Sijua area, BCCL. This Cluster of mines is located in northern part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project has been worked out to be more than 30 years considering annual production target of 6.311 MTPA (Toposheet no – 73 I/6).

The present leasehold area of Cluster-V is 1724.52 Ha. The area has a general undulating topography, with an overall gentle south-west slope. The RL varies from 210 m to 170 m AMSL. Jarian Nala, Nagri Jore, Ekra Jore and their tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Jarian Nala and Ekra Jore.

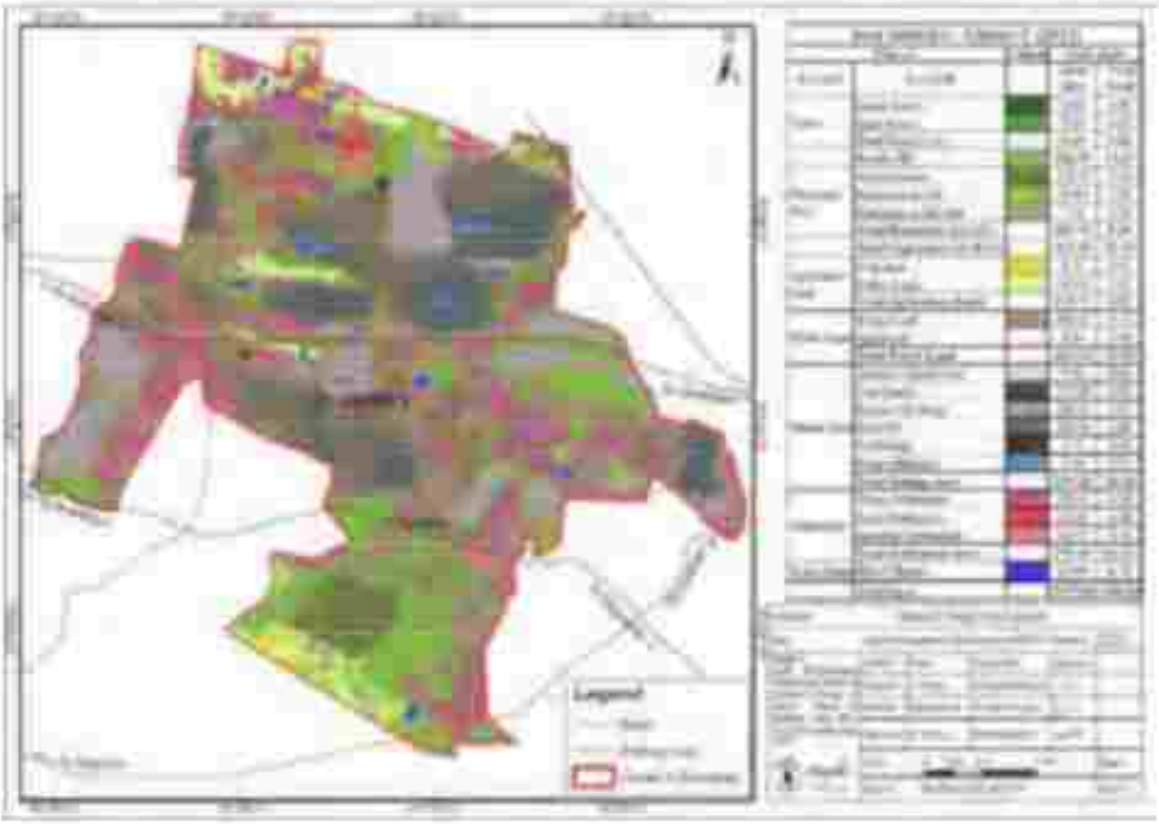
Monitoring stations (**A016 and A027**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | A016 | Ekra | 4.56 | 3.29 | 3.49 | 3.81 | 5.55 | 1.35 | 3.52 | 4.3 | 5.8 | 1.35 | 3.08 | 3.99 |
| 2 | A027 | Tetulmari | 7.00 | 3.18 | 3.72 | 4.38 | 1.7 | 0.55 | 1.6 | 1.8 | 1.9 | 0.1 | 1.33 | 1.5 |
| ***Average WL (bgl)*** | | | 5.78 | 3.24 | 3.61 | 4.08 | 3.63 | 0.95 | 2.56 | 3.05 | 3.85 | 0.73 | 2.21 | 2.25 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.70 m  Max – 7.00 m
Post-monsoon GW Level (m): Min – 1.33 m  Max – 3.72 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-V MINES, BCCL



| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 527.26 x $10^4$ | 0.0 | 527.26 x $10^4$ |
| 2 | Open Land | 973.52 x $10^4$ | 0.0 | 973.52 x $10^4$ |
| 3 | Road/ Paved Area | 217.50 x $10^4$ | 0.0 | 217.50 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 24.24 x $10^4$ | 0.0 | 24.24 x $10^4$ |
| 5 | Total | 1724.52 x $10^4$ | 0.0 | 1724.52 x $10^4$ |

## F. GROUND WATER LEVEL OF CLUSTER-VI

Cluster–VI consists of four coal mines namely, East Bassuriya opencast (OC), Bassuriya underground (UG), Gonduidih Khas-Kusunda OC and Godhur Mixed Mines (OC and UG) of BCCL. This Cluster of mines is located in central part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project has been worked out to be more than 30 years considering annual production target of 7.631 MTPA (Toposheet no – 73 I/6).

The present leasehold area of Cluster-VI is 831.83 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.

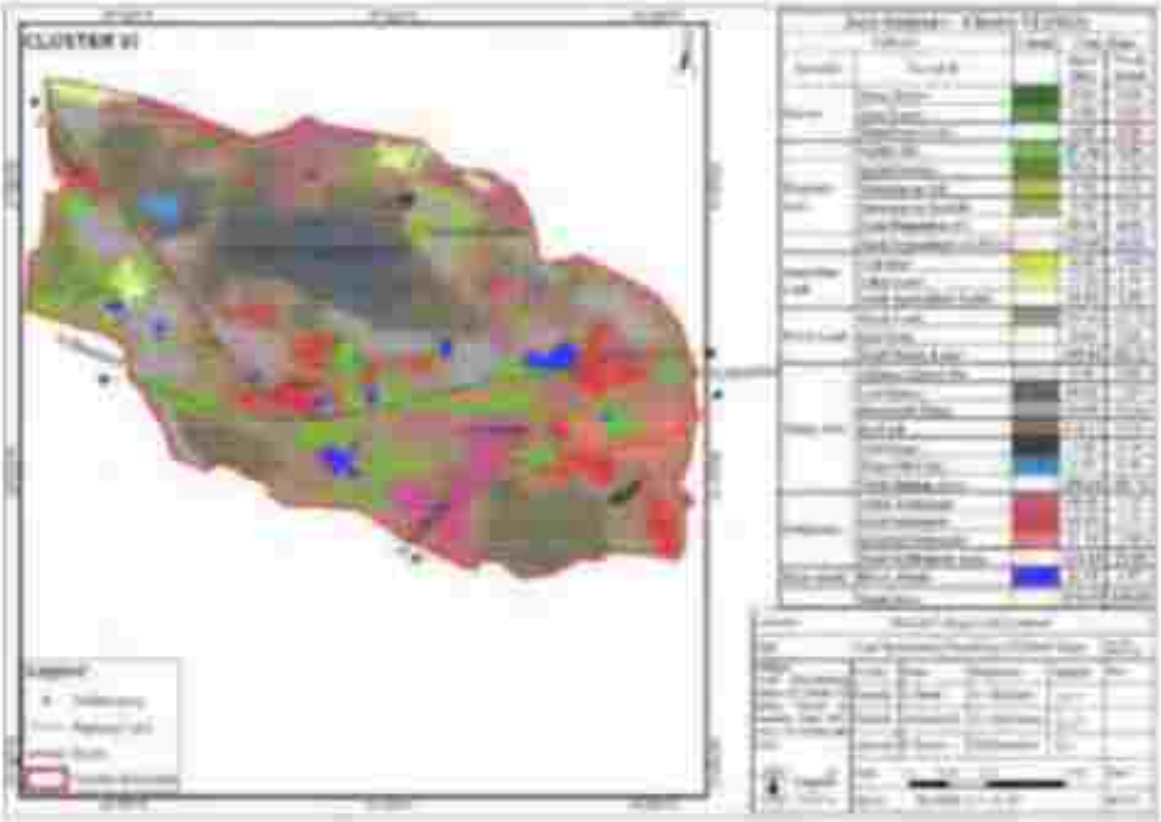
Monitoring stations (**D025, D030 and D034**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | D025 | Godhur | 6.33 | 3.24 | 3.47 | 5.20 | 4.40 | 1.80 | 3.40 | 4.20 | 11.90 | 2.58 | 4.70 | 5.30 |
| 2 | D030 | Borkibos | 4.12 | 1.39 | 2.28 | 2.68 | 4.08 | 2.10 | 2.20 | 3.44 | 4.37 | 1.80 | 2.29 | 4.15 |
| 3 | D034 | Kusunda | 4.30 | 2.12 | 2.63 | 2.99 | 3.80 | 1.80 | 2.50 | 2.89 | 5.00 | 2.15 | 3.15 | 3.22 |
| ***Average WL (bgl)*** | | | 4.92 | 2.25 | 2.79 | 3.69 | 4.09 | 1.90 | 2.70 | 3.51 | 7.09 | 2.18 | 3.38 | 4.22 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 3.80 m  Max – 11.90 m
Post-monsoon GW Level (m): Min – 2.20 m  Max – 4.70 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-VI MINES, BCCL



| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 122.39 X $10^4$ | 0.0 | 122.39 X $10^4$ |
| 2 | Open Land | 581.14 X $10^4$ | 0.0 | 581.14 X $10^4$ |
| 3 | Road/ Paved Area | 68.81 X $10^4$ | 0.0 | 68.81 X $10^4$ |
| 4 | Rooftop area of building/ sheds | 59.49 X $10^4$ | 0.0 | 59.49 X $10^4$ |
| 5 | Total | 831.83 X $10^4$ | 0.0 | 831.83 X $10^4$ |

## G. GROUND WATER LEVEL OF CLUSTER-VII

Cluster-VII consists of fourteen mines within Kusunda Area, Bastacolla Area and PB Area, B.C.C.L, Jharia Coalfield. Coal mines namely Dhansar UG, Dhansar OCP, Kusunda OCP and Viswakarma OCP (proposed) are under the administrative control of Kusunda Area and Industry UG (closed), Alkusa UG, Ena OCP, S.Jharia/Rajapur OCP, Burragarh UG, Simlabahal UG, Hurriadih UG, Bhatgora UG (Re-opening), Kustore UG (closed) and E.Bhuggatdih UG (closed) are under Bastacolla and PB Area. This Cluster of mines is located in east central part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project has been worked out to be more than 30 years considering annual production target of 8.226 MTPA (Topcsheet no – 73 I/6).

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 their tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Kari Jore and Chatkari Jore.

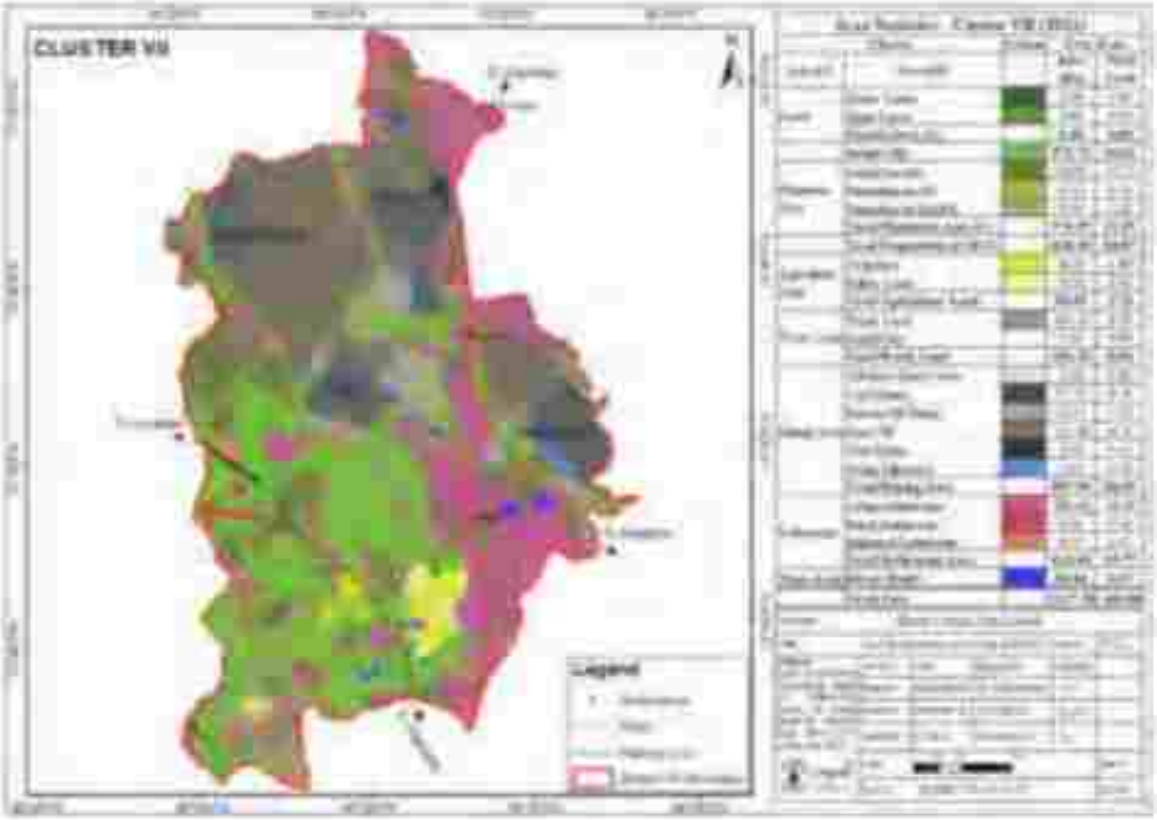
Monitoring stations (**D003, D034, D047 and D080**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | D003 | Dhansar | 1.95 | 0.87 | 1.71 | 1.88 | 3.15 | 1.22 | 1.85 | 2.28 | 5.96 | 0.55 | 1.32 | 1.34 |
| 2 | D034 | Kusunda | 4.30 | 2.12 | 2.63 | 2.99 | 3.8 | 1.8 | 2.5 | 2.89 | 5 | 2.15 | 3.15 | 3.22 |
| 3 | D047 | Parastarir | 4.32 | 2.14 | 3.38 | 3.65 | 4.45 | 2.57 | 3.27 | 3.85 | 6.55 | 4.32 | 5.85 | 11.4 |
| 4 | D080 | Bastacolla | 3.66 | 2.14 | 2.55 | 2.71 | 4.75 | 1.75 | 2.6 | 3.42 | 3.3 | 2.4 | 3.08 | 1.8 |
| ***Average WL (bgl)*** | | | 3.56 | 1.82 | 2.57 | 2.81 | 4.04 | 1.84 | 2.56 | 3.11 | 5.2 | 2.61 | 3.35 | 4.44 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.95 m  Max – 6.55 m
Post-monsoon GW Level (m): Min – 1.32 m  Max – 5.85 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-VII MINES, BCCL




| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 968.53 x $10^4$ | 0.0 | 968.53 x $10^4$ |
| 2 | Open Land | 748.72 x $10^4$ | 0.0 | 748.72 x $10^4$ |
| 3 | Road/ Paved Area | 380.73 x $10^4$ | 0.0 | 380.73 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 31.71 x $10^4$ | 0.0 | 31.71 x $10^4$ |
| 5 | Total | 2127.70 x $10^4$ | 0.0 | 2127.70 x $10^4$ |

## H. GROUND WATER LEVEL OF CLUSTER-VIII

Cluster - VIII of B.C.C.L mines are under administrative control of Bastacolla Area, Jharia Coalfield. Cluster-VIII consists of ten mines namely Bastacolla mixed mines (OC & UG), Bera mixed mines (OC&UG), Dobari UG, Kuya mixed mines (OC&UG), Proposed Gokuldih (NC) OC mine, Ghanoodih OC mine and Kujama OC mine. This cluster is located in west part of Jharia Coalfield in Dhanbad district of Jharkhand. All the above mines are contiguous in nature and the environmental impact is overlapping in ambient environment due to cumulative effect of mining activities. The life of the project has been worked out to be up to 25 years considering annual production target of 6.383 MTPA (toposheet no.: 73 I/5 and I/6).

The present leasehold area of Cluster-VIII is 1331.85 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 their tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Chatkari Jore.

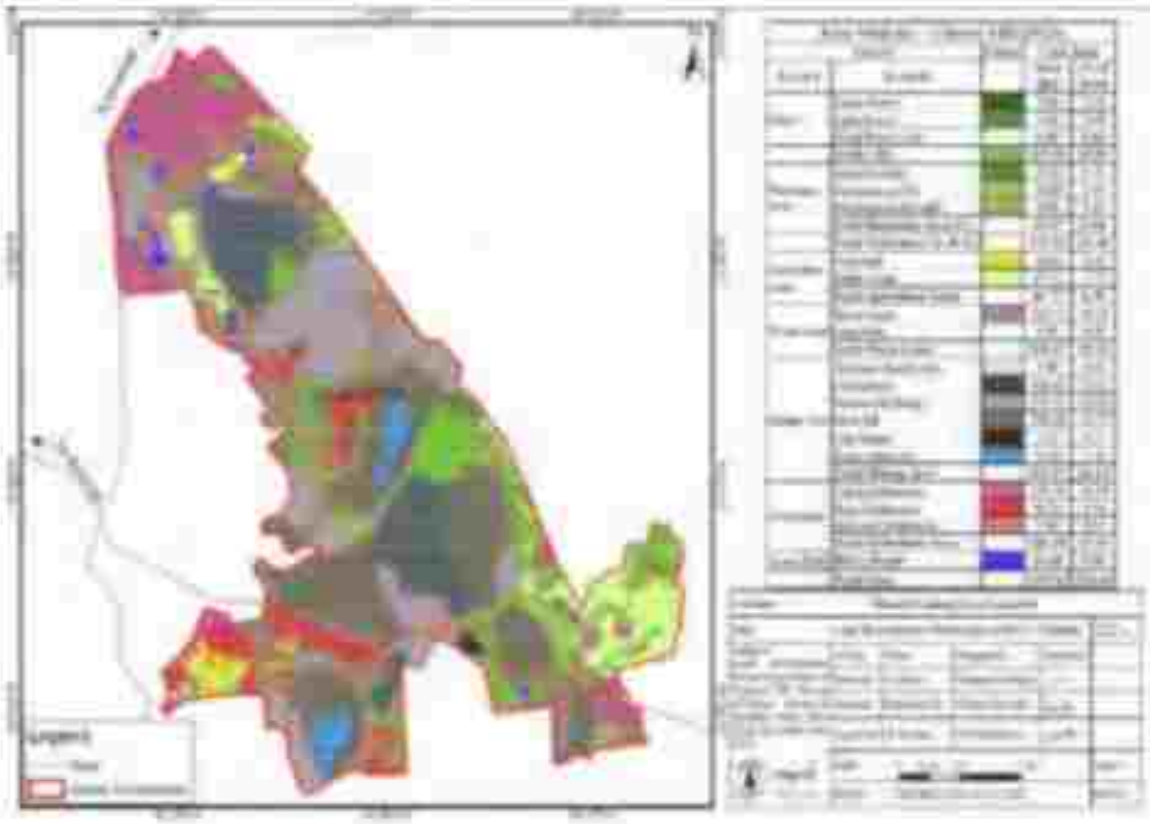
Monitoring stations (**D008 and D039**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl. No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | D008 | Akashline | 8.90 | 2.74 | 4.82 | 5.47 | 7.70 | 4.42 | 4.82 | 6.75 | 8.10 | 4.25 | 5.42 | 6.34 |
| 2 | D039 | Tilaboni | 3.20 | 2.51 | 2.77 | 2.87 | 8.52 | 2.52 | 3.28 | 5.75 | 7.50 | 1.85 | 3.05 | 1.75 |
| **Average WL (bgl)** | | | 6.05 | 2.63 | 3.80 | 4.17 | 8.11 | 3.47 | 4.05 | 6.25 | 6.91 | 3.05 | 4.24 | 4.05 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 3.20 m  Max – 8.90 m
Post-monsoon GW Level (m): Min – 2.77 m  Max – 5.42 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-VIII MINES, BCCL



| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 279.69 x $10^4$ | 0.0 | 279.69 x $10^4$ |
| 2 | Open Land | 886.66 x $10^4$ | 0.0 | 886.66 x $10^4$ |
| 3 | Road/ Paved Area | 97.19 x $10^4$ | 0.0 | 97.19 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 68.43 x $10^4$ | 0.0 | 68.43 x $10^4$ |
| 5 | Total | 1331.95 x $10^4$ | 0.0 | 1331.95 x $10^4$ |

## I. GROUND WATER LEVEL OF CLUSTER-IX

Mines of cluster-IX are under administrative control of Lodna Area of B.C.C.L in western part of Jharia Coalfield which is located in Dhanbad district of Jharkhand. Cluster- IX consists of eight mines namely; North Tisra/South Tisra OCP, Jeenagora OCP, North Tisra UG, Lodna UG, Bagdigi UG, Bararee UG, Joyrampur UG and Jealgora UG (closed). Among them N. Tisra/S. Tisra OCP, Jeenagora OCP and N. Tisra UG mine will be amalgamated and will form North Tisra/South Tisra Expansion OCP. All above the mines are contiguous in nature and the environmental impact is overlapping in ambient environment due to cumulative effect of mining activities. The life of the project has been worked out to be up to 30 years considering annual production target of 8.513 MTPA (topcsheet no. 73 I/6).

The present leasehold area of Cluster-IX is 1967.22 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, Sukunga Jore and their tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Chatkari Jore.

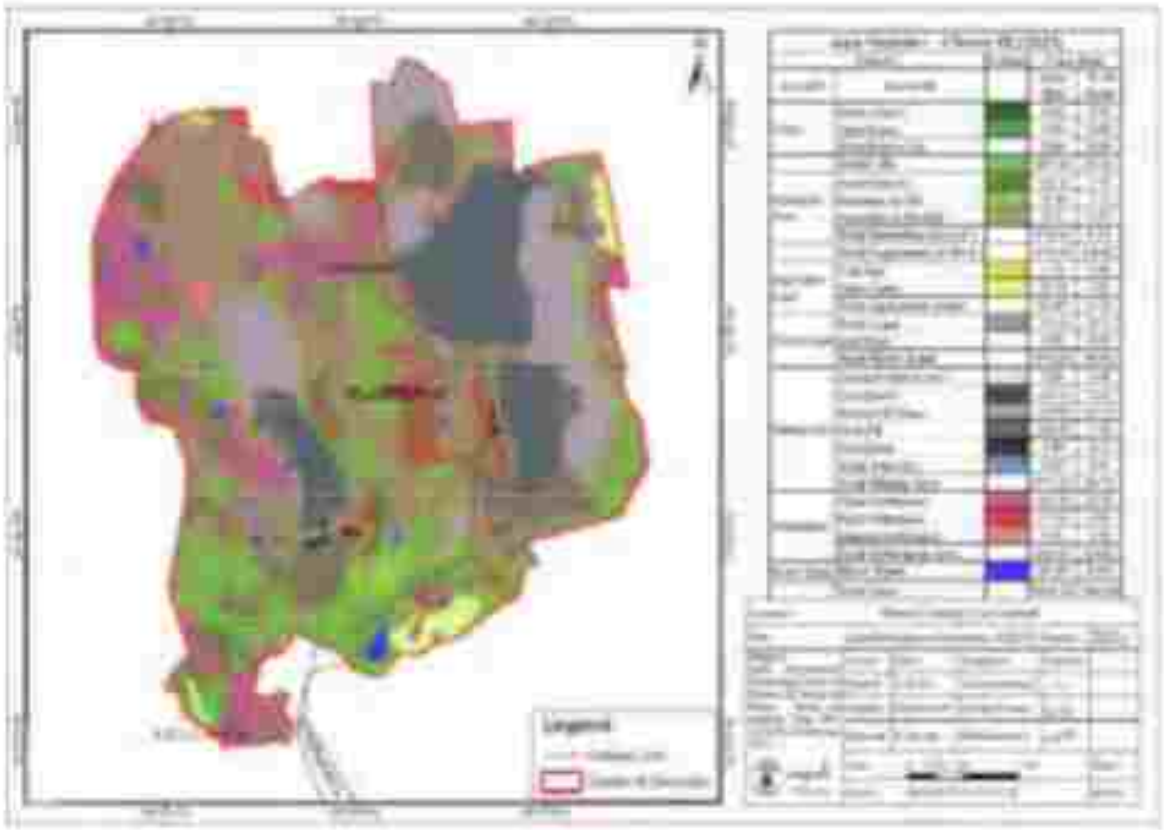
Monitoring stations (**D005, D007, D039 and D074**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | D005 | Jyalgora | 8.70 | 4.53 | 6.02 | 7.35 | 8.20 | 4.08 | 5.90 | 6.54 | 8.40 | 3.36 | 7.01 | 6.95 |
| 2 | D007 | Golden Pahari | 9.82 | 2.70 | 3.52 | 5.67 | 9.03 | 1.88 | 3.64 | 5.16 | 9.03 | 2.17 | 5.67 | 6.57 |
| 3 | D039 | Tilabani | 3.20 | 2.51 | 2.77 | 2.87 | 8.52 | 2.52 | 3.28 | 5.75 | 7.50 | 1.85 | 3.05 | 1.75 |
| 4 | D074 | Bhutia/Baranee | 4.74 | 2.65 | 3.73 | 3.89 | 4.57 | 3.10 | 3.54 | 4.09 | 6.17 | 3.20 | 5.77 | 7.90 |
| ***Average WL (bgl)*** | | | 6.62 | 3.10 | 4.01 | 4.95 | 7.58 | 2.90 | 4.09 | 5.39 | 7.78 | 2.65 | 5.38 | 6.29 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 3.20 m  Max – 9.82 m
Post-monsoon GW Level (m): Min – 2.77 m  Max – 7.01 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-IX MINES, BCCL



| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 601.52 x $10^4$ | 0.0 | 601.52 x $10^4$ |
| 2 | Open Land | 1076.47 x $10^4$ | 0.0 | 1076.47 x $10^4$ |
| 3 | Road/ Paved Area | 232.31 x $10^4$ | 0.0 | 232.31 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 56.92 x $10^4$ | 0.0 | 56.92 x $10^4$ |
| 5 | Total | 1967.22 x $10^4$ | 0.0 | 1967.22 x $10^4$ |

## J. GROUND WATER LEVEL OF CLUSTER-X

Cluster-X consists of Bhowrah North OC & UG, Bhowrah South OC & UG, Amalgamated Sudamdih Pathardih, Sudamdih Shaft, Amlabad UG (Closed) and Sudamdih Coal Washery which comes under the administrative control of Eastern Jharia Area of Bharat Coking Coal Limited (B.C.C.L - A Subsidiary of Coal India Limited). This cluster of mines is located in eastern part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project has been worked out to be more than 30 years considering annual production target of 2.289 MTY.

Cluster-X mine involves leasehold area of about 2057.47 Ha of land. It is covered in Survey of India toposheet no. 73 I/5. The area of Bhowrah North OC & UG, Bhowrah South OC & UG, Amalgamated Sudamdih Pathardih, Sudamdih Shaft, Amlabad UG (Closed) are 280.83 Ha, 571.58 Ha, 496.61 Ha, 391.50 Ha and 386.95 Ha respectively.

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.

Monitoring stations (**A019, D035, D036 and D077**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24, the Ground water level data is presented in the table below:

| Sl No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | A019 | Bhowrah | 3.12 | 2.49 | 2.51 | 2.77 | 2.90 | 2.10 | 2.60 | 2.73 | 4.10 | 1.82 | 2.54 | 1.79 |
| 2 | D035 | Pathardih | 5.19 | 3.28 | 4.10 | 4.70 | 5.23 | 3.45 | 3.90 | 4.10 | 6.10 | 3.70 | 4.68 | 5.50 |
| 3 | D036 | Sudamdih | 2.64 | 0.45 | 0.74 | 1.13 | 1.85 | 0.50 | 0.60 | 1.00 | 3.25 | 0.15 | 0.80 | 1.44 |
| 4 | D077 | Amlabad | 6.15 | 3.80 | 4.01 | 4.76 | 5.98 | 3.90 | 3.93 | 5.07 | 6.50 | 3.40 | 4.70 | 6.00 |
| ***Average WL (bgl)*** | | | 4.27 | 2.51 | 2.84 | 3.34 | 3.99 | 2.49 | 2.76 | 3.23 | 4.99 | 2.27 | 3.13 | 3.68 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.85 m  Max – 6.50 m
Post-monsoon GW Level (m): Min – 0.60 m  Max – 4.70 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-X MINES, BCCL

| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 1085.72 x $10^4$ | 0.0 | 1085.72 x $10^4$ |
| 2 | Open Land | 661.04 x $10^4$ | 0.0 | 661.04 x $10^4$ |
| 3 | Road/ Paved Area | 228.39 x $10^4$ | 0.0 | 228.39 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 82.32 x $10^4$ | 0.0 | 82.32 x $10^4$ |
| 5 | Total | 2057.47 x $10^4$ | 0.0 | 2057.47 x $10^4$ |

## K. GROUND WATER LEVEL OF CLUSTER-XI

Cluster–XI consists of eight coal mines; Moonidih UG, 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) which are under the administrative control of Western Jharia Area of Bharat Coking Coal Limited (B.C.C.L - A Subsidiary of Coal India Limited). The Cluster- XI is located in central part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project has been worked out to be up to 50 years considering annual production target of 6.604 MTPA (toposheet no. no. 73 I/5 7 73 I/6).

The present leasehold area of Cluster-XI is 3527.56 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, Ekta Jore and Kari Jore are controlling the drainage of the area. The area comes under the watershed of Katri River and Kari Jore.

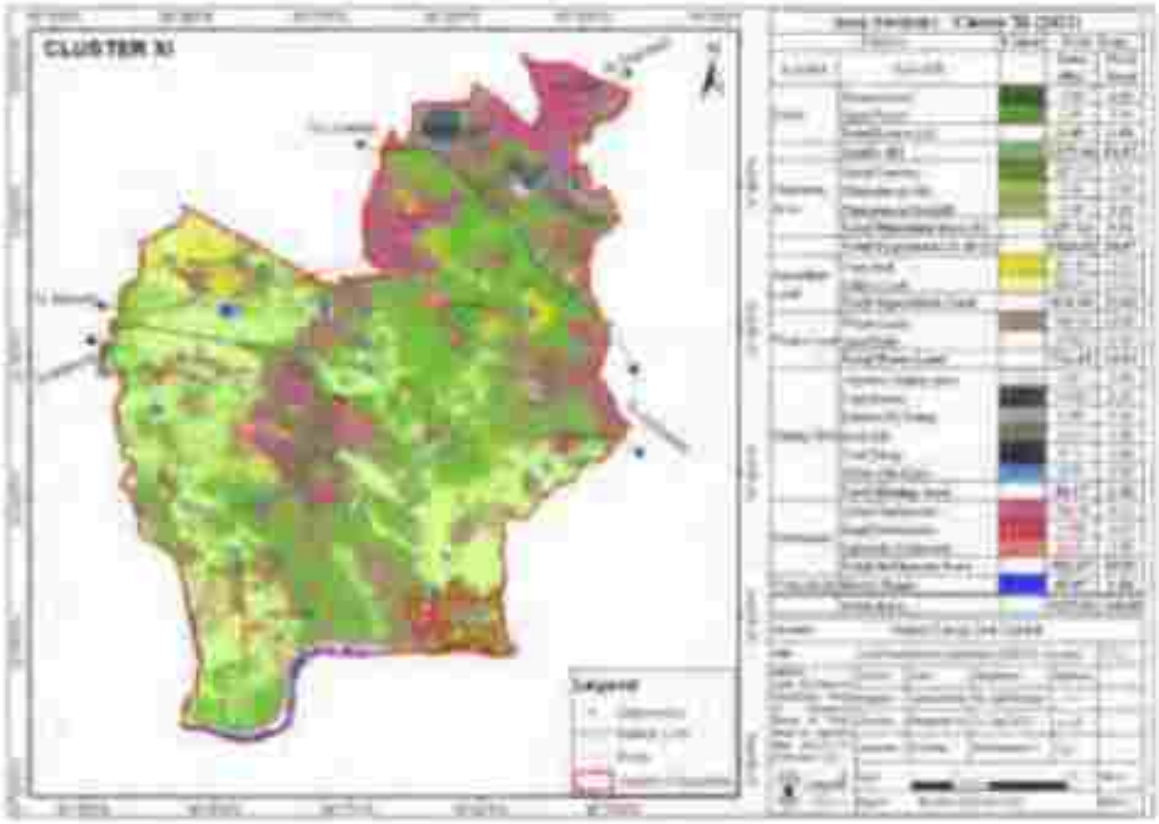
Monitoring stations (**A017, A020 and A032**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | A017 | Kachi Balihari | 3.16 | 2.11 | 2.26 | 2.51 | 2.41 | 1.76 | 2.19 | 2.57 | 2.62 | 2.06 | 2.59 | 2.64 |
| 2 | A020 | Gorbudih | 7.90 | 4.15 | 4.30 | 5.10 | 8.02 | 4.05 | 4.20 | 7.27 | 5.59 | 3.16 | 3.54 | 5.27 |
| 3 | A032 | Baludih | 3.51 | 1.59 | 1.72 | 2.15 | 3.83 | 0.95 | 1.80 | 2.09 | 2.25 | 0.65 | 1.75 | 2.79 |
| ***Average Wl. (bgl)*** | | | 4.86 | 2.62 | 2.76 | 3.25 | 4.75 | 2.26 | 2.66 | 3.98 | 3.49 | 1.96 | 2.63 | 3.57 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 2.25 m  Max – 8.02 m
Post-monsoon GW Level (m): Min – 1.60 m  Max – 4.30 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-XI MINES, BCCL




| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 1060.61 x $10^4$ | 0.0 | 1293.46 x $10^4$ |
| 2 | Open Land | 1518.33 x $10^4$ | 0.0 | 1509.06 x $10^4$ |
| 3 | Road/ Paved Area | 171.08 x $10^4$ | 0.0 | 171.08 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 777.56 x $10^4$ | 0.0 | 563.06 x $10^4$ |
| 5 | Total | 3527.58 x $10^4$ | 0.0 | 3527.58 x $10^4$ |

## L. GROUND WATER LEVEL OF CLUSTER-XIII

Cluster-XIII, consists of one running mine (Murulidih 20/21 pit UG mine) and six abandoned mines i.e. Bhurungiya colliery, Muchraidih colliery, Hantoodih colliery, Padugora colliery, Murulidih colliery and Bhatdee colliery of Western Jharia area, BCCL which is located in the south-western part of Jharia coal field in Dhanbad district of Jharkhand. The area is covered under Survey of India toposheet no. 73 I/6. The life of the project has been worked out to be about 15 years considering annual production target of 0.234 MTPA.

The present leasehold area of Cluster-XIII is 1698.62 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.

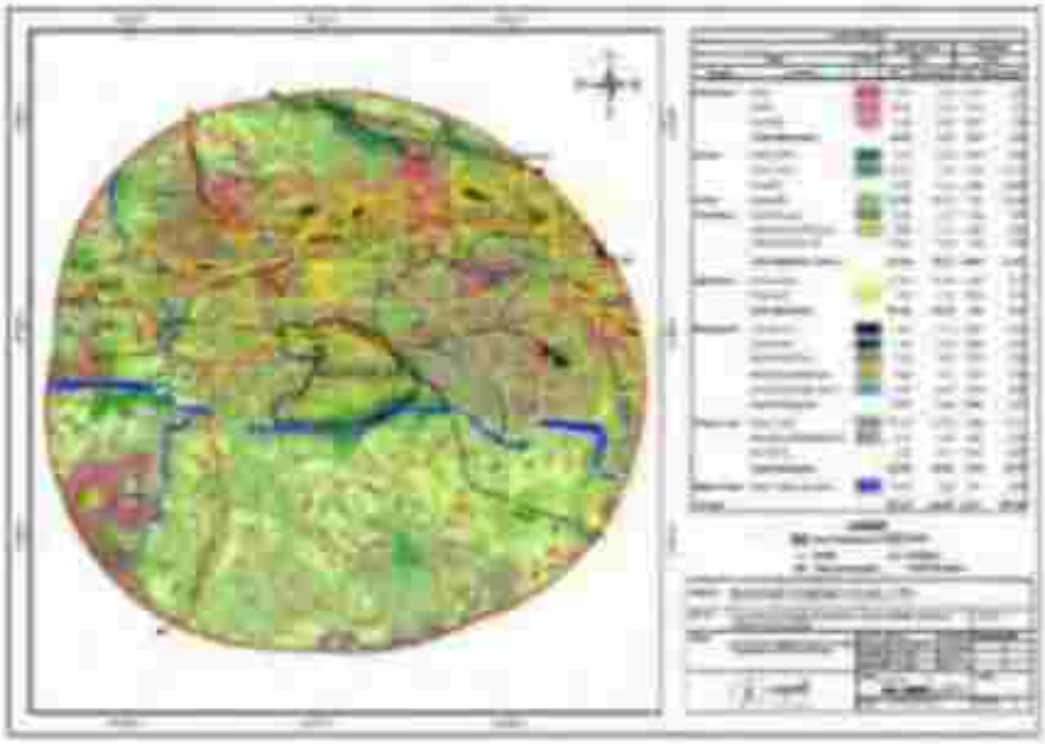
Monitoring stations (**A023, A034 and B048**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | A023 | Machhayara | 10.44 | 2.72 | 5.72 | 6.95 | 9.00 | 5.10 | 5.71 | 7.90 | 7.97 | 1.14 | 4.79 | 6.67 |
| 2 | A034 | Mahuda vill | 6.54 | 1.82 | 3.90 | 4.92 | 6.54 | 2.98 | 4.01 | 4.85 | 8.20 | 3.65 | 6.35 | 6.95 |
| 3 | B048 | Mahuda | 5.99 | 4.58 | 4.95 | 5.23 | 6.13 | 4.55 | 5.65 | 5.57 | 6.85 | 0.65 | 6.25 | 5.80 |
| ***Average WL (bgl)*** | | | 7.66 | 3.04 | 4.86 | 5.70 | 7.22 | 4.21 | 4.92 | 6.11 | 7.67 | 1.81 | 5.80 | 6.47 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 5.99 m  Max – 10.44 m
Post-monsoon GW Level (m): Min – 3.90 m  Max – 6.35 m

LAND USE / LAND COVER MAP OF THE CLUSTER (III MINES, BCCL



| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 1464.41 x $10^4$ | 0.0 | 1570.48 x $10^4$ |
| 2 | Open Land | 163.26 x $10^4$ | 0.0 | 97.22 x $10^4$ |
| 3 | Road/ Paved Area | 71.84 x $10^4$ | 0.0 | 71.83 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 159.09 x $10^4$ | 0.0 | 159.09 x $10^4$ |
| 5 | Total | 1898.62 x $10^4$ | 0.0 | 1898.62 x $10^4$ |

## M. GROUND WATER LEVEL OF CLUSTER-XIV

Mines of Cluster-XIV are under administrative control of Western Jharia Area of B.C.C.L (Jharia Coalfield) which is located in Dhanbad district of Jharkhand. This cluster consists of Lohapatty UG and Lohapatty OC patch (proposed). The life of the project has been worked out to be up to 08 years considering annual production target of 0.526 MTPA. It is covered in Survey of India toposheet no. 73 I/2.

The present leasehold area of Cluster-XIV is 1418.25 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.

Monitoring stations (**B024 and B067**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl. No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2023-24 | | | | 2022-23 | | | | 2021-22 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | B024 | Telmuchu | 4.63 | 3.13 | 3.24 | 3.93 | 5.53 | 1.34 | 3.46 | 4.23 | 5.68 | 1.55 | 2.08 | 3.07 |
| 2 | B067 | Simalsani | 8.05 | 3.85 | 5.32 | 6.27 | 8.50 | 3.55 | 6.30 | 7.35 | 8.95 | 2.45 | 2.95 | 3.65 |
| **Average WL (bgl)** | | | 6.34 | 3.49 | 4.28 | 5.1 | 7.02 | 2.45 | 4.88 | 5.79 | 7.32 | 2.00 | 2.52 | 3.36 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 4.63 m  Max – 8.50 m
Post-monsoon GW Level (m): Min – 3.22 m  Max – 6.30 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-XIV MINES, BCCL

| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 1251.76 x $10^4$ | 0.0 | 1251.76 x $10^4$ |
| 2 | Open Land | 78.76 x $10^4$ | 0.0 | 78.76 x $10^4$ |
| 3 | Road/ Paved Area | 85.83 x $10^4$ | 0.0 | 85.83 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 0.90 x $10^4$ | 0.0 | 0.90 x $10^4$ |
| 5 | Total | 1416.25 x $10^4$ | 0.0 | 1416.25 x $10^4$ |

## N. GROUND WATER LEVEL OF CLUSTER-XV

Mines o Cluster - XV comes under administrative control of Govindpur Area and barora Area of B.C.C.L (Jharia Coalfield) which is located in Dhanbad district of Jharkhand. Cluster–XV consists of four coal mines: Kharkharee UG (underground mine) and Dharmaband UG which are under administrative control of Govindpur Area and Madhuband UG & Phularitand UG which are under the administrative control of Barora Area. The life of the project has been worked out to be up to 30 years considering annual production target of 0.423 MTPA. It is covered in Survey of India toposheet no. 73 I/1 and 73 I/5.

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 controling the drainage of the area. The area comes under the watershed area of both Jamunia River and Khudia River.

Monitoring stations (**A024, B032 and B062**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl. No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | A024 | Pipratand | 5.43 | 3.71 | 3.96 | 4.12 | 5.38 | 3.60 | 3.90 | 5.00 | 7.28 | 2.55 | 4.33 | 5.32 |
| 2 | B032 | Madhuband | 6.60 | 2.10 | 3.60 | 4.82 | 5.35 | 3.93 | 3.60 | 5.42 | 4.15 | 0.70 | 2.56 | 4.15 |
| 3 | B062 | Sadiyanbh | 4.97 | 3.01 | 3.19 | 3.80 | 4.80 | 2.35 | 3.10 | 4.00 | 6.45 | 1.77 | 4.91 | 5.15 |
| ***Average WL (bgl)*** | | | 5.67 | 2.94 | 3.58 | 4.25 | 5.18 | 3.29 | 3.53 | 4.81 | 5.96 | 1.67 | 3.93 | 4.87 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 4.15 m  Max – 7.28 m
Post-monsoon GW Level (m): Min – 2.56 m  Max – 4.91 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-XV MINES, BCCL

| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 365.18 x $10^4$ | 0.0 | 957.34 x $10^4$ |
| 2 | Open Land | 1130.53 x $10^4$ | 0.0 | 538.37 x $10^4$ |
| 3 | Road/ Paved Area | 101.67 x $10^4$ | 0.0 | 101.67 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 99.17 x $10^4$ | 0.0 | 99.17 x $10^4$ |
| 5 | Total | 1696.55 x $10^4$ | 0.0 | 1696.55 x $10^4$ |

## 0. GROUND WATER LEVEL OF CLUSTER-XVI

Mines of Cluster - XVI (Dahibari-Basantimata Group of mines) are under administrative control of Chanch Victoria Area of B.C.C.L (western part of Raniganj Coalfield) which is located in Dhanbad district of Jharkhand. There are total five collieries within this Cluster- XVI (Dahibari-Basantimata OC, Basantimata UG, New Laikdih OC, Laikdih Deep UG and Chanch UG Colliery). All the above mines are contiguous in nature and the environmental impact is overlapping in ambient environment due to cumulative effect of mining activities. Life of the project has been worked out to be up to 24 years considering annual production target of 1.963 MTPA. It is covered in Survey of India toposheet no. 73 I/14.

The present leasehold area of Cluster-XVI is 2008.40 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.

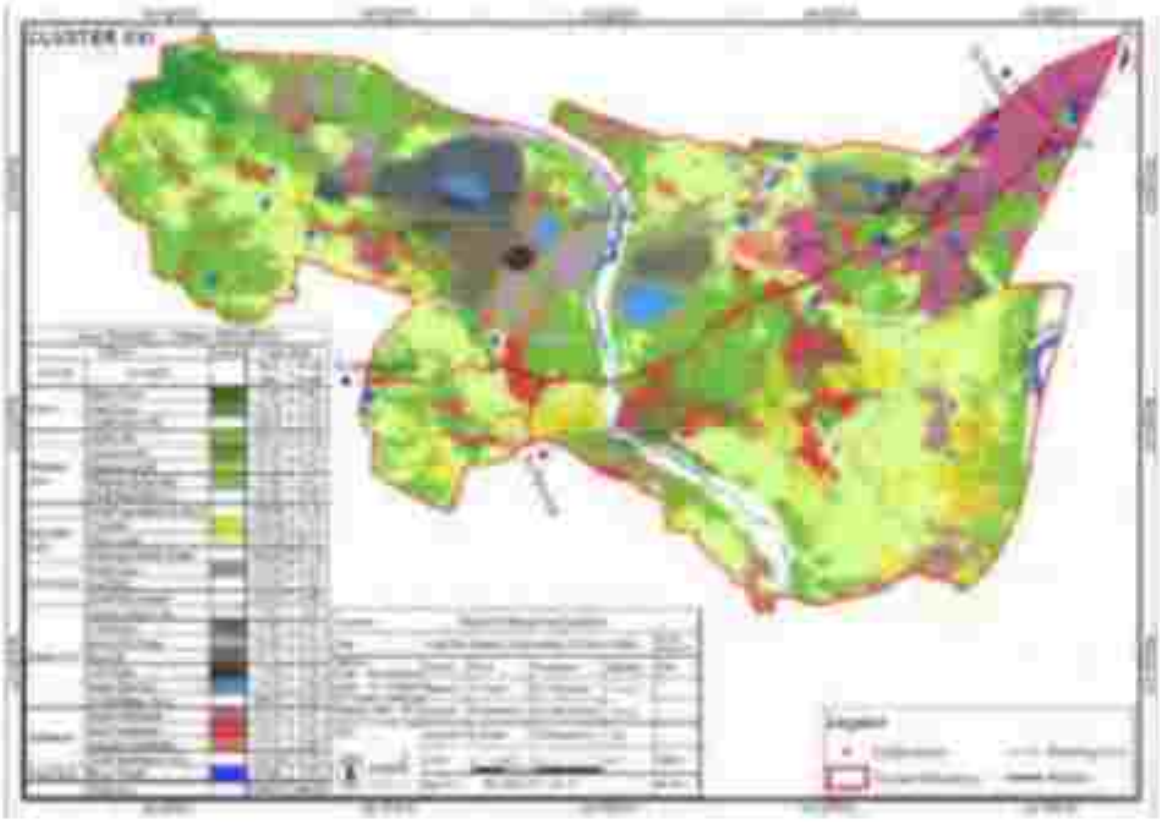
Monitoring stations (**DB022, DB023, DB024 & DB025**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of May'23, August'23, and Nov'23 and January'24. The Ground water level data is presented in the table below:

| Sl No. | Well No. | Location | Water level (bgl in metres) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | DB022 | Dahibari, Basti | 4.06 | 1.63 | 2.33 | 3.07 | 4.25 | 2.07 | 2.43 | 3.31 | 3.72 | 1.47 | 1.99 | 1.58 |
| 2 | DB023 | Dahibari OC | 4.56 | 1.24 | 2.79 | 3.07 | 4.80 | 2.61 | 2.94 | 4.24 | 3.56 | 1.71 | 2.60 | 2.40 |
| 3 | DB024 | Dahibari | 7.84 | 3.73 | 6.92 | 6.98 | 8.25 | 3.50 | 4.16 | 6.87 | 7.08 | | 3.91 | |
| **Average WL (bgl)** | | | 5.49 | 2.20 | 4.02 | 4.37 | 5.77 | 2.73 | 3.16 | 4.81 | 4.79 | 1.59 | 2.83 | 1.99 |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 3.56 m Max – 8.25 m
Post-monsoon GW Level (m): Min – 1.99 m Max – 6.92 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-XVI MINES, BCCL



| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 1349.29 x $10^4$ | 0.0 | 1349.29 x $10^4$ |
| 2 | Open Land | 401.55 x $10^4$ | 0.0 | 401.55 x $10^4$ |
| 3 | Road/ Paved Area | 142.41 x $10^4$ | 0.0 | 142.41 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 115.15 x $10^4$ | 0.0 | 115.15 x $10^4$ |
| 5 | Total | 2008.40 x $10^4$ | 0.0 | 2008.40 x $10^4$ |

## P. GROUND WATER LEVEL OF CLUSTER-XVII

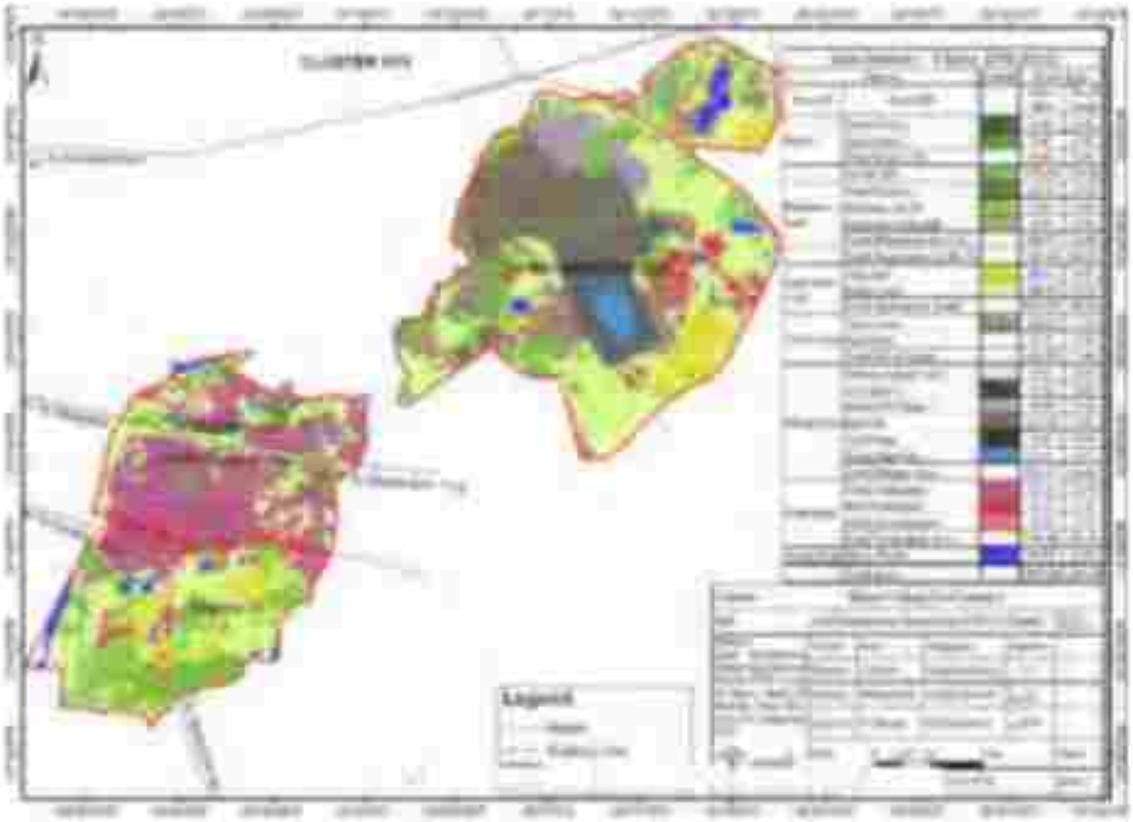
Cluster-XVII mines are under administrative control of Charich Victoria Area, BCCL, located in western part of Raniganj coalfield in Dhanbad district of Jharkhand. Cluster–XVII consists of two closed Underground (UG) coal mines (Begunia Colliery and Victoria-West Colliery) and one opencast mines (Kalyaneshwari OCP). The Leasehold area of the Cluster is located between latitude 23° 45' 09" to 23° 46' 26" N and longitude 86° 47' 46" to 86° 52' 11" E. All the above mines are contiguous in nature and the environmental impact is overlapping in the ambient due to cumulative effect of the mining activities. Leasehold area of the Cluster is 1397.18 ha and the capacity of the project is 4.0 MTPA using opencast method. Cluster-XVII mines is covered in Survey of India toposheet no. 73 I/13. The cluster is approachable both by rail and road. Salanpur and Kulti railway stations of Eastern Railways are at a distance of about 0.6 km from the eastern and southwestern boundary of the cluster respectively. The National Highway No.19 (NH-19) passes through the north eastern part of the cluster and the National Highway No.419 (NH-419) passes along the eastern boundary of the cluster while the Kulti and Barakar townships are about 2 km by road to the south east of the area.The study area has an undulating topography with gentle slope towards south and south west. The buffer zone is predominantly characterized by plain land, with highlands located in parts of the northwest, northeast and southwest. The area comes under the watershed area of Barakar River.

| Sl. No. | Well No. | Location | Water level (bgl in meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2024-25 | | | | 2023-24 | | | | 2022-23 | | | |
| | | | May | Aug | Nov | Jan | May | Aug | Nov | Jan | May | Aug | Nov | Jan |
| 1 | DB8 | Chanpir | 5.40 | 3.06 | 4.10 | 4.76 | 4.50 | 2.55 | 3.42 | 3.97 | 4.67 | | 2.66 | |
| 2 | DB9 | Barakar | 10.26 | 6.42 | 7.34 | 8.93 | 9.50 | 4.17 | 5.18 | 6.47 | 9.68 | | 4.85 | |
| 3 | DB12 | Satiarpur | 5.60 | 3.07 | 2.37 | 3.27 | 5.44 | 2.81 | 2.30 | 3.17 | 4.56 | | 1.89 | |
| 4 | K26 | | 2.14 | 1.36 | 1.53 | 1.58 | 2.10 | 1.33 | 1.50 | 1.55 | 1.83 | | 1.29 | |
| ***Average WL (bgl)*** | | | 5.85 | 3.23 | 3.84 | 4.64 | 5.39 | 2.52 | 3.10 | 3.79 | 5.21 | | 2.72 | |

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.93 m  Max – 10.26 m
Post-monsoon GW Level (m): Min – 1.29 m  Max – 7.34 m

## LAND USE / LAND COVER MAP OF THE CLUSTER-XVII MINES, BCCL



| Sl no | Land Use Details | Existing (sq. meter) | Proposed (sq. meter) | Grand Total (sq. meter) |
|---|---|---|---|---|
| 1 | Green Belt Area | 336.55 x $10^4$ | 0.0 | 336.5 x $10^4$ |
| 2 | Open Land | 1008.81 x $10^4$ | 0.0 | 1008.81 x $10^4$ |
| 3 | Road/ Paved Area | 26.81 x $10^4$ | 0.0 | 26.81 x $10^4$ |
| 4 | Rooftop area of building/ sheds | 25.06 x $10^4$ | 0.0 | 25.06 x $10^4$ |
| 5 | Total | 1397.23 x $10^4$ | 0.0 | 1397.23 x $10^4$ |

## 4.0 GROUND WATER LEVEL SCENARIO

The summarized water level data of all clusters given in **Table – 7**.

**Table –7: Groundwater level data (Cluster-wise)**

| Sl. No. | Cluster of BCCL | No. of Monitoring Wells | Water level Below ground level (May, Aug, Nov'24 & Jan'25) | Avg. Fluctuation (in meters) during 2024 | Geological Formation |
|---|---|---|---|---|---|
| 1 | I | 3 nos. | 0.80 to 5.20 m | 1.48 m | Barakar |
| 2 | II | 4 nos. | 0.50 to 10.73 m | 2.16 m | Barakar |
| 3 | III | 4 nos. | 1.09 to 10.73 m | 2.09m | Barakar |
| 4 | IV | 3 nos. | 1.55 to 8.45 m | 3.59 m | Barakar |
| 5 | V | 2 nos. | 0.55 to 5.55 m | 1.07 m | Barakar |
| 6 | VI | 3 nos. | 1.60 to 4.40 m | 1.39 m | Barakar |
| 7 | VII | 4 nos. | 1.22 to 4.75 m | 1.48 m | Barakar |
| 8 | VIII | 2 nos. | 2.52 to 8.52 m | 4.06 m | Barakar |
| 9 | IX | 4 nos. | 1.88 to 9.03 m | 3.49 m | Barakar |
| 10 | X | 4 nos. | 0.50 to 5.98 m | 1.23 m | Barakar |
| 11 | XI | 3 nos. | 0.95 to 8.02 m | 2.09 m | Barakar & Barren Measure |
| 12 | XII | 3 nos. | 2.98 to 9.00 m | 2.30 m | Raniganj |
| 13 | XIV | 2 nos. | 3.13 to 8.05 m | 2.06 m | Raniganj |
| 14 | XV | 3 nos. | 2.38 to 5.42 m | 1.64 m | Barakar & Barren Measure |
| 15 | XVI | 3 nos. | 2.07 to 8.25 m | 2.50 m | Barakar |

Depth to water level (in bgl) values describe that water level goes down to maximum 10.73 m during summer season and minimum up to 0.50 m during monsoon season of 2023. Un-confined aquifer is affected around 20 m to 30 m of maximum radius 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 is shown in **Annexure–VI**. Water Table contour map and Depth to water level map both during pre & post-monsoon season is shown in **Plate-IV (A, B) & V (A, B)**.

Monitoring of groundwater (quantity & quality) to assess the present condition and resource has been done regularly in the coalfield area. Well hydrographs (**Annexure–VI**) are prepared and studied to identify long-term trends. Hydrograph trend analysis of CGWB monitoring wells and observation wells reveals increasing groundwater level trends in most of the Cluster of mines. However, declining trends in both Pre and Post-monsoon GW level in Cluster-I, Cluster-V, Cluster-VI, Cluster-VIII and Cluster-XIII are recorded but no significant declining 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 (**Plate–II**) with collection points details (dug wells) are given in **Annexure–V** and Quality is given in **Annexure–VII**.

## 5.0 DETAILS OF PIEZOMETERS

A piezometer network is useful for monitoring the impact of mining activity on groundwater regime. Total 23 nos. of Piezometers were constructed during 2022-23 within JCF and RCF to monitor GW level (**Plate-III**). The depth of piezometers varies from 30m to 300m below ground level.

Water level in the piezometers from May23 to Jan24 are furnished below in **Table-8** and the hydrographs (May22 to Jan24) are given in the Annexure VIII.

**Table –8: Groundwater level data in Piezometers (Cluster-wise)**

| PZ ID | Cluster | Lat. | Long. | Depth (m) | May 23 | June23 | July23 | Aug23 | Sept 23 | Oct 23 | Nov 23 | Dec 23 | Jan24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PZ1A | I | 23.7692 | 86.1754 | 40 | 12.20 | 13.20 | 8.80 | 6.75 | 6.50 | 7.30 | 8.40 | 9.80 | 11.88 |
| PZ1B | I | 23.7692 | 86.1763 | 118 | 30.20 | 29.10 | 24.04 | 19.00 | 19.90 | 21.80 | 24.06 | 26.90 | 30.45 |
| PZ2A | II | 23.7672 | 86.1800 | 87 | 30.90 | 31.00 | 22.50 | 17.50 | 16.50 | 18.90 | 22.50 | 25.50 | 28.33 |
| PZ2B | II | 23.7908 | 86.2470 | 77 | 8.02 | 7.30 | 5.10 | 3.50 | 3.80 | 4.30 | 4.50 | 4.40 | 4.6 |
| PZ3A | III | 23.8015 | 86.2824 | 172 | 89.5 | 89.1 | 83.73 | 78.50 | 78.85 | 81.00 | 82.64 | 84.00 | 86.42 |
| PZ3B | III | 23.7798 | 86.2418 | 30 | 24.72 | 23.72 | 16.0 | 14.1 | 13.2 | 15.12 | 18.3 | 20.4 | 23.23 |
| PZ3C | III | 23.8016 | 86.2824 | 124 | - | - | - | - | - | - | - | - | - |
| PZ4A | IV | 23.7764 | 86.3123 | 70 | 38.1 | 37.5 | 32.2 | 26.5 | 27.39 | 29.5 | 31.3 | 33.5 | 34.9 |
| PZ4B | IV | 23.7765 | 86.3125 | 240 | 100.9 | 98.2 | 94.6 | 89.9 | 90.8 | 91.3 | 91.6 | 92.1 | 92.7 |
| PZ5A | V | 23.7817 | 86.3569 | 35 | 8.5 | 7.8 | 6.8 | 2.5 | 3.6 | 4.4 | 4.8 | 5 | 5.31 |
| PZ5B | V | 23.7999 | 86.3619 | 94 | 90.94 | 88.5 | 85.1 | 75.06 | 73.2 | 78.04 | 82.0 | 86.1 | 90.32 |
| PZ7A | VII | 23.7701 | 86.4110 | 159 | 109.9 | 110.1 | 105.02 | 98.5 | 92.9 | 96.8 | 98.1 | 101.0 | 104.86 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PZ7B | VII | 23.7400 | 86.3997 | 35 | 29.36 | 30.02 | 21.36 | 16.63 | 15.88 | 17.66 | 21.38 | 24.23 | 26.16 |
| PZ7C | VII | 23.7542 | 86.4433 | 105 | 92.27 | 90.88 | 86.40 | 78.03 | 80.43 | 82.62 | 84.29 | 85.68 | 85.2 |
| PZ8A | VIII | 23.7556 | 86.4271 | 140 | 49.23 | 49.01 | 46.05 | 40.08 | 38.37 | 42.55 | 43.45 | 44.20 | 46 |
| PZ9A | IX | 23.7305 | 86.4464 | 84 | 43.85 | 44.55 | 41.87 | 38.25 | 39.43 | 40.50 | 41.32 | 42.00 | 40.32 |
| PZ9B | IX | 23.6962 | 86.4159 | 100 | 72.6 | 71.05 | 67.6 | 67.2 | 58.9 | 59.8 | 61.3 | 63.35 | 63.7 |
| PZ10A | X | 23.6880 | 86.4061 | 134 | 6.9 | 6.2 | 4.01 | 3.1 | 3.6 | 4.05 | 4.6 | 5.1 | 6.35 |
| PZ11A | XI | 23.7264 | 86.3419 | 300 | 52.7 | 47.5 | 37.2 | 26.09 | 34.6 | 37.1 | 39.05 | 40.9 | 53.15 |
| PZ13A | XII | 23.7138 | 86.2016 | 90 | 39.9 | 36.3 | 32.1 | 23.6 | 25.8 | 26.5 | 28.1 | 30.1 | 21.61 |
| PZ14A | XIV | 23.7415 | 86.2139 | 90 | 12.8 | 10.1 | 7.9 | 4.8 | 5.5 | 6.1 | 7.3 | 7.9 | 8.39 |
| PZ14B | XIV | 23.7415 | 86.2139 | 162 | 14.6 | 13.5 | 9.8 | 6.05 | 8.3 | 7.5 | 9.1 | 10.5 | 12.58 |
| PZ16A | XVII | 23.7308 | 86.7605 | 90 | 35.58 | 35.64 | 32.49 | 28.60 | 28.54 | 30.40 | 31.06 | 32.0 | 32.24 |

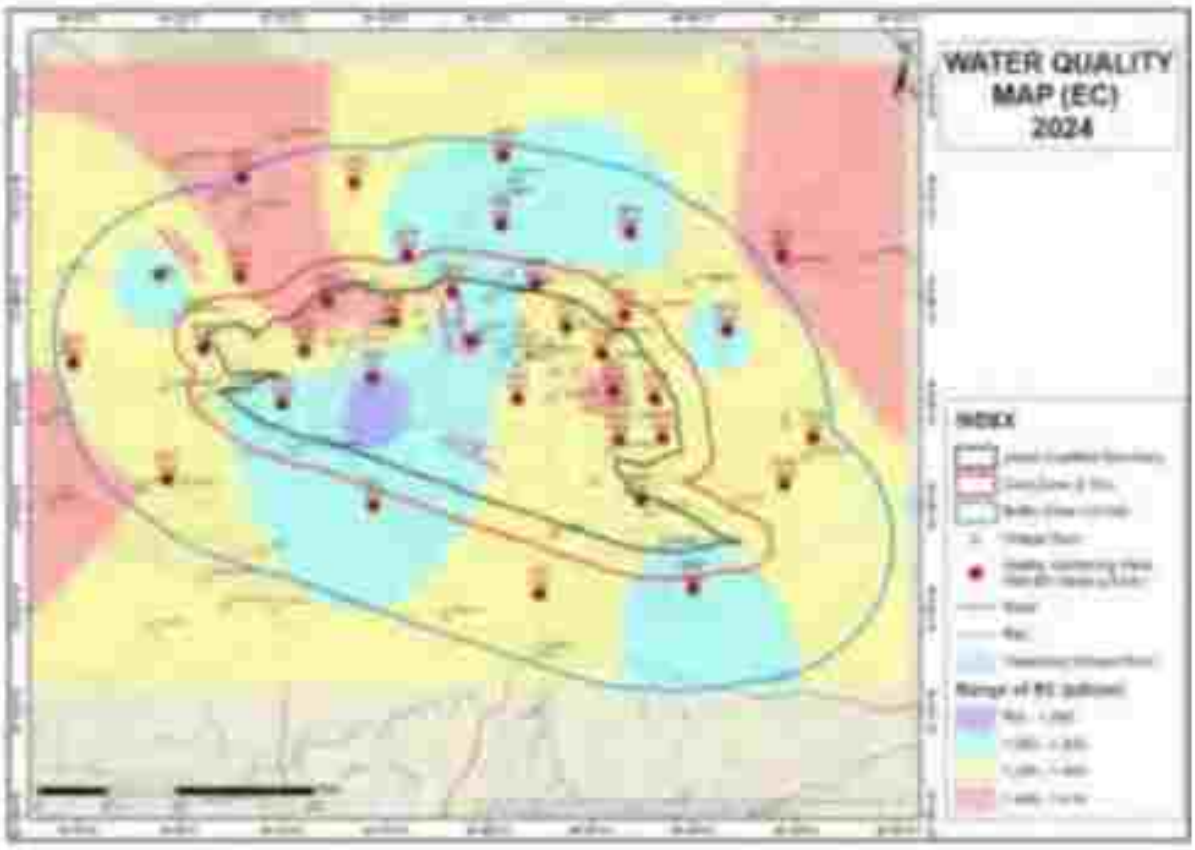
## 6.0 GROUND WATER QUALITY

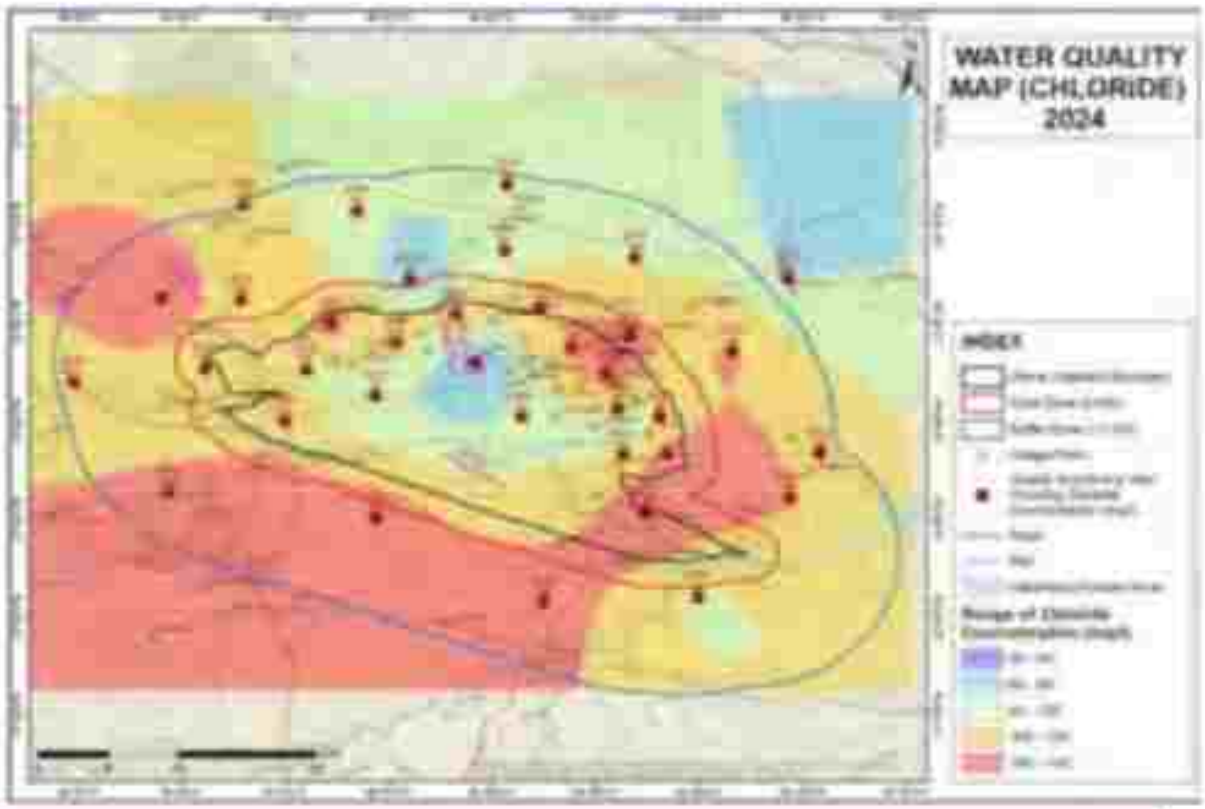
The ground water samples of the study area (16 nos. of Cluster of mines, BCCL) were collected from dug wells and analyzed. Thirty-five ground water samples were analyzed during the month of May'2024 at CMPDI, RI-III, Dhanbad. The water sampling details is given in **Annexure–V** and Water sample locations are shown in **Plate-II**. The water quality data is presented in **Annexure–VII.**

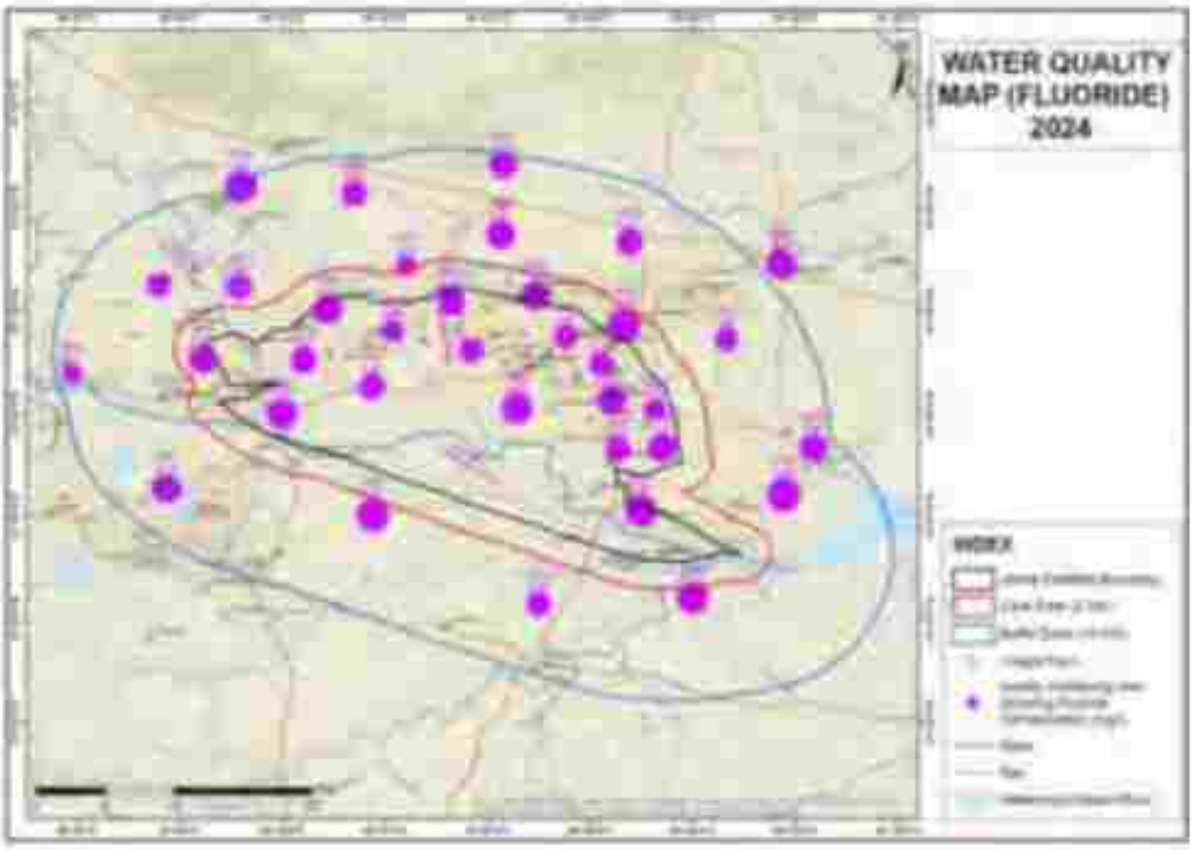
The study of the variations in water quality parameters is described below:

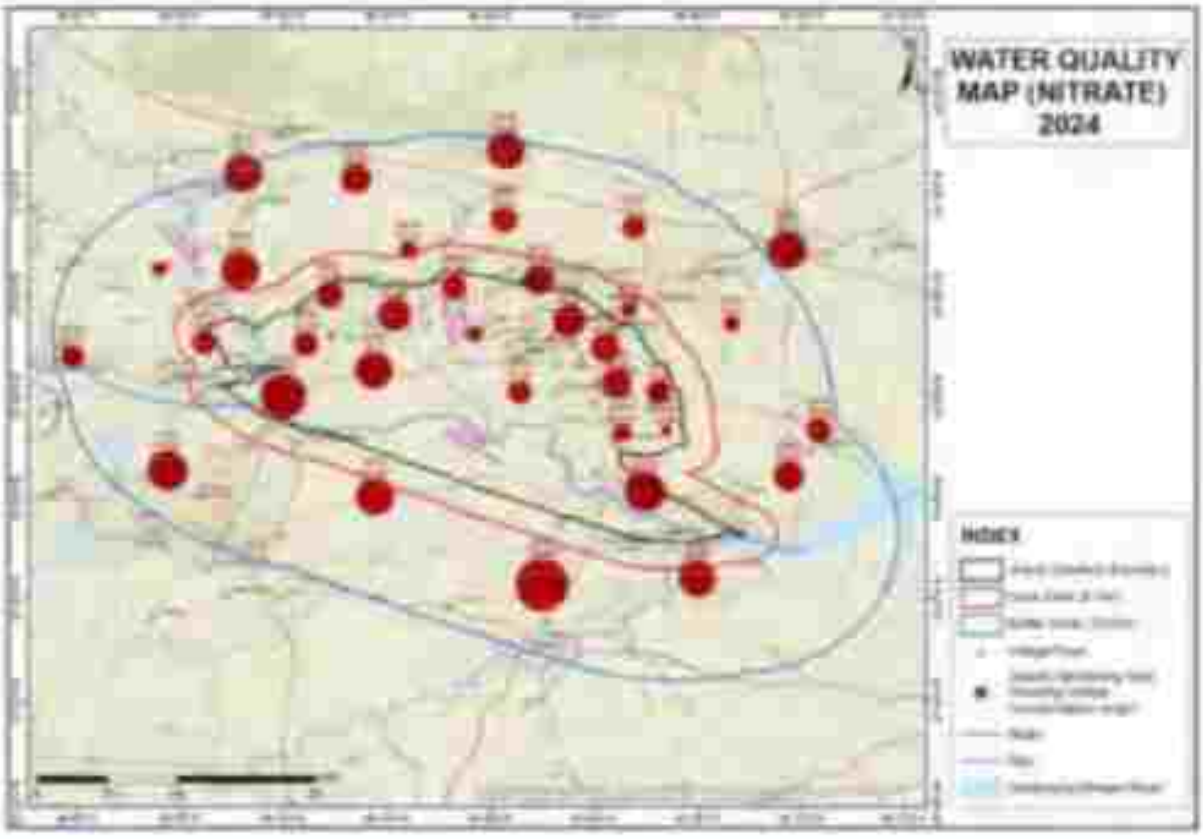
In wells of JCF concentration of magnesium in the water samples varies 103 (D-70) to 125 mg/l (D-4) and is above the permissible limit (100 mg/l) of drinking water standards. The total hardness mg/l ranges from 614 (A-09) to 824 mg/L (D-72) and is above the permissible limit of (600 mg/L) of drinking water standards. The Iron, Manganese, Zinc and Chromium concentration in the water samples found to be below the upper IS 10500:2012 limits for drinking water.

In RCF part of BCCL Command area At a few locations, the total hardness value of the analyzed samples exceeds the permissible limit of 600 mg/L, specifically at DB2A (650 mg/L), DB4 (680 mg/L), DB30 (648 mg/L), DB38 (705 mg/L), and DB39 (602 mg/L). The rest of the groundwater quality data indicates that the values are well within the permissible limits as per the IS 10500:2012 drinking water standards.


WATER QUALITY
MAP (EC)
2024
INDEX


WATER QUALITY
MAP (CHLORIDE)
2024
INDEX


WATER QUALITY
MAP (FLUORIDE)
2024
INDEX


WATER QUALITY
MAP (NITRATE)
2024
INDEX

## 7.0 STAGE OF GROUNDWATER EXTRACTION

The groundwater is mainly utilized for domestic needs and irrigation purposes. The groundwater abstraction is mainly through dug wells and bore wells. The stage of groundwater development in Dhanbad District is 74.34% (as per GWRE 2023-24, INGRES Portal). The highest stage of development is in Baliapur Block (110.03%) & Dhanbad Urban Block (95.65%) and lowest stage of development is in Purbi Tundi Block (26.15%) and Chirkunda Block (34.53%) as per GWRA-2023-24 (Source: Ingres Portal). The Gondwana sandstones in general, 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. Block wise data of Dhanbad District given below:

**Table–9A: Block wise Stage of Groundwater development**

| Sl No. | Administrative Unit | | | Category (GWRA-2017) | Category (GWRA-2022) | Category (GWRA-2023-24) |
|---|---|---|---|---|---|---|
| | State | District | Block | | | |
| 1 | Jharkhand | DHANBAD | BAGHMARA | **Over-exploited** | **Over-exploited** | Semi-Critical |
| 2 | Jharkhand | DHANBAD | BALIAPUR | Critical | Safe | **Over Exploited** |
| 3 | Jharkhand | DHANBAD | DHANBAD | Semi-Critical | **Over-exploited** | Semi-Critical |
| 4 | Jharkhand | DHANBAD | DHANBAD URBAN | **Over-exploited** | Semi-critical | Critical |
| 5 | Jharkhand | DHANBAD | JHARIA | **Over-exploited** | Critical | Hilly Area |
| 6 | Jharkhand | BOKARO | CHANDRAPURA | Critical | Critical | Safe |
| 7 | West Bengal | PASCHIM BARDHAMAN | SALANPUR | Safe | Safe | Safe |

- **Dynamic Groundwater Resource Assessment, CGWB as per 2017, 2022 and 2023-24.**

**Table–9B: Cluster wise Groundwater development scenario**

| Cluster/ Area | Administrative Blocks/Stage Of GW Extraction | Total Water demand (cum/day) | | | | Avg. GW level (bgl in m) 2024-25 | | GW level declining trend 2020-2023 | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mine Discharge + Bfl pumping | Surface Water Source | Total Use (Domestic + Industrial) | Excess Or other use | Pre-monsoon | Post-monsoon | Pre-monsoon | Post-monsoon | |
| Cluster-I | Chandrapura (SOD: Safe) | 2173 (2065+108) | NIL | 2112 (1698+414) | 61 | 4.28 | 2.20 | YES | YES | Recharge structure needed |
| Cluster-II | Baghmara (SOD: Semi Critical) | 8350 | Jamunia river | 6737 (2755+3982) | 1613 | 5.29 | 3.05 | NO | NO | Excess mine water needed to be utilized |
| Cluster-III | | 12760 (10960+1800) | NIL | 8946 (7849+1097) | 3814 | 5.10 | 3.37 | YES | NO | |
| Cluster-IV | | 5900 | MADA | 5100 (3605+1495) | 800 | 7.30 | 3.22 | YES | NO | |
| Cluster-V | | 12590 (11025+1565) | MADA | 11083 (5710+5363) | 1597 | 5.78 | 3.61 | YES | YES | |
| Cluster-VI | Dhanbad (SOD: Critical) | 4150 | MADA | 4150 (1664+2486) | 0.0 | 4.82 | 2.79 | YES | NO | – |
| Cluster-VII | | 21505 | MADA | 20826 (17596+3230) | 739 | 3.56 | 2.07 | YES | YES | Excess mine water needed to be utilized |
| Cluster-VIII | | 9320 | MADA | 5294 (3730+1564) | 4026 | 6.05 | 3.80 | YES | NO | |
| Cluster-IX | | 12960 | MADA | 9358 (4549+4809) | 3622 | 6.62 | 4.01 | NO | NO | |
| Cluster-X | | 11825 | Damodar river | 6201 (4255+1946) | 5624 | 4.27 | 2.64 | NO | NO | |
| Cluster-XI | Dhanbad (SOD: Critical) | 24960 | MADA & DVC | 19420 (14010+5410) | 5535 | 4.86 | 2.76 | YES | NO | |
| Cluster-XII | Baghmara (SOD: Critical) | 750 | Damodar river | 692 | 58.0 | 7.66 | 4.66 | NO | NO | – |
| Cluster-XIV | | 943 | NA | 668 | 275 | 6.34 | 4.28 | NO | NO | – |
| Cluster-XV | | 6260 | NA | 5941 (4600+1341) | 259 | 5.67 | 3.58 | NO | NO | – |
| Cluster-XVI | Chirkunda (SOD: Safe) | 1910 | DVC (Barakar river) | 1730 (1380+350) | 180 | 5.48 | 4.02 | NO | NO | – |
| Cluster-XVII | Selaiyur (SOD: Safe) | 5091 * | DVC (Barakar river) | 5091 (1472+1465) | 2216 | 5.85 | 3.84 | NO | NO | – |

*EAC awaited

MADA – Mineral Area Development Authority, Jharkhand, Dhanbad (payment basis).

DVC – Damodar Valley Corporation, Maithon/Panchat, Jharkhand (payment basis).

## 8.0 IMPACT OF MINING ON GROUND WATER REGIME

## 8.1 GENERAL CONSEQUENCES OF COAL MINES ON AMBIENT HYDROGEOLOGICAL REGIME

Mining of coal either by opencast or underground method is bound to incise one or more water bearing strata (aquifers) which, in turn, may result in depletion or draw down in water levels and a corresponding inflow of water into the mine workings. The potential effects of coal mining operations on the hydrogeological regime are as under:

- Creates disruption in formation/aquifer
- Dewatering of aquifers
- Change in hydraulic gradient
- Modification in recharge of aquifers
- Change in groundwater flow pattern

The general need in mine planning from the hydrogeological point of view is the estimation of ground water seepage into the mine, its rate, the mine pumping capacity to meet the storm rainwater accumulation, extent of depression of water surface and management of mine effluent (mine water). It is also desirable that the consequences of mining operation on groundwater regime be determined in advance. However, the mine pumping in most of the cases are passive dewatering for the safety of the mine pit, active mine dewatering is done in few cases for very high potential aquifers.

## 8.2 POTENTIAL CONSEQUENCES OF OPENCAST AND UNDERGROUND COAL MINES ON HYDROGEOLOGICAL REGIME IN JHARIA COALFIELD

Generally, in the opencast and underground mines of Jharia Coalfield, alluvium and overlying weathered mantle are the first to be excavated, followed by upper Barakar Formation / Aquifer. Since these formations vary in thickness, compaction and their constituents over the area, their aquifer properties also vary.

The porosity and the compactness in the sandstone controls the discharge from these aquifers. The alluvium and weathered Formation wherever loose and fragile possess more porosity and this has high groundwater potential. Due to the mine out, a depression in the water table is created. The initial discharges due to this depression is large in amount because of concentration of flow to that region. In the top zones, water table condition prevails and semi-confined conditions exist in the stratified section (Gondwana Sedimentary basin). With progress of mine operations, there is an increase in the depth of incision, as a result which, the semi-confined aquifers are also gets punctured.

During mining, the hydraulic gradients generally steep down near mine i.e. within the mine influence area. In the up-dip region, only un-confined aquifer is punctured through the mining process and thus only

unconfined aquifer is affected whereas in the down-dip region both un-confined and semi-confined aquifers may be affected. The confined aquifers of lower Barakar Formation in the mining area are not punctured as it lies below the working coal seams and hence normally there is no noticeable effect in the aquifer related to this formation.

## 8.3 ESTIMATION OF RADIUS OF MINE INFLUENCE ZONE

Radius of influence can be defined as the radial distance from the center of the borehole to the point where there is no lowering of groundwater table/potentiometric surface.

The radius of influence (R) for Opencast and UG Mines within Jharia CF is calculated by using Sichardt's formula based on present mining scenario.

$$R_0 = C^*(H-h) * \sqrt{(K)}$$

Where, $R_0$- Radius of influence (m), C - Constant =3000,

(H-h)- Drawdown (m), K – Hydraulic conductivity (m/s).

Here, K for Barakar Formations is 0.05 m/d or $5.7 \times 10^{-7}$ m/sec.

Here, it may be appropriate to mention that the presence of prominent boundaries/water bodies, faults or inter-fingring of sandstone and shale beds may restrict the propagation of drawdown cone. With the presence of low permeable beds such as clay/shale and younger coal seams in the formation, laying above the working seams the water level in the phreatic aquifer is not directly affected. Both, the phreatic and semi-confined aquifers, get affected during the working by board and pillar method as subsidence takes place while extracting total coal (depillaring). Surface vigilance and filling up subsided zone, if any, has to be constantly under observation. The effect on groundwater level for most of the coalmine in Jharia coalfield has been observed in the down-dip side, generally within a distance up to 500 m from active mine zone and becomes milder/ negligible thereafter.

## 9.0 CONSERVATION MEASURES & FUTURE STRATEGY

- BCCL has installed 25 Pressure Filter Plant of total capacity of 4.16 MGD to meet drinking water requirement in nearby area. At present 63 Water Treatment Plants are operational having capacity of 16.16 MGD within Jharia Coalfield area. Further, installation of 29 more Pressure Filter Plants having capacity of 5.84 MGD are in progress.

- BCCL has 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 plants have been proposed at other sites of BCCL.
- A scheme titled '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 persistance 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 by mine discharge at mines of Barora, Block-II and Govindpur Area through pipe line.
- Rooftop rainwater harvesting (RWH) has been taken up in the project areas using the administrative buildings. 138 no. of quarters having roof-top area of about 14950 sq. m. is ready to harvest rainwater and around 13150 cum/annum of water is going to recharge the nearby groundwater system through RWH structures. Proposal has already been made to facilitate this kind of RWH structure at suitable locations i.e., Lodna Area, Kusunda Area (Jawahar Nagar, Malkunia, Coal Board Colony), Sijua Area (Nichitpur and Tetulmari Colony) within Jharia Coalfield to augment groundwater recharge.
- After cessation of mining, with plenty of 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 by connecting pipelines to abandoned dug wells. Utilization of mine water for irrigation 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.
- Imparting awareness among workers and local peoples about Rainwater harvesting and artificial recharge will have 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 continue under routine monitoring (May, August, November & Jan).

## 10.0 EXISTING/PROPOSED RAINWATER HARVESTING STRUCTURES IN BCCL COAL MINES

Fig-3 to 4.

Proposed Rain Water Harvesting Site GVTC, Cluster-I, Barora Area

Proposed Rain Water Harvesting Site Nehru Balika Vidhalaya, Cluster-I, Barora Area
Fig-5 to 6.

Proposed Rain Water Harvesting Site Barora Area Guest House, Cluster-I, Barora Area

Proposed Rain Water Harvesting Site Regional Hospital Baghmara, Cluster-I, Barora Area

Fig-7 to 8.

Proposed Rain Water Harvesting Site – Barora Area Office, Cluster-I, Barora Area

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

Fig-9 to 10.

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

FILTER PLANT IN THE MINE AREA

Fig-11 to 12.

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

Fig-13 to 14

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

Annexure – IV

25 Year Normal Rainfall Data (in mm) for Dhanbad District (Source: WRIS Grided Data)

| Yearly Rainfall (25 Years Normal: 1998-2022) | |
|---|---|
| Year | Rainfall (in mm) |
| 1998 | 1578 |
| 1999 | 1903 |
| 2000 | 1481 |
| 2001 | 1648 |
| 2002 | 1564 |
| 2003 | 1546 |
| 2004 | 1401 |
| 2005 | 1149 |
| 2006 | 1390 |
| 2007 | 1773 |
| 2008 | 1173 |
| 2009 | 1303 |
| 2010 | 1027 |
| 2011 | 1296 |
| 2012 | 1152 |
| 2013 | 1203 |
| 2014 | 1002 |
| 2015 | 996 |
| 2016 | 1398 |
| 2017 | 1385 |
| 2018 | 1144 |
| 2019 | 1357 |
| 2020 | 1116 |
| 2021 | 1745 |
| 2022 | 982 |

| Monthly Rainfall (25 Years Normal: 1998-2022) | |
|---|---|
| Month | Rainfall (in mm) |
| January | 8.2 |
| February | 15.1 |
| March | 19.8 |
| April | 32.1 |
| May | 77.6 |
| June | 204.6 |
| July | 329.6 |
| August | 285.8 |
| September | 259.9 |
| October | 105.5 |
| November | 6.4 |
| December | 4.5 |
| Total | 1549.1 |

| Monthly Rainfall (16 Years Normal: 2008-2023) Bardhaman District, RCF | |
|---|---|
| Month | Rainfall (in mm) |
| January | 7.55 |
| February | 16.06 |
| March | 17.69 |
| April | 37.68 |
| May | 131.88 |
| June | 198.55 |
| July | 254.46 |
| August | 240.09 |
| September | 180.82 |
| October | 92.15 |
| November | 9.44 |
| December | 14.95 |
| Total | 1201.72 |

**Annexure – IV**

**Block wise Rainfall Data as per GWRE 2023-24 (Source: INGRES Portal)**

| State | District | Block | Category (GWRE 2023-24) | Rainfall in mm |
|---|---|---|---|---|
| Jharkhand | DHANBAD | BAGHMARA | SEMI-CRITICAL | 1393.60 |
| Jharkhand | DHANBAD | BALIAPUR | OVER EXPLOITED | 1393.60 |
| Jharkhand | DHANBAD | DHANBAD | SEMI-CRITICAL | 1393.60 |
| Jharkhand | DHANBAD | DHANBAD URBAN | CRITICAL | 1393.60 |
| Jharkhand | DHANBAD | JHARIA | HILLY AREA | 0.00 |
| Jharkhand | BOKARO | CHANDRAPURA | SAFE | 1211.50 |
| West Bengal | PASCHIM BARDHAMAN | SALANPUR | SAFE | 1348.20 |

**Annexure – IV**

## Rainfall Data (in mm) At Dhansar (Rescue station) Observatory Station
## State Sec Deptt of Coord, BCCL

| Year | January | February | March | April | May | June | July | August | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | 34.20 | 22.80 | 41.80 | 32.20 | 33.30 | 183.00 | 542.00 | 107.80 | 185.60 | 39.20 | 0.00 | 2.00 | 1233.80 |
| 2006 | 0.00 | 0.00 | 34.40 | 33.80 | 97.60 | 214.20 | 477.70 | 246.30 | 172.20 | 0.00 | 1.00 | 0.00 | 1267.00 |
| 2007 | 0.00 | 22.00 | 37.80 | 0.00 | 78.70 | 167.20 | 545.00 | 426.40 | 351.40 | 52.00 | 0.00 | 0.00 | 1680.50 |
| 2008 | 9.60 | 4.80 | 17.80 | 18.40 | 18.00 | 216.10 | 433.48 | 183.80 | 297.80 | 85.80 | 0.00 | 0.00 | 1281.78 |
| 2009 | 0.00 | 0.00 | 1.60 | 2.20 | 112.00 | 72.80 | 269.20 | 100.80 | 333.00 | 99.20 | 10.20 | 0.00 | 1002.00 |
| 2010 | 0.00 | 12.20 | 7.60 | 9.20 | 64.30 | 205.20 | 199.40 | 212.60 | 230.10 | 45.30 | 3.4 | — | 991.90 |
| 2011 | 7.60 | 0.00 | 18.0 | 11.40 | 121.60 | 344.20 | 163.40 | 452.0 | 374.0 | 41.80 | 0.00 | 0.00 | 1534.20 |
| 2012 | 17.6 | 12.4 | 1.0 | 9.0 | 6.60 | 62.0 | 328.20 | 315.10 | 267.70 | 11.60 | 61.60 | 18.0 | 1201.80 |
| 2013 | 0.0 | 32.0 | 3.0 | 33.80 | 195.40 | 244.20 | 102.60 | 264.40 | 304.70 | 233.60 | 0.0 | 0.0 | 1599.0 |
| 2014 | 12.40 | 39.80 | 21.80 | 2.60 | 79.60 | 217.60 | 305.30 | 315.60 | 178.0 | 6.40 | 0.0 | 0.0 | 1178.0 |
| 2015 | 23.80 | 0.0 | 8.20 | 76.20 | 35.80 | 122.10 | 407.60 | 244.40 | 145.20 | 25.60 | 0.0 | 6.20 | 1093.10 |
| 2016 | 3.0 | 20.60 | 0.50 | 0.0 | 99.40 | 181.50 | 248.80 | 456.70 | 443.60 | 50.40 | 0.0 | 0.0 | 1509.60 |
| 2017 | 9.60 | 0.0 | 3.80 | 17.60 | 33.20 | 120.0 | 533.40 | 264.70 | 247.40 | 207.70 | 3.40 | 0.0 | 1460.30 |
| 2018 | 0.0 | 0.0 | 0.0 | 102.90 | 76.30 | 270.60 | 382.30 | 338.80 | 159.50 | 38.80 | 2.40 | 37.60 | 1346.60 |
| 2019 | 0.0 | 49.60 | 10.20 | 94.20 | 132.0 | 188.0 | 319.10 | 343.60 | 403.10 | 196.40 | 3.20 | 10.80 | 1867.20 |
| 2020 | 22.0 | 7.60 | 77.80 | 76.80 | 88.20 | 214.10 | 296.80 | 351.40 | 214.0 | 62.0 | 0.0 | 0.0 | 1438.70 |
| 2021 | 0.00 | 0.00 | 21.8 | 13 | 157.4 | 295 | 382.2 | 130.2 | 453.8 | 285 | 54.4 | 43 | 1832.8 |
| 2022 | 12.8 | 89.8 | 0 | 8 | 61.8 | 130.2 | 104.6 | 350.1 | 172.2 | 64.4 | 8 | 3 | 894.9 |
| 2023 | 0.00 | 0.00 | 19.40 | 47.20 | 128.00 | 61.20 | 126.50 | 424.20 | 286.80 | 211.20 | 0.00 | 49.20 | 1356.7 |
| 2024 | 8.80 | 11.00 | 90.00 | 0.00 | 80.20 | 89.60 | 284.00 | 676.20 | 404.60 | 105.60 | 0.00 | 0.00 | 1740.8 |

Annexure – V

## Location of Hydrograph Stations (Dug Wells)

| Well No | Latitude | Longitude | Well No | Latitude | Longitude |
|---|---|---|---|---|---|
| A002 | 86.2586 | 23.8181 | D029 | 86.3742 | 23.8208 |
| A004 | 86.3417 | 23.8492 | D030 | 86.3640 | 23.8096 |
| A006 | 86.3149 | 23.8498 | D034 | 86.3837 | 23.7733 |
| A007 | 86.2982 | 23.8287 | D035 | 86.4321 | 23.6705 |
| A008 | 86.2635 | 23.8527 | D036 | 86.4360 | 23.6564 |
| A009 | 86.2462 | 23.8758 | D039 | 86.4371 | 23.7195 |
| A010 | 86.2805 | 23.8290 | D046 | 86.5211 | 23.7377 |
| A013 | 86.3226 | 23.7735 | D047 | 86.4076 | 23.7539 |
| A015 | 86.3425 | 23.8249 | D052 | 86.4473 | 23.7538 |
| A016 | 86.3598 | 23.7807 | D054 | 86.3751 | 23.7222 |
| A017 | 86.3672 | 23.7520 | D056 | 86.4600 | 23.6590 |
| A019 | 86.4004 | 23.6847 | D057 | 86.4999 | 23.8467 |
| A020 | 86.3272 | 23.7461 | D059 | 86.5253 | 23.6806 |
| A023 | 86.2581 | 23.7502 | D062 | 86.4805 | 23.7029 |
| A024 | 86.2275 | 23.7535 | D063 | 86.4636 | 23.8760 |
| A025 | 86.2540 | 23.7830 | D065 | 86.4929 | 23.7442 |
| A026 | 86.3005 | 23.7787 | D068 | 86.4623 | 23.7054 |
| A027 | 86.3402 | 23.8090 | D070 | 86.5443 | 23.7112 |
| A028 | 86.2979 | 23.7900 | D071 | 86.5248 | 23.7922 |
| A029 | 86.2713 | 23.7865 | D072 | 86.5238 | 23.8293 |
| A032 | 86.3521 | 23.7360 | D074 | 86.4255 | 23.7015 |
| A034 | 86.2537 | 23.7136 | D075 | 86.3985 | 23.6509 |
| B001 | 86.2402 | 23.8164 | D077 | 86.3707 | 23.6802 |
| B002 | 86.2091 | 23.7950 | D080 | 86.4067 | 23.7650 |
| B009 | 86.1797 | 23.8387 | D088 | 86.3950 | 23.6230 |
| B010 | 86.1718 | 23.8153 | D089 | 86.3872 | 23.5968 |
| B011 | 86.2063 | 23.8256 | D090 | 86.4209 | 23.6058 |
| B012 | 86.2049 | 23.8094 | D091 | 86.4378 | 23.5621 |
| B014 | 86.2704 | 23.8008 | D096 | 86.4663 | 23.6135 |
| B015 | 86.1484 | 23.7685 | D105 | 86.3295 | 23.6436 |
| B017 | 86.1194 | 23.7514 | D109 | 86.1983 | 23.6554 |
| B018 | 86.0918 | 23.7459 | D112 | 86.2586 | 23.6670 |
| B024 | 86.2161 | 23.7410 | D113 | 86.2785 | 23.6948 |
| B027 | 86.3418 | 23.7562 | D115 | 86.1250 | 23.6843 |
| B029 | 86.2076 | 23.6992 | D117 | 86.1787 | 23.7136 |
| B032 | 86.2135 | 23.7676 | DB001 | 86.7902 | 23.7303 |
| B033 | 86.2053 | 23.8552 | DB002 | 86.7794 | 23.75 |
| B038 | 86.2135 | 23.8834 | DB003 | 86.7638 | 23.6555 |
| B040 | 86.1731 | 23.8799 | DB004 | 86.8062 | 23.6541 |
| B041 | 86.1611 | 23.9121 | DB005 | 86.8216 | 23.6785 |
| B043 | 86.2420 | 23.8949 | DB008 | 86.81519 | 23.79067 |
| B044 | 86.1276 | 23.8735 | DB009 | 86.8135 | 23.7354 |
| B046 | 86.1195 | 23.8163 | DB010 | 86.8561 | 23.7085 |
| B047 | 86.1233 | 23.7702 | DB012 | 86.8713 | 23.7638 |
| B048 | 86.2783 | 23.7259 | DB013 | 86.8887 | 23.7814 |

| | | | | | |
|---|---|---|---|---|---|
| B051 | 86.1521 | 23.7941 | DB018 | 86.7915 | 23.7394 |
| B053 | 86.1636 | 23.7683 | DB019 | 86.7483 | 23.7194 |
| B054 | 86.3639 | 23.8660 | DB022 | 86.7571 | 23.7237 |
| B056 | 86.3427 | 23.8940 | DB023 | 86.7514 | 23.7291 |
| B057 | 86.2860 | 23.8738 | DB024 | 86.7509 | 23.7309 |
| B059 | 86.2293 | 23.8000 | DB025 | 86.7399 | 23.7337 |
| B060 | 86.2541 | 23.8059 | DB026 | 86.75 | 23.7194 |
| B062 | 86.1929 | 23.7628 | DB027 | 86.7232 | 23.7298 |
| B065 | 86.3076 | 23.8083 | DB028 | 86.6836 | 23.7472 |
| B067 | 86.2325 | 23.7233 | DB029 | 86.6548 | 23.7462 |
| B068 | 86.0873 | 23.7225 | DB030 | 86.6654 | 23.795 |
| B071 | 86.0799 | 23.8088 | DB033 | 86.8126 | 23.7645 |
| D003 | 86.4149 | 23.7804 | DB034 | 86.7877 | 23.7785 |
| D005 | 86.4180 | 23.7098 | DB036 | 86.7546 | 23.798 |
| D007 | 86.4574 | 23.7220 | DB038 | 86.7361 | 23.8346 |
| D008 | 86.1915 | 23.8340 | DB039 | 86.715 | 23.7996 |
| D010 | 86.4947 | 23.7252 | DB047 | 86.7509 | 23.7557 |
| D012 | 86.4484 | 23.7771 | K010 | 86.9157 | 23.7059 |
| D014 | 86.4864 | 23.7808 | K012 | 86.9277 | 23.7267 |
| D018 | 86.4317 | 23.8189 | K015 | 86.9103 | 23.8177 |
| D019 | 86.4253 | 23.8440 | K020 | 86.8824 | 23.8514 |
| D020 | 86.4023 | 23.8527 | K021 | 86.9277 | 23.7267 |
| D022 | 86.4021 | 23.8015 | K026 | 86.8808 | 23.7414 |
| D025 | 86.3837 | 23.7828 | K030 | 86.8472 | 23.7396 |
| D028 | 86.4016 | 23.8223 | | | |

**Annexure – VA**

## Details of Hydrograph Stations (Dug Wells)

| Well No | Location | M.P. (agl) in m | Well Dia in m | Well Depth (m bmp) | Formation | Owner | Utility |
|---|---|---|---|---|---|---|---|
| A002 | Beharekudar | 0.63 | 3.00 | 12.93 | Metamorphic | Nirva Das | Domestic |
| A004 | Daldal | 0.52 | 3.12 | 6.00 | Metamorphic | Govt. | Domestic |
| A006 | Barwadi Kanko | 0.75 | 3.15 | 9.10 | Metamorphic | Govt. | Domestic |
| A007 | Chaddiderdih | 0.45 | 1.80 | 5.95 | Metamorphic | Hazi | Domestic |
| A008 | Sirkari | 0.60 | 1.85 | 12.50 | Metamorphic | Govt. | Domestic |
| A009 | Sitrampur | 0.43 | 2.10 | 9.80 | Metamorphic | Mosque | Domestic |
| A010 | Phulwar | 0.63 | 1.90 | 10.90 | Metamorphic | Govt. | Domestic |
| A013 | Sijua | 0.40 | 2.35 | 6.90 | Barakar | Rajen | Domestic |
| A015 | Tetulmari | 0.90 | 1.85 | 9.00 | Metamorphic | Dharmendar | Domestic |
| A016 | Ekra, Kalali | 0.45 | 3.10 | 6.50 | Barakar | Govt. | Domestic |
| A017 | Kachi Balihari | 0.56 | 1.60 | 5.30 | Barakar | Govt. | Domestic |
| A019 | Bhaura | 0.54 | 3.15 | 11.65 | Barakar | Govt. | Domestic |
| A020 | Gorbhudih | 0.43 | 3.30 | 8.30 | BM | Govt. | Domestic |
| A023 | Machhyara | 0.43 | 1.85 | 12.40 | Raniganj | Govt | Domestic |
| A024 | Pipra Tanr | 0.22 | 1.80 | 19.55 | Raniganj | Govt | Domestic |
| A025 | Sindih | 0.22 | 2.00 | 11.30 | Barakar | Govt | Domestic |
| A026 | Pasturv | 0.32 | 1.80 | 9.65 | Barakar | Govt | Domestic |
| A027 | Chandor | 0.60 | 2.50 | 5.50 | Barakar | Govt | Domestic |
| A028 | Lakarka 6 no | 0.65 | 1.30 | 5.25 | Barakar | BCCL | Domestic |
| A029 | Aamtagan | 0.10 | 2.60 | 9.15 | Barakar | Govt | Domestic |
| A032 | Baludih | 0.55 | 2.30 | 6.85 | BM | Govt | Domestic |
| A034 | Bhaldih | 0.55 | 3.50 | 24.50 | Raniganj | BCCL | Domestic |
| B001 | Muradih | 0.47 | 1.80 | 5.35 | Talchir | Govt | Domestic |
| B002 | Baghmara Tola | 0.32 | 1.85 | 11.25 | Metamorphic | Govt | Domestic |
| B009 | Jari Tanr | 0.80 | 2.57 | 9.00 | Metamorphic | Hariram Majhi | Domestic |
| B010 | Narayanpur | 0.23 | 4.57 | 8.60 | Metamorphic | Mukteswar | Domestic |
| B011 | Nachitpur | 0.60 | 2.08 | 11.30 | Metamorphic | Babulal Das | Domestic |
| B012 | Harvia | 0.37 | 2.20 | 10.87 | Metamorphic | Ramayan | Domestic |
| B014 | Mathadih | 0.76 | 2.15 | 3.75 | Barakar | Govt | Domestic |
| B015 | Bera Basti | 0.55 | 1.60 | 2.50 | Talchir | Dhanu Roy | Domestic |
| B017 | Chandrapura | 0.40 | 1.85 | 11.40 | Barakar | Govt | Domestic |
| B018 | Khanoodih | 0.66 | 2.30 | 13.25 | Metamorphic | Govt | Domestic |
| B024 | Telmuchu | 0.67 | 4.35 | 10.83 | Raniganj | Govt | Domestic |
| B027 | Chirudih Basti | 0.08 | 1.40 | 11.00 | BM | Govt | Domestic |
| B029 | Pipanki | 0.50 | 1.70 | 6.50 | Metamorphic | Govt | Domestic |
| B032 | Madhubanti | 0.80 | 4.30 | 8.60 | Barakar | BCCL | Domestic |
| B033 | Ramakunda | 0.75 | 3.20 | 9.65 | Metamorphic | Lilaram Mahato | Domestic |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| B036 | Tantri | 0.4 | 1.80 | 11.3 | Metamorphic | Panchayat | Domestic |
| B040 | BhurwarChuta | 0.4 | 1.80 | 9.15 | Metamorphic | Govt | Domestic |
| B041 | Pawapur | 0.45 | 3.00 | 6.7 | Metamorphic | Govt | Domestic |
| B043 | Chutatanr | 0.5 | 1.50 | 9.2 | Metamorphic | Govt | Domestic |
| B044 | Lachmipur | 0.35 | 3.35 | 10.1 | Metamorphic | Govt | Irrigation |
| B046 | Telo | 0.2 | 1.50 | 8.1 | Metamorphic | Govt | Domestic |
| B047 | Madanpur | 0.7 | 1.80 | 10.8 | Metamorphic | DVC | Domestic |
| B048 | Mahuda | 0.85 | 2.10 | 11.50 | Raniganj | Mosque | Domestic |
| B051 | Tarainga | 0.00 | 2.50 | 5.75 | Metamorphic | Basin | Irrigation |
| B053 | Karmatanr | 0.58 | 2.70 | 13.25 | Barakar | Govt | Domestic |
| B054 | Domanpur | 0.45 | 3.30 | 9.55 | Metamorphic | Govt | Domestic |
| B055 | Raintanr | 0.50 | 3.40 | 5.25 | Metamorphic | Govt | Domestic |
| B057 | Kotaldih | 0.60 | 3.20 | 7.5 | Metamorphic | Govt | Domestic |
| B059 | Khodowaly | 0.60 | 2.40 | 9.30 | Barakar | BCCL | Domestic |
| B060 | Bahiyardih | 0.77 | 3.00 | 15.60 | Barakar | BCCL | Domestic |
| B062 | Sadanyadih | 0.15 | 3.10 | 9.50 | Barakar | Govt | Domestic |
| B065 | Jhinjpahari | 0.95 | 2.20 | 12.4 | Metamorphic | Private | Domestic |
| B067 | Simatanr | 0.55 | 2.20 | 11.8 | Raniganj | Govt | Domestic |
| B068 | Sibutanr | 0.4 | 2.20 | 6 | Metamorphic | DVC | Domestic |
| B071 | Bandiyo | 0.55 | 3.50 | 7.1 | Metamorphic | Govt | Irrigation |
| D003 | Dhamar | 0.6 | 1.70 | 8.7 | Barakar | Govt | Domestic |
| D005 | Jiyalgora PO | 0.7 | 2.80 | 10.55 | Metamorphic | Govt | Domestic |
| D007 | Golden Pahari | 0.67 | 2.85 | 10.05 | Barakar | BCCL | Domestic |
| D008 | Alokdiha | 0.35 | 1.75 | 8.15 | Metamorphic | Govt | Domestic |
| D010 | Rakhisitpur | 0.55 | 1.65 | 4.6 | Metamorphic | Govt | Domestic |
| D012 | Dhowatanr | 0.75 | 1.85 | 13.2 | Metamorphic | Govt | Domestic |
| D014 | Karmatanr | 0.48 | 1.90 | 11.55 | Metamorphic | Nepal | Domestic |
| D018 | Dhaiya | 0.44 | 2.00 | 8.1 | Metamorphic | Govt | Domestic |
| D019 | Mernko More | 0.42 | 3.80 | 7.57 | Metamorphic | Govt | Domestic |
| D020 | Dhanbad | 0.22 | 3.10 | 11.45 | Metamorphic | | Domestic |
| D022 | Shyamnagar | 0.35 | 1.70 | 6.3 | Metamorphic | Govt | Domestic |
| D025 | Godhar More | 0.6 | 2.75 | 5.8 | Barakar | Govt | Domestic |
| D028 | Nawadih | 0.46 | 2.00 | 10.6 | Metamorphic | Gitarani Paul | Domestic |
| D029 | Karamata | 0.5 | 3.10 | 10.5 | Metamorphic | Govt | Domestic |
| D030 | Barkibua | 0.7 | 2.00 | 5.6 | Metamorphic | Haru | Domestic |
| D034 | Kusunda | 0.6 | 1.50 | 3.45 | Barakar | BCCL | Domestic |
| D035 | Patherdih | 0.4 | 2.00 | 11.2 | Metamorphic | Govt | Domestic |
| D036 | Sudamdih | 0.9 | 2.00 | 6.2 | Metamorphic | BCCL | Domestic |
| D039 | Tilabani | 0.85 | 2.00 | 20 | Barakar | BCCL | Domestic |
| D045 | Sinduptur | 0.74 | 3.00 | 8.75 | Metamorphic | Govt | Domestic |
| D047 | Ena colliery | 0.45 | 3.20 | 23.8 | Barakar | BCCL | Domestic |
| D052 | Gobindih | 0.47 | 3.10 | 5 | Metamorphic | Govt | Domestic |
| D054 | Amtal | 0.65 | 6.40 | 10.8 | Barakar | Govt | Domestic |
| D056 | Bhungoria | 0.5 | 1.80 | 12.75 | Metamorphic | Govt | Domestic |
| D057 | Kandra | 0.37 | 2.10 | 6.55 | Metamorphic | Govt | Domestic |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| D059 | Belgunta Tola | 0.5 | 3.60 | 9.3 | Metamorphic | Govt | Domestic |
| D062 | Bendachuna | 0.65 | 2.80 | 12.1 | Metamorphic | Saheb Ram | Domestic |
| D063 | Chatahad | 0.2 | 1.90 | 10.7 | Metamorphic | Govt | Domestic |
| D065 | Nischitpur | 0.15 | 3.15 | 10.6 | Metamorphic | Govt | Domestic |
| D068 | Surunga | 0.53 | 3.00 | 10.25 | Metamorphic | Govt | Domestic |
| D070 | Jaladih | 0.7 | 1.80 | 9.5 | Metamorphic | Govt | Domestic |
| D071 | Dumandih | 0.65 | 2.00 | 13.5 | Metamorphic | Govt | Domestic |
| D072 | Gobindpur | 0.4 | 1.70 | 6.7 | Metamorphic | Govt | Domestic |
| D074 | Bhulan-Barari | 0.1 | 1.60 | 12.8 | Barakar | Govt | Domestic |
| D075 | Manpur | 0.6 | 2.90 | 10.2 | BM | Govt | Domestic |
| D077 | Rohoniatanr | 0.4 | 3.15 | 6.9 | BM | Govt | Domestic |
| D080 | Bastacolla | 0.7 | 2.50 | 24.95 | Barakar | Govt | Domestic |
| D088 | Lagda more | 0.35 | 2.00 | 7.75 | Metamorphic | Govt | Domestic |
| D089 | Muchatum | 0.6 | 1.60 | 9.15 | Metamorphic | Govt | Domestic |
| D090 | Marradih | 0.42 | 3.10 | 8.8 | Metamorphic | Govt | Domestic |
| D091 | Asurbandh | 0.65 | 1.80 | 8.1 | Metamorphic | Govt | Domestic |
| D096 | Paradih | 0.85 | 1.30 | 9.2 | BM | Private | Domestic |
| D105 | Bandhwatanr | 0.55 | 3.00 | 9.15 | Metamorphic | Dasarath Mahato | Domestic |
| D109 | Domatanr | 0.65 | 9.15 | 9 | Metamorphic | Shiv Charan Mahato | Domestic |
| D112 | Banara | 0.45 | 1.38 | 7.75 | Metamorphic | | Domestic |
| D113 | Dumarda | 0.7 | 3.00 | 11 | Metamorphic | Govt | Domestic |
| D115 | Mahuar | 0.15 | 2.00 | 6.45 | Metamorphic | Private | Domestic |
| D117 | Bhatua | 0.23 | 2.70 | 10 | Metamorphic | Govt | Domestic |
| D8001 | Loikadih | 1 | 2.00 | 14.90 | Barakar | BCCL | Domestic |
| D8010 | Kulti College | 0.6 | 1.8 | 13.88 | BM | Govt | Domestic |
| D8012 | Sahapur | 0.88 | 1.8 | 9.6 | Barakar | Govt | Domestic |
| D8013 | Dundua More | 0.5 | 2 | 7.85 | - | Govt | Domestic |
| D8018 | Sarsupahari | 0.75 | 1.8 | 7 | Barakar | Govt | Domestic |
| D8019 | Luchibad | 0.73 | 1.8 | 8.45 | Talchir | Govt | Domestic |
| D8002 | Sulduri | 0.42 | 1.8 | 9.63 | Barakar | Govt | Domestic |
| D8022 | Dubihari Majhi Basti | 0.8 | 1.85 | 10.25 | Barakar | Govt | Domestic |
| D8023 | BCCL Substation,Dubihari | 0.87 | 1.42 | 5.75 | Barakar | Govt | Domestic |
| D8-24 | Dubihari,LHS | 0.88 | 2 | 12.8 | Barakar | Govt | Domestic |
| D8026 | Patlahari | 0.7 | 4 | 9.8 | Metamorphic | DVC | Domestic |
| D8027 | Lodaharia Village | 0.87 | 2.4 | 10.65 | Metamorphic | Govt | Domestic |
| D8028 | Pathurkuta | 0.5 | 2.2 | 8 | Barakar | BCCL | Domestic |
| D8029 | Kalyanol | 0.6 | 3.8 | 13.7 | Barakar | BCCL | Domestic |
| D8003 | Pirapur | 0.37 | 1.88 | 8.25 | Raniganj | Govt | Domestic |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DB030 | Ramkamali Village | 0.6 | 3.1 | 10.55 | Metamorphic | Govt | Domestic |
| DB033 | Barajol/Anikura | 0.7 | 2 | 8.2 | Talchir | Kajal Chatterjee | Domestic |
| DB034 | Tetuldanga | 0.6 | 3.6 | 11.6 | Talchir | Govt | Domestic |
| DB036 | Madanpur | 0.55 | 2.4 | 8 | Talchir | Chhotka Marandi | Domestic |
| DB038 | Lukuidih | 0.55 | 3.8 | 7.6 | Metamorphic | Govt | Domestic |
| DB039 | Pandra | 0.55 | 3 | 8.9 | Talchir | Forest Dept. | Domestic |
| DB004 | Sarbari | 0.62 | 2.22 | 8.96 | Raniganj | DVC | Domestic |
| DB047 | Mugma | 0.65 | 3.2 | 8.3 | Barakar | Govt | Irrigation |
| DB005 | Parbelia | 0.48 | 3.2 | 7.8 | Raniganj | Govt | Domestic |
| DB006 | Chungei | 0.8 | 2.2 | 5.75 | BM | Govt | Domestic |
| DB009 | Begunia Temple | 0.68 | 3 | 19.25 | Barakar | Govt | Domestic |
| K010 | Phatepur | 0.8 | 2.05 | 28.2 | Raniganj | Govt | Domestic |
| K012 | Ethora | 0.81 | 2 | 15.9 | Raniganj | Govt | Domestic |
| K015 | Kankarkunda | 0.55 | 2.1 | 12.5 | - | Govt | Domestic |
| K020 | Majhladih | 0.79 | 1.22 | 11.77 | - | Govt | Domestic |
| K021 | Pratappur | 0.6 | 1.4 | 10.94 | - | Govt | Domestic |
| K026 | Bodra | 0.8 | 2.1 | 10 | BM | Govt | Domestic |
| K030 | Kulti Station | 0.31 | 0.75 | 4.25 | BM | 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 – VB**

## Historical Water Level data of Hydrograph Stations

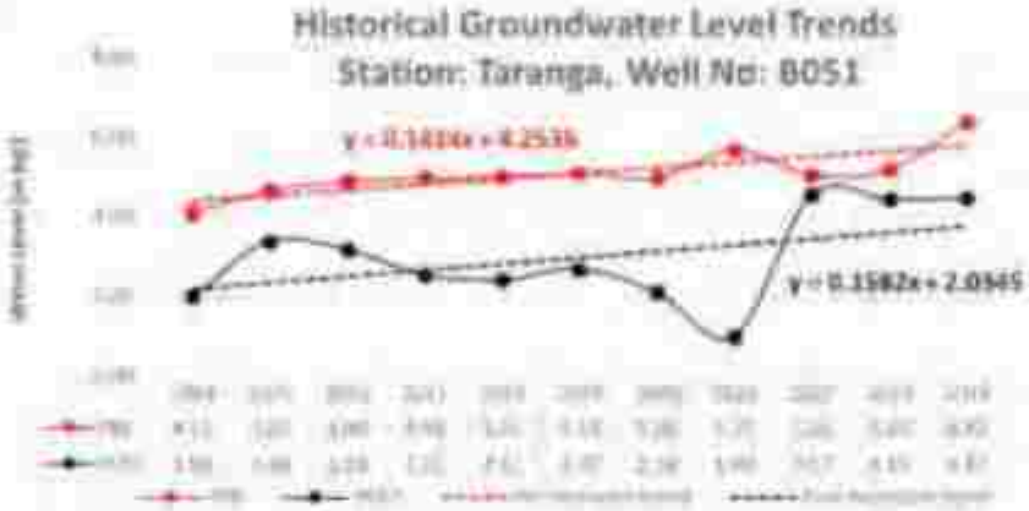
| Well No | Water levels below ground level (bgl) in meters | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | May 16 | Nov 16 | May 17 | Nov 17 | May 18 | Nov 18 | May 19 | Nov 19 | May 20 | Nov 20 | May 21 | Nov 21 | May 22 | Nov 22 | May 23 | Nov 23 |
| | JCF | | | | | | | | | | | | | | | |
| A002 | 9.10 | 9.21 | 8.30 | 4.85 | 6.15 | 4.35 | 6.27 | 4.78 | 7.55 | 3.25 | 6.85 | 3.00 | 6.87 | 4.50 | 6.45 | 4.01 | 4.80 | 3.10 |
| A005A | 4.56 | 1.79 | 5.20 | 1.48 | 3.48 | 0.91 | 4.48 | 1.73 | 3.56 | 1.79 | 4.23 | 3.28 | 3.51 | 1.83 | 4.42 | 1.80 | 3.51 | 1.92 |
| A008 | 8.25 | 8.25 | 8.25 | 2.85 | 6.95 | 3.30 | 8.40 | 6.55 | 4.90 | 4.25 | 7.75 | 5.30 | 7.20 | 4.07 | 8.40 | 5.30 | 7.35 | 4.72 |
| A007 | 7.79 | 4.57 | 9.45 | 5.27 | 7.06 | 2.55 | 7.40 | 3.79 | 9.45 | 4.10 | 7.35 | 3.70 | 8.63 | 3.88 | 7.46 | 3.75 | 8.15 | 5.65 |
| A008 | | 9.73 | 11.80 | 3.30 | 9.66 | 1.38 | | | 11.50 | | | | 8.99 | 4.30 | 9.80 | 4.31 | 10.10 | 6.03 |
| A009 | 6.70 | 5.47 | 7.23 | 4.44 | 7.77 | 2.42 | 6.42 | 5.23 | 8.67 | 5.07 | 6.12 | 4.02 | 7.42 | 4.55 | 6.30 | 5.05 | 7.42 | 4.78 |
| A010 | 5.61 | 3.37 | | 2.42 | 7.47 | 2.27 | 7.72 | 5.47 | 8.17 | 5.57 | 7.27 | 5.29 | 8.92 | 5.65 | 7.70 | 5.40 | 8.92 | 5.05 |
| A014 | 3.90 | 5.30 | 5.20 | 3.85 | 4.40 | | | | 5.10 | | | | 4.03 | 2.60 | 4.80 | 2.50 | 4.83 | 2.31 |
| A015 | 7.15 | 7.60 | 7.85 | 5.20 | 6.56 | 3.95 | | | 7.00 | | | | 6.01 | 2.79 | 6.70 | 2.50 | 6.93 | 3.62 |
| A018 | 5.55 | 4.17 | 5.85 | 3.15 | 3.85 | 2.26 | 4.50 | 3.85 | 5.45 | 1.95 | 7.15 | 1.75 | 5.45 | 2.08 | 6.80 | 3.08 | 5.55 | 3.52 |
| A017 | 3.75 | 2.84 | 2.44 | 3.00 | 2.44 | 2.24 | 3.34 | 2.84 | 2.94 | 2.24 | 2.14 | 1.89 | 3.36 | 2.37 | 2.62 | 2.39 | 2.41 | 2.18 |
| A019 | | | 7.81 | 4.11 | 6.38 | 2.48 | 5.50 | 2.45 | 4.90 | 3.44 | 6.30 | 3.28 | 5.31 | 1.91 | 4.10 | 2.54 | 2.90 | 2.60 |
| A020 | 4.58 | 2.92 | 7.49 | 2.90 | 4.27 | 1.77 | 4.57 | 2.57 | 4.57 | 1.62 | 8.47 | 2.87 | 5.47 | 2.02 | 5.58 | 2.54 | 8.02 | 4.26 |
| A023 | 11.27 | 9.27 | 11.87 | 8.13 | 11.67 | 8.97 | 11.16 | 7.17 | 11.01 | 2.72 | 9.42 | 9.62 | 9.52 | 2.62 | 7.57 | 4.79 | 9.60 | 8.71 |
| A024 | 17.20 | 14.58 | 18.62 | 12.43 | 16.28 | 4.38 | 14.58 | 6.84 | 15.86 | 2.49 | 4.68 | 4.28 | 10.13 | 2.79 | 7.28 | 4.33 | 5.38 | 3.90 |
| A025 | 7.79 | 5.85 | 7.43 | 4.58 | 6.38 | 2.88 | 6.83 | 3.13 | 6.89 | 1.93 | 2.98 | 1.82 | 5.78 | 2.43 | 3.31 | 2.08 | 2.93 | 2.80 |
| A026 | 7.33 | 3.18 | 8.93 | 4.48 | 5.28 | 2.53 | 6.23 | 3.86 | 6.58 | 3.33 | 8.58 | 3.18 | 5.88 | 2.73 | 6.42 | 4.31 | 8.40 | 3.83 |
| A027 | 4.40 | 2.99 | 4.85 | 1.80 | 2.90 | 1.25 | 2.90 | 1.00 | 3.40 | 0.92 | 3.40 | 1.10 | 1.87 | 0.30 | 1.90 | 1.23 | 1.70 | 1.60 |
| A028 | 4.35 | 3.60 | 5.35 | 1.47 | 4.30 | 1.55 | 4.15 | 2.83 | 2.45 | 3.15 | 4.00 | 3.03 | 6.23 | 3.75 | 4.23 | 3.30 | 3.46 | 3.35 |
| A029 | 4.55 | 4.60 | 5.65 | 6.96 | 6.40 | 1.30 | 6.45 | 2.10 | 4.85 | 3.40 | 6.20 | 3.20 | 6.49 | 5.80 | 4.80 | 1.55 | 6.60 | 3.20 |
| A032 | 4.47 | 2.53 | 4.75 | 2.10 | 3.15 | 1.55 | 2.85 | 0.70 | 2.75 | 0.55 | 1.90 | 1.75 | 2.56 | 0.98 | 2.25 | 1.70 | 3.83 | 1.60 |
| A034 | 6.40 | 4.81 | 4.75 | 4.40 | 12.40 | 4.45 | 5.80 | 3.70 | 6.35 | 2.95 | 6.35 | 3.45 | 5.20 | 2.55 | 6.20 | 5.35 | 6.54 | 4.01 |
| B001 | 3.28 | 2.75 | 3.58 | 1.93 | 2.33 | 1.83 | 2.88 | 2.08 | 3.18 | 1.73 | 3.28 | 1.83 | 2.58 | 1.81 | 2.10 | 1.61 | 3.20 | 2.40 |
| B002 | - | - | 10.93 | 8.89 | 10.8 | 8.8 | - | - | 10.88 | 8.58 | - | - | 10.13 | 8.5 | 9.8 | 8.4 | 10.55 | 8.47 |
| B003 | 8.82 | 3.50 | 8.90 | 2.90 | 7.80 | 2.30 | 8.40 | 3.40 | 8.90 | 3.25 | 8.81 | 3.27 | 7.01 | 2.19 | 7.40 | 4.60 | 8.75 | 3.20 |
| B010 | 7.12 | 3.60 | 8.77 | 4.88 | 7.97 | 4.42 | 6.97 | 2.79 | 6.62 | 2.77 | 6.62 | 2.86 | 7.12 | 3.30 | 6.90 | 2.70 | 7.47 | 4.42 |
| B011 | 9.49 | 3.40 | 9.20 | 4.55 | 10.60 | 2.80 | 9.96 | 4.69 | 9.39 | 4.85 | 10.05 | 4.90 | 8.24 | 4.02 | 9.50 | 4.60 | 10.33 | 3.75 |
| B012 | 8.78 | 7.31 | 7.17 | 8.60 | 9.01 | 5.33 | 8.37 | 4.60 | 8.98 | 8.60 | 8.63 | 5.68 | 8.68 | 8.88 | 8.8 | 4.7 | 8.88 | 5.63 |
| B014 | 2.94 | 2.29 | 2.44 | 0.47 | 2.94 | 1.84 | 3.64 | 2.84 | 2.24 | 2.79 | 2.44 | 1.04 | 2.54 | 2.09 | 2.24 | 2.6 | 2.54 | 2.24 |
| B015 | 1.5 | 0.48 | 1.85 | 0.50 | 1.65 | | 1.85 | 0.95 | 1.9 | 0.95 | 2.7 | 1.47 | 1.48 | 0.30 | 1.87 | 1.02 | 1.3 | 1 |
| B017 | 6.85 | 2.9 | 4.8 | 3.15 | 3 | 2.85 | 6.81 | 6.4 | 7.8 | 4.6 | 6.85 | 4.75 | 6.5 | 4.25 | 6.5 | 4.2 | 7.85 | 4.33 |
| B018 | 5.21 | 6.19 | 6.25 | 5.19 | 6.24 | 1.89 | 8.98 | 3.39 | 8.54 | 3.34 | 8.54 | 3.52 | 7.84 | 3.62 | 8.3 | 3.2 | 7.38 | 3.8 |
| B024 | 10.05 | 9.78 | 10.83 | 4.28 | 10.03 | 4.01 | 9.28 | 4.33 | 4.58 | 2.32 | 5.49 | 3.03 | 9.48 | 2.08 | 5.53 | 3.48 | 4.83 | 3.24 |
| B027 | 9.97 | 9.47 | 9.07 | 4.32 | 8.12 | 3.87 | 9.97 | 5.67 | 7.32 | 5.42 | 8.87 | 5.47 | 8.89 | 4.71 | 10.1 | 4.8 | 8.89 | 4.78 |
| B029 | 5.58 | 5.15 | 5.85 | 3.85 | 5.5 | | | | 4.8 | 3.65 | | | 5.38 | 3.48 | 5.5 | 2.55 | 3.8 | 1.8 |
| B032 | 7.55 | 3.32 | 8.85 | 3.07 | 6.86 | 2.8 | 6.75 | 3.9 | 5.55 | 1.7 | 3.3 | 3 | 5.6 | 1.7 | 4.15 | 2.58 | 7.3 | 3.54 |
| B033 | 6.52 | 4.72 | 5.45 | 4.05 | 5.2 | 4.15 | 6.2 | 3.45 | 6.45 | 3.3 | 6.29 | 3.3 | 5.38 | 3.43 | 4.75 | 3.1 | 7.3 | 3.54 |
| B034 | 10.05 | 7.95 | 10.82 | 4.2 | 7.8 | 4.5 | 10.3 | 5.1 | 10.8 | 4.82 | 9.17 | 4.85 | 9.34 | 4.18 | 8.1 | 5.2 | 8.17 | 5.2 |
| B040 | 5.83 | 4.45 | 7.65 | 3.45 | 4.7 | 3.4 | 6.1 | 4.8 | 6.7 | 4.8 | 5.88 | 4.15 | 5.59 | 3.24 | 5.2 | 3.1 | 3.9 | 1.98 |
| B041 | 6.9 | 3.85 | 6.55 | 3.75 | 6.55 | 2.9 | 6.25 | 2.85 | | 1.85 | 6.37 | 2.25 | 5.56 | 2.4 | 5.05 | 3.6 | 6.45 | 4.02 |
| B043 | 7.85 | 5.1 | 7.75 | 2.82 | 7.6 | 2.4 | 7.5 | 4.2 | | 4.55 | 7.35 | 3.7 | 7.28 | 3.79 | 6.5 | 4.6 | 7.28 | 2.83 |
| B044 | 9.15 | 9.54 | 7.7 | 4.79 | 8.8 | 3.75 | 8.68 | 5.05 | | 4.8 | 8.58 | 4.73 | 7.21 | 3.83 | 9.1 | 8.3 | 9.35 | 7.83 |
| B046 | 6.85 | 4.82 | 5.85 | 4.82 | 5.6 | 3.8 | 5.9 | 3.8 | | | 5.55 | 3.35 | 5.5 | 3.62 | 6.05 | 3.75 | 7.25 | 3.9 |
| B047 | 9.23 | 8.8 | 8.85 | 6.7 | 10 | 4.37 | 8.2 | 5.2 | | 5.1 | 8.02 | 4.88 | 7.95 | 4.73 | 8.75 | 5.6 | 7.8 | 4.85 |
| B048 | 7.5 | 3.42 | 8.35 | 4.6 | 7.7 | 4.15 | 7.33 | 2.67 | 7.25 | 4.35 | 8.2 | 3.85 | 7.23 | 8.05 | 6.85 | 5.25 | 8.13 | 5.85 |
| B051 | 4.85 | 3.4 | 4.8 | 3.18 | 4.88 | 2.55 | 6.02 | 2.42 | 5.1 | 2.7 | 5 | 2.1 | 8.7 | 1 | 5.08 | 4.57 | 5.2 | 4.45 |
| B053 | 5.58 | 3.82 | | 2.67 | 4.02 | 1.92 | 3.82 | 1.42 | 3.23 | 1.42 | 3.12 | 1.8 | 4.85 | 1.67 | 4.42 | 3.54 | 2.82 | 1.13 |

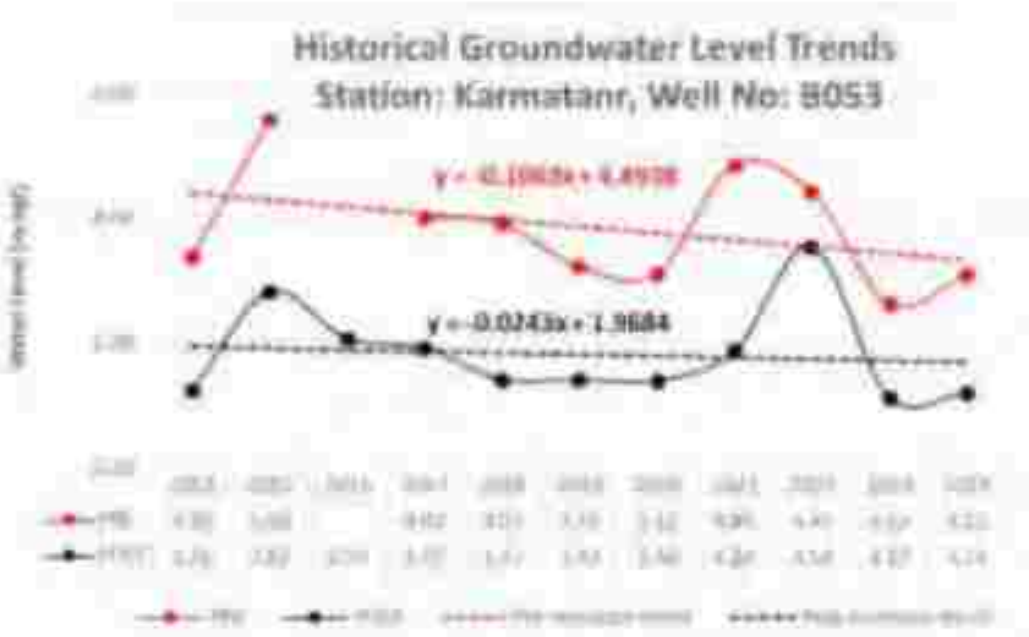
| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B054 | 7.62 | 4.56 | 9.25 | 4.65 | 7.2 | 6.1 | 7.55 | 3.65 | 9.65 | 3.55 | 7.7 | 3.67 | 7.4 | 3.43 | 7.3 | 8.75 | 7.85 | 5.8 |
| B055 | 3.48 | 2.25 | 4.45 | 2.3 | 4.8 | 5.52 | 3.6 | 2.48 | | 2.5 | 4.15 | 2.58 | 3.73 | 2.52 | 3.5 | 9 | 3.73 | 2.2 |
| B057 | 6.58 | 3.35 | 6.6 | 3.45 | 5.9 | 3.8 | 6.2 | 3.1 | | 2.95 | 6.4 | 3.05 | 5.58 | 3.02 | 6.1 | 3.5 | 5.58 | 3.28 |
| B058 | 4.12 | 1.8 | 4.4 | 1.8 | 5.4 | 3.6 | 3.6 | 0.9 | 6.2 | 0.9 | 5.25 | 1.8 | 5.48 | 0.9 | 4.8 | 1.14 | 1.88 | 0.7 |
| B060 | 9.21 | 9.28 | 10.32 | 5.03 | 10.25 | 3.18 | 13.68 | 4.23 | 8.13 | 3.23 | 10.33 | 3.27 | 11.26 | 2.23 | 10.52 | 5.8 | 10.73 | 5.73 |
| B062 | 9.1 | 9.21 | 9.3 | 4.85 | 8.15 | 4.35 | 8.27 | 4.58 | 7.25 | 3.26 | 8.85 | 3 | 8.87 | 4.5 | 8.45 | 4.91 | 4.8 | 3.1 |
| B065 | 7.62 | 8.87 | 7.15 | 2.88 | 9.05 | 1.25 | 10.63 | 2.4 | 11.05 | 1.95 | 9.25 | 2.3 | 9.03 | 1.42 | 7.45 | 2.27 | 8.45 | 2.35 |
| B067 | 9.21 | 5.51 | 9.03 | 4.3 | 9.1 | 2.15 | 9.55 | 4 | 8.87 | 4.35 | 7.35 | 1.95 | 8.85 | 2.95 | 8.3 | 8.3 | 8.05 | 8.52 |
| B069 | 8.15 | 3.42 | 8.25 | 2.8 | 4.55 | | 5.2 | 3.85 | | 3.65 | 8.1 | 3.48 | 4.18 | 3.76 | 5.5 | 4.6 | 7.82 | 4.6 |
| B071 | 9.48 | 3.2 | 8.15 | | | | 5.5 | 3.47 | | 3.45 | | | 9.43 | 3.25 | 5.3 | 3.8 | 10.29 | 8.84 |
| D003 | 4.25 | 2.25 | 2.35 | 1.9 | 2.15 | 2.3 | 3.43 | 2.45 | 1.75 | 1.3 | 5.4 | 1.38 | 3.41 | 0.85 | 5.88 | 1.32 | 3.15 | 1.85 |
| D005 | 8.37 | 8.23 | 8.4 | 8.4 | 7.9 | 5.2 | 7.8 | 5.3 | 9.25 | 4.85 | 8.9 | 7.7 | 7.29 | 4 | 8.4 | 7.01 | 8.4 | 7.01 |
| D007 | 8.25 | 5.61 | 7.03 | 4.83 | 7.33 | 2.88 | 7.51 | 2.83 | 8.21 | 3.28 | 7.21 | 6.11 | 6.08 | 2.63 | 9.23 | 9.67 | 9.23 | 3.84 |
| D008 | 6.34 | 4.58 | 8 | 5.43 | 5.15 | 1.85 | 5.65 | 1.85 | 4.8 | 3.85 | 5.83 | 2.75 | 4.56 | 2.27 | 5.8 | 2.5 | 7.7 | 4.82 |
| D010 | 3.77 | 2.3 | 3.77 | 1.8 | 3.85 | 1.8 | 3.85 | 2.8 | 3.5 | 2.73 | 3.78 | 2.45 | 3.55 | 1.47 | 3.5 | 1.8 | 5.4 | 2 |
| D012 | 12.25 | 7.8 | 12.25 | 6.6 | 12.45 | 6.85 | 11.35 | 7.7 | 12.25 | 7.2 | 10.82 | 8.87 | 11.58 | 7.28 | 12 | 9.5 | 11.58 | 7.75 |
| D014 | 11.02 | 9.47 | 10.77 | 8.12 | 10.22 | 7.47 | 10.92 | 7.42 | 10.32 | 7.07 | 9.47 | 9.65 | 9.57 | 7.02 | 10.3 | 7.1 | 9.57 | 6.18 |
| D016 | 7.01 | 4.45 | 5.38 | 1.98 | 3.58 | 2.78 | 7.58 | 3.85 | | 3.88 | | | 3.88 | 3.11 | 4.5 | 2.3 | 3.88 | 2.25 |
| D018 | 8.43 | 8.12 | 8.33 | 5.5 | 7.79 | 4.88 | 7.53 | 4.81 | 7.45 | 4.85 | 7.21 | 4.25 | 7.47 | 4.4 | 7.25 | 4.4 | 7.68 | 5.48 |
| D020 | 7.42 | 8.58 | 8.02 | 5.89 | 7.89 | 4.42 | 7.38 | 3.88 | 8.18 | 4.33 | 7.28 | 3.81 | 7.88 | 3.88 | 8.4 | 5.5 | 8.48 | 4.28 |
| D022 | 6.78 | 2.87 | 5.45 | 4.75 | 4.15 | 1.15 | 5.8 | 1.75 | | 2.5 | 5.75 | 1.7 | 3.8 | 0.8 | 4.6 | 1.7 | 3.8 | 1.38 |
| D025 | 4.48 | 2.45 | 2.4 | 1.6 | 2.4 | 1.2 | 2.6 | 2.4 | 3.3 | 0.38 | 0.5 | 3.38 | 0.89 | 3.8 | 10.5 | 4.7 | 4.4 | 3.4 |
| D028 | 9.38 | 7.22 | 8.27 | 3.57 | 8.64 | 2.79 | 9.04 | 3.74 | 8.62 | 5.08 | 7.44 | 8.02 | 9.75 | 5.51 | 7.9 | 9.6 | 8.76 | 8.87 |
| D029 | 9.02 | 4.35 | 8.32 | 4.2 | 8.2 | 3.48 | 9.8 | 3.2 | 9.35 | 5 | 8.69 | 5 | 9.05 | 5.1 | 8.75 | 7.1 | 9.05 | 5.87 |
| D031 | 4.55 | 3.15 | 4.45 | 3.2 | 4.4 | 1.25 | 4.58 | 1.1 | 4.6 | 0.75 | 4.3 | 1.35 | 4.23 | 0.84 | 4.37 | 2.25 | 4.08 | 2.2 |
| D034 | 2.55 | 1.45 | 2.3 | 0.3 | 1.8 | 0.55 | 2.8 | 0.45 | 2.4 | 2 | 2.9 | 2.4 | 3.38 | 2.5 | 5 | 3.15 | 3.8 | 5.5 |
| D039 | 9.8 | 7.9 | 9.62 | 8.45 | 8.8 | 3.8 | 8.4 | 6.45 | 8 | 5.8 | 8.2 | 5.4 | 8.8 | 2.8 | 8.1 | 4.88 | 9.23 | 3.9 |
| D058 | 1.88 | 1.13 | 0.78 | 0.05 | 1.3 | 0.7 | 1.2 | 0.6 | 1.3 | 0.55 | 2.1 | 1 | 2.02 | 0.45 | 3.35 | 0.6 | 1.85 | 0.6 |
| D036 | 5 | 2.81 | 2.18 | 2.85 | 5.55 | 4.75 | 4.95 | 4.35 | 4.95 | 5.6 | 9.05 | 6.7 | 10.35 | 4.75 | 7.9 | 3.35 | 8.52 | 3.28 |
| D046 | 6.14 | 3.31 | 7.48 | 3.28 | 7.16 | 3.21 | 6.28 | 3.24 | 7.61 | 3.38 | 6.01 | 3.21 | | | 7.05 | 4.6 | 7.88 | 4.18 |
| D047 | 5.9 | 3.8 | 3.18 | 2.95 | 3.15 | 2.85 | 5.32 | 2.55 | 4.55 | 4.55 | 5.45 | 5.42 | 4.05 | 2.45 | 3.2 | 1.5 | 4.45 | 3.27 |
| D052 | | | 4.23 | 1.82 | 3.52 | 1.58 | 4.82 | 3.33 | 2.09 | 3.54 | 4.58 | 3.28 | | | 3.9 | 2 | 3.2 | 1.85 |
| D054 | 8.78 | 6.7 | 9.3 | 3.55 | 8.45 | 5.35 | 8.85 | 3.45 | 9.25 | 3.55 | 7.23 | 3.68 | | | 9.3 | 6.9 | 8.83 | 6.3 |
| D056 | 10.4 | 6.9 | 8.48 | 5.25 | 7.1 | 5 | 10.48 | 5.8 | 6.2 | 6.55 | 10 | 8.75 | 8.85 | 4.88 | 8.8 | 5.8 | 5.9 | 3.73 |
| D057 | 5.56 | 5.52 | 6.1 | 5.41 | 5.23 | 5.43 | 6.83 | 4.83 | 5.23 | 4.43 | 6.53 | 2.88 | 5.42 | 3.5 | 5.5 | 4.85 | 5.58 | 2.85 |
| D059 | 6.88 | 3.32 | 7.7 | 4.88 | 7.36 | 3.55 | | | 7.3 | | | | 7.3 | 3.6 | 7.38 | 3.85 | 7.3 | 4.83 |
| D062 | 7.43 | 4.12 | 6.33 | 3.9 | 7.76 | 3.65 | 7.35 | 4 | 7.45 | 3.85 | 7.21 | 3.85 | 7.47 | 3.4 | 7.75 | 4.4 | 7.47 | 3.74 |
| D063 | 6.41 | 4.3 | 5.8 | 3.74 | 7.65 | 3.15 | 6.3 | 3.3 | 7.58 | 3.3 | 6.43 | 5.17 | 7.75 | 3.14 | 6.8 | 5.7 | 7.75 | 4.55 |
| D067 | 7.48 | 4.36 | 8.85 | 2.35 | 8.65 | 4.85 | 7.45 | 3.8 | 8.35 | 3.85 | 7.68 | 3.85 | 7.41 | 4.83 | 7.9 | 5.7 | 8.4 | 4.85 |
| D068 | 8.48 | 4.8 | 9.45 | 3.54 | 8.42 | 4.27 | 7.27 | 3.27 | | 3.97 | 8.97 | 3.03 | 7.62 | 4.22 | 8.2 | 5.3 | 7.82 | 4.8 |
| D070 | 7.1 | 4.25 | 7.85 | 3.88 | 8.5 | 4.28 | 7.2 | 5.1 | 8.1 | 4.8 | 7.12 | 4.8 | 8.13 | 3.78 | 7.5 | 8.88 | 8.8 | 4.83 |
| D071 | 10.65 | 8.55 | 11.25 | 5.45 | 10.35 | 4.85 | 10.65 | 8.89 | 10.83 | 8.85 | 10.8 | 7 | 10.28 | 3.35 | 10.15 | 7.5 | 10.28 | 5.84 |
| D072 | 4.82 | 2.8 | 3.41 | 2.3 | 2.8 | | 5.85 | 2.8 | | 2.75 | 6.82 | 3.88 | 4.58 | 2.88 | 3.2 | 2.3 | 5 | 2.9 |
| D074 | 10.05 | 7.2 | 7.77 | 5 | 9.25 | 3.85 | 8.8 | 6.8 | 5.8 | 3.97 | 4.2 | 3.83 | 6.83 | 2.9 | 8.17 | 8.77 | 4.57 | 3.54 |
| D075 | 7.42 | 4.3 | 5.75 | 3.4 | 3.2 | 1.3 | 7.4 | 3.4 | 5.25 | 4 | 7.45 | 3.27 | | | 5.8 | 2.3 | 5.75 | 2.8 |
| D077 | 8.44 | 5.8 | 4.8 | 2.9 | 8.5 | 4.9 | 6.3 | 5.2 | 8.5 | 2.2 | 8.4 | 2.5 | 5.98 | 4.88 | 6.5 | 4.7 | 5.98 | 3.93 |
| D080 | 10.07 | 3.35 | 8.45 | 4.75 | 8.85 | 3.7 | 9.35 | 4.3 | 5 | 3.35 | 4.3 | 8.8 | 7.1 | 2.55 | 8 | 3.3 | 4.75 | 2.4 |
| D088 | 5.83 | 3.85 | | 4.2 | 6.55 | 3.75 | 6.15 | 3.88 | | 3.45 | 6.12 | 4.03 | 6.55 | 2.52 | 6.6 | 2.8 | 6.55 | 3.1 |
| D089 | 5.3 | 3.22 | | 6.7 | 8 | 2.7 | 5.3 | 3.7 | | 3.8 | 5.45 | 3.63 | 4.41 | 2.55 | 6.7 | 4.3 | 4.41 | 3.55 |
| D090 | 6.88 | 3.88 | | 3.68 | 4.03 | 2.58 | 6.83 | 3.83 | | 3.88 | 5.92 | 3.48 | 5.43 | 2.88 | 7 | 4.5 | 5.83 | 3.68 |
| D091 | 6.85 | 4.85 | | 4.15 | 5.85 | 2.85 | 6.85 | 3.15 | | 3.4 | 6.4 | 3.4 | 5.18 | 3.08 | 5.2 | 3.7 | 5.18 | 3.2 |
| D098 | 5.6 | 3.53 | | 3.75 | 8 | | 6.45 | 3.55 | | | | | 6.87 | 2.73 | 7.75 | 4.35 | 6.1 | 3.2 |
| D105 | 7.37 | 3.1 | 8.15 | | 7.85 | 4.3 | 4.1 | 4.2 | 7.7 | 4.48 | 6.7 | | 8.3 | 8 | 7.05 | 4.82 | | |
| D106 | 6.15 | 6.55 | 5.8 | 4.15 | 7.25 | | 7.78 | 3.5 | 6.35 | 3.85 | 7.9 | 3.33 | 7.33 | 3.1 | 5.2 | 3 | 7.33 | 3.88 |
| D112 | 8.8 | 3.75 | 9.85 | 3.4 | 7.88 | 3.5 | 6.83 | 4.11 | 7.25 | 4.67 | 8.74 | 4.83 | 8.8 | 4.85 | 7.45 | 3.35 | 8.8 | 3.35 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D112 | 8.6 | 3.55 | | 3.96 | 7.28 | 3.39 | 6.86 | 3.5 | | 3.5 | 8.1 | 3.45 | 8.6 | 3.99 | 7.5 | 4.2 | 5.75 | 3.48 |
| D113 | | 4.86 | | 5.22 | 6.03 | 2.7 | 7.1 | 3.01 | | 2.95 | 7.45 | 2.4 | 7.65 | 3.43 | 5.5 | 4.6 | 6.36 | 3.83 |
| D117 | 7.98 | 5.54 | | 6.67 | 8.6 | 4.37 | 7.92 | 5.02 | | 5.02 | 7.22 | 4.78 | 7.87 | 6.11 | 8.7 | 5.5 | 7.27 | 5.25 |
| RCP (Pair) | | | | | | | | | | | | | | | | | | |
| D8001 | 5.4 | 4.08 | 4.17 | 3.7 | 4.6 | 3.6 | 4.36 | 4.2 | 4.86 | 4.2 | 5.09 | 4.08 | 4.98 | 3.98 | 4.73 | 3.78 | 3.96 | 3.77 |
| D8002 | 3 | 4.8 | 3.2 | 1.98 | 3.42 | 2 | 2.56 | 2.02 | 3.4 | 2.62 | 2.97 | 2.43 | 3.34 | 2.31 | 3.26 | 2.54 | 2.9 | 2.25 |
| D8003 | 4.8 | 3 | 5.3 | 3.23 | 5.32 | 2.42 | 5.6 | 3.1 | 5.67 | 3.12 | 4.72 | 3.37 | 4.53 | 3.21 | 4.42 | 3.11 | 4.56 | 3.38 |
| D8004 | 7.5 | 4 | 7.32 | 5.12 | 6.59 | 3.42 | 6.8 | 4.1 | 5.8 | 3.55 | 5.17 | 5.11 | 4.96 | 3.98 | 4.81 | 2.89 | 5.1 | 4.83 |
| D8005 | 6.98 | 3.26 | 5.48 | 3.6 | 5.48 | 3.6 | 4.96 | 3.13 | 5.58 | 2.76 | 5.1 | 3.26 | 4.56 | 3.16 | 4.75 | 3.33 | 5.52 | 3.51 |
| D8006 | 4.8 | 2.8 | 4.57 | 3.02 | 4.17 | 3.13 | 4.17 | 3.66 | 4.27 | 3.07 | 5.01 | 3.1 | 4.61 | 3.95 | 4.67 | 3.66 | 4.5 | 3.42 |
| D8007 | 5.45 | 4.3 | 10.5 | 5.36 | 11.3 | 6.36 | 9.36 | 5.22 | 11.01 | 6.36 | 10.4 | 6.44 | 9.98 | 5.06 | 9.68 | 4.85 | 9.3 | 5.18 |
| D8010 | 5.68 | 4.07 | 4.75 | 3.75 | 4.4 | 3.5 | 4.6 | 2.8 | 4.96 | 2.95 | 5.29 | 3.07 | 5.07 | 2.92 | 4.92 | 2.83 | 4.6 | 3.12 |
| D8012 | 6.3 | 2.05 | 6.76 | 2.79 | 6.2 | 2.73 | 6.18 | 2.55 | 6.66 | 2.73 | 6.8 | 2.06 | 4.76 | 1.95 | 4.56 | 1.89 | 5.64 | 2.36 |
| D8013 | 5.56 | 6.3 | 3.25 | 5.8 | 3.72 | 5.5 | 5.1 | 5.3 | 2.92 | 5.4 | 3 | 4.8 | 4.88 | 2.98 | 4.73 | 2.88 | 4.5 | 2.76 |
| D8019 | 5.48 | 3.05 | 4.8 | 3.2 | 4.2 | 3.3 | 4.2 | 3.99 | 4.6 | 2.55 | 3.9 | 2.9 | 3.85 | 2.79 | 3.54 | 2.67 | 4.25 | 2.81 |
| D8020 | 5.36 | 3.42 | 5.5 | 2.93 | 5.53 | 3.18 | 4.88 | 3.03 | 5.53 | 3.36 | 4.9 | 3.02 | 4.76 | 2.87 | 4.56 | 2.78 | 4.8 | 2.96 |
| D8022 | 4.87 | 3.1 | 4.63 | 2.23 | 4.83 | 2.53 | 3.19 | 1.93 | 3.8 | 2 | 2.99 | 2.18 | 3.83 | 2.05 | 2.72 | 1.89 | 4.25 | 2.43 |
| D8023 | 4.05 | 2.62 | 4.17 | 2.97 | 2.5 | 2.57 | 4.4 | 2.17 | 4.67 | 2.27 | 3.82 | 2.62 | 3.67 | 2.68 | 3.56 | 2.62 | 4.8 | 2.59 |
| D8024 | 5.47 | 6.3 | 3.48 | 4.06 | 7.38 | 4.2 | 6.88 | 4.08 | 6.53 | 4.48 | 7.6 | 3 | 7.33 | 2.65 | 7.08 | 3.91 | 8.25 | 4.18 |
| D8025 | 8.1 | 2.5 | 7.73 | 3.63 | 6.98 | 3.23 | 6.66 | 2.65 | 8.4 | 2.78 | 5.25 | 3.05 | 5.04 | 2.96 | 4.89 | 2.81 | 5.15 | 2.96 |
| D8026 | 5.9 | 3.77 | 8.14 | 3.53 | 8.6 | 3.52 | 7.3 | 4.88 | 7.6 | 4.6 | 8.93 | 3.77 | 8.65 | 3.59 | 8.45 | 3.47 | 8.9 | 3.66 |
| D8027 | 6.26 | 3.2 | 5.77 | 2.92 | 6.02 | 3.35 | 5.97 | 3.69 | 5.97 | 3.37 | 8 | 3.09 | 5.76 | 3.41 | 5.59 | 3.31 | 6.85 | 3.63 |
| D8028 | 3.68 | 3.74 | 1.8 | 4.1 | 2.7 | 3.8 | 1.88 | 4.3 | 2.6 | 3.8 | 1.9 | 3.35 | 3.88 | 3.03 | 3.88 | 1.97 | 4.2 | 2.24 |
| D8029 | 9.1 | 4.8 | 8.6 | 4.6 | 8.1 | 3.88 | 7.6 | 4.1 | 7.1 | 4.25 | 8.6 | 4.3 | 6.02 | 4.88 | 6.43 | 3.86 | 8.3 | 4.67 |
| D8030 | 7.02 | 3.4 | 7.6 | 3.8 | 8.8 | 3.84 | 7.1 | 3.8 | 6.85 | 3.3 | 6.01 | 4.25 | 5.77 | 4.04 | 5.66 | 3.92 | 7.5 | 3.86 |
| D8031 | 7.86 | 3.78 | 7.44 | 3.6 | 8.8 | 3.9 | 6.45 | 3.8 | 6.56 | 3.55 | 4.91 | 3.78 | 4.71 | 3.88 | 4.87 | 3.48 | 5.7 | 2.88 |
| D8033 | 6.05 | 4 | 8.85 | 3.85 | 9.07 | 3.65 | 5.56 | 2.8 | 5.6 | 2.55 | 4.83 | 3 | 4.53 | 2.85 | 4.37 | 2.79 | 5.6 | 2.92 |
| D8034 | 9.3 | 4.02 | 7.83 | 3.5 | 6.66 | 3.88 | 8.4 | 3.3 | 5.9 | 3.16 | 5.53 | 3.9 | 6.42 | 3.61 | 5.94 | 3.52 | 5.5 | 3.38 |
| D8036 | 6.48 | 4.15 | 8.1 | 4.8 | 6.75 | 3.98 | 7.86 | 3.8 | 8.4 | 4.25 | 6.48 | 3.8 | 6.37 | 3.81 | 6.02 | 3.66 | 9.04 | 3.24 |
| D8038 | 4 | 2.95 | 4.2 | 2.05 | 3.8 | 2.8 | 3.85 | 2.42 | 3.55 | 2.31 | 3.48 | 2.95 | 3.53 | 2.82 | 3.42 | 2.72 | 3.73 | 2.88 |
| D8039 | 5.45 | 3.31 | 8 | 3.6 | 8.8 | 3.8 | 6.62 | 3.47 | 8.1 | 3.5 | 6.74 | 3.31 | 5.51 | 3.14 | 5.35 | 3.05 | 6.87 | 3.06 |
| D8047 | 7.62 | 4.8 | 8.77 | 3.27 | 6.77 | 3.62 | 8.87 | 3.83 | 9.07 | 3.77 | 8.56 | 3.9 | 8.36 | 3.97 | 8.11 | 3.86 | 7.02 | 4.03 |
| R010 | 3.1 | 1.8 | 3.85 | 1.85 | 3 | 1.8 | 2.95 | 1.86 | 3.61 | 2.01 | 3.11 | 1.98 | 2.99 | 1.89 | 2.96 | 1.82 | 3.5 | 1.98 |
| R012 | 4.14 | 1.98 | 4.8 | 2.5 | 3.9 | 1.75 | 4.05 | 1.8 | 3.75 | 1.8 | 3.65 | 1.95 | 3.56 | 1.85 | 3.46 | 1.81 | 3.7 | 2.03 |
| R015 | 4.75 | 2.48 | 4.52 | 2.3 | 4 | 2.3 | 4.3 | 2.25 | 4.1 | 2.22 | 4.1 | 2.2 | 3.94 | 2.09 | 3.82 | 2.03 | 4.8 | 2.12 |
| R020 | 7.25 | 3.65 | 7.1 | 2.7 | 6.5 | 3.6 | 6.75 | 2.99 | 6.3 | 3.5 | 6.2 | 3.4 | 5.86 | 3.28 | 5.77 | 2.21 | 5.64 | 2.90 |
| R021 | 5.45 | 2.88 | 5.3 | 2.6 | 5.4 | 3.08 | 5.1 | 3 | 4.86 | 2.8 | 4.9 | 2.7 | 4.76 | 2.57 | 4.56 | 2.48 | 4.9 | 3.03 |
| R026 | 2.2 | 1.48 | 2.7 | 1.8 | 2.1 | 1.8 | 2.08 | 1.85 | 2.1 | 1.55 | 2.07 | 1.4 | 1.96 | 1.23 | 1.93 | 1.29 | 2.1 | 1.51 |
| R030 | 2.5 | 1.4 | 2.4 | 1.4 | 2.27 | 1.53 | 2.4 | 1.83 | 2.6 | 1.1 | 2.27 | 1.3 | 2.13 | 1.24 | 2.07 | 1.29 | 2.4 | 1.52 |

**Annexure – VI**

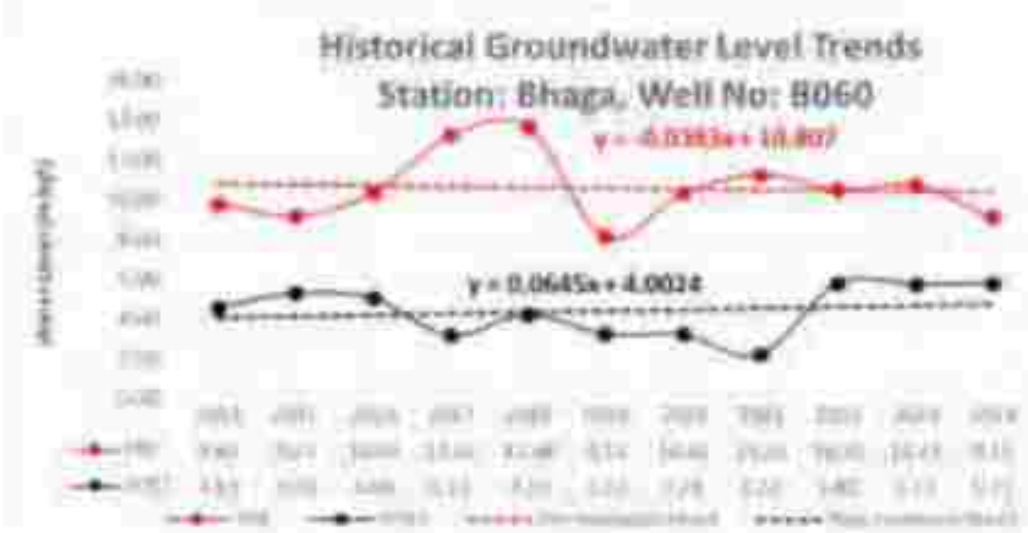
HYDROGRAPHS OF CLUSTER-I



**Annexure – VI**

HYDROGRAPHS OF CLUSTER-II

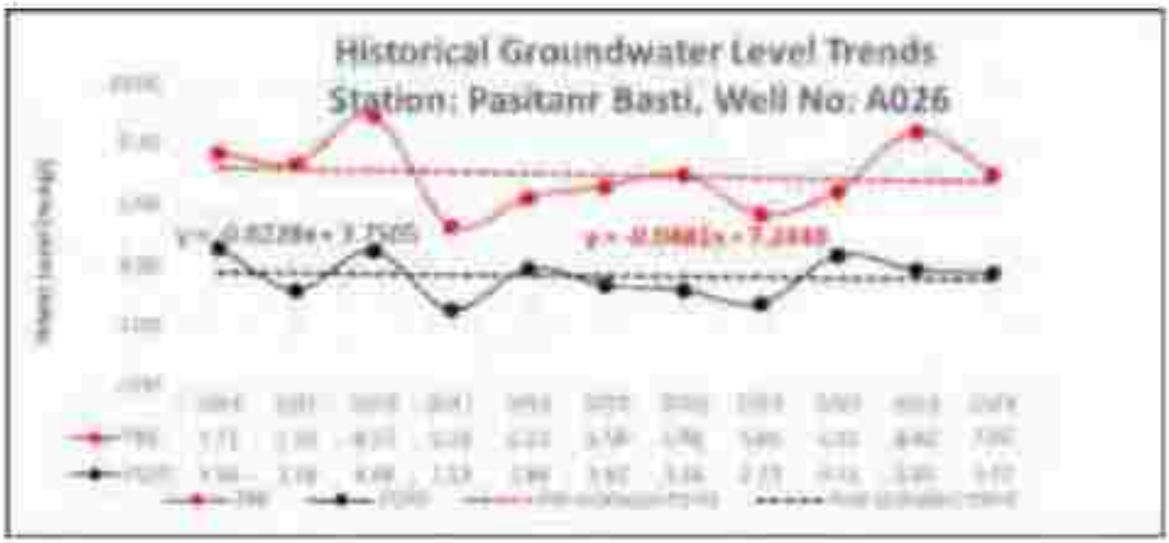


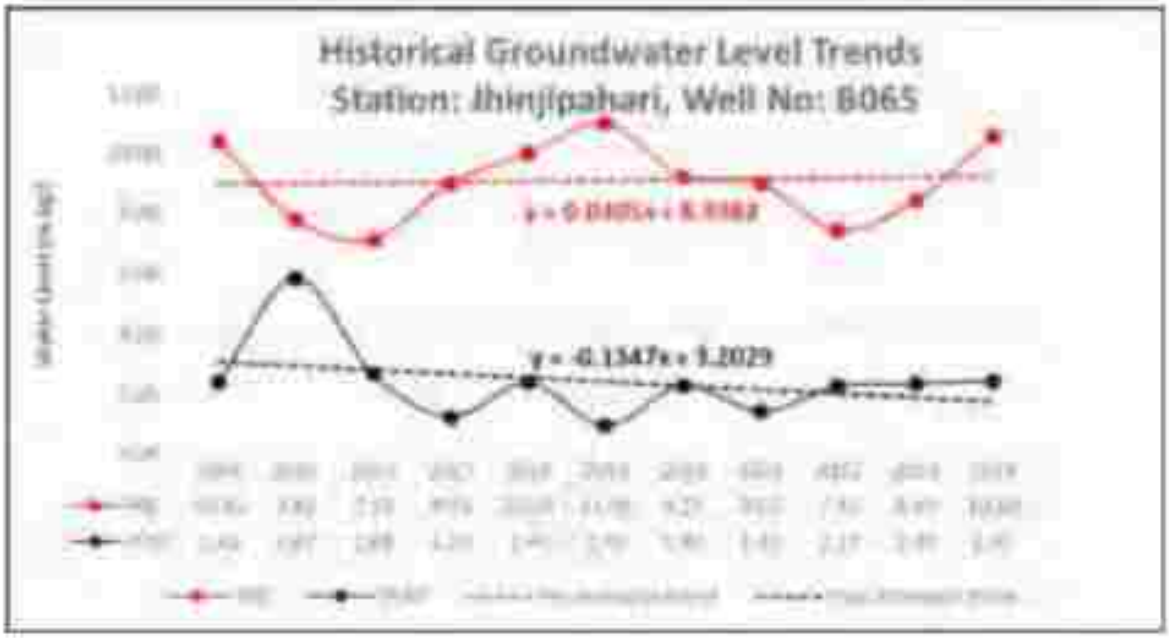
**Annexure – VI**

HYDROGRAPHS OF CLUSTER-III

**Annexure – VI**

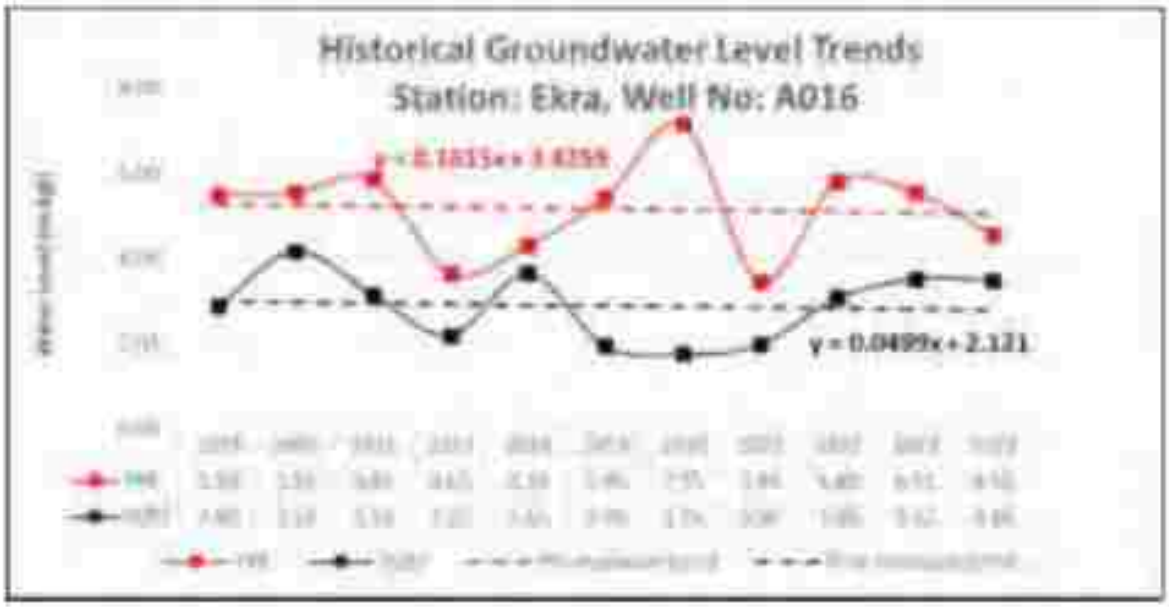
HYDROGRAPHS OF CLUSTER-IV

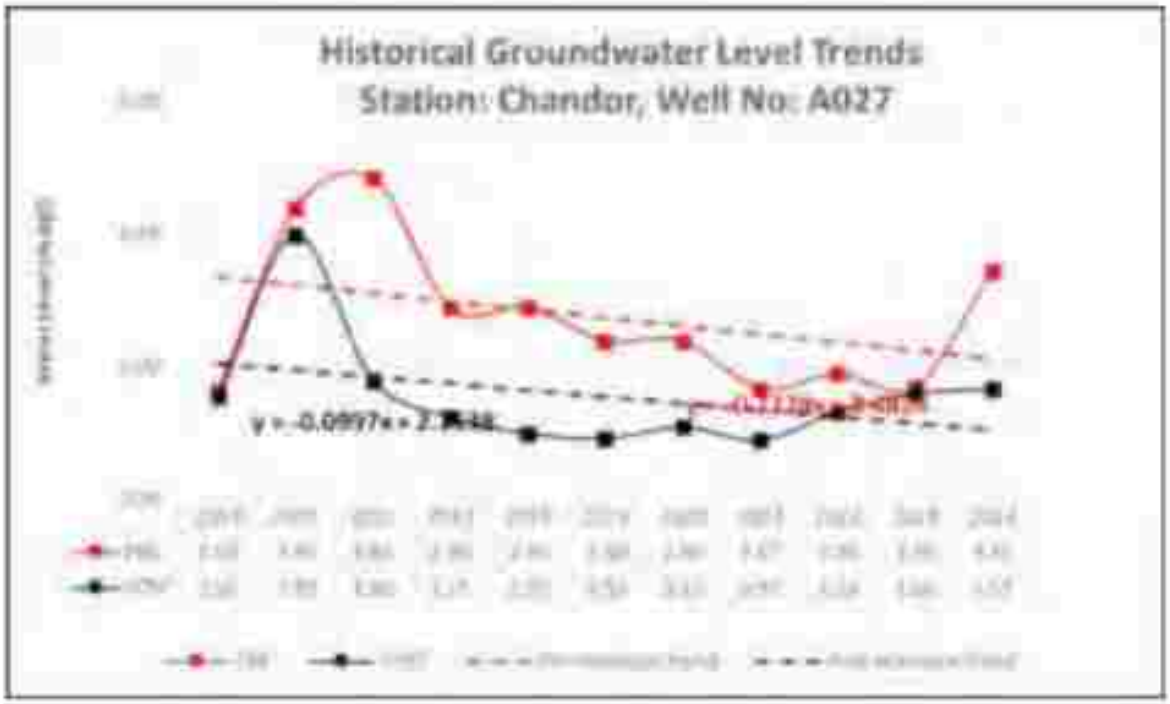


**Annexure – VI**

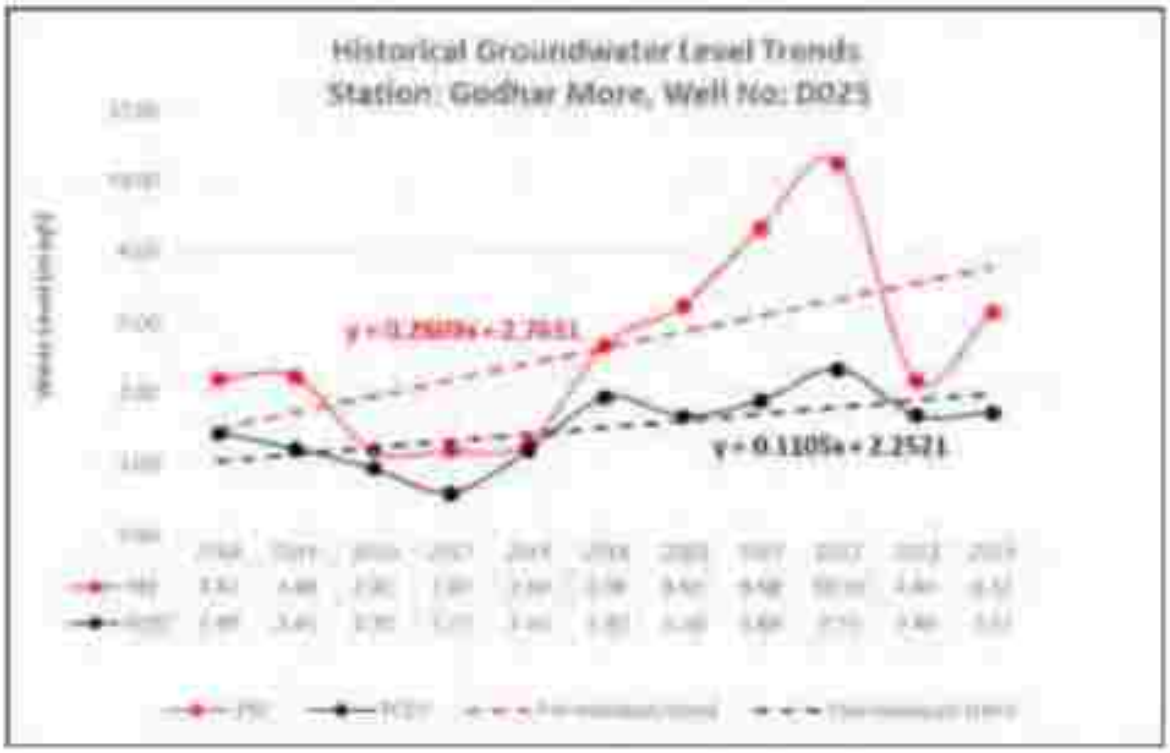
HYDROGRAPHS OF CLUSTER-V

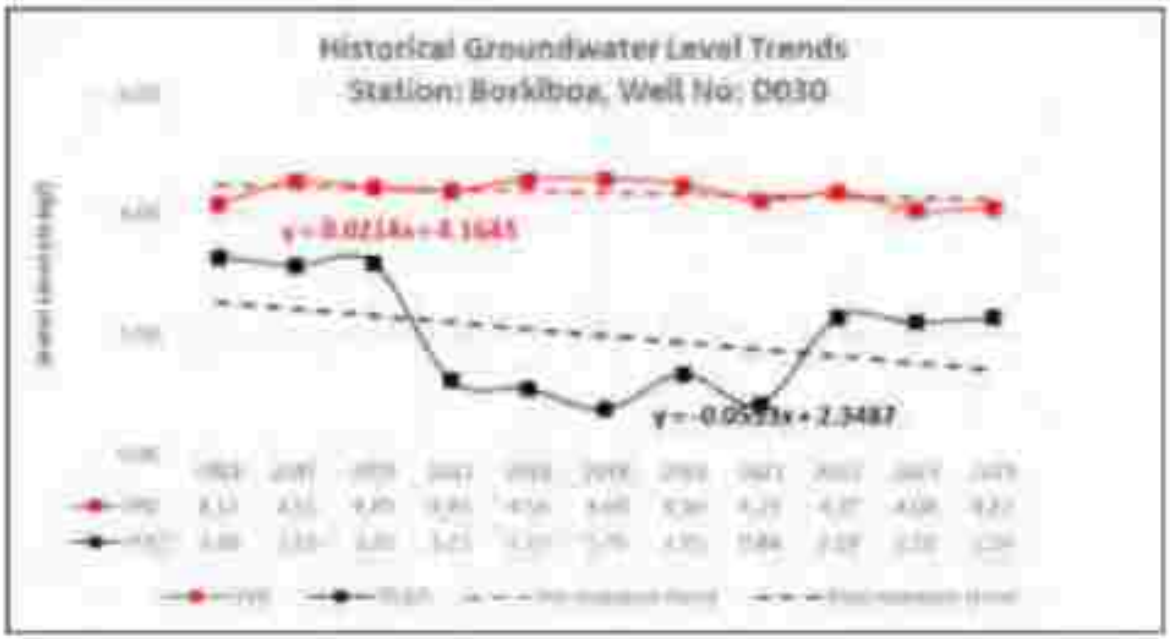


**Annexure – VI**

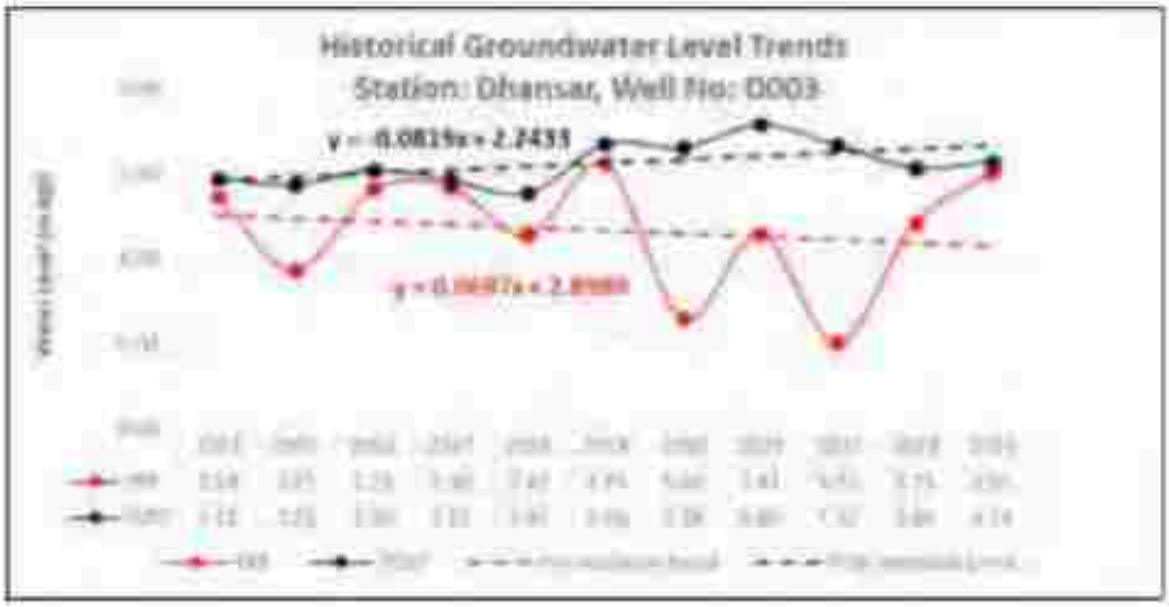
HYDROGRAPHS OF CLUSTER-VI

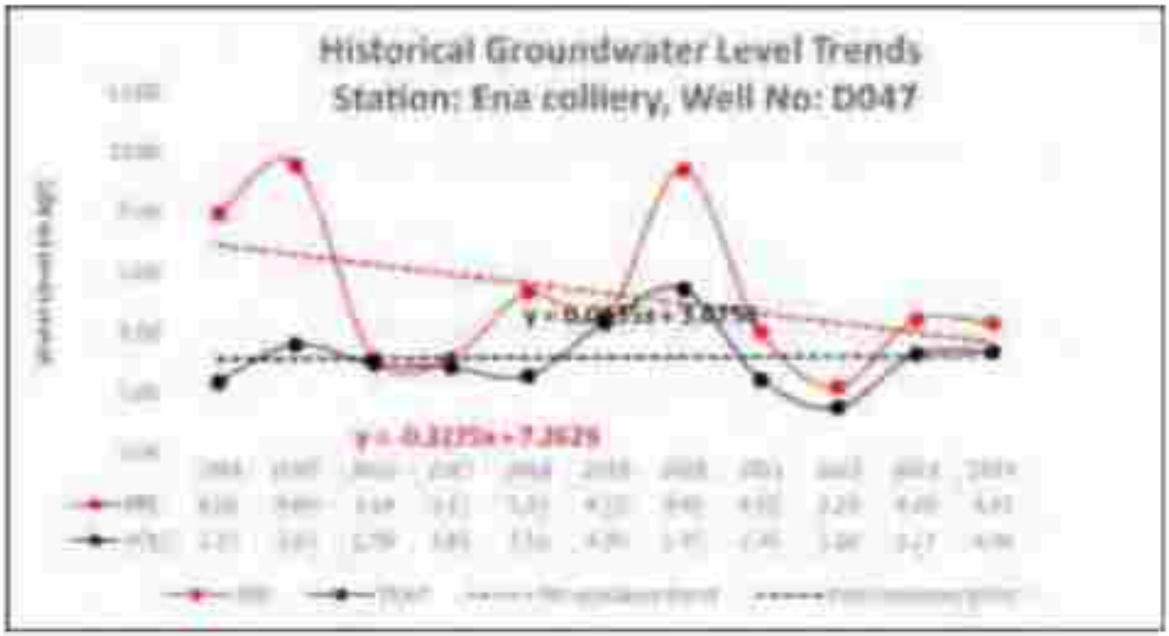


**Annexure – VI**

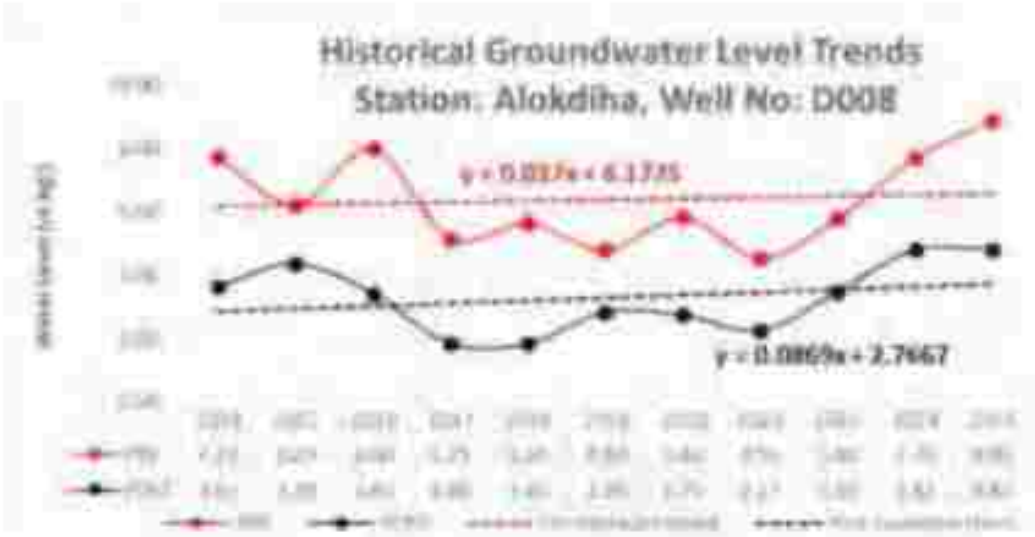
HYDROGRAPHS OF CLUSTER-VII

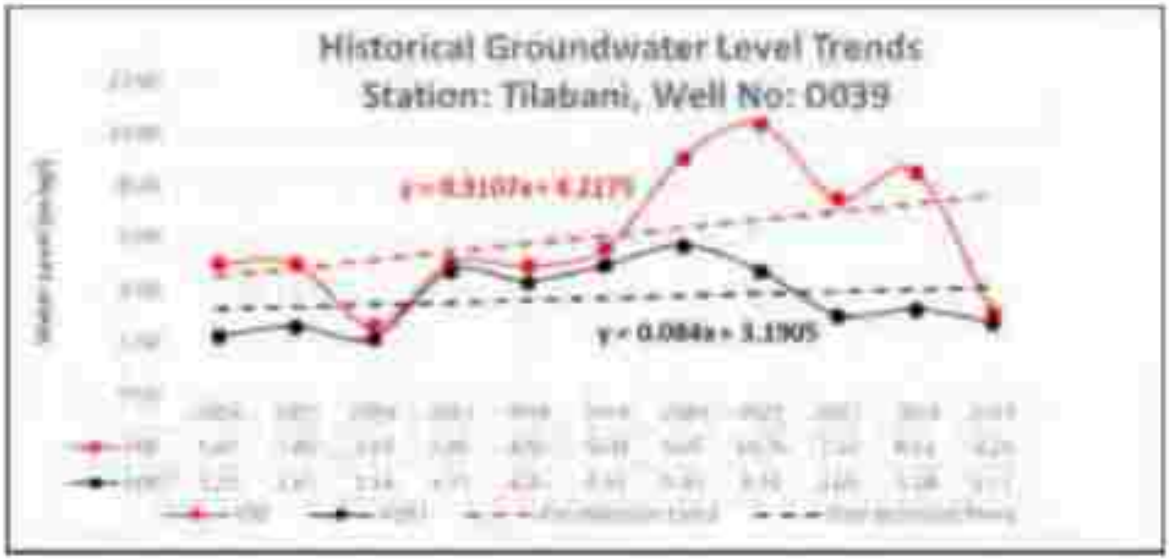


**Annexure – VI**

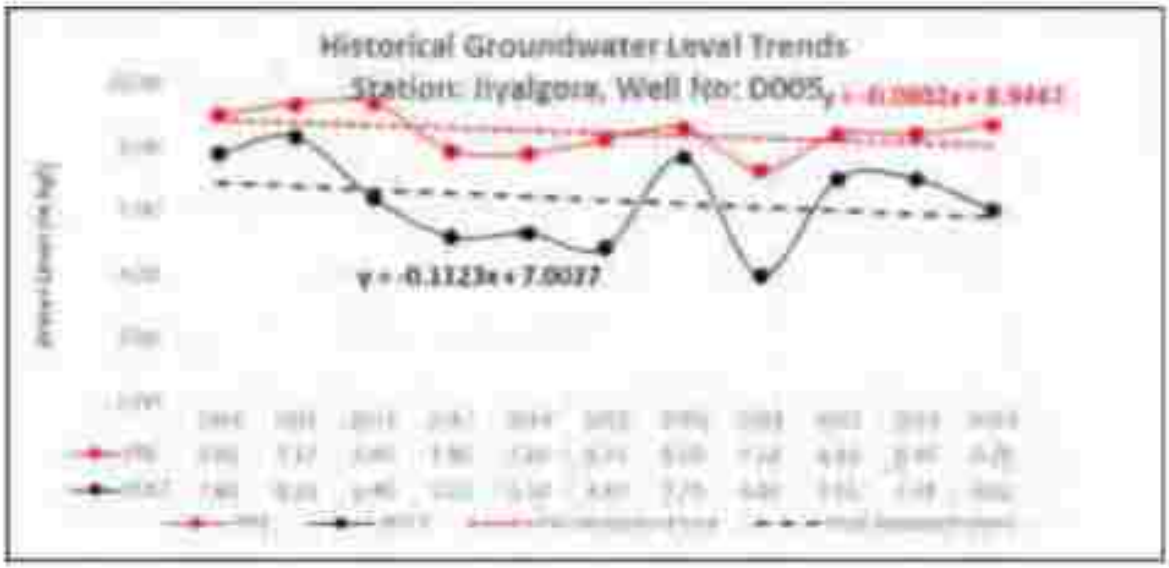
HYDROGRAPHS OF CLUSTER-VIII

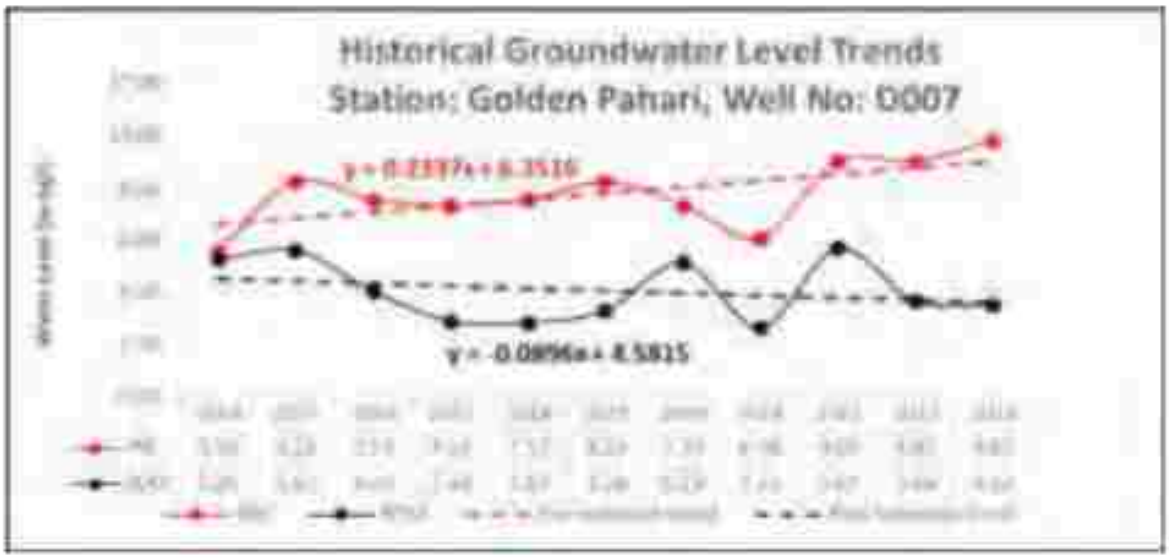


**Annexure – VI**

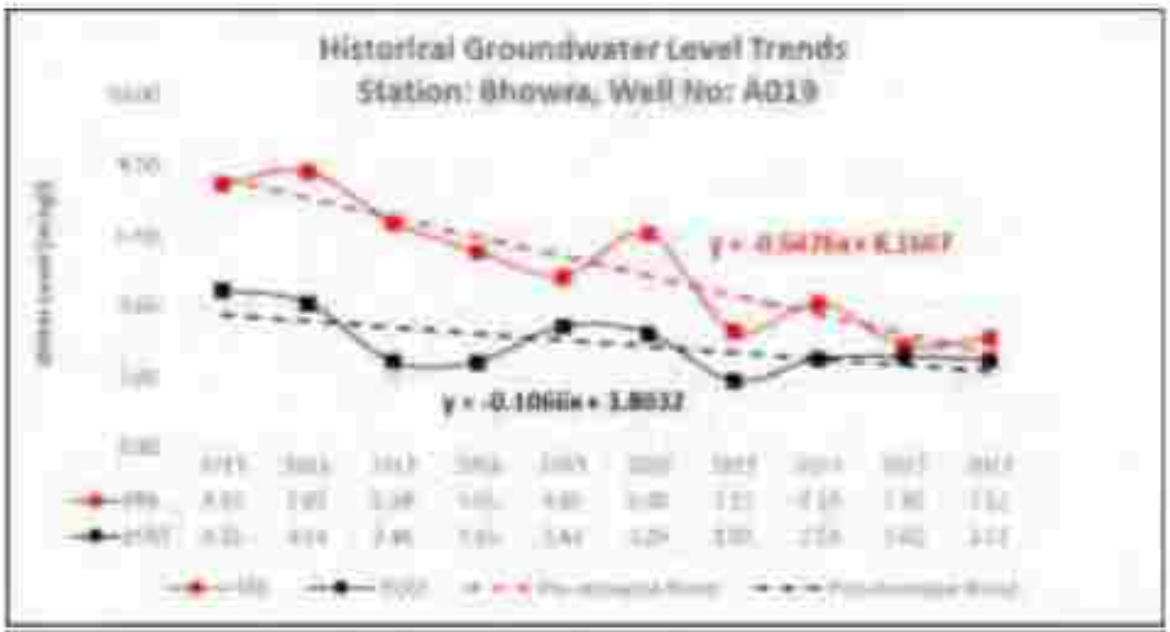
HYDROGRAPHS OF CLUSTER-IX

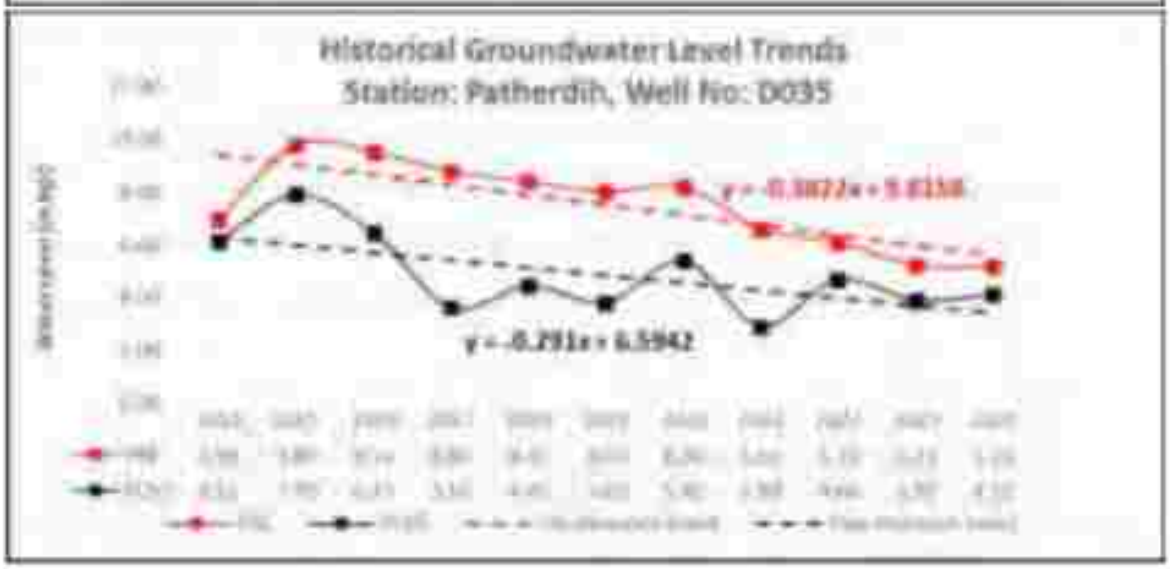


**Annexure – VI**

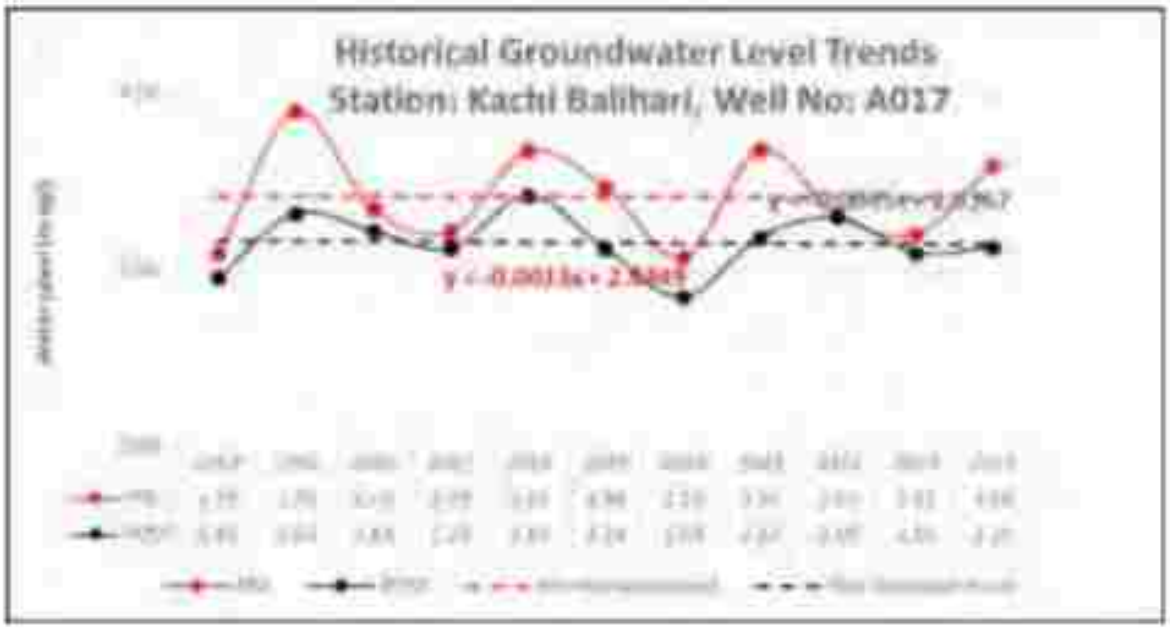
HYDROGRAPHS OF CLUSTER-X

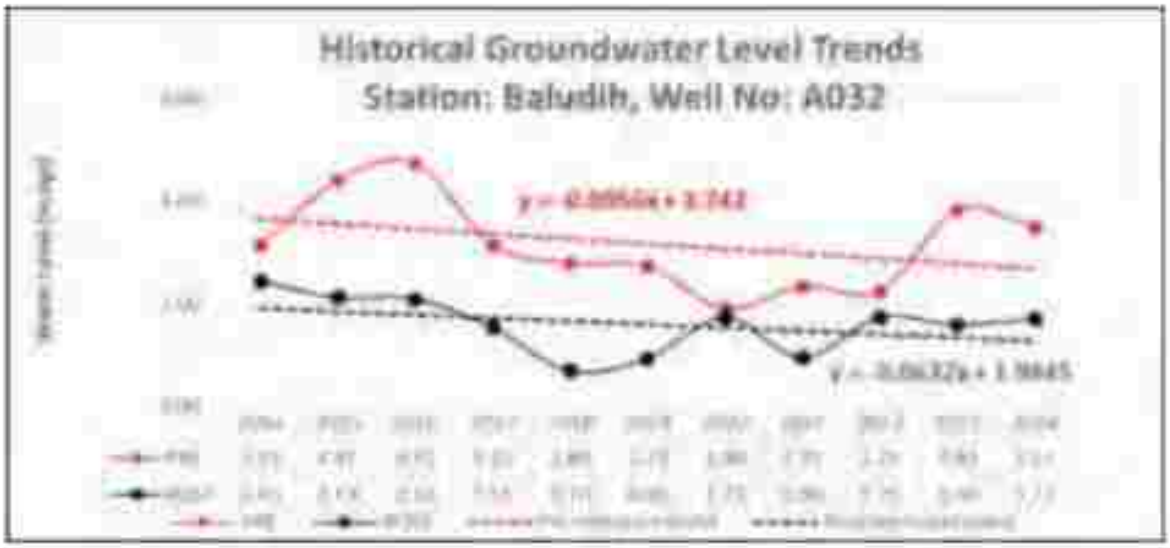


**Annexure – VI**

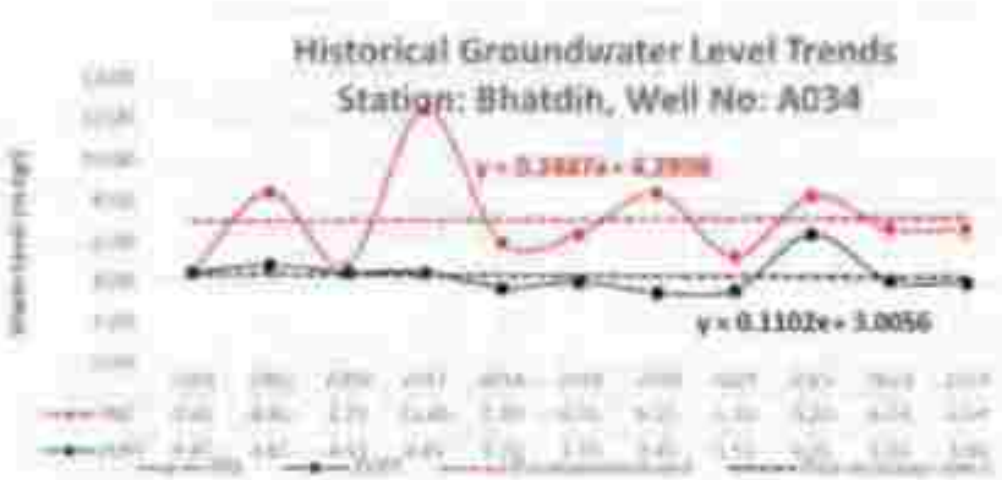
HYDROGRAPHS OF CLUSTER-XI

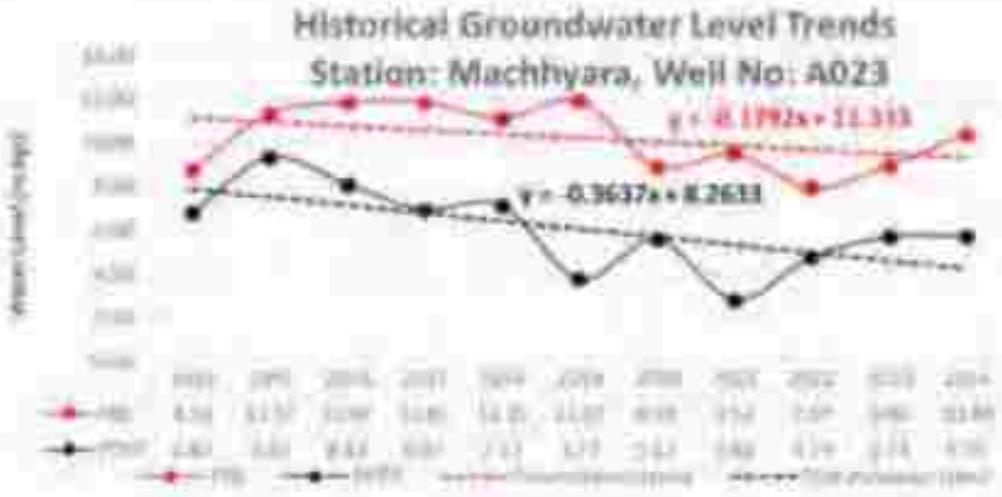


**Annexure – VI**

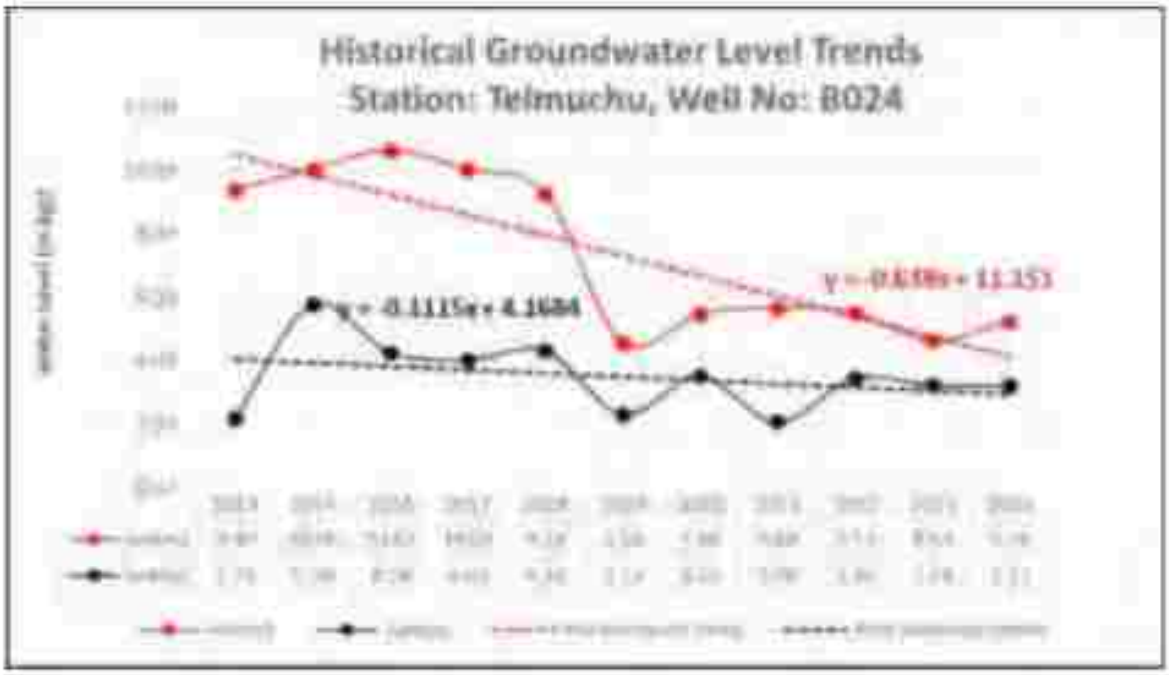
## HYDROGRAPHS OF CLUSTER-XIII

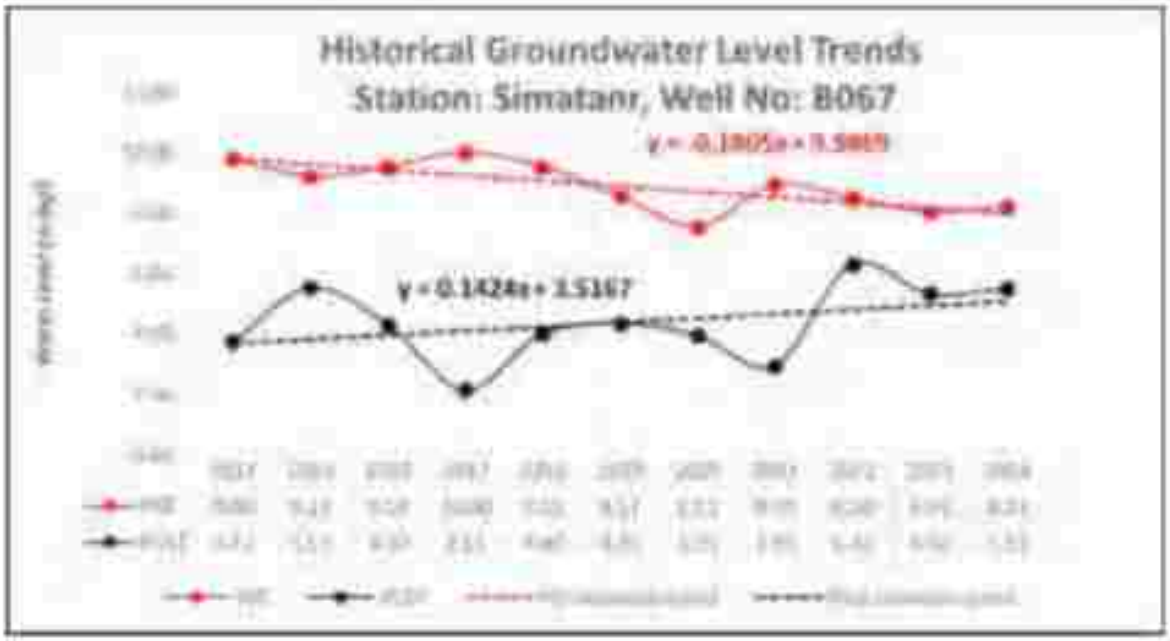


**Annexure – VI**

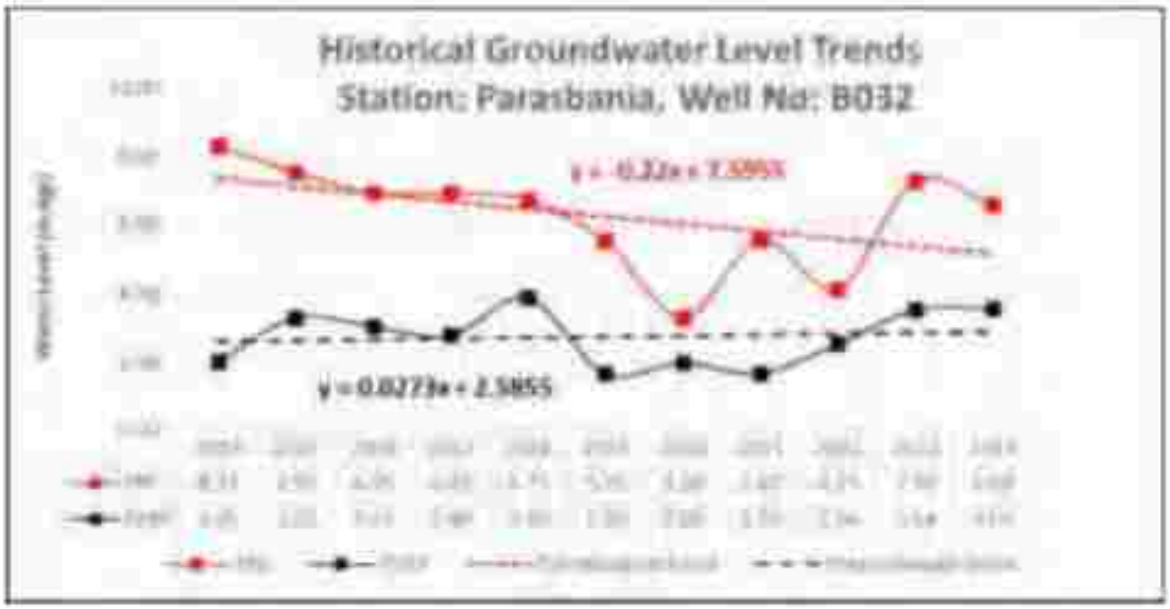
HYDROGRAPHS OF CLUSTER-XIV

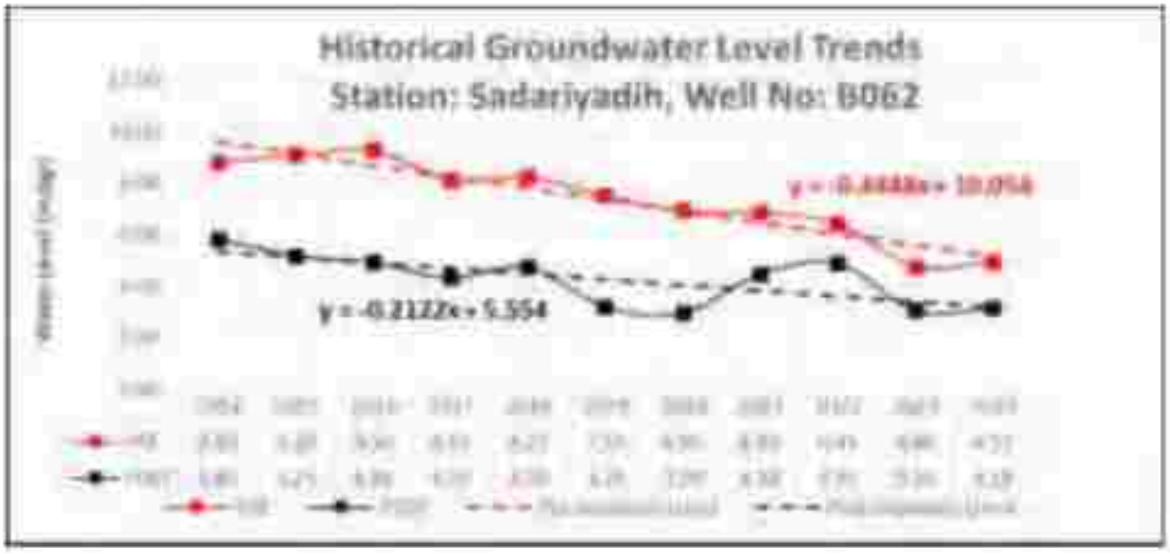


**Annexure – VI**

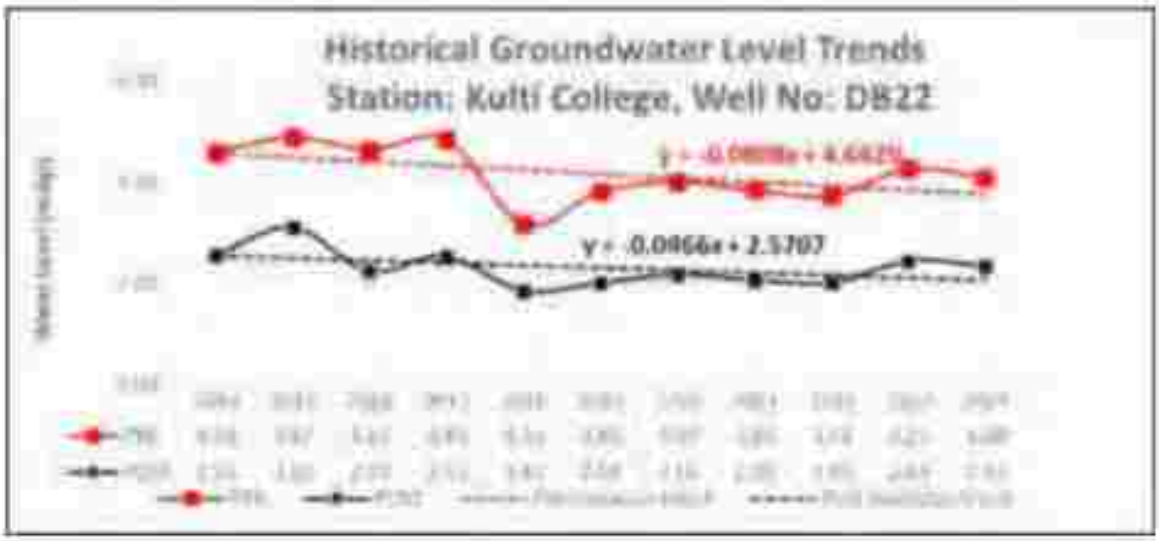
HYDROGRAPHS OF CLUSTER-XV

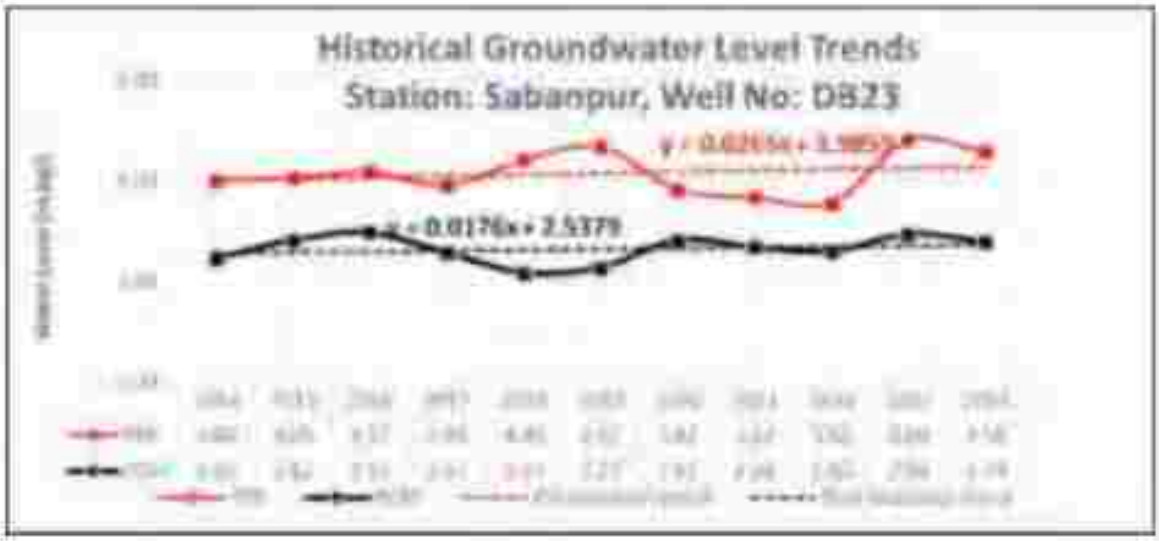


**Annexure – VI**

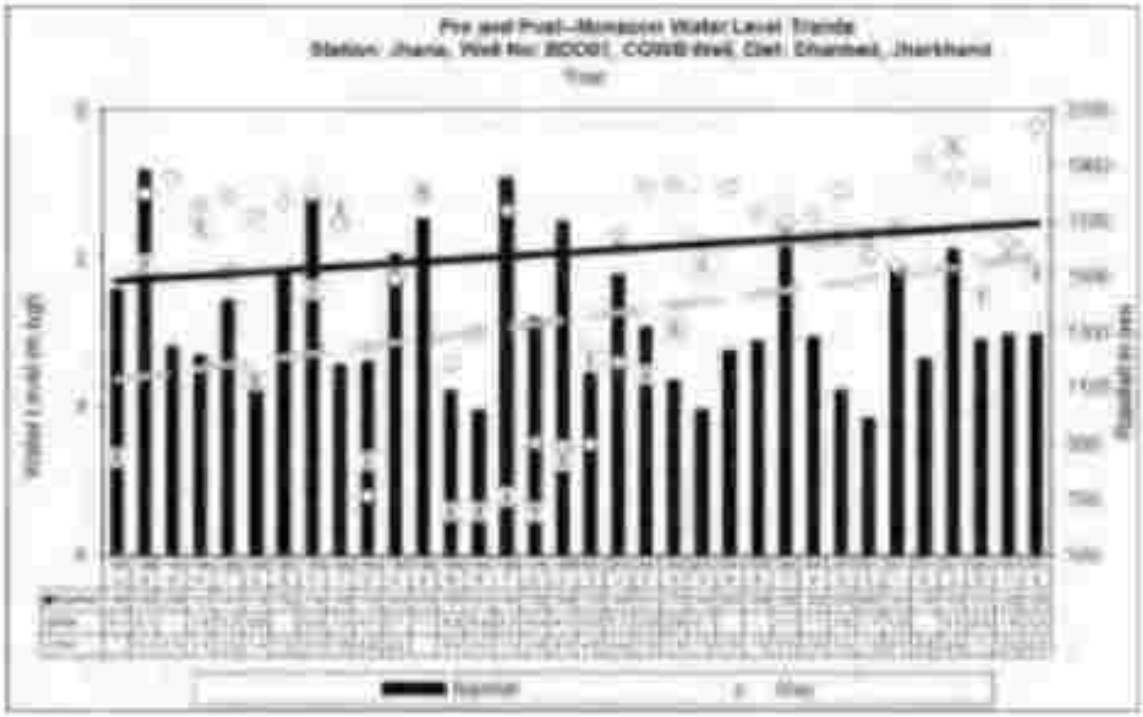
HYDROGRAPHS OF CLUSTER-XVI

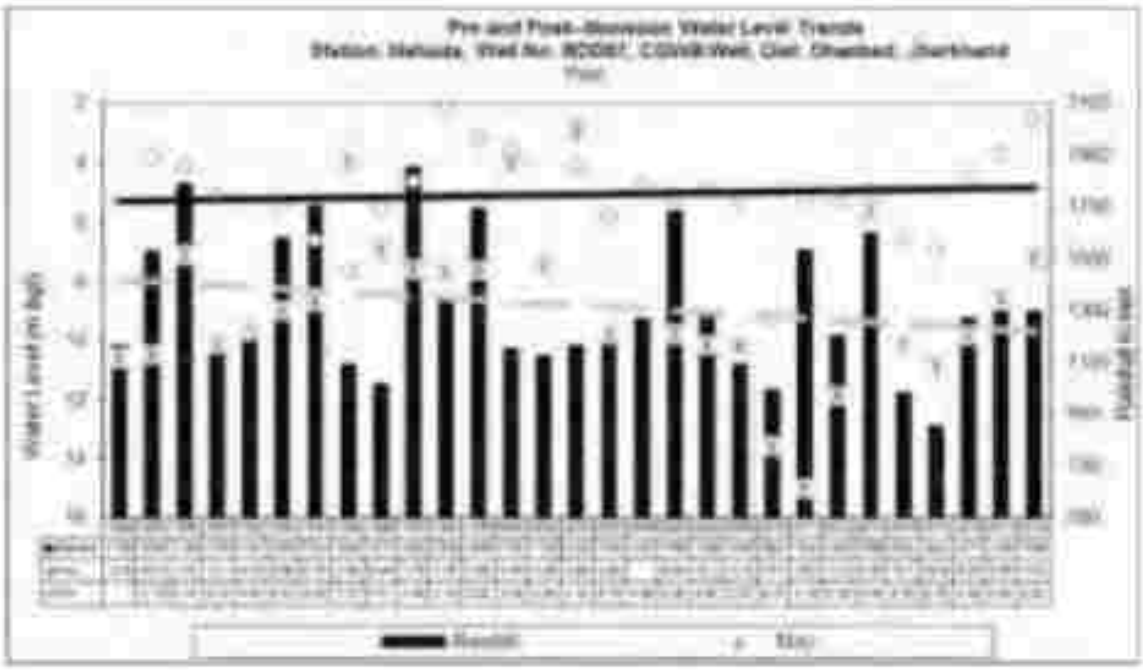


Annexure – VI

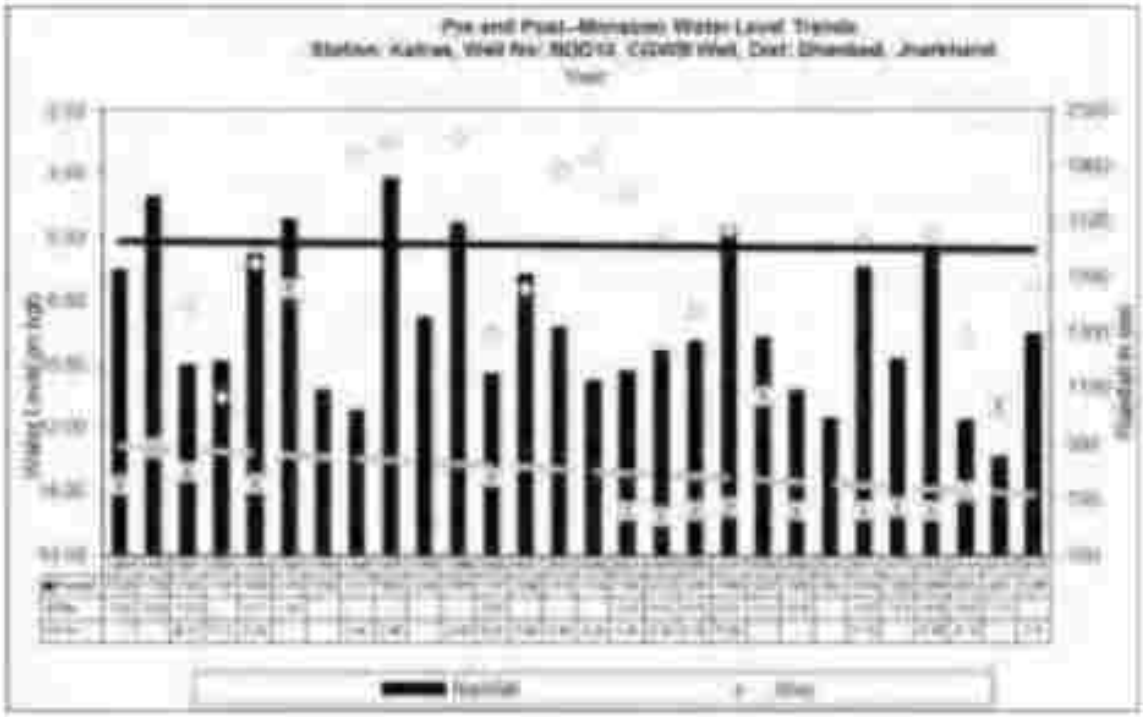
## HYDROGRAPHS OF CGWB PERMANENT OBSERVATION STATIONS

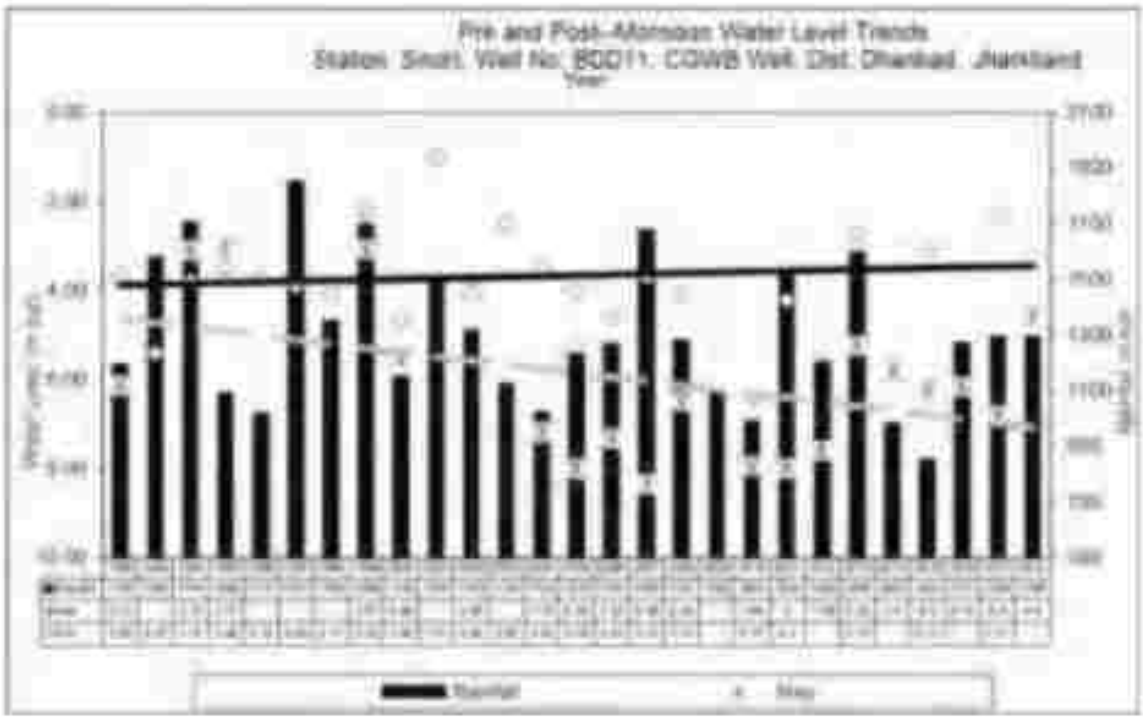




**Annexure – VI**

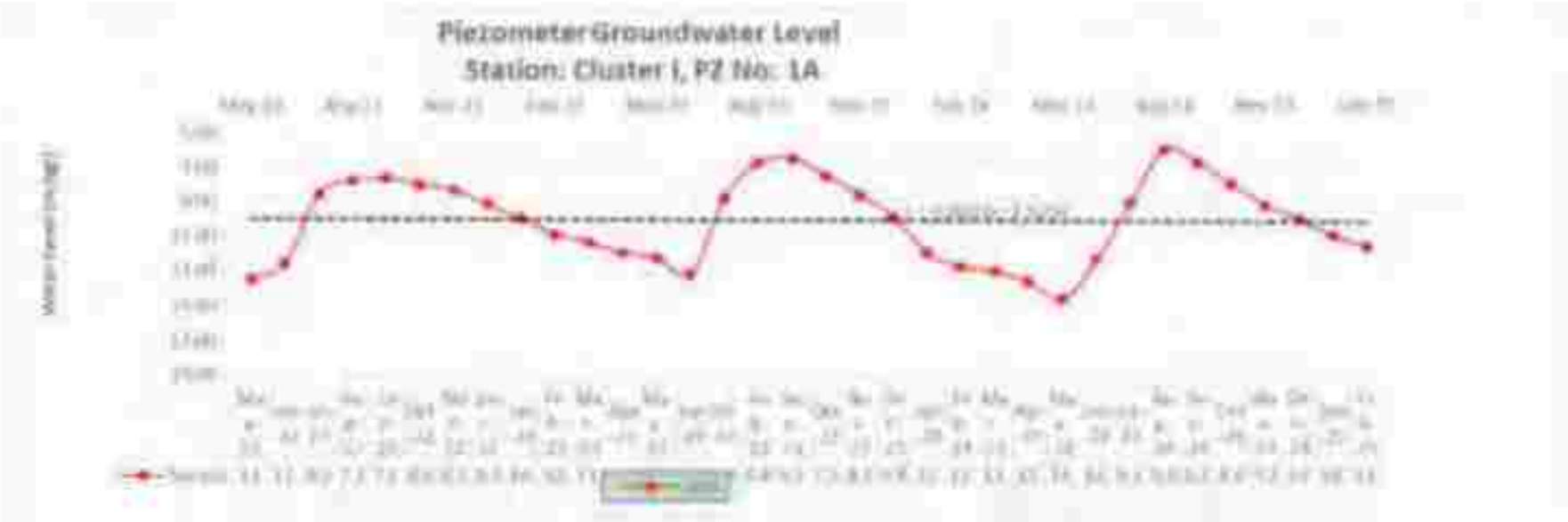
## HYDROGRAPHS OF CGWB PERMANENT OBSERVATION STATIONS



**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS

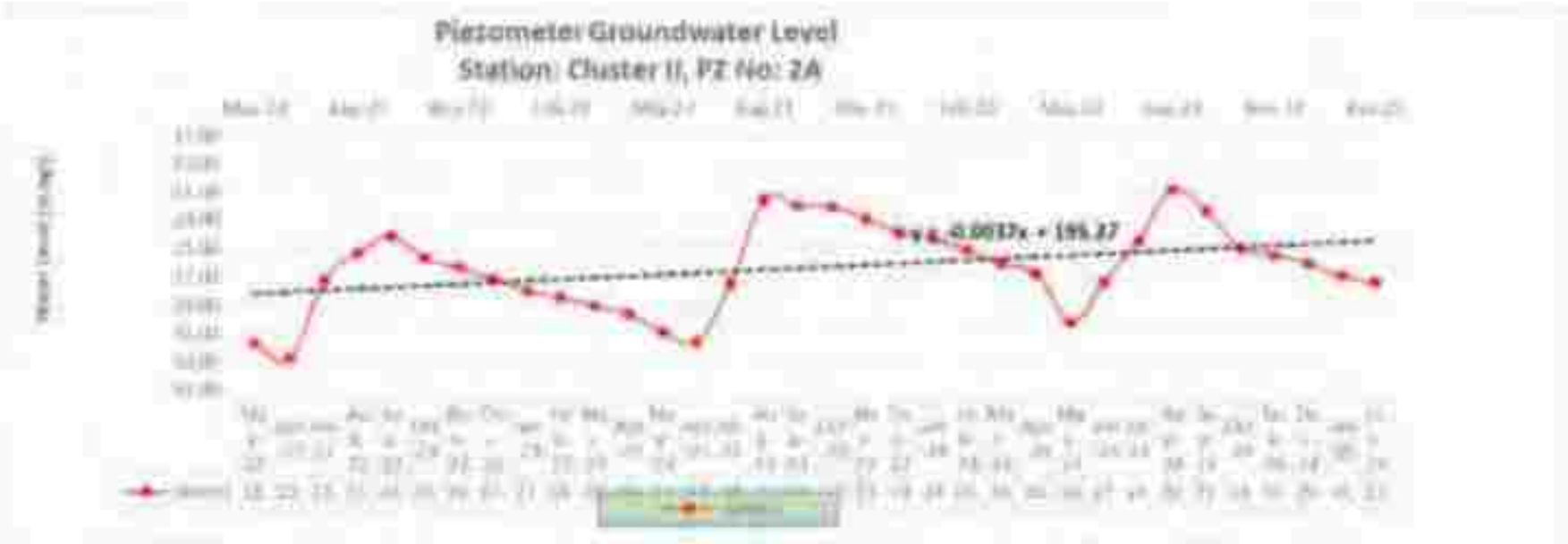


Annexure – VIA

## PIEZOMETER HYDROGRAPHS

**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS



**Annexure – VIA**

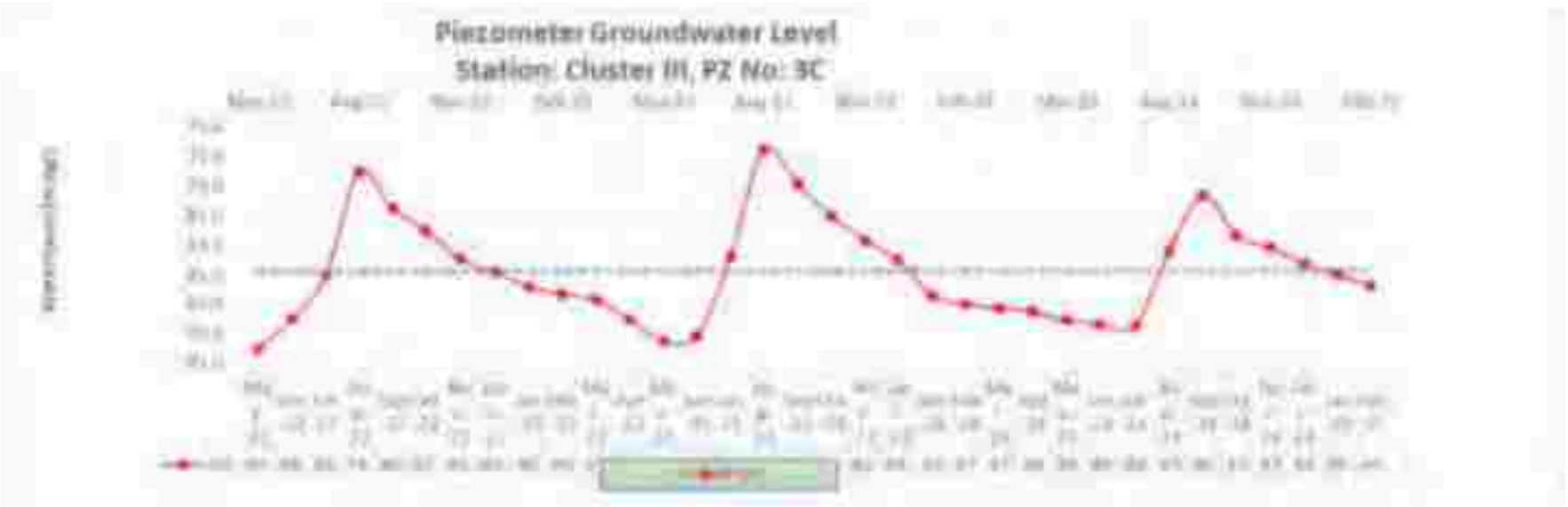
## PIEZOMETER HYDROGRAPHS

**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS

**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS



**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS

Annexure – VIA

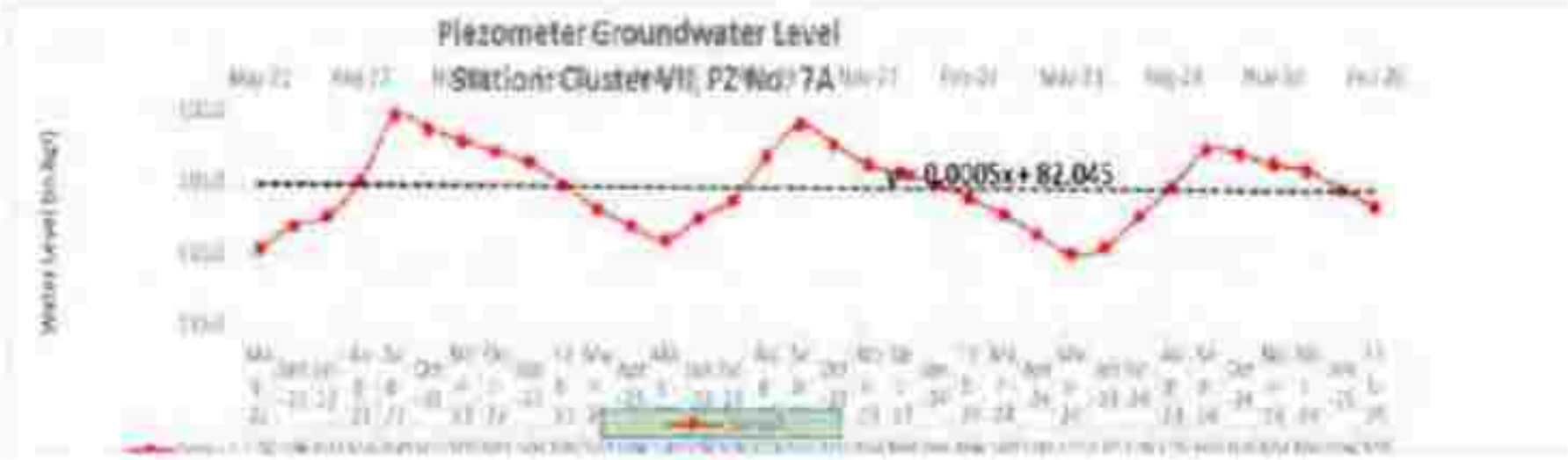
## PIEZOMETER HYDROGRAPHS

Annexure – VIA

## PIEZOMETER HYDROGRAPHS

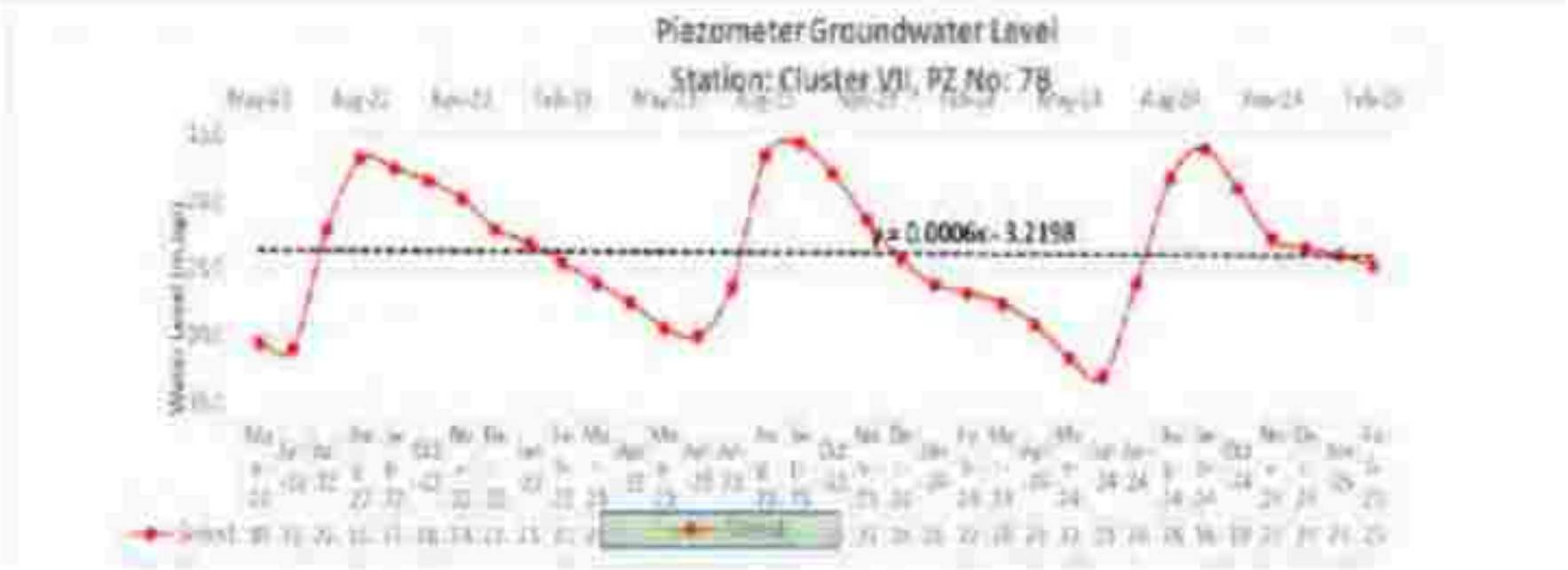
Annexure – VIA

## PIEZOMETER HYDROGRAPHS



**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS

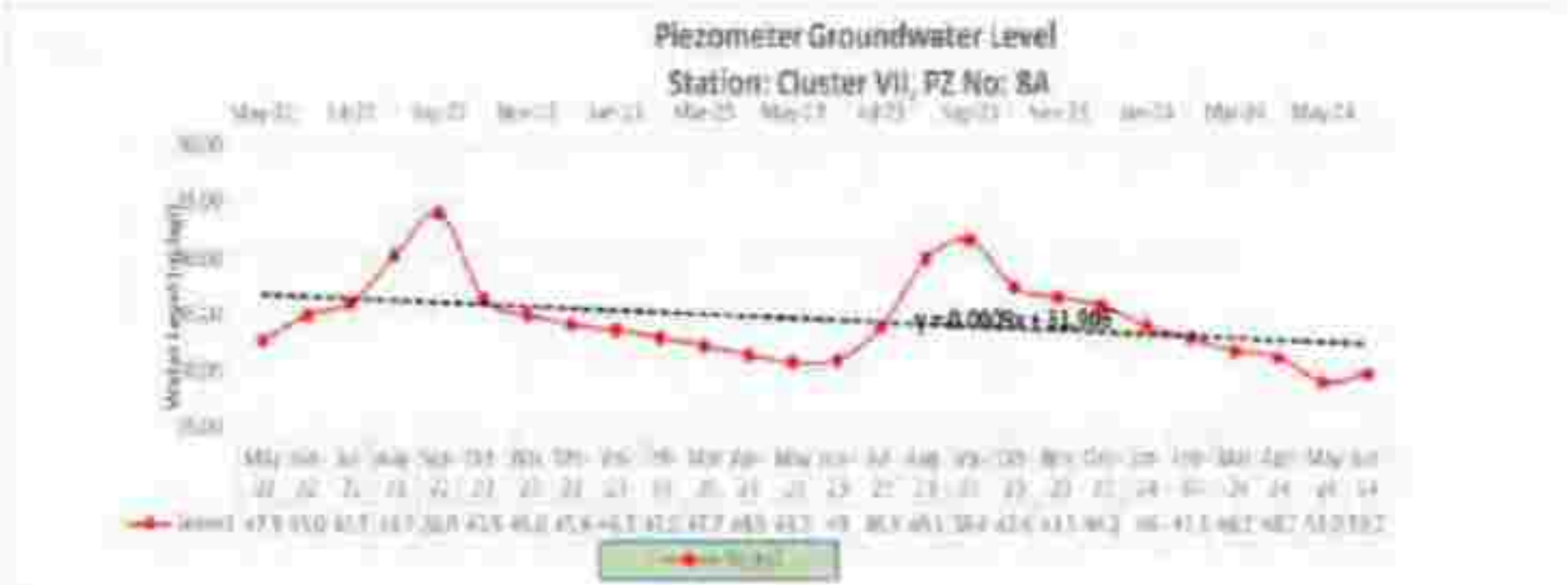


**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS

**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS



**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS

**Annexure – VIA**

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**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS

**Annexure – VIA**

## PIEZOMETER HYDROGRAPHS

Annexure – VII

## GROUNDWATER SAMPLE LOCATION DETAILS

**Sampling month:** June month of the assessment year of 2023-24

| Sl No | Dug well (CMPDI) | Location | Sampling Date |
|---|---|---|---|
| | | | June'2024 |
| Jharia Coalfield | | | |
| 1 | A4 | DALDOLI | 12.06.24 |
| 2 | A5 | SRIRAMPUR | 12.06.24 |
| 3 | A10 | PHULWARI | 12.06.24 |
| 4 | A13 | BHELATANR | 11.06.24 |
| 5 | A23 | MACHHAYARA | 05.06.24 |
| 6 | A29 | GOVINDPUR, AMBAGAN VILLAGE | 06.06.24 |
| 7 | A32 | MOONIDIH BAZAR | 05.06.24 |
| 8 | B10 | AMDIH NARAYANPUR | 06.06.24 |
| 9 | B15 | BEKA VILLAGE | 07.06.24 |
| 10 | B19 | BHANDARIDAH | 07.06.24 |
| 11 | B23 | LOHAPATTI VILLAGE | 05.06.24 |
| 12 | B32 | MADHUBAND VILLAGE | 06.06.24 |
| 13 | B40 | BHUANCHITRO | 07.06.24 |
| 14 | B46 | TELO | 07.06.24 |
| 15 | B55 | RANTANR VILLAGE | 12.06.24 |
| 16 | B59 | KHODOVALY VILLAGE | 06.06.24 |
| 17 | B64 | KESHALPUR, BATIGHAR | 06.06.24 |
| 18 | D2 | BIRSA MUNDA CHAWK, BANKMORE | 03.06.24 |
| 19 | D4 | JHARIA THANA | 03.06.24 |
| 20 | D5 | JYALGORA (NEAR P.O.) | 03.06.24 |
| 21 | D14 | KARMATANR | 13.06.24 |
| 22 | D19 | MENKO MORE | 06.06.24 |
| 23 | D25 | GODHUR MORE | 05.06.24 |
| 24 | D30 | BORKOBDA VILLAGE | 06.06.24 |
| 25 | D35 | PATHERDIH RAILWAY COLONY | 06.07.24 |
| 26 | D41 | JOYRAMPUR | 03.06.24 |
| 27 | D49 | TISRA THANA | 03.06.24 |
| 28 | D59 | SITALPUR | 04.06.24 |
| 29 | D70 | URLADIH | 04.06.24 |
| 30 | D72 | CHATI GOVINDPUR | 07.06.24 |
| 31 | D80 | DHANSAR MINE RESCUE STATION | 03.06.24 |
| 32 | D96 | BANSHRA | 04.06.24 |
| 33 | D107 | BOGULA | 04.06.24 |
| 34 | D112 | DEMUDI (DOMATANR) | 05.06.24 |
| 35 | D115 | TELMUCHU | 06.07.24 |

| Sl No | Dug well (CMPDI) | Location | Sampling Date |
|---|---|---|---|
| | | | June'2024 |
| **Raniganj Coalfield** | | | |
| 1 | DB-2A | Sulibari | 13.06.24 |
| 2 | DB-4 | Sarbari | 14.06.24 |
| 3 | DB-8 | Chungri | 14.06.24 |
| 4 | DB-10 | Kulti | 14.06.24 |
| 5 | DB-12 | Sabanpur | 14.06.24 |
| 6 | DB-13 | Dendua More | 14.06.24 |
| 7 | DB-18 | Luchibad | 13.06.24 |
| 8 | DB-26 | Lodaharia | 13.06.24 |
| 9 | DB-27 | Hodla | 13.06.24 |
| 10 | DB-29 | Kalyanpur | 13.06.24 |
| 11 | DB-30 | Ramkanali | 14.06.24 |
| 12 | DB-38 | Lukudih | 14.06.24 |
| 13 | DB-39 | Pandra | 14.06.24 |
| 14 | K-12 | Ethora | 14.06.24 |
| 15 | K-20 | Majhladih | 14.06.24 |

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - A10 , PHULWAR*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Reg/Work No. | [illegible] | | | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: [illegible]) | | | | | Date of Issue | 19.09.2024 |
| Project | [illegible] | Sample Ref. No. | BCCL/ENVT/CL/ [illegible] | | Sampling Method | CMPDI/BCCL/ENVT/CL/ [illegible] | |
| Sampling Standard | [illegible] | Date of Sampling | | Sample Collected in Clear bottle , Color as observed is transparent | | | |
| | | | Period of Analysis | | | TO | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | LOQ | Range Of Testing | LOD | Acceptable Limits (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Silver (as Ag) mg/l, Max. | APHA, 24th edition, 3 section | [illegible] | [illegible] | [illegible] | 0.1 | 1 |
| 2 | Copper (as Cu) mg/l, Max. | IS 3025 Part 42 : 1992 R : 2009, ASTM Latest APHA, 24th edition, Sect 3125 A | [illegible] | [illegible] | [illegible] | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA, 23rd Edition, 4500 Cl- B (Iodometric Method-I) | [illegible] | [illegible] | [illegible] | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max. | IS 3025/Part 47/ 1994 (Reaffirmed 2012), APHA, 24th edition, 3120 (B) | [illegible] | [illegible] | [illegible] | 0.01 | No relaxation |
| 5 | Phenolic compounds (as $C_6H_5OH$), mg/l, Max. | APHA, 24th Edition 5-P Amino Antipyrine | [illegible] | [illegible] | [illegible] | 0.002 | 0.002 |
| 6 | Selenium, mg/l, Max. | APHA 24th edition 3125 (part 3a (ICP)) & 3113 C, ASTM Latest | [illegible] | [illegible] | [illegible] | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max. | IS 3025 part 37:1988, R: 2017 APHA 24th edition 3120 (B) | [illegible] | [illegible] | [illegible] | 0.01 | 0.05 |
| 8. | Total Chromium (as Cr), mg/l, Max. | IS 3025 Part 52 :2003 R:2019 Addl. Flame APHA, 24th edition, 3120 (B) | [illegible] | [illegible] | [illegible] | 0.05 | No relaxation |
| 9 | Nickel, as Ni, mg/l Max. | IS 3025 Part 54 : 2003 R : 2019, ASTM Latest APHA, 24th edition, 3120 (B) | [illegible] | [illegible] | [illegible] | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/l, Max. | APHA, 24th Edition 3111 with 3120 (B) Method | [illegible] | [illegible] | [illegible] | 0.1 | 0.3 |

***All units in mg/l unless specified otherwise

**Grab sampling carried out for water samples. *LOQ indicates Lower Detection Limit & BDL indicates Below Detection Limit

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

1. *Ground Water Sampling at Monitoring Station Code: - A13, BHELATANR*

**Date of Sampling at Station:** June 2024

| Month & Year | June 2024 | Dug Well No | A13 | | |
|---|---|---|---|---|---|
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: gmenv.bcclho@coalindia.in] | | | Date of Issue | 19.06.2024 |
| Project | Bharat Coal Field | Sample Ref. No. | BCCL/ENV/DHN/2024-25/GW | Sampling Method | CWPRS/40 IS:3.PW 1129 2023 Part-1] |
| Sampling Station | 23°55'37.5"N 86°25'49.8"E | Date of Sampling | | Sample Collected in 1 Lit terrmaster Color as observed is transparent | |
| | | Period of Analysis | | TAT | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | UMS | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max)* |
| 1 | Boron (as B), mg/l, Max | APHA, 24th edition, Carmine | <0.1 | 0.2-10 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu) mg/l, Max | IS 3025 Part 42: 1992 R: 2019, 4500-Phase APHA, 24th edition, AAS-GTA | <0.01 | 0.02-3.00 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA, 23rd Edition, 4500 Cl-B (Iodometric Method-I) | <0.04 | 0.04-5 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max | IS 3025 Part 47] 1994 (Reaffirmed 2019) APHA, 24th edition, AAS-GTA | <0.005 | 0.005-10 | 0.005 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as C6H5OH), mg/l, Max | APHA, 24th Edition,5-Amino Antipyrine | <0.001 | 0.001-10 | 0.001 | 0.002 | 0.002 |
| 6 | Selenium, mg/l, Max | APHA 24th edition IS 3025 part 56:2003 & 2014), AAS-VGA | <0.007 | 0.007-10 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max. | IS 3025 part 37 1988, R: 2019) APHA 24th edition AAS-VGA | <0.005 | 0.005-10 | 0.005 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr) mg/l, Max | IS 3025 Part 52 2003, R:2019 Add. Phase APHA, 24th edition, AAS-GTA | <0.01 | 0.02-10.0 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel (as Ni) mg/l Max | IS 3025 Part 54 : 2003 R: 2019, Add Phase APHA, 24th edition, AAS-GTA | <0.005 | 0.005-10 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese (as Mn) mg/l, Max | APHA, 24TH Edition 2023 AAS-GTA Method | <0.02 | 0.02-10.0 | 0.02 | 0.1 | 0.3 |

***All values in mg/l, unless specified otherwise.

**Grab sampling carried out for water samples. *LOD, indicates Lowest Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

1. *Ground Water Sampling at Monitoring Station Code: - A23(MACHHAYARA)*

**Date of Sampling at Station: June 2024**

| Month & Year | June 2024 | Dug Well No | A23 | | |
|---|---|---|---|---|---|
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: gmenv.bcclho@coalindia.in] | | | Date of Issue | 19.09.2024 |
| Project | Jharia Coalfield | Sample Ref. No. | BCCL/ENVT/LAB/2024/ | Sampling Method | CMPDI/RI-II/EPM-112A/2023/Part-1] |
| Sampling Stations | Machhayara | Date of Sampling | | Sample Collected in 1 Lit. borosilicate bottle as observed in transparent | |
| | | Period of Analysis | | To | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | UMT | Range Of Testing | LOD | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternative Source (Max.) |
| 1 | Boron (as B), mg/l, Max. | APHA, 24th edition, Carmine | <0.1 | 0.2-0.9 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu) mg/l, Max. | IS 3025 Part 42: 1992 R: 2019, 4500-Plasma APHA, 24th edition, Addl-CU-1 | <0.01 | 0.02-0.03 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min. | APHA, 23rd Edition, 4500 Cl-B (Iodometric Method-1) | <0.04 | 0.04-0 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max. | IS 3025(Part 47) 1994 (Reaffirmed 2019) APHA, 24th edition, Addl-CT3 | <0.005 | 0.005-0.0 | 0.005 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as $C_6H_5OH$), mg/l, Max. | APHA, 24th Edition,4- Amino Antipyrine | <0.001 | 0.001-0.0 | 0.001 | 0.002 | 0.002 |
| 6 | Selenium, mg/l, Max. | APHA 24th edition IS 3025 part 56:2003 & 2014), Addl-TE21 | <0.007 | 0.007-0.0 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max. | IS 3025 part 37 1988, R: 2019, APHA 24th edition Addl-TE24 | <0.005 | 0.005-0.0 | 0.005 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr) mg/l, Max. | IS 3025 Part 52 2003, R:2019 Addl-Plasma APHA, 24th edition, Addl-CT3 | <0.01 | 0.02-0.03 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel (as Ni) mg/l Max. | IS 3025 Part 54 : 2003 R: 2019, Addl-Plasma APHA, 24th edition, Addl-CT3 | <0.005 | 0.005-0.0 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese (as Mn) mg/l, Max. | IS 3025(Part 59) : 2006,R:2019, Addl-Plasma Method | <0.02 | 0.02-0.03 | 0.02 | 0.1 | 0.3 |

***All values are mg/l, unless specified otherwise.

**Grab sampling carried out for water samples. *LOD, indicates Lowest Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

1. *Ground Water Sampling at Monitoring Station Code: - A29, GOVINDPUR,AMBAGAN VILLAGE*

**Date of Sampling at Station:** June 2024

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | A29 | | | | |
| Customer | Environment Engineers, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gouree.ben@bharatcoalfields.in) | | | | | Date of Issue | 19.09.2024 |
| Project | Bharat Coalfield | | Sample Ref. No | BCCL/ENVIRO/ERM/2024/24-25/GW | Sampling Method | CMPDI/IS 15.LPW 11.05.1025 Part-II | |
| Sampling Station | GOVINDPUR, AMBAGAN VILLAGE | Date of Sampling | | Sample collected in 5 Ltr Jerrycane , Color as observed is transparent | | | |
| | | | Period of Analysis | | TO | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | UNIT | Range Of Testing | LOQ | Acceptable Limit (Max)** | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/l, Max | APHA, 24th edition, Carmine | <0.2 | 0.2-4.0 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/l, Max | IS 3025 Part 42 : 1992 R: 2003, R2019 Hydro APHA, 24th edition, 3500-Cu B | <0.01 | 0.01-5.00 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA, 23rd Edition, 4500-Cl-B (Iodometric Method-I) | <0.20 | 0.20-5 | 0.20 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max | IS 3025(Part 47):1994 (Reaffirmed 2017) APHA, 24th edition, 3500-Cl B | <0.005 | 0.005-50 | 0.005 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as C6H5OH), mg/l, Max | APHA, 24th Edition,5-Series-Astigmatic | <0.001 | 0.001-10 | 0.001 | 0.001 | 0.002 |
| 6 | Selenium, mg/l, Max | APHA 24th edition IS: 3025(Part 56):2003 & 2014, Edn-Fifth | <0.007 | 0.007-50 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max | IS 3025 part 37:1988 R-2019/ APHA 24th edition 3500-As B | <0.006 | 0.006-50 | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/l, Max | IS: 3025 Part 52 :2003 R:2019,Anti-Hydro APHA, 24th edition, 3500-Cr B | <0.01 | 0.01-100 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni mg/l Max | IS 3025 Part 54 :2003(R : 2019, Anti-Hydro APHA, 24th edition, 3500-Ni B | <0.005 | 0.005-50 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/l, Max | APHA, 23rd Edition (2017) 3500-Mn B(Persulfate) | <0.02 | 0.02-500 | 0.02 | 0.1 | 0.3 |

***BIS values for mg/l (unless specified otherwise)

**Check sampling carried out for water samples. *LOQ- Indicates Lowest Detectable Limit & BDL- Indicates Below Detectable Limit

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - A32 , MOONIDIH BAZAR*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year: | June 2024 | Dag Wrk No: | 532 | | | | |
| Customer: | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [P. work granted by CMPDI at Ranchi] | | | | | Date of Comp: | 19.06.2024 |
| Project: | Water Quality | | Sample Ref. No. | BCCL/ENVIRONMENT/CMPDI/2024-25/536 | Sampling Method: | CMPDI/BA-III/EPM 11.2/8 2023/Part-11 | |
| Sampling Engineer: | MOHAMMAD RAFAM | Date of Sampling: | | Sample Collected in 1 Ltr Borosilicate Colour as observed in transparent | | | |
| | | | Period of Analysis: | | | Till | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | UNIT | Range till Tuesday | LOD | Acceptable Limit (Max)* | Permissible Limit in the absence of Alternate Source (Max)* |
| 1 | Boron (as B), mg/l, Max | APHA 24th edition, Curcumin | <0.2 | 0.2-0.9 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/l, Max | IS 3025 Part 42 : 1992 R: 2019, Anti-Plasis APHA 24th edition, 3a0-CTA | <0.01 | 0.01-0.02 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA 23rd Edition, 4500-Cl-B (Iodometric Method-I) | <0.04 | 0.04-0.1 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max | IS 3025(Part 47) 2008 (Reaffirmed 2019) APHA, 24th edition, 3500-CTA | <0.001 | 0.001-0.01 | 0.001 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as C6H5OH), mg/l, Max | APHA, 24th Edition,6-Amino Antipyrine | <0.001 | 0.001-0.01 | 0.001 | 0.001 | 0.002 |
| 6 | Selenium, mg/l, Max | APHA 24th edition, IS 3025(part 56):2003 & 2019), Anti-TCA | <0.007 | 0.007-0.01 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max. | IS 3025(part 37):1988 R:2019/ APHA 24th edition 3500-TCA | <0.006 | 0.006-0.01 | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/l, Max. | IS 3025 Part 52 (Sec1, R:2019,Anti-Plasis APHA, 24th edition, 3a0-CTA | <0.01 | 0.01-0.02 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/l, Max | IS 3025 Part 54 : 2003 R : 2019, Anti-Plasis APHA, 24th edition, 3500-CTA | <0.005 | 0.005-0.01 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/l, Max. | APHA, 24th Edition,3500-Anti-CCA Method | <0.02 | 0.02-0.07 | 0.02 | 0.1 | 0.3 |

***All results in mg/l unless specified otherwise.

**Drink sampling carried out for water samples. *LOD: Indicates Lowest Detectable Level & BDL Indicates Below Detection Level.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

1. *Ground Water Sampling at Monitoring Station Code : - A4, DALDOLI*

**Date of Sampling at Station:** June 2024

| Month & Year | June 2024 | Dug Well No | A4 | | |
|---|---|---|---|---|---|
| Customer | Environment Department, Mineral Linking Coal Limited (MCCL), Mouza Bhimsar, Khandbad (D. wash [illegible] | | | Date of Issue | 19.09.2024 |
| Purpose | Ground Water Monitoring | Sample Ref. No. | [illegible] | Sampling Method | CMFRI/BI-SL-EPR-1.1/01-SOP/Para 11 |
| Sampling Duration | 9:00 [illegible] | Date of Sampling | | Sample Collected on Clear [illegible] | |
| | | | Period of Analysis | | TC |

| SI. No | Parameters | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-1 | Range till Testing | LOD | Acceptable Limit (Max.)* | Permissible Limit in the absence of Alternate source (Max) |
| 1 | Boron (as B), mg/l, Max | APHA, 24th ed Edition Complete,2023 | <0.1 | 0.1 to | 0.1 | 0.5 | 1 |
| 2 | Copper (as Cu) mg/l, Max | IS 3025 Part 65 : 1993 R : 2019, Add-1Fluxo, APHA, 24th edition, Add-1/23 | <0.01 | 0.01 to 0.1 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA, 24th Edition, 4500-Cl- B, Incubation Method-FC,2023 | <0.05 | 0.1 to 0. | 0.05 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max | IS 3025/Part 47):1994 (Re-affirmed 2019),APHA, 24th edition, Add-1/3.5 | <0.005 | 0.005 to 0. | 0.005 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as C6H5OH), mg/l, Max | APHA, 24th Edition,A-Amino Antipyrine | <0.001 | 0.001 to 0. | 0.001 | 0.002 | 0.002 |
| 6 | Selenium, mg/l, Max | APHA, 24th Edition,3120 B,and Tm:1991 R (2017), Add-1/3.5,2023 | <0.007 | 0.007 to | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max | IS 3025/part 37:1988 (R-2019) APHA 24th edition Add-1/3.5 | <0.006 | 0.006 to 0. | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/l, Max | IS 3025 Part 52:2003, R:2019,Add1-Fluxo, APHA, 24th Edition, Add-1/3.5,2023 | <0.01 | 0.01 to 0.0 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni mg/l Max | IS 3025 Part 54 : 2003 R : 2019, Add1-Fluxo APHA, 24th Edition, Add-1/3.5,2023 | <0.005 | 0.005 to 0. | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/l, Max | APHA, 24th Edition,2023 Add-1/3.5 Method | <0.01 | 0.01 to 0.1 | 0.01 | 0.1 | 0.3 |

***All parameters except specified otherwise

**Each sampling carried out for seven samples, *LOD- Indicates Lower Detection Limit & BDL-Indicates Below Detection Limit*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

1. *Ground Water Sampling at Monitoring Station Code: - A9, SRIRAMPUR*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | A9 | | | IS10 No | |
| Customer | Environment Department, Bhaskar Cooking Coal Limited (BCCL), Bharat Bhawan, Dhanbad (P. Govt. [illegible]) | | | | | Date of Issue | 03.09.2024 |
| Project | District wise[illegible] | | Sample Ref. No. | RO:JI/ENVIRON/[illegible]/24-25/CW | Sampling Method | CMPDI/BCCL/ENV [illegible] | |
| Sampling Stations | SRIRAMPUR | Date of Sampling | | Sample Collected in Clear bottles. Odour as observed is Unobjected | | | |
| | | | Period of Analysis | | | Ref: | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | UW1 | Range of Tuning | UW2 | Acceptable Limit (Max.) | Permissible Limit in the Absence of Alternate Source (Max.) |
| 1 | Colour Hazen units | APHA, 23rd edition, 2120 c, Spectrophotometric Single Wavelength Method, 2017 | 5 | [illegible] | 5 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Titrimetric Method & APHA Method | 114 | [illegible] | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, RA 2019 Argentometric Method | 86 | [illegible] | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 23rd Edition, 4500(D) Method | 0.69 | [illegible] | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) 2003 RA 2019, ASV Method Method | 0.2 | [illegible] | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 40 | [illegible] | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-[illegible] Spectrophotometric Method | 21.26 | [illegible] | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 RA 2019 Electrometric pH Value Method | 7.44 | [illegible] | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA –24th edition, 4500 S Turbidity Method | 3.55 | [illegible] | 0.5 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (CaCO3 mg/l) as Alkalinity | IS 3025, Part 23: 1986, RA 2019 Titration Method | 186 | [illegible] | 4 | 200 | 600 |
| 13 | Total Hardness (CaCO3 mg/l) | IS 3025, Part 21: 1983 RA 2019 Complexometric method | 750 | [illegible] | 25 | 200 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21): 2009 RA 2019 Method | 814 | [illegible] | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, RA 2019 Nephelometric/Turbidimetric Method | 2.8 | [illegible] | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,RA 2019 AAS Flame Method | <0.1 | [illegible] | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise

*Check sampling carried out for twelve samples, *LOR: Indicates Lowest Detectable Level & BDL indicates Below Detection Level.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - B10, AMDIH NARAYANPUR*

**Date of Sampling at Station:** June 2024

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | B10 | | | DEE No | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (P. O. and district Dhanbad) | | | | | Date of Issue | 11.09.2024 |
| Project | District wise(B&M) | | Sample Ref. No. | BCCL/ENVT/B&M/2024/1651/24-21/CW | Sampling Method | CMPDI/Bd (E)/EPM 11/20-2023/Part (I) | |
| Sampling Stations | AMDIH NARAYANPUR | Date of Sampling | | Sample Collected in Clear bottles. Odour as observed is Unobjected | | | |
| | | | | Period of Analysis | | Etc | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | LOQ | Range of Tuning | LOD | Acceptable Limit (Max) | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour Hazen units | APHA, 23rd edition, 2120-c Spectrophotometric Single Wavelength Method 2017 | 2 | 1-150 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Method | 5.0 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, RA 2019 Argentometric Method | 5.00 | 2.0-1000.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500-F D Method | 0.04 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53): 2003, RA 2019, Ferrozine Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 2.0 | 1.0-150 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 10.0 | 0.2-45.0 | 0.2 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 RA 2023 Electrometric pH Value Method | 7.44 | 1.14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA - 24th edition 4500 S-2 Turbidity Method | 10.0 | 0.02-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (Conc.), mg/l Max | IS 3025, Part 23: 1986 RA 2019 Titration Method | 2.00 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Hardness (as CaCO3), mg/l | IS 3025, Part 21: 1983, RA 2023 Complexometric method | 9.04 | 2.02-1000.0 | 27 | 300 | 1000 |
| 14 | Total Dissolved Solids, mg/l | IS 3025 (Part 16): 2023 RA Method | 0.02 | 4.0-2500.0 | 4 | 500 | 2000 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, RA 2023 Nephelometric Turbidimeter Method | 0.9 | 1.000 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,RA 2019, AAS Flame Method | <0.1 | 0.02 - 3.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

**Cost sampling carried out for water samples. *LOL indicates Lower Detection Level & BDL indicates Below Detection Level.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - B15, BERA VILLAGE*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | B15 | | | WIR No | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (P. West Bengal Pin-826001, India) | | | | | Date of Issue | 03.09.2024 |
| Project | District Level Monitoring | | Sample Ref. No | BCCL/ENVIRONMENT/24-25/CW | Sampling Method | CMPDI/Bd Ill/LFM 11/19-2023/Part-II | |
| Sampling Distance | 9884 Vill.Mill | Date of Sampling | | Sample Collected in 1 Ltr Jerrycan, Color as observed in transparent | | | |
| | | | | Period of Analysis | | Dt. | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GWY | Range of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour, Hazen units | APHA, 24th edition, 2120-C, Spectrophotometric Single Wavelength Method, 2023 | 1 | 1-150 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part- 40): 1991 & 2011/ASTM Flame Method & EDTA Method | 144 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025/(Part- 32): 1988, & 2019 , Argentometric Method | 196 | 2.0-2500.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, SPADNS Method | 0.72 | 0.1-2.00 | 0.1 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53): 2003 & , 2019 , AAS Flame Method | <0.1 | 0.2-50 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B, Calculation Method | 39 | 0.01-700 | 0 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3- Spectrophotometric Method | 20.69 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 2022 & 2023 Electrometric pH Meter) Method | 7.52 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition 4500 S Turbidity Method | 137 | 2.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as Ca CO3 mg/l), Max | IS 3025, Part 23 1986 & 2019 Titration Method | 260 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984 & 2023 Gravimetric method | 728 | 25.0-5000.0 | 25 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21) 2019 EDTA Method | 604 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10) 1984, & 2023 Nephelometric (Turbidimeter) Method | 0.6 | 1-999 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025/(Part- 49) : 1994 & 2019, AAS Flame Method | <0.1 | 0.10 – 10.0 | 0.1 | 5 | 15 |

***All results in mg/l, unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lowest Detection Level & BDL indicates Below Detection Level.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - B19 , BHANDARIDIH*

**Date of Sampling at Station: June 2024**

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | B19 | GLR No. | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (Jharkhand) | | | Date of Issue | 19.09.2024 |
| Project | Bharat Coal Bhawan | Sample Ref. No. | BCCL/ENVIRONMENT/2024-25/CW | Sampling Method | CMPDI/IS:10500/Part-II |
| Sampling Station | Bharat Coal Bhawan | Date of Sampling | 06.07.2024 | Sample Collected on Tube Tubewell. Colour as observed is transparent | |
| | | | Period of Analysis | | to |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | As per IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | CBH 19 | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max)* |
| 1 | Colour, Hazen unit | APHA, 24th edition, 2120 C+ Spectrophotometric Single Wavelength Method, 2021 | 2 | 1-Dec-0 | 1 | 5 | 15 |
| 2 | Turbidity, mg/l | IS 3025, (Part 10): 2021 R2019,Anti-Formin Method & R2019 Method | 1.94 | 1.0-488.0 | 1 | 1.0 | 5.0 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, R-2019 Argentometric Method | 112 | 2.0-1304.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 23rd Edition, 4500(D) Method | 0.51 | 0.1-1.249 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003 R., 2019 , ASV/Trace Method | <0.2 | 0.2-10 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculated Method | 98 | 4.0-730 | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 B Spectrophotometric Method | 17.17 | 0.2-45.0 | 0.2 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2022 Electrometric pH Value Method | 7.11 | 2-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA, 24th edition, 4500 E Turbidity Method | 140 | <0.6-800.0 | 1.0 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity as CaCO3, mg/l (Max) | IS 3025, Part 23, 1986, R 2019 Titration Method | 282 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984, R 2021 Gravimetric method | 974 | 10.0-7000.0 | 10 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21) 2009 EDTA Method | 713 | 4.0-2200.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2017 Nephelometric/Turbidimeter Method | 2.3 | 1.0-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,R-2019 ASV/Trace Method | <0.1 | 0.10 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise*

***Grab sampling carried out for water samples. *LOD- Indicates Lower Detection Limit & BDL indicates Below Detection Limit*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code: - B23 , LOHAPATTI VILLAGE*

**Date of Sampling at Station: June 2024**

| Month & Year | June 2024 | Bag/Well No. | B23 | | | GLR No. | |
|---|---|---|---|---|---|---|---|
| Customer | Environment Department, Bhorat Coking Coal Limited (BCCL), Bank Dhanbad, Dhanbad [E-mail: gmenv.bccl@coalindia.in] | | | | | Date of Issue | 11.07.2024 |
| Project | Bharat Coal Bhawan | | Sample Ref. No. | BCCL/ENVIRONMENT/2024-25/GW/ | Sampling Method | CMPDI/IS:3025(Part-1) | |
| Sampling Station | LOHAPATTI VILLAGE | Date of Sampling | | Sample Collected on 5 Lit Jerrycan. Color as observed is inappropriate | | | |
| | | | Period of Analysis | | to | | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | As per IS:10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW23 | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max)* |
| 1 | Colour, Hazen unit | APHA, 24th edition, 2120 C+ Spectrophotometric Single Wavelength Method, 2017 | 2 | 1-Detect | 1 | 5 | 15 |
| 2 | Cyanide, mg/l | IS 3025, (Part 65): 2018 RA 2023,ASTM Silver Method & ASTM Method | ND | 2.5-600.0 | 1 | 70 | 200 |
| 3 | Chlorides, mg/l | IS 3025(Part 32):1988, RA 2019 , Argentometric Method | 116 | 2.0-2500.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, SPADNS Method | 0.55 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003, RA : 2019 , ASV Plated Method | <0.2 | 0.2-50 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B, Calculation Method | 46 | 4.0-150 | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 B, Spectrophotometric Method | 10.5% | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 B | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 RA 2017 Electrometric pH Value Method | 7.65 | 2-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S2- , Turbidity Method | 119 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Hardness (CaCO3), mg/l as | IS 3025, Part 21 (Reaffirmed 2019) Titration Method | 280 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, (1984 RA 2017) Gravimetric method | 442 | 25.0-1000.0 | 25 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21) 2009, RA 2014 Method | 520 | 4.0-1000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, RA 2017 Nephelometric/Turbidimeter Method | 2.1 | 1-200 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,RA 2019, ASV Plated Method | 0.17 | 0.10 - 10.0 | 0.1 | 5 | 15 |

***All results in mg/l, unless specified otherwise.

**Grab sampling carried out for water samples. *LOD- Indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

1. *Ground Water Sampling at Monitoring Station Code : - B32, MADHUBANDAH*

**Date of Sampling at Station : June 2024**

| Month & Year | June 2024 | Reg Work No | B32 | ULR No | |
|---|---|---|---|---|---|
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: pgoswami.bcclhq@yahoo.in] | | | Date of Dispatch | 19.09.2024 |
| Protocol | Starter Cum/Bold | Sample Ref No | BCCL/ENVIRONMENT/2024-25/LAB/ | Sampling Method | CMPDI/BCCL/EPM 11.2/E 2023/Part-II |
| Sampling Stations | MADHUBANDAH COLLIERY | Date of Sampling | | | |
| | | Permit of Sources | | no | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternative Source (Max)* |
|---|---|---|---|---|---|---|---|
| | | | GW22 | Range Of Testing | LOD | | |
| 1 | Colour, Hazen unit | APHA, 24th edition, 2120-c Spectrophotometric Single Wavelength Method, 2023 | 4 | 1-150 Hz | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Titrimetric Method & APHA Method | 132 | 2.0-800.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025(Part 32):1988; RA 2019 - Argentometric Method | 96 | 2.0-2500.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500D Method | 0.67 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003 RA 2019, APH Phene Method | 0.1 | 0.2-10 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 50 | 4.0-500 | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 0.015 | 0.5-100 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 24th Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 RA 2017 Electrometric pH Value Method | 7.43 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA - 24th edition 4500 S2- Turbidity Method | 151 | 5.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23: 1986 RA 2019 Titration Method | 230 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Hardness (as CaCO3 mg/l | IS 3025, Part 21: 1983 RA 2019 Complexometric method | 850 | 20.0-5000.0 | 20 | 300 | 1000 |
| 14 | Total Residues, mg/l | IS 3025 (Part 15): 2005 RA Method | 476 | 4.0-2000.0 | 4 | 500 | 2000 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, RA 2019 Nephelometric (Turbidimeter) Method | 2.1 | 1-400 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part) 49) : 1994,RA 2019 APH Phene Method | 0.21 | 0.05 - 50.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

*#Grab sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - B40 , BHUIANCHITRO*

**Date of Sampling at Station: June 2024**

| Month & Year | June 2024 | Dug Well No | B40 | | | WQI No | |
|---|---|---|---|---|---|---|---|
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (P. Bag-[illegible]) | | | | | Date of Issue | 03.09.2024 |
| Protocol | [illegible] | | Sample Ref. No. | [illegible] | Sampling Method | CWPRS/Bul.IS:4/PM-11/20-2023/Part-01 | |
| Sampling Station | [illegible] | Date of Sampling | | Sample Collected in 1 Ltr borosilicate Color as observed is transparent | | | |
| | | | Permit of Analysis | | | Qty | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | [illegible] | Range of Tolerance | LOD | Acceptable Limit (Max.) | Permissible Limit in the Absence of Alternate Source (Max.) |
| 1 | Colour Hazen units | APHA, 23rd edition, 2120-c, Spectrophotometric Single Wavelength Method, 2017 | 3 | 1-15[illegible] | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Titrimetric Method & APHA Method | 144 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, RA 2019 Argentometric Method | 334 | 2.0-1000.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500-F C Method | 0.61 | 0.2-1.50 | 0.2 | 1 | 1.5 |
| 5. | Iron, mg/l | IS 3025 (Part 53): 2003, RA 2019, Ferrozine Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6. | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 70 | 0.5-150 | 0 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 28.13 | 0.2-45.0 | 0.2 | 45 | No relaxation |
| 8. | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9. | pH Value | IS 3025, Part 11 : 1983 RA 2019 Electrometric pH Value Method | 7.38 | 1 to | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA - 24th edition 4500 S Turbidity Method | 181 | 0.02-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max. | IS 3025, Part 23: 1986 RA 2019 Titration Method | 226 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Hardness (as CaCO3 mg/l | IS 3025, Part 21: 1983, RA 2019 Complexometric method | 700 | 20.0-1000.0 | 20 | 300 | 1200 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21): 2009 RA 2019 Method | 736 | 4.0-1000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, RA 2019 Nephelometric Turbidimeter Method | 2.5 | 1-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49), Am. 1994,RA 2019, AAS Flame Method | <0.1 | 0.05 - 3.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

*#Cost sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

1. *Ground Water Sampling at Monitoring Station Code : - B46 , TELO*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | B46 | | | ULR No | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (P. Bag-grparn No.09, Dhanbad-826 001) | | | | | Date of Issue | 11.07.2024 |
| Protocol | District wise/B&M | | Sample Ref. No. | BCCL/ENVIRONMENT/24-25/GW/ | Sampling Method | CMPDI/Bd Bl/LFM 11/19-2023/Part-II | |
| Sampling Stations | TELO | Date of Sampling | | Samples Collected in 1 Ltr borosilicate / other as observed in transparent | | | |
| | | | | Period of Analysis | | Dt | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | UW14 | Range of Tuning | LOD | Acceptable Limit (Max) | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour Hazen units | APHA, 23rd edition, 2120-c, Spectrophotometric Single Wavelength Method-2017 | 3 | 1-150 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 (Edta Titrate Method & EDTA Method | 72 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS-3025(Part 32):1988, RA 2019 , Argentometric Method | 120 | 2.0-1000.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500-F Method | 0.59 | 0.1-2.00 | 0.1 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003, RA : 2019, Ash Digest Method | <0.1 | 0.1-50 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 60 | 0.5-100 | 0 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 12.40 | 0.2-45.0 | 0.2 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 RA 2023 Electrometric pH Value Method | 7.39 | 1.1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA - 24th edition 4500 S - Turbidity Method | 96 | 0.01-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (Caco3 mg/l) Max | IS 3025, Part 23: 1986 R 2019 Titration Method | 222 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Residual Solids mg/l | IS 3025, Part 15: 1984, R 2023 Gravimetric method | 402 | 20.0-2000.0 | 20 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21): 2009 RA'19 Method | 300 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025 (Part 10):1984, R-2023 Nephelometric Turbidimeter Method | 0.9 | 1.000 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,R-2019, AAS Flame Method | 0.1 | 0.02 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

*NC=not sampling received not for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : -B55 , RANTANR VILLAGE*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | B55 | | | UER No | |
| Customer | Environment Department, Mukand Ltd Unit Kalmbd (MCC), Kalmbd Dhanbad, Dhanbad [F-mail-gmgen.kalmbd@mukandltd.in] | | | | | Date of Issue | 03.06.2024 |
| Project | Monitoring | | Sample Ref. No. | BO/E/ENV/KAL/GW/24-25/GW/ | Sampling Method | CWPRS/Tech G/ISO 17025:2017/Part-01 | |
| Sampling Station | RANTANR VILLAGE | Date of Sampling | | Sample Collected in Clear bottles. Color as observed is transparent | | | |
| | | | Period of Analysis | | | Qty | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | UWSS | Range of Tolerance | LOD | Acceptable Limit (Max) | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour Hazen units | APHA, 23RD edition, 2120 c, Spectrophotometric Single Wavelength Method 2017 | 1 | 1-10(H) | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Titrimetric Method & APHA Method | 110 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988 RA 2019 Argentometric Method | 90 | 2.0-1000.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500-F D Method | 0.09 | 0.2-1.50 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) 2003 RA 2019, Ferrozine Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 70 | 0.5-150 | 0 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 27.20 | 0.2-45.0 | 0.2 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 C | agreeable | Qualitative | Qualitative | agreeable | agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 RA 2019 Electrometric pH Meter Method | 7.44 | 1.1-14 | 1.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA - 24th edition 4500 S Turbidity Method | 110 | 0.02-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23: 1986 RA 2019 Titration Method | 230 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Hardness (as CaCO3 mg/l | IS 3025, Part 21: 1983 RA 2019 Complexometric method | 512 | 20.0-1000.0 | 20 | 300 | 1000 |
| 14 | Total Dissolved Solids mg/l | IS 3025 (Part 16): 2023 RA Method | 760 | 4.0-2000.0 | 4 | 500 | 2000 |
| 15 | Turbidity, NTU | IS 3025 (Part 10):1984 RA 2023 Nephelometric Turbidimeter Method | 0.6 | 1.000 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994 RA 2019, AAS Flame Method | <0.1 | 0.05 - 5.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

**Cost sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - B59, KHODOVALY VILLAGE*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | B59 | | | IS:10 No | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (P. West Bengal) Pin-826001 | | | | | Date of Issue | 11.09.2024 |
| Project | District Level Monitoring | | Sample Ref. No. | BCCL/ENVIRONMENT/24-25/GW/ | Sampling Method | CWPRS/Tech Bulletin/ 3.1/29 /2023/Part-01 | |
| Sampling Stations | KHODOVALY | Date of Sampling | | Samples Collected in 1 Ltr borosil bottles. Odour as observed is Unobjectionable | | | |
| | | | Period of Analysis | | | Dt | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW1b | Range of Tolerance | LOD | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max.) |
| 1 | Colour Hazen units | APHA, 23RD edition, 2120-c, Spectrophotometric Single Wavelength Method, 2017 | 2 | 1-20(+) | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Titrimetric Method & APHA Method | 116 | 2.0-408.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, RA 2019 Argentometric Method | 220 | 2.0-2300.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500-F D Method | 0.79 | 0.1-2.00 | 0.1 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) 2003, RA 2019, Atm Digest Method | <0.1 | 0.1-44 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 95 | 0.25-730 | 0 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 19.28 | 0.2-410 | 0.2 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | agreeable | Qualitative | Qualitative | agreeable | agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 RA 2019 Electrometric pH Value Method | 7.72 | 1.14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA - 24th edition 4500 S Turbidity Method | 132 | 0.02-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max. | IS 3025, Part 23: 1986 RA 2019 Titration Method | 220 | 4.0-2000.0 | 4 | 200 | 600 |
| 13 | Total Hardness (as CaCO3 mg/l | IS 3025, Part 21: 1983, RA 2019 Complexometric method | 996 | 20.0-7000.0 | 20 | 300 | 1000 |
| 14 | Total Dissolved Solids mg/l | IS 3025 (Part 16): 2023 RA Method | 682 | 6.0-2240.0 | 6 | 500 | 2000 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, RA 2023 Nephelometric Turbidimeter Method | 2.0 | 1.000 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,RA 2019, AAS Flame Method | <0.1 | 0.10 - 300 | 0.1 | 5 | 15 |

***All units in mg/l, unless specified otherwise.

**Cost sampling carried out for water samples. *LOD indicates Lower Detection Level & BDL indicates Below Detection Level.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - B64 , KESHALPUR,BATIGHAR*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | B64 | | | ULR No. | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: please to cdh.ea@bcclin.in] | | | | | Date of Issue | 19.09.2024 |
| Protocol | Bureau Cred Mandi | | Sample Ref. No. | BCB/ENVIRONMENT/2024/KM | Sampling Method | CWP94/IS:0:LPM 13.28:2015,Part-01 | |
| Sampling Stations | KESHALPUR, BATIGHAR | Date of Sampling | | Sample Collected as it is Borehole. Could not abstracted in transparent | | | |
| | | | Period of Analysis | | | Lot | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | CHEXT | Range Of Testing | LOD | Acceptable Limit (Max) | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour, Hazen units | APHA, 23RD edition ,2120-c Spectrophotometric Single Wavelength Method 2013 | 2 | 1-300.0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 R 2019/ASTM Flame Method & EDTA Method | 96 | 2.0-400.0 | 2 | 75 | 200 |
| 4 | Chlorides, mg/l | IS 3025(Part 32):1988, R 2019 Argentometric Method | 216 | 2.0-1000.0 | 2 | 250 | 1000 |
| 5 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.68 | 0.1-2.00 | 0.1 | 1 | 1.5 |
| 6 | Iron, mg/l | IS 3025 (Part 53) : 2003 R : 2019 Atomic Method | <0.2 | 0.2-10 | 0.2 | 1 | No relaxation |
| 7 | Magnesium | APHA 24th edition, 3500-Mg, B Calculation Method | 83 | 1.0-150 | 1 | 30 | 100 |
| 8 | Nitrate, mg/l | APHA, 24th edition, 4500-Norganic-B Spectrophotometric Method | 17.66 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 9 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 10 | pH value | IS 3025, Part 11 : 1983 R 2019 Electrometric pH Meter Method | 7.67 | 2-14 | 0.1 | 6.5-8.5 | No relaxation |
| 11 | Sulphate, mg/l | APHA –24th edition, 4500 S Turbidity Method | 110 | 10.0-400.0 | 10 | 200 | 400 |
| 12 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 13 | Total Alkalinity (as CaCO3 mg/l), Max. | IS 3025, (Part 23) 1986, R 2019 Titration Method | 244 | 4.0-1000.0 | 4 | 200 | 600 |
| 14 | Total Hardness (as CaCO3 mg/l) | IS 3025, Part 21: 1983 R 2019 Complexometric method | 326 | 25.0-3000.0 | 25 | 200 | 1000 |
| 15 | Total Hardness mg/l | IS 3025, (Part 21): 2009 EDTA Method | 326 | 4.0-1000.0 | 4 | 200 | 600 |
| 16 | Turbidity, NTU | IS 3025, (Part 10):1984, R 2017 Nephelometric Turbidimeter Method | 1.0 | 1-400 | 0.1 | 1 | 5 |
| 17 | Zinc, mg/l | IS 3025(Part 49) : 1994(R 2014) AAS Flame Method | 0.01 | 0.1.0 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lowest Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

1. *Ground Water Sampling at Monitoring Station Code : - D107, BOGULA*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | D107 | | | ULR No | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (P. O. and district Dhanbad) | | | | | Date of Issue | 11.09.2024 |
| Protocol | State Code/NABL | | Samples Ref. No | BCCL/ENVIRONMENT/24-25/GW/ | Sampling Method | CMPDI/Bd ULR/ 11139 2023/Part-II | |
| Sampling Stations | BOGULA | Date of Sampling | | Samples Collected in 1 Lit Normalcy Color as observed is transparent | | | |
| | | | | Period of Analysis | | Dt | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | D107 | Range of Tolerance | LOD | Acceptable Limit (Max.) | Permissible Limit in the Absence of Alternate Source (Max.) |
| 1 | Colour Hazen units | APHA, 23RD edition, 2120 c, Spectrophotometric Single Wavelength Method, 2023 | 4 | 1-15(H) | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Titrimetric Method & APHA Method | 112 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988 RA 2019 Argentometric Method | 220 | 2.0-1000.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500-F D SPADNS Method | 0.67 | 0.2-1.50 | 0.2 | 1 | 1.5 |
| 5. | Iron, mg/l | IS 3025 (Part 53) 2003 RA 2019, Atomic Absorption Method | <0.1 | 0.2-10 | 0.2 | 1 | No relaxation |
| 6. | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 49 | 0.5-500 | 0 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 B Spectrophotometric Method | 0.28 | 0.2-45.0 | 0.2 | 45 | No relaxation |
| 8. | Odour | APHA 23rd Edition, 2150 C | agreeable | Qualitative | Qualitative | agreeable | agreeable |
| 9. | pH Value | IS 3025, Part 11 : 1983 RA 2023 Electrometric pH Value Method | 7.72 | 1.1 to | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition 4500 S Turbidity Method | 270 | 0.02-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | agreeable |
| 12 | Total Alkalinity (Conc.) mg/l Max. | IS 3025, Part 23: 1986 RA 2019 Titrimetric Method | 272 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Residual Solids mg/l | IS 3025, Part 16: 1984, RA 2023 Gravimetric method | 806 | 20.0-2000.0 | 20 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21): 2009 EDTA Method | 442 | 4.0-1000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025 (Part 10):1984, RA 2023 Nephelometric Turbidimeter Method | 0.9 | 1.0-80 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,RA 2019, AAS Flame Method | <0.1 | 0.02 - 5.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise.

**Cost sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - D112, DEMUDI(DOMATANR)*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | D112 | | | DEE No | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (P. O. and district Dhanbad) | | | | | Date of Issue | 19.09.2024 |
| Project | | Sample Ref. No | BCCL/ENVIRONMENT/24-25/GW/ | | Sampling Method | CMPDI/Bd (E)/EPM 11/29-2023/Part-II | |
| Sampling Station | DEMUDI(DOMATANR) | Date of Sampling | | Sample Collected in Clear bottles. Odour as observed is Unobjected | | | |
| | | | Period of Analysis | | | to | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | DWT4 | Range of Tuning | LOD | Acceptable Limit (Max) P | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour (Hazen unit) | APHA, 23rd edition, 2120-c, Spectrophotometric Single Wavelength Method, 2017 | 2 | 1-150 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 (Edta Titrate Method & APHA Method | 86 | 2.0-400.0 | 2 | 75 | 200 |
| 4 | Chlorides, mg/l | IS:3025(Part 32):1988, RA 2019 , Argentometric Method | 136 | 2.0-1000.0 | 5 | 250 | 1000 |
| 5 | Fluoride, mg/l | APHA, 24th Edition, 4500-F Method | 0.61 | 0.1-1.50 | 0.1 | 1 | 1.5 |
| 6 | Iron, mg/l | IS 3025 (Part 53) : 2003, RA : 2019, Ferrozine Method | <0.1 | 0.1-50 | 0.1 | 1 | No relaxation |
| 7 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 47 | 0.5-100 | 0 | 30 | 100 |
| 8 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 27.89 | 0.2-45.0 | 0.2 | 45 | No relaxation |
| 9 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 10 | pH Value | IS 3025, Part 11 : 1983 RA 2017 Electrometric pH Value Method | 7.52 | 1.1 to | 0.1 | 6.5-8.5 | No relaxation |
| 11 | Sulphate, mg/l | APHA - 24th edition 4500 S Turbidity Method | 117 | 0.01-400.0 | 01 | 200 | 400 |
| 12 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 13 | Total Alkalinity (Conc.) mg/l Max | IS 3025, Part 23: 1986 R 2019 Titration Method | 210 | 4.0-1000.0 | 4 | 200 | 600 |
| 14 | Total Hardness (as Caco3 mg/l | IS 3025, Part 21: 1983, R 2019 Complexometric method | 474 | 2.0-1000.0 | 27 | 300 | 1000 |
| 15 | Total Dissolved Solids mg/l | IS 3025 (Part 16): 2023 RA Method | 490 | 6.0-2000.0 | 6 | 500 | 2000 |
| 16 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2023 Nephelometric Turbidimeter Method | 0.5 | 1-800 | 0.1 | 1 | 5 |
| 17 | Zinc, mg/l | IS 3025(Part 49): 1994,R-2019, AAS Flame Method | 0.1 | 0.02 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/l, unless specified otherwise.

**Cost sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - D115, TELMUCHU*

**Date of Sampling at Station: June 2024**

| Month & Year | June 2024 | Dug Well No | D115 | WIR No | |
|---|---|---|---|---|---|
| Customer | Environment Department, Mizoram Pollution Control Committee (MPCC) & Public Relations, Dhalkhal [E-mail: gmpcb.tech@rediffmail.com] | | | Date of Issue | 19.09.2024 |
| Project | District wise Monitoring | Sample Ref. No | RO:IL/D115/MZ/20.06.24/1,2,4-21,/CW | Sampling Method | CWPRS/Rd Q:1/FM 11/19-2023,Part-01 |
| Sampling Distance | 111.0 to 200 | Date of Sampling | | Sample Collected in 1 Ltr Container , Color as observed is unsatisfactory | |
| | | | Result of Analysis | | Pass |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | As per IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | D115 | Range of Tolerance | LOD | Acceptable Limit (DWQ)* | Permissible Limit in the absence of Alternate Source (DWQ) |
| | Colour, Hazen units | APHA, 24th Edition, 2120(c)-Spectrophotometric Single Wavelength Method, 2023 | 3 | 1.0-50.0 | 1 | 5 | 15 |
| 2. | Cyanide, mg/l | IS 3025, (Part 44): 2003 RA 2019/ISO 6703-1:1984, Flow Analysis & ASTM Method | BDL | 0.0-100.0 | 1 | 15 | 200 |
| 3. | Chlorides, mg/l | IS 3025(Part 32):1988, RA 2019 Argentometric Method | 104 | 2.0-1500.0 | 1 | 250 | 1000 |
| 4. | Fluoride, mg/l | APHA, 24th Edition, SPADNS Method,2023 | 0.72 | 0.1-2.00 | 0.1 | 1 | 1.5 |
| 5. | Iron, mg/l | IS 3025 (Part 53): 2003, RA 2019, APH Phenz Method | 0.05 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6. | Magnesium | APHA 24th Edition, 3500-Mg B Calculation Method,2023 | 37 | 0.5-100 | 0.5 | 30 | 100 |
| 7. | Nitrate, mg/l | APHA, 24th Edition, UV-Spectrophotometric Method,4500 | 25.50 | 0.5-125 | 0.5 | 45 | No relaxation |
| 8. | Odour | APHA 24th Edition, 2150 (C),2023 | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9. | pH value | IS 3025, Part 11 : 1983, RE 2022 Electrometric pH Value Method | 7.56 | 2.0-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10. | Sulphate, mg/l | APHA –CAP Edition, 4500 S Turbidity Method,2023 | 204 | 10.0-400.0 | 10 | 200 | 400 |
| 11. | Taste | APHA,24th Edition, 2160-C, 2023 | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12. | Total Alkalinity (Conc) mg/l as | IS 3025, Part 23: 1986, RE 2019 Titration Method | 194 | 4.0-1000.0 | 4 | 200 | 600 |
| 13. | Total Hardness (EDTA) mg/l | IS 3025, Part 21: 1983 RE 2022 Complexometric method | 157 | 20.0-2000.0 | 20 | 200 | 1000 |
| 14. | Total Dissolved mg/l | IS 3025, (Part 16): 2017 RE2019, Method | 189 | 4.0-2000.0 | 4 | 500 | 2000 |
| 15. | Turbidity, NTU | IS 3025, (Part 10):1984, RE 2017 Nephelometric (Turbidimeter) Method | 3.1 | 1-400 | 0.1 | 1 | 5 |
| 16. | Zinc, mg/l | IS 3025(Part 49): 1994,RE 2019, AAS Flame Method | <DL | 0.10 – 10.0 | 0.1 | 5 | 15 |

*[***All units in mg/l, unless specified otherwise*

*[**Grab sampling carried out for water samples, *LOD: Indicates Lower Detection Limit & BDL indicates Below Detection Limit]*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

1. *Ground Water Sampling at Monitoring Station Code : - D14 , KARMATANR*

**Date of Sampling at Station:** June 2024

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | D14 | | | WQI No | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [P. Mandal, Email: [illegible]] | | | | | Date of Issue | 11.09.2024 |
| Project | [illegible] | | Sample Ref. No | BCCL/ENVT/[illegible]/24-25/KM | Sampling Method | CWPRS/Bd Sl/APM 11/19-2023/Part-II | |
| Sampling Distance | [illegible] | Date of Sampling | | Sample Collected as it is or Ammonia , Color as observed is unsatisfactory | | | |
| | | | | Result of Analysis | | Etc | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | DWQI | Range of Tolerance | LDL | Acceptable Limit (DWQI)* | Permissible Limit in the absence of Alternate Source (DWQI) |
| 1 | Colour Hazen unit | APHA, 23rd edition, 2120 C, Spectrophotometric Single Wavelength Method 2017 | 5 | 1-15Hz | 1 | 5 | 15 |
| 2 | Odour, mg/l | IS 3025, (Part 44): 1993 R-2019 [Reaff 2019] Hazen Method & ASTM Method | 1Dr | 1-2 ODR | 1 | 1Dr | 3Dr |
| 3 | Chlorides, mg/l | IS 3025(Part 32):1988, R-2019 Argentometric Method | 122 | 2.5-1Dr0Hz | 1 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 23rd Edition, 4500F Method | 0.59 | 0.1-1.00 | 0.1 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53): 2003, R-2019, AAS Flame Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculated Method | 36 | 0.5-150 | 0 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 B Spectrophotometric Method | 11.01 | 0.1-45.0 | 0.1 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 C | Agreeable | Unobjection | Unobjectio n | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 R 2021 Electrometric pH Value Method | 7.39 | 1-14 | 4.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S2- Turbidity Method | 114 | 0.07-400.0 | 0.1 | 200 | 400 |
| 11 | Taste | APHA,24th edition,2160 C | Acceptable | Unobjectio | Unobjectio n | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23: 1986 R 2019 Titration Method | 240 | 4.0-1Dr0.0 | 8 | 200 | 600 |
| 13 | Total Hardness (as CaCO3 mg/l | IS 3025, Part 21: 1983 R 2019 Complexometric method | 304 | 21.0-1Dr0.0 | 20 | 300 | 1Dr0 |
| 14 | Total Residues, mg/l | IS 3025, (Part 15): 2017, R2019 Method | 500 | 4.0-1Dr0.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2022 Nephelometric Turbidimeter Method | 1.5 | 1-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R-2019, AAS Flame Method | <0.1 | 0.07 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/l, unless specified otherwise.

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - D19, MEMKO MORE*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | D19 | | | DEE No | |
| Customer | Environment Department, Mukand Ltd Unit Kandla (MUL), Kandla Dharamsi, Dhanbad (P. Box-[illegible]) | | | | | Date of Issue | 11.07.2024 |
| Project | [illegible] | | Sample Ref. No | [illegible] | Sampling Method | CWPRS/Bd III/LPM 11/19-2023/Part-II | |
| Sampling Station | MEMKO MORE | Date of Sampling | | Sample Collected in 1 Ltr borosilicate Color as observed is transparent | | | |
| | | | Period of Analysis | | | Etc | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | Acceptable Limit (Max) | Permissible Limit in the Absence of Alternate Source (Max) |
|---|---|---|---|---|---|---|---|
| | | | [illegible] | Range of Fluoride | LDL | | |
| 1 | Colour Hazen units | APHA, 23rd edition, 2120-c Spectrophotometric Single Wavelength Method 2017 | 3 | 1-15[illegible] | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Titrimetric Method & APHA Method | 80 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988 RA 2019 Argentometric Method | 96 | 2.0-1000.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500-F Method | 0.67 | 0.1-2.00 | 0.1 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003 RA 2019, Ferrozine Method | 0.00 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 31 | 0.5-100 | 0.5 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 17.53 | 0.2-45.0 | 0.2 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | agreeable | Qualitative | Qualitative | agreeable | agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 RA 2023 Electrometric pH Value Method | 7.32 | 1 to | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA - 24th edition 4500 S Turbidity Method | 70 | 0.02-400.0 | 01 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23: 1986 RA 2019 Titration Method | 282 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Hardness (as CaCO3 mg/l | IS 3025, Part 21: 1983 RA 2019 Complexometric method | 452 | 2.0-1000.0 | 01 | 300 | 1000 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21): 2009 RA 2019 Method | 429 | 4.0-1000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, RA 2023 Nephelometric Turbidimeter Method | 0.6 | 1-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,RA 2019, AAS Flame Method | <0.1 | 0.02 - 5.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

1. *Ground Water Sampling at Monitoring Station Code : - D2 , BIRSA MUNDA CHAWK,BANKMORE*

**Date of Sampling at Station:** June 2024

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | D2 | | UTR No | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: gmenv.bccl@coalindia.in] | | | | Date of Issue | 19.09.2024 |
| Project | Bharat Coalfield | | Sample Ref. No | BCCL/BSMD/EQUIP/2024-25/536 | Sampling Method | CPCB/Ref.No.BCCL/EPM.12.25/2015,Part-II |
| Sampling Agency | BIRSA MUNDA CHAWK, BANKMORE | Date of Sampling | | Sample Collected in 5 Ltr Jerrycans , Color as observed as transparent | | |
| | | | Period of Analysis | | Vol. | |

| Sl. No. | Parameters | Method of Analysis | Observed Values | | | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
|---|---|---|---|---|---|---|---|
| | | | Less than | Range of Testing | LOQ | | |
| | Colour, Hazen units | APHA, 24th Edition, 2120-C, Spectrophotometric Single Wavelength Method, 2023 | 1 | 1 (MDL) | 1 | 5 | 15 |
| 2. | Cyanide, mg/l | IS 3025, (Part- 65): 2022 & 2023 Photo Method & ISO 6 Method | 0.04 | 0.04-0.07 | 0 | 0.1 | 0.2 |
| 3 | Chloride, mg/l | IS 3025(Part- 32):1988) & 2019 , Argentometric Method | 2.84 | 2.84-170.63 | 3 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, SM4500-Method 2023 | 0.02 | 0.2-1.09 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003 & : 2019 , Atomic Method | 0.1 | 0.2-10 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th Edition, 3500-Mg B Calculation Method 2023 | 10 | 5.47-120 | 6 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th Edition, 4500-Spectrophotometric Method,2023 | 0.50 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA,24th Edition, 2150-C,2023 | Agreeable | Qualitative | Qualitativ e | Agreeable | Agreeable |
| 9 | pH value | IS 3025 (Part 11 : 2022) 84 Electrometric pH Meter Method | 5.56 | 7.14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th Edition, 4500 S Turbidity Method 2023 | 10 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA,24th Edition, 2160-C, 2023 | Acceptable | Qualitative | Qualitativ e | Acceptable | Agreeable |
| 12 | Total Alkalinity (CaCO3 mg/l) Max | IS 3025, (Part 23) 1986 & 2019 Titration Method | 10 | 4.0-238.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids mg/l | IS 3025, Part 16, 1984 & 2023 Gravimetric method | 101 | 21.0-1410.0 | 21 | 500 | 2000 |
| 14 | Total Hardness mg/l | IS 3025, (Part 21) 2009 EDTA Method | 140 | 4.0-238.0 | 4 | 200 | 600 |
| 15 | Turbidity NTU | IS 3025, (Part 10):1984, & 2023 Nephelometric Turbidimeter Method | 1.0 | 1.000 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part- 49), : 1994,& 2019 AAS Flame Method | MDL | 0.10-3.63 | 0.1 | 5 | 15 |

*All units in mg/l, unless specified otherwise.*

***Grab sampling carried out for water samples. *LOL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - D25 , GODHUR MORE*

**Date of Sampling at Station: June 2024**

| Month & Year | June 2024 | Dug Well No | D25 | | | | | DEE No | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (P. O. Box-[illegible]) | | | | | | | Date of Issue | 11.09.2024 | |
| Project | [illegible] | | Sample Ref. No. | BCCL/ENVIRONMENT/24-25/SW | | | Sampling Method | CWPRS/Tech Bulletin/ENVIRONMENT/2019/Part-II | | |
| Sampling Stations | [illegible] | Date of Sampling | | Samples Collected in 1 Ltr borosilicate Colour as observed is transparent | | | | | | |
| | | | Permit of Aquaria | | | | Etc | | | |
| Sl. No. | Parameter | Method of Analysis | Observed Values | | | | | IS 10500: 2012 | | |
| | | | UMCL | Range of Training | LDL | Acceptable Limit (Max.) | | Permissible Limit in the Absence of Alternate Source (Max.) | | |
| 1 | Colour Hazen units | APHA, 23rd edition, 2120 c, Spectrophotometric Single Wavelength Method, 2017 | 3 | 1-500 | 1 | 5 | | 15 | | |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Titrimetric Method & APHA Method | 130 | 2.0-400.0 | 2 | 75 | | 200 | | |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, RA 2019 Argentometric Method | 220 | 2.0-2500.0 | 5 | 250 | | 1000 | | |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500-F D Method | 0.62 | 0.2-2.00 | 0.2 | 1 | | 1.5 | | |
| 5 | Iron, mg/l | IS 3025 (Part 53) 2003, RA 2019, Ferrozine Method | 0.2 | 0.2-50 | 0.2 | 1 | | No relaxation | | |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 100 | 0.5-500 | 0 | 30 | | 100 | | |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 23.01 | 0.2-450 | 0.2 | 45 | | No relaxation | | |
| 8 | Odour | APHA 23rd Edition, 2150 C | agreeable | Qualitative | Qualitative | agreeable | | agreeable | | |
| 9 | pH Value | IS 3025, Part 11 : 1983 RA 2019 Electrometric pH Value Method | 7.51 | 1.1-14 | 0.1 | 6.5-8.5 | | No relaxation | | |
| 10 | Sulphate, mg/l | APHA - 24th edition 4500 S - Turbidity Method | 230 | 0.02-400.0 | 10 | 200 | | 400 | | |
| 11 | Taste | APHA 24th edition 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | | agreeable | | |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max. | IS 3025, Part 23: 1986 RA 2019 Titration Method | 242 | 4.0-2000.0 | 4 | 200 | | 600 | | |
| 13 | Total Residual Solids mg/l | IS 3025, Part 15: 1984, RA 2019 Gravimetric method | 552 | 252-98000 | 27 | 500 | | 2000 | | |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21): 2009 EDTA Method | 710 | 4.0-2500.0 | 4 | 200 | | 600 | | |
| 15 | Turbidity, NTU | IS 3025 (Part 10):1984, RA 2017 Nephelometric Turbidimeter Method | 2.5 | 1.000 | 0.1 | 1 | | 5 | | |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,RA 2019, AAS Flame Method | 0.24 | 0.02 - 500 | 0.1 | 5 | | 15 | | |

***All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*1. Ground Water Sampling at Monitoring Station Code : - D30 , BORKIBOA VILLAGE*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Well No. | [illegible] | | | ULR No. | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: gmenv.bcclhf@coalindia.in] | | | | | Date of Issue | 19.09.2024 |
| Process | [illegible] | | Sample Ref. No. | [illegible] | Sampling Method | CMPDI/Bd-II/LFM-11/19-2023/Part-II | |
| Sampling Stations | [illegible] | Date of Sampling | | Sample Collected in 1 Lit. bottles. Color as observed in transparent | | | |
| | | | Period of Analysis | | | Etc. | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | [illegible] | Range of Testing | LOD | Acceptable Limit (Max.)* | Permissible limit in the absence of Alternate Source (Max.) |
| 1 | Odour, Fluoro-ride | APHA, [illegible] edition, 2510 A, Spectrophotometric Diode-Wavelength Method, 2023 | 1 | [illegible] | 1 | 5 | 10 |
| 2 | Calcium, mg/l | IS 3025, (Part- 40): 1991 RA 2019 EDTA Titrimetric Method & 3025 B Method | 184 | [illegible] | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 4022(Part- 12):1986, RA 2019 Argentometric Method | 116 | [illegible] | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500D, Method | 0.76 | [illegible] | 0.1 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53), 2003, R. 2019, ASV Phase Method | <0.1 | [illegible] | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B, Calculation Method | 49 | [illegible] | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 B, Spectrophotometric Method | [illegible] | [illegible] | 0.1 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2017 Electrometric pH Value Method | 7.36 | [illegible] | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition 4500 S Turbidity Method | 144 | [illegible] | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max. | IS 3025, Part 23 :1986 R 2019 Titration Method | 332 | [illegible] | 4 | 200 | 600 |
| 13 | Total Residual Solids mg/l | IS 3025, Part 16: 1984, R 2019 Gravimetric method | 742 | [illegible] | 27 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21) 2009 EDTA Method | 540 | [illegible] | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025 (Part 10):1984, R 2019 Nephelometric Turbidimeter Method | 3.8 | [illegible] | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R 2019, ASV Phase Method | 0.1 | [illegible] | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

**Cost sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - D35* , PATHERDIH RAILWAY COLONY

*1.*

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dag/Well No. | 035 | | | UCR No. | |
| Contractor | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: gmenv.bcclho@rediffmail.com] | | | | | Date of Issue | 19.09.2024 |
| Project | Quality Conditions | | Sample Ref. No. | BCCL/ENV&CSD/2024/JUN/214-215/GW | Sampling Method | CMPDI/RI/ENV/2020/Part-II | |
| Sampling Stations | PATHERDIH RAILWAY COLONY | Date of Sampling | | Sample Collected as 2 Lit. borewater. Color as observed in transparent | | | |
| | | | Period of Analysis | | TO | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | | IS 10500: 2012 |
|---|---|---|---|---|---|---|---|
| | | | GW35 | Range Of Testing | UOM | Acceptable Limit (Max) | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour (Pure unit) | APHA, 24th edition 2120-C (spectrophotometric Single Wavelength Method) 2012 | 3 | 1-20(U) | U | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991, R-2019 EDTA Method | 116 | 12-480(U) | U | 75 | 200 |
| 3 | Chloride, mg/l | IS 3025(Part 32):1988, R-2019 , Argentometric Method | 136 | 2.6-728(U) | U | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.53 | 0.2-1.0(P) | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003 R : 2019, ASS Flame Method | <0.2 | 0.2-1.0 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg, B, Calculation Method | 79 | 0.6-73(P) | 0 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3- (penol)(photometric) Method | 30.35 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2017 Electrometric pH Meter Method | 7.64 | 1-14 | U | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA –C&S, edition, 4500 S-, Turbidity Method | 137 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (CaCO3) mg/l, Max | IS 3025, Part 23: 1986, R 2019 Titration Method | 304 | 4.0-2000.0 | 4 | 200 | 600 |
| 13 | Total Hardness (CaCO3) mg/l | IS 3025, Part 21: 1983 R 2019 Complexometric method | 772 | 20.0-3000.0 | 20 | 200 | 600 |
| 14 | Total Dissolved, mg/l | IS 3025, (Part 16): 2017 R2019 Method | 617 | 4.0-2000.0 | 4 | 200 | 2000 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R 2017 Nephelometric (Turbidimeter) Method | 2.5 | 1-400 | U | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R 2019, ASS Flame Method | <0.1 | 0.05-10.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise

**Grab sampling carried out for water samples. *LOL indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - D4 ,* JHARIA THANA
*1.*

**Date of Sampling at Station:** June 2024

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dag/Work No. | 04 | | | ULR No | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bcclho@sailbcl.in) | | | | | Date of Issue | 19.09.2024 |
| Project | Jharia Coalfield | | Sample Ref. No. | BCCL/ENV/LAB/24-25/ 24,25,26 | Sampling Method | CMPDI/BCCL/ENV/ 2020 (Part-1) | |
| Sampling Station | JHARIA THANA | Date of Sampling | | Sample Collected in 5 Ltr Jerrycans , Color as observed is transparent | | | |
| | | | Period of Analysis | | TAT | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | CW-04 | Range of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour, Hazen unit | APHA, 23rd edition, 2120 C, Spectrophotometric Single Wavelength Method, 2017 | 7 | 1-300.0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025 (Part 40): 1991 R-2019 (Titrimetric Method & EDTA Method) | 104 | 2.0-400.0 | 1 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025(Part 32):1988, R-2019 (Argentometric Method) | 98 | 2.0-2500.0 | 1 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 23rd Edition, 4500-F- Method | 0.71 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) :2003, R- 2019, ASS Plasma Method | 0.07 | 0.2-50 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 23RD edition, 3500-Mg, D, Calculation Method | 170 | 0.5-500 | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3- Spectrophotometric Method | 12.29 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 B | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R-2017 Electrometric pH Value Method | 7.34 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA –23rd edition, 4500 S - Turbidity Method | 289 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 23rd edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max. | IS 3025, Part 23 : 1986, R- 2019 Titration Method | 292 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984, R- 2017 Gravimetric method | 542 | 25.0-5000.0 | 25 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 R2019 Method | 392 | 4.0-2500.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2017 Nephelometric Turbidimeter Method | 3.5 | 1-400 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,R-2019, ASS Plasma Method | <0.1 | 0.1 – 10.0 | 0.1 | 5 | 15 |

***All values in mg/L unless specified otherwise.*

***Grab sampling carried out for water samples. *LOD: Indicates Lower Detection Limit & BDL indicates Below Detection Limit.*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - D41 ,* JOYRAMPUR
1.

**Date of Sampling at Station:** June 2024

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Reg/Work No | 941 | ULR No | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: pgoswami.bcclltd@coalindia.in] | | | Date of Receipt | 19.09.2024 | |
| Protocol | Starch Modified | Sample Ref. No. | BCCL/ENVIRONMENT/LAB/2024/1521/1 | Sampling Method | CMPDI/BCCL/EPM 11.1/E 2023 (Part-I) | |
| Sampling Station | JOYRAMPUR | Date of Sampling | | Sample Collected in 1 Lit Sterilized Tubes in Presence of Officials | | |
| | | | Period of Analysis | to | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | DWZ36 | Range Of Testing | Lim | Acceptable Limit (Max)* | Permissible Limit in the absence of Alternate Source (Max) |
| 1 | Colour (Hazen unit) | APHA, 24th edition, 2120-c Spectrophotometric Single Wavelength Method, 2017 | 1 | 1-100.0 | 1 | 5 | 15 |
| 2 | Chloride, mg/l | IS 3025, (Part 32): 1988, Reaffirmed 2019 Argentometric Method | 119 | 2.0-999.0 | 2 | 250 | 1000 |
| 3 | Chloride, mg/l | IS 3025(Part 32):1988, Reaffirmed 2019 Argentometric Method | 332 | 2.0-2500.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.71 | 0.1-2.00 | 0.1 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53): 2003, Reaffirmed 2019 | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 3500 edition, 3500-Mg B Calculation Method | 72 | 0.01-500 | 0.1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 0.84 | 0.5-450 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 24th Edition, 2150 B | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 Reaffirmed 2017 Electrometric pH Value Method | 7.12 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA, 24th edition, 4500 S Turbidity Method | 27 | 5.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity as CaCO3 mg/l (Max) | IS 3025, Part 23: 1986, Reaffirmed 2019 Titration Method | 245 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16: 1984, Reaffirmed 2017 Gravimetric method | 636 | 10.0-2000.0 | 10 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 429 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, Reaffirmed 2017 Nephelometric Turbidimeter Method | 2.7 | 1-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,Reaffirmed 2019 Atomic Method | <0.1 | 0.05-5.00 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

*Grab sampling carried out for water samples. *LOR indicates Lower Detection Limit & BDL indicates Below Detection Limit.*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - D49 ,* TISRA THANA

**Date of Sampling at Station:** June 2024

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Slag Well No | D49 | | | UER No | |
| Customer | Environment Department, Bhurkot Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: gmenv.bcclith.co@bccl.in] | | | | | Date of Issue | 19.09.2024 |
| Project | Bharat Coal Mield | | Sample Roll No | BCCL/BSMD/EQ/2024/21/536 | Sampling Method | CMPDI/BCCL/EPM-1/(25-2023)/Part-II | |
| Sampling Station | TISRA THANA | Date of Sampling | | Sample Collected in 2 Lit Jerrycan . Color as observed in transparent | | | |
| | | | | Period of Analysis | | to | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | LOR** | Range Of Testing | LDL | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour (Hazen unit) | APHA, 24th edition, 2310 (b), Spectrophotometric Single Wavelength Method | 1 | 1 TO 5 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | EDTA titrati on Method | 1.0 | 23 TO 80 | 1 | 75 | 200 |
| 3 | Chloride, mg/l | Argentometric Method | 10 | 23 TO 84 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th, Edition, SPADNS Method | 0.01 | 0.12 TO 0.34 | 0.12 | 1 | 1.5 |
| 5 | Iron, mg/l | Method | 0.1 | 0.2 TO 0.5 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg, B, Calculation Method | 1.0 | 6.0 TO 22 | 6 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 B, Spectrophotometric Method | 0.120 | 0.5 TO 2.8 | 0.2 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition 2150 B | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | Method | 0.01 | 7.19 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA 24th edition, 4500 S Turbidity Method | 2.00 | 10.0 TO 40.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 12 | Total Alkalinity (Caco3 mg/l) as | Method | 2.00 | 4.0 TO 16.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids mg/l | Gravimetric method | 7.00 | 21.0 TO 84.0 | 21 | 500 | 2000 |
| 14 | Total Hardness mg/l | Method | 4.00 | 4.0 TO 16.0 | 4 | 200 | 600 |
| 15 | Turbidity NTU | Nephelometric (Turbidimeter) Method | 0.1 | 0.4 TO 1.6 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | Method | 0.01 | 0.12 – 0.14 | 0.1 | 5 | 15 |

***All results in mg/l unless specified otherwise.

**Limit quantifying concentration for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Level.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - D5,* JIYALGORA (NEAR P.O.)

**Date of Sampling at Station: June 2024**

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No. | D5 | ULB No. | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: gkpatro.bcclhq@sailbcclhq.in] | | | Date of Issue | 19.09.2024 |
| Protocol | Bureau Cred Mehdi | Sample Ref. No. | BCCL/ENVIRONMENT/24-25/D5 | Sampling Method | CMPDI/BCCL/EPM 13.2/D 5025 Part-01 |
| Sampling Standard | (IS 5612:1984 (RA 2019)) | Date of Sampling | | Sample Collected in 1 Liter borosilicate / Cubitz as discussed in management | |
| | | | Period of Analysis | | Etc. |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | As per IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | CW 28 | Range Of Tolerance | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour, Hazen units | APHA, 23RD edition 2120-c Spectrophotometric Single Wavelength Method 2017) | 2 | 1-30(c) | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 R 2019/ASTM Flame Method & EDTA Method | 170 | 2.5-200.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025/Part 32):1988, R 2019 Argentometric Method | 90 | 2.5-1000.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.07 | 0.1-2.00 | 0.1 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53): 2003 R : 2019 SPECTROSCOPIC Method | <0.2 | 0.2-10 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg, B Calculation Method | <1 | 1.0-150 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3-Spectrophotometric Method | 11.64 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 R 2019 Electrometric pH Meter Method | 7.12 | 2-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA –23rd, edition, 4500 S Turbidity Method | 110 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l), Max. | IS 3025, (Part 23): 1986, R 2019 Titration Method | 240 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Hardness (as CaCO3 mg/l) | IS 3025, Part 21: 1983 R 2019 Complexometric method | 720 | 25.0-3000.0 | 25 | 300 | 1000 |
| 14 | Total Hardness mg/l | IS 3025, (Part 21): 2009 EDTA Method | 580 | 4.0-1000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R 2017 Nephelometric Turbidimeter Method | 2.9 | 1-400 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025/Part 49) : 1994(R 2014) AAS Flame Method | <0.1 | 0.05 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lowest Detection Limit & BDL indicates Below Detection Limit*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - D59,* SITALPUR

**Date of Sampling at Station:** June 2024

| Month & Year | June 2024 | Dug Well No. | D59 | | | GLP No. | |
|---|---|---|---|---|---|---|---|
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: gmenv.bcclho@yahoo.in] | | | | | Date of Issue | 19.09.2024 |
| Project | Water Analysis | | Sample Ref. No. | BCB/HYD/GEOL/D59/24-25/GW/ | Sampling Method | CMPDI/BCB/LAB/1120.3625/Part-II | |
| Sampling Station | SITALPUR | Date of Sampling | | Sample Collected in 2 Lit Jerrycan. Color as observed in Investigation | | | |
| | | | Period of Analysis | | | to | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | | As per IS 10500: 2012 |
|---|---|---|---|---|---|---|---|
| | | | CW29 | Range Of Testing | LOQ | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max)* |
| 1 | Colour, Hazen unit | APHA, 24th edition, 2120-C (Spectrophotometric Single Wavelength Method) 2017 | 2 | 1.0000 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 R:2019 (Titrimetric Method & EDTA Method) | 116 | 12.0000 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025(Part 32):1988; R:2019 , Argentometric Method | 112 | 2.0-1500.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.61 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003 R : 2019 Atomic Absorption Method | 0.12 | 0.1-1.0 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 51 | 4.0-150 | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3- Spectrophotometric Method | 22.61 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 24th Edition, 2150 B | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 R 2017 (Electrometric pH Value) Method | 7.60 | 2-16 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA –24th edition 4500 S2- Turbidity Method | 2.54 | 0.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA,24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total alkalinity as CaCO3 mg/l Max | IS 3025, Part 23: 1986 R 2019 Titration Method | 100 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16: 1984 R 2017 Gravimetric method | 615 | 20.0-2000.0 | 20 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21): 2009 EDTA Method | 320 | 4.0-1000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025 (Part 10):1984, R:2017 Nephelometric/Turbidimetric Method | 1.77 | 1.0-80 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R:2019 AAS (Flame Method) | 0.1 | 0.05-5.00 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

**Grab sampling carried out for water samples. *LOQ indicates Lower Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - D70* JALADIH

**Date of Sampling at Station: June 2024**

| Month & Year | June 2024 | Stg Well No | D70 | CCR No | |
|---|---|---|---|---|---|
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | Date of Issue | 19.09.2024 |
| Project | Jharia Coalfield | Sample Ref. No | BCCL/ENVIRONMENT/24-25/GW/ | Sampling Method | CMPDI/IS:3025 (Part-1) |
| Sampling System | Grab | Date of Sampling | | | |
| | | Period of Analysis | | to | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | As per Table: 2312 | |
|---|---|---|---|---|---|---|---|
| | | | CW-D1 | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour, Hazen unit | APHA, 24th edition, 2120 C+ Spectrophotometric Single Wavelength Method, 2023 | 1 | 1 (Colo) | 1 | 5 | 25 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 2022 RA 2017 (Edta Method & 3025 Method | Nil | 2.0-400.0 | 1 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025(Part 32):1988 RA 2019+, Argentometric Method | 112 | 2.0-1000.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(B) Method | 0.64 | 0.2-1.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003 RA : 2019 ; ASV Flame Method | 0.11 | 0.2-10 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 115 | 6.0-100 | 6 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 10.50 | 0.2-45.0 | 0.2 | 45 | No relaxation |
| 8 | Odour | APHA 24th Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 RA 2017 Electrometric pH Value Method | 7.41 | 2-16 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA – 24th edition 4500 S Turbidity Method | 111 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160 C | Agreeable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (Conc.), mg/l Max | IS 3025, Part 23: 1986 RA 2019 Titration Method | 272 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16: 1984 RA 2021 Gravimetric method | 604 | 21.0-2000.0 | 20 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 RA Method | 472 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10)(1984, RA 2017 Nephelometric Turbidimetric Method | 2.1 | 1.000 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994 RA 2019, ASV Flame Method | 0.03 | 0.10 – 10.0 | 0.1 | 5 | 15 |

***All units in mg/l, unless specified otherwise.

**Grab sampling carried out for water samples. *LOD: Indicates Lower Detection Limit & BDL Indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - D72,* CHATI GOVINDPUR

**Date of Sampling at Station: June 2024**

| Month & Year | June 2024 | Dug/Bore No. | BTG | UGB No. | |
|---|---|---|---|---|---|
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: gkpatro.bcclltd@gmail.com] | | | Date of Issue | 19.09.2024 |
| Preserv | Nitric Acid/Add | Sample Roll No. | BCB/BTG/BOKARO/CGWB/24-25/GW/ | Sampling Method | CMPSH/BCB/LAPM 13.2/E 3825 Part-II |
| Sampling Starting | CHATI GOVINDPUR | Date of Sampling | | Sample Collected as it is (enclosed, Cooler as delivered to Investigator) | |
| | | | Period of Analysis | to | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | ICMOD | Range Of Tuning | LOD | Acceptable Limit (Max) | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour, Hazen units | APHA, 23RD edition 2120-c Spectrophotometric Single Wavelength Method 2017) | 2 | 1-200.0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 R 2019/ASTM Flame Method & EDTA Method | 172 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025/Part 32):1988, R 2019 Argentometric Method | 70 | 2.0-2000.0 | 2 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.74 | 0.1-2.00 | 0.1 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53): 2003, R : 2019 Colorimetric Method | <0.2 | 0.2-10 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg, B Calculation Method | 58 | 1.0-100 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3-B Spectrophotometric Method | 20.13 | 0.2-45.0 | 0.2 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 R 2017 Electrometric pH Value Method | 7.58 | 2-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA –23rd edition, 4500 S Turbidity Method | 170 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l), Max. | IS 3025, (Part 23): 1986, R 2019 Titration Method | 270 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Hardness (as CaCO3 mg/l) | IS 3025, Part 21: 1983 R 2019 Complexometric method | 766 | 20.0-3000.0 | 20 | 200 | 1000 |
| 14 | Total Hardness mg/l | IS 3025, (Part 21): 2009 EDTA Method | 604 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R 2017 Nephelometric Turbidimeter Method | 2.5 | 1-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025/Part 49 : 1994(R 2014) AAS Flame Method | <0.1 | 0.05 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lowest Detection Limit & BDL indicates Below Detection Limit.

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - D80* DHANSAR MINE RESCUE STATION

**Date of Sampling at Station: June 2024**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Pkg/Well No. | D80 | | | ULR No | |
| Customer | Correspond Department, Bharat Coking Coal Limited (BCCL), Katrie Bhawan, Dhanbad (Jharkhand) | | | | | Date of Issue | 01.07.2024 |
| Project | Quarterly Compliance | | Sample Roll No. | No.GE/RI/EMOE/EIA/D/1/24-25/EW/ | Sampling Method | CWPT&TI/EC-II/EPM-II/(D-30)/2023/Part-II | |
| Sampling Address | DHANSAR MINE RESCUE STATION | Date of Sampling | | Sample Collected in 5 Ltr Jerrycan , Color as observed in transparent | | | |
| | | | Period of Analysis | | Lot | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW1Y | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour, Hazen unit | APHA, 24th, edition ,2023,4500-Spectrophotometric Single Wavelength Method ,2023 | 3 | 1-300 | 1 | 5 | 15 |
| 2 | Cyanide, mg/l | IS 3025 (Part 65) 2021/ ISO 20595:2018 Flow Method & 4500 Method | 116 | 2.6-800.0 | 1 | 70 | 200 |
| 3 | Chloride, mg/l | IS 3025(Part 32):1988, R-2019 , Argentometric Method | 130 | 2.0-2500.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500D Method | 0.52 | 0.12-2.00 | 0.12 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) ,2003 & 2019 , AAS Flame Method | <0.1 | 0.2-50 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 47 | 4.0-100 | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-Spectrophotometric Method | 23.80 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA,23rd Edition ,(2017) | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 , 1983 & 2022 Electrometric pH Meter Method | 7.2a | 2.1a | 0.2 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA ,-24th edition, 4500 S Turbidity Method | 2.21 | 10.0-400.0 | 5a | 200 | 400 |
| 11 | Taste | APHA,24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Hardness (CaCO3), mg/l, Max | IS 3025, Part 21 ,1986 & 2019, Titration Method | 378 | 4.0-2000.0 | 4 | 200 | 600 |
| 13 | Total Residual Solids, mg/l | IS 3025, Part 15, 1984 & 2023 Gravimetric method | 760 | 20.0-5000.0 | 20 | 500 | 2000 |
| 14 | Total Alkalinity, mg/l | IS 3025, (Part 23) 2019 EDTA Method | 246 | 4.0-1000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10) 1984, R-2023 Nephelometric Turbidimeter Method | 2.2 | 1-400 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) 1994,R-2019, AAS Flame Method | 0.19 | 0.10 - 5.00 | 0.1 | 5 | 15 |

***All results in mg/l unless specified otherwise.*

***Grab sampling carried out for water samples. *LOD- Indicates Lower Detectable Limit & BDL indicates Below Detection Limit.*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - D96* BANSHRA

**Date of Sampling at Station:** June 2024

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dag/Well No | [illegible] | | | GSR No | |
| Customer | [illegible] | | | | | Date of Issue | 19.09.2024 |
| Project | [illegible] | | Sample Ref. No. | [illegible] | Sampling Method | CWPRS/IR/E/LPW/1128/2023/Part-II | |
| Sampling Stations | [illegible] | Date of Sampling | | Sample Collected in 5 Ltr borrowser, Color as observed is transparent | | | |
| | | | Period of Analysis | | | Lot | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternative Source (Max)* |
|---|---|---|---|---|---|---|---|
| | | | [illegible] | Range Of Testing | LOD | | |
| 1 | Color (Pure water) | APHA, 24th edition, 2120-C, Spectrophotometric Single Wavelength Method, 2023 | 3 | 1-150cu | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 & 2018 EDTA Titrimetric Method & 2018 Method | 220 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025(Part 32) (1988): R-2019 , Argentometric Method | 94 | 10.0-1000.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, SPADNS Method | 0.75 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) (2003): R - 2014 , ASV Plasma Method | <0.1 | 0.2-10 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 50 | 4.0-150 | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 B Spectrophotometric Method | 17.68 | 4.5-45.0 | 4.5 | 45 | No relaxation |
| 8 | Nitrite | APHA 23rd Edition, 4500-I | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 R 2022 Electrometric pH Meter Method | 7.60 | 1.2A | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA - 4500, edition 4500 S Turbidity Method | 187 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l, Max | IS 3025, Part 23, 1986 R 2019, Titration Method | 232 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984 R 2017 Gravimetric method | 432 | 25.0-5000.0 | 25 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 550 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2017 Nephelometric Turbidimeter Method | 0.6 | 1-400 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,R-2019, ASV Plasma Method | <0.1 | 0.10 – 10.0 | 0.1 | 5 | 15 |

****All units in mg/l unless specified otherwise.*

**Grab sampling carried out for water samples. **LOD: Indicates Lower Detection Limit & BDL indicates Below Detection Limit.*

## PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES

*(Wherever not specified, characteristics are expressed in mg/l, maximum)*

*Ground Water Sampling at Monitoring Station Code : - DB2A*

**Date of Sampling at Station: June 2024**

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

GROUND WATER ANALYSIS TEST REPORT

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | DW 2A | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: ...) | | | Date of Issue | 30.06.2024 |
| Project | Bongaru Coalfield | Sample Ref. No. | BCE/MDB/BGR/ENVLOG/2024/[illegible] | Sampling Method | CMPDI/BCE/EMP/ENVLOG/2024/Part-II |
| Sampling Stations | Jharkhanpur Village | Date of Sampling | | Sample Collected in 1 Ltr Jerrycan - Color as observed is transparent | |
| | | | Period of Analysis | | TO |

| Sl. No. | Parameters | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | DW2A | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour, Hazen unit | APHA, 24th edition, 2120 C, Spectrophotometric Single Wavelength Method, 2023 | 5 | 5 (MDL) | 5 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 2021 RA 2017/APHA Edition Method & EDTA Method | 96 | 2.4-300.0 | 1 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025/Part 32 (1988): RA 2019 - Argentometric Method | 84 | 2.4-1500.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.61 | 0.2-1.2 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53): 2003, RA 2019 - ASV Flame Method | <0.2 | 0.2-50 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg, B- Calculation Method | 96 | 1.0-150 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 B- Spectrophotometric Method | 28.31 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 B | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 RA 2017 Electrometric pH Meter Method | 7.74 | 2-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA – 24th edition, 4500 S-2 - Turbidity Method | 102 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23: 1986, RA 2019 Titration Method | 240 | 4.0-1500.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16: 1984 RA 2021 Gravimetric method | 562 | 25.0-5000.0 | 10 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21): 2009 RA2019 Method | 630 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10)/1984, RA 2017 Nephelometric/Turbidimeter Method | 1.6 | 1-400 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025/Part 49) - 1994/RA 2019, AAS Flame Method | <0.1 | 0.10 – 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise

**Grab sampling carried out for water samples, *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit

[Amit Raj Mishra]

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

## GROUND WATER ANALYSIS TEST REPORT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | DW-14 | | | | |
| Customer | Environment Department, Mineral Mining Unit Limited (MMUL), Mishra Bhawan, Dhanbad (E. mail: [illegible]) | | | | | Date of Dispatch | 30.06.2024 |
| Project | Bangwar Coalfield | | Sample Ref. No. | RI/EIR[illegible]/JUL/24-25/439 | Sampling Method | CMPDI/RI-II/LEM/13/2015(Part-1) | |
| Sampling Stations | Jaiswaspur Village | Date of Sampling | | Sample Collected as it is (primitive, Color as observed in investigation) | | | |
| | | | Period of Analysis | | | Till | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | AW-14 | Range Of Testing | Unit | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/l, Max | APHA, 24th edition, Carmine | <0.1 | 0.1-0.6 | 0.1 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/l, Max | IS 3025 Part 42 : 1992 R : 2019, Amd-2(Jan) APHA, 24th edition, 3111 B | <0.01 | 0.01-0.03 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA, 23rd Edition, 4500-Cl- B (Iodometric Method-I) | <0.04 | 0.04-0 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max | IS 3025(Part-47): 1994 (Reaffirmed 2019) APHA, 24th edition, 3500-[illegible] | <0.001 | 0.001-0.0 | 0.001 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as [illegible]), mg/l, Max | APHA, 24th Edition 5-Amino Antipyrine | <0.001 | 0.001-0.0 | 0.001 | 0.001 | 0.002 |
| 6 | Selenium, mg/l, Max | APHA 24th edition 3113B,also No 3500-Se D 2015), 3500-[illegible] | <0.001 | 0.001-0.0 | 0.001 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max | IS 3025 part 37 1988 R 2017) APHA 24th edition 3500-[illegible] | <0.001 | 0.001-0.0 | 0.001 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/l, Max | IS 3025 Part 52 2003 R 2019 Amd-1 Aug 2021 Amd-2 Jan 2023 Amd-3 Aug 2023 Amd-4 Jan 2024 Amd-5 Aug 2024 Amd-6 Jan 2025 Amd-7 Aug 2025 Amd-8 Jan 2026 Amd-9 Aug 2026 Amd-10 Jan 2027 Amd-11 Aug 2027 Amd-12 Jan 2028 Amd-13 Aug 2028

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II

# GROUND WATER ANALYSIS TEST REPORT

(CMPDI, R-I)
KOYLA BHAWAN COMPLEX
DHANBAD - 826001
Phone:0326-229 850
email: rilcmpdi@coalindia.in

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | GW-4 | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E. mail: gmenv.bcclhq@coalindia.in) | | | Date of Issue | 28/06/2024 |
| Project | Baragarh Coalfield | Sample Ref. No. | BCCL/ENV/RIDC&EIA/GWA/24-25/538 | Sampling Method | CMPDI/RI-II/EPM 11(3)-2025/Part-11 |
| Sampling Distance | Surface | Date of Sampling | | Sample Collected in 1 Lit. bottle, Color as observed in transparent | |
| | | | Period of Analysis | | TO |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-17 | Range Of Testing | LOD | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max.) |
| 1 | Colour, Hazen unit | APHA, 24th, edition, 2550-A, Spectrophotometric Single Wavelength Method, 2023 | 1 | 1-15Hz-0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1992 R-2014,EDTA Titrimetric Method & APHA Method | 116 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, R-2019 Argentometric Method | 70 | 2.0-1500.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, SPADNS Method | 0.65 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) :2003, R - 2019, ASS Flame Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B, Calculation Method | 35 | 0.5-150 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, UV-Spectrophotometric Method | 00.19 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2017 Electrometric pH Value Method | 7.36 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S Turbidity Method | 95 | 0.5-400.0 | 50 | 200 | 400 |
| 11 | Taste | APHA,24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23, 1986 R 2014 Titration Method | 267 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984 R 2017 Gravimetric method | 974 | 10.0-5000.0 | 10 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 600 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2017 Nephelometric Turbidimeter Method | 1.9 | 1-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R-2019, ASS Flame Method | <0.1 | 0.10-10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

(Kumar Vaibhav)
**REVIEWED BY**

(Amit Rai Mishra)
**Authorised Signatory**

**ANALYSED BY**

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env.), CMPDI, RI-II.



--- End of Report ---

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

## GROUND WATER ANALYSIS TEST REPORT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | MW-4 | | | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (Jharkhand) | | | | | Date of Dispatch | 08.08.2024 |
| Project | Bangwar Coalfield | | Sample Ref. No. | BCCL/ENVT/RI-II/2024-25/GW | Sampling Method | CMPDI/BCCL/EPM 11.2/0.2022/Part-2.1 | |
| Sampling Distance | Surface | Date of Sampling | | Sample collected on 5 Liter Jerrycan, Color as observed in transparent | | | |
| | | | Period of Analysis | | To | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-1* | Range in Testing | Unit | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Arsenic (as As), mg/l, Max | APHA, 24th edition, Cl.3500 | <0.2 | 0.2-BDL | 0.2 | 0.05 | 0.1 |
| 2 | Copper (as Cu), mg/l, Max | IS 3025 Part 42 : 1992 R : 2019, ASTM D4190-19a, APHA, 24th edition, 3111 (D) | <0.01 | BDL-BDL | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA, 23rd Edition, 4500-Cl-B (Iodometric Method) | <0.04 | 0.04-0.3 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max | IS 3025(Part-47): 1994 (Reaffirmed 2017), APHA, 24th edition, 3111-C/3-B | <0.005 | BDL-ND | 0.005 | 0.01 | No relaxation |
| 5 | Fluoride, manganese (as Mn), mg/l, Max | EPA, 1983, Volume-II, Annex-Antigenite | <0.001 | BDL-ND | 0.001 | 0.001 | 0.001 |
| 6 | Selenium, mg/l, Max | APHA 24th edition (23rd Edition) Sec 3500, B, 2015 (c), 4500-Se D | <0.007 | BDL-ND | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max | IS 3025,part 37 1988, R-2019 APHA 24th edition 4500-Cl-D | <0.006 | 0.006-ND | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/l, Max | IS 3025 Part 52 2003 R:2019 APHA 24th edition 4500-CrB | <0.01 | BDL-BDL | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/l, Max | IS 3025 Part 54 : 2003 R : 2019, APHA 24th edition, 3111 (D) | <0.005 | 0.005-ND | 0.005 | 0.05 | No relaxation |
| 10 | Manganese as Mn, mg/l, Max | APHA, 24th Edition (2023 Addition) 3114 Method | <0.02 | BDL-BDL | 0.02 | 0.1 | 0.3 |

***All units in mg/l unless specified otherwise

**Grab sampling carried out for water samples. *GW indicates Ground Water Level & BDL indicates Below Detection Level

[Kumar Vaibhav]

**ANALYSED BY** **REVIEWED BY**

[Amit Rai Mishra]

**Authorised Signatory**

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.



End of Report

CMPDI, R-II
KOYLA BHAWAN COMPLEX
DHANBAD - 826001
Phone:0326-220 000
email: rd2@cmpdi.co.in

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

## Environment Laboratory, Regional Institute-II

## GROUND WATER ANALYSIS TEST REPORT

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | GW-8 | | |
| Customer | Environment Management, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (Jharkhand) | | | Date of Issue | 28/06/2024 |
| Project | Bansgarh Coalfield | Sample Ref. No. | RI-II/ENVIRO/GW/2024/25,526 | Sampling Method | CMPDI/RI-II/EPM/1129/2025/Part-II |
| Sampling Stations | Chiragora | Date of Sampling | | Sample Collected in 2 Lit Jerrycans , Color as observed in Unpreserved | |
| | | | Period of Analysis | TO | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-08 | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour (Hazen unit) | APHA, 24th edition, 2310 (Spectrophotometric Single Wavelength) Method 2015 | 2 | 1-300 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991, R-2019 EDTA Method | 92 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025(Part 32):1988, R-2019 Argentometric Method | 36 | 2.5-2500 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA 24th Edition, 4500-F Method | 0.60 | 0.2-1.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53): 2003, R - 2019 ASS Phen Method | <0.1 | 0.2-50 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 40 | 0.6-700 | 0 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3- Spectrophotometric Method | 2.60 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 R 2021 Electrometric pH Value Method | 8.01 | 2-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA - 24th edition, 4500-S2- Turbidity Method | 44 | 5.0-400.0 | 5.0 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3), mg/l | IS 3025, Part 23: 1986, R 2019 Titration Method | 170 | 4.0-2000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16: 1984 & 2023 Gravimetric method | 239 | 10.0-2000.0 | 10 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 420 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2023 Nephelometric (Turbidimeter) Method | 2.7 | 1-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,R 2019, ASS Phen Method | <0.1 | 0.05 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise

**Grab sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit

(Kumar Vaibhav)

(Amit Rai Mishra)

**ANALYSED BY** **REVIEWED BY** **Authorised Signatory**

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.



---- End of Report ----

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | DW-X | | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (Jharkhand) | | | | Date of Dispatch | 30.06.2024 |
| Project | Bangwar Coal Block | Sample Ref. No. | BCCL/ENVT/CMPDI/RI-II/2024-25/GW | Sampling Method | CMPDI/BCCL/EPM-11/29-2022/Part-II | |
| Sampling Station | Chunapur | Date of Sampling | | Sample Collected on 11th September, Color as observed in transparent | | |
| | | | Period of Analysis | | TC | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | Value | Range in Testing | Unit | Acceptable Limit (Max.) | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/L Max | APHA 24th edition, Carmine | <0.2 | 0.2-0.6 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/L Max | IS 3025 Part 42 : 1992 R : 2019, Edition 2.1 APHA, 24th edition, 3500-Cu B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/L Min | APHA, 23rd Edition, 4500-Cl-B (Iodometric Method I) | <0.04 | 0.06-0.3 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/L Max | IS 3025(Part 47): 1994 (Reaffirmed 2019), APHA, 24th edition, 3500-Cl B | <0.005 | 0.005-0.01 | 0.005 | 0.01 | No relaxation |
| 5 | Fluoride, manganese (as Cr(VI)(Cr)), mg/L Max | APHA, 24th Edition 4-Amino Antipyrine | <0.001 | 0.001-0.01 | 0.001 | 0.002 | 0.002 |
| 6 | Selenium, mg/L Max | APHA 24th edition IS 3025,part 56:2003 & 2015, 3500-Se B | <0.007 | 0.007-0.01 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/L Max | IS 3025,part 37 1988 & 2015, APHA 24th edition 3500-As B | <0.006 | 0.006-0.01 | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/L Max | IS 3025 Part 52 2003, R:2019 LASO Plume APHA, 24th edition, 3500-Cr B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/L Max | IS 3025 Part 54 : 2003 R : 2019, Edition APHA, 24th edition, 3500-Ni B | <0.005 | 0.005-0.01 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/L Max | APHA, 24th Edition 2023, 3500-Mn B Method | <0.02 | 0.02-0.03 | 0.02 | 0.1 | 0.1 |

***All Units in mg/L unless specified otherwise

**Grab sampling carried out for water samples. *LDL-Indicates Lower Detection Level & HDL-Indicates Higher Detection Level

[redacted]
[Kumar Vaibhav]
**REVIEWED BY**

[redacted]
[Amit Rai Mishra]
**Authorised Signatory**

**ANALYSED BY**

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | GW-19 | | |
| Customer | Environment Programmer, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E. Govt. sector, Jharkhand) | | | Date of Issue | 28/06/2024 |
| Project | Baragarh Coalfield | Sample Ref. No. | BCK/ENVIRO/GW/2024/25/538 | Sampling Method | CMPDI/RI-II/EPM 11(2)/2023/Part-II |
| Sampling Distance | Kathi | Date of Sampling | | Sample Collected in 1 Lit. bottle, Color as observed in transparent | |
| | | | Period of Analysis | | 1Hr |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-19 | Range Of Testing | LOD | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max.) |
| 1 | Colour (Hazen unit) | APHA, 24th, edition, 2550-A, Spectrophotometric Single Wavelength Method 2023 | 0 | 1-15Hz-0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1992 R-2014,EDTA Titrimetric Method | 74 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, R-2019 Argentometric Method | 40 | 2.0-1500.0 | 1 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.14 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) :2003, R - 2019, ASS Flame Method | 0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 24 | 0.5-150 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-Spectrophotometric Method | 27.20 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2017 Electrometric pH Value Method | 7.44 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S Turbidity Method | 114 | 0.5-400.0 | 50 | 200 | 400 |
| 11 | Taste | APHA,24th edition, 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23, 1986 R 2019 Titration Method | 172 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984 R 2023 Gravimetric method | 325 | 20.0-5000.0 | 20 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 290 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R 2017 Nephelometric Turbidimeter Method | 2.1 | 1-1000 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R 2019, ASS Flame Method | 0.14 | 0.10 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

(Kumar Vaibhav)
**REVIEWED BY**

(Amit Rai Mishra)
**Authorised Signatory**

**ANALYSED BY**

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env.), CMPDI, RI-II.



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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

## GROUND WATER ANALYSIS TEST REPORT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | DW-01 | | | | |
| Customer | Environment Department, Mineral Linking Unit Limited (MECL), Nuapa Bhawan, Dhanbad (P. Govt. Govt. Undertaking) | | | | | Date of Dispatch | 08.08.2024 |
| Project | Rampur Coal Mine | | Sample Ref. No. | RI/ENVIRON/GW/24-25/036 | Sampling Method | CMPDI/RI-II/LPM 11/19-2021/Part-II | |
| Sampling Thickness | Open | Date of Sampling | | Sample Collected on 11th September, Color as observed in transparent | | | |
| | | | Period of Analysis | | To | | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | Value | Range in Testing | Unit | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/L Max | APHA 24th edition, Carmine | <0.2 | 0.2-0.6 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/L Max | IS 3025 Part 42 : 1992 R : 2019, Cl 9.1 and APHA 24th edition, 3500-Cu B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/L Min | APHA 23rd Edition, 4500-Cl-B (Iodometric Method I) | <0.04 | 0.04-0.3 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/L Max | IS 3025(Part 47): 1994 (Reaffirmed 2019), APHA 24th edition, 3111-C/3-B | <0.005 | 0.005-0.01 | 0.005 | 0.01 | No relaxation |
| 5 | Fluoride, manganese (as (MnO4)), mg/L Max | EPA, 1983, Edition-II, Annex Antigenite | <0.001 | 0.001-0.01 | 0.001 | 0.001 | 0.001 |
| 6 | Selenium, mg/L Max | APHA 24th edition IS 3025,part 56:2003 & 2015, 3500-Se B | <0.007 | 0.007-0.01 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/L Max | IS 3025,part 37:1988 & 2015, APHA 24th edition 3500-As B | <0.006 | 0.006-0.01 | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/L Max | IS 3025 Part 52:2003, R:2019,EPA-218.1,Para APHA 24th edition, 3500-Cr B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/L Max | IS 3025 Part 54 : 2003 R : 2019, Cl 9.1 and APHA 24th edition, 3111-C/3-B | <0.005 | 0.005-0.01 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese (as Mn), mg/L Max | IS 3025(Part 59) : 2006,R:2019, 3111-B,Para Nitrous | <0.02 | 0.02-0.03 | 0.02 | 0.1 | 0.1 |

***All Limits in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LOL-Indicates Lower Detection Level, & HDL-Indicates Higher Detection Level.

[redacted]

[Kumar Vaibhav]

**REVIEWED BY**

[redacted]

[Amit Rai Mishra]

**Authorised Signatory**

**ANALYSED BY**

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

# GROUND WATER ANALYSIS TEST REPORT

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | GW 11 | | |
| Customer | Environment Department, Mineral Linking Unit Limited (MLU), Kusla Bhawan, Dhanbad (E. mail: [redacted]) | | | Date of Issue | 28/06/2024 |
| Project | Ramgarh Coalfield | Sample Ref. No. | RI-II/ENV/GW/11/2024-25/538 | Sampling Method | CMPDI/RI-II/EPM 11(2)/2025/Part-11 |
| Sampling Statement | Submitted | Date of Sampling | | Sample Collected in 1 Lit. bottle, Color as observed & transparent | |
| | | | Period of Analysis | | 11/ |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-11 | Range Of Testing | LOD | Acceptable Limit (Max.) | Permissible Limit in the Absence of Alternate Source (Max.) |
| 1 | Colour, Hazen unit | APHA, 24th, edition, 2310-A, Spectrophotometric Single Wavelength Method, 2023 | 3 | 1-70Hz-0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1992 R-2014,EDTA Titrimetric Method | 56 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025(Part 32):1988, R-2019 Argentometric Method | 45 | 2.0-2500.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, SPADNS Method | 0.50 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) :2003, R - 2019 , ASV Flame Method | 0.11 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B, Calculation Method | 31 | 0.5-150 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th, edition, 4500-NO3 Spectrophotometric Method | 24.99 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2017 Electrometric pH Value Method | 8.01 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th, edition, 4500 S Turbidity Method | 3.51 | 0.0-400.0 | 0.1 | 200 | 400 |
| 11 | Taste | APHA,24th edition, 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3), mg/l Max | IS 3025, Part 23, 1986 R 2014 Titration Method | 280 | 4.0-2000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984 R 2023 Gravimetric method | 285 | 10.0-5000.0 | 10 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 280 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2017 Nephelometric Turbidimeter Method | 2.5 | 1.0-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R-2019, ASV Flame Method | 0.10 | 0.10 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

[redacted]

(Kumar Vaibhav)

**REVIEWED BY**

[redacted]

(Amit Rai Mishra)

**Authorised Signatory**

***ANALYSED BY***

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

## Environment Laboratory, Regional Institute-II

## GROUND WATER ANALYSIS TEST REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | NR-11 | | | |
| Customer | Environment Department, Mineral Linking Unit Limited (MCCL), Kusta Dhanbad, Dhanbad (P. Govt. Sector Undertaking Co.) | | | | Date of Dispatch | 08.08.2024 |
| Project | Bangwar Coalfield | Sample Ref. No. | R/EDD/DCR/GW/24-25/036 | Sampling Method | CMPDI/BI-II/LPM 11/19:2023/Part-1) | |
| Sampling Statement | Subsurface | Date of Sampling | | Sample Collected on 11th September , Color as observed in transparent | | |
| | | | Period of Analysis | | To | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | Value | Range in Testing | Unit | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/l, Max | APHA 3500 edition, Carmine | <0.2 | 0.2-0.6 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/l, Max | IS 3025 Part 42 : 1992 R : 2019, ASTM Lane APHA, 24th edition, 3500-Cu B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA 23rd Edition, 4500-Cl-B (Iodometric Method I) | <0.04 | 0.04-0.3 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max | IS 3025(Part 47): 1994 (Reaffirmed 2019), APHA, 24th edition, 3500-Cl B | <0.005 | 0.005-0.0 | 0.005 | 0.01 | No relaxation |
| 5 | Fluoride, manganese (as (MnO4)), mg/l, Max | EPA, 24th Edition-A Annex Assignment | <0.001 | 0.001-0.0 | 0.001 | 0.001 | 0.001 |
| 6 | Selenium, mg/l, Max | APHA 24th edition IS 3025,part 56:2003, B 2019, 400 PQA | <0.007 | 0.007-0.0 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max | IS 3025,part 37 1988, B 2019, APHA 24th edition 400 PQA | <0.006 | 0.006-0.0 | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/l, Max | IS 3025 Part 52 2003, R:2019 LAQS Plume APHA, 24th edition, 400 CFA | <0.01 | 0.02-0.02 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/l, Max | IS 3025 Part 54 : 2003 R : 2019, ASTM Lane APHA, 24th edition, 400 CFA | <0.005 | 0.005-0.0 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese (as Mn, mg/l, Max | APHA, 24th Edition (2023 Add-, 3114 Method | 0.07 | 0.02-0.03 | 0.02 | 0.1 | 0.1 |

***All Limits in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LOQ: Indicates Lower Determination Level; & BDL: Indicates Below Detection Level.

[Kumar Vaibhav]
**REVIEWED BY**

[Amit Rai Mishra]
**Authorised Signatory**

***ANALYSED BY***

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

## GROUND WATER ANALYSIS TEST REPORT

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | DW 11 | | |
| Customer | Environment Department, Mineral Mining Cell Limited (MCCL), Noida Bhawan, Ghaziabad (U. Pradesh) | | | Date of Issue | 28/06/2024 |
| Project | Rampura Agucha | Sample Ref. No. | RI-II/ENV/GW/DW/2024-25/06 | Sampling Method | CMPDI/RI-II/EPM 11/29-2025/Part-11 |
| Sampling Engineer | Shankar Nayak | Date of Sampling | | Sample Collected in 1 Lit. bottle, Color as observed in transparent | |
| | | | Period of Analysis | | 11 |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW11 | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour (Hazen unit) | APHA 23rd edition 2120 C Spectrophotometric (High Wavelength) Method 2017 | 0 | 1 Digit | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 R:2014,Edt:3 (Reaff 2003) & EDTA Method | 30 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, R:2019 Argentometric Method | 40 | 2.0-2500.0 | 1 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 23rd Edition, SPADNS Method | 0.09 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003, R : 2019 , ASS Flame Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B (Calculation Method) | 10 | 0.5-700 | 0 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 23rd edition, UV-Spectrophotometric Method | 14.4 | 0.1-450 | 0.1 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 R 2017 (Electrometric) pH Meter) Method | 8.01 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S Turbidity Method | 106 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23, 1986, R 2014 Titration Method | 120 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Residual Solids mg/l | IS 3025, Part 15, 1984 R 2021 Gravimetric method | 320 | 20.0-5000.0 | 20 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 280 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R:2022 Nephelometric Turbidimeter Method | 2.6 | 1-1000 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R:2019, AAS Flame Method | 0.1 | 0.05 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

ANALYSED BY

(Kumar Vaibhav)
REVIEWED BY

(Amit Rai Mishra)
Authorised Signatory

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**Environment Laboratory, Regional Institute-II**

**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June (2024) | Dug/Bore No. | BW-11 | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: [redacted]) | | | Date of Issue | 08.08.2024 |
| Project | Barora Area | Sample Ref. No. | BCCL/ENVT/CMPDI/RI-II/LAB/2024-25/GW/01 | Sampling Method | CMPDI/BCCL/RI-II/LAB/2024-25/Part-II |
| Sampling Business | Dhanbad Main | Date of Sampling | 04.06.2024 | Sample Collected in 1 Ltr Borosilicate Glass Bottle | |
| | | | Period of Analysis | 05 | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW11 | Range of Testing | LOD | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/l, Max. | APHA, 24th edition / similar | <0.1 | 0.2-10 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/l, Max. | IS 3025 Part 42 : 2022 & : 2019, US Plants APHA, 24th edition, 4500-CU B | <0.01 | 0.01-10.0 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min. | APHA, Chlor. Orthoto., 4500-Cl-G (Colorimetric Method-I) | <0.10 | 0.10-5 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max. | IS 3025/Part 47/ 2008 (Reaffirmed 2019) APHA, 24th edition, 3500-PB B | <0.005 | 0.005-10 | 0.005 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as C6H5OH), mg/l, Max. | APHA, 24th Edition,5-530 Amino Antipyrine | <0.001 | 0.001-10 | 0.001 | 0.002 | 0.001 |
| 6 | Selenium, mg/l, Max. | APHA 24th edition IS 3025/Part 56/2003 & 2019 / ASS-TECH | <0.007 | 0.007-10 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max. | IS 3025/part 37/1988 & 2019 / APHA 24th edition 3500-TCB | <0.004 | 0.004-10 | 0.004 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/l, Max. | IS 3025 Part 52 2003 & 2019 ASS Plants APHA 24th edition, 3500-CR | <0.01 | 0.01-10.0 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni mg/l Max | IS 3025 Part 54 : 2003 & : 2019, US Plants APHA 24th edition, 3500-CR | <0.005 | 0.005-10 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/l, Max. | APHA, 24th Edition,3500-Mn-CPA Method | <0.01 | 0.01-10.0 | 0.01 | 0.1 | 0.3 |

***All units in mg/L unless specified otherwise

**Grab sampling carried out for water samples. *LOD indicates Lowest Detection Limit & BDL indicates Below Detection Limit

(Kumar Vaibhav)
**REVIEWED BY**

(Amrit Raj Mishra)
**Authorised Signatory**

**ANALYSED BY**

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*Page -2 of 2*

*---- End of Report ----*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | GW-10 | | |
| Customer | Environment Department, Mineral Linking Unit Limited (MLUL), Kusha Bhawan, Dhanbad (E. mail: [illegible]) | | | Date of Issue | 28/06/2024 |
| Project | MCF | Sample Ref. No. | RI-II/ENV/GW/2024/06/25,526 | Sampling Method | CMPDI/RI-II/ENV/1129/2025/Part-II |
| Sampling Distance | Lucknow | Date of Sampling | | Sample Collected in 1 Lit. bottle, Color as observed in transparent | |
| | | | Period of Analysis | | 1Hr |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW#1 | Range Of Testing | LOD | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max.) |
| 1 | Colour (Hazen unit) | APHA, 24th, edition, 2120-c, Spectrophotometric Single Wavelength Method, 2023 | 2 | 1-70Hz-0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1992 R-2014,EDTA Titrimetric Method | 42 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, R-2019 Argentometric Method | 24 | 2.0-2500.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.26 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) :2003, R : 2019, ASV Flame Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B, Calculation Method | 39 | 0.5-150 | 5 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 'UV-Spectrophotometric' Method | BDL | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 24th Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983, R 2017 Electrometric pH Value Method | 8.08 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S Turbidity Method | 14 | 0.5-400.0 | 0.5 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23, 1986, R 2019, Titration Method | 142 | 4.0-2000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984, R 2023 Gravimetric method | 440 | 20.0-5000.0 | 20 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 324 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R 2017 Nephelometric Turbidimeter Method | 1.9 | 1.0-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R 2019, ASV Flame Method | <0.1 | 0.10-10.0 | 0.1 | 5 | 15 |

***All units in mg/l unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

(Kumar Vaibhav)
**REVIEWED BY**

(Amit Rai Mishra)
**Authorised Signatory**

**ANALYSED BY**

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## Environment Laboratory, Regional Institute-II

## GROUND WATER ANALYSIS TEST REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | DW-10 | | | |
| Customer | Environment Department, Mineral Linking Unit Limited (MLUL), Noida Bhawan, Ghaziabad (U.P.) and [illegible] | | | | Date of Dispatch | 08.08.2024 |
| Project | EIA | Sample Ref. No. | EL/EIA/DGR/GW/24-25/439 | Sampling Method | CMPDI/EI-II/LPM-11/(3-2022)/Part-1) | |
| Sampling Distance | Lucknow | Date of Sampling | | Sample Collected on 3 Litre Borosilicate, Color as observed in transparent | | |
| | | | Period of Analysis | | to | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW(1) | Range (I) Testing | Unit | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/l, Max | APHA, 24th edition, Carmine | <0.2 | 0.2-0.6 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/l, Max | IS 3025 Part 42 : 1992 R : 2019, APHA 24th edition, 3111 B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA 23rd Edition, 4500-Cl- B (Iodometric Method) | <0.04 | 0.04-0.3 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max | IS 3025(Part 47): 1994 (Reaffirmed 2019), APHA, 24th edition, 3111 C | <0.005 | 0.005-0.0 | 0.005 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as $C_6H_5OH$), mg/l, Max | EPA, 1978 Volume II-Annex Antipyrine | <0.001 | 0.001-0.0 | 0.001 | 0.002 | 0.002 |
| 6 | Selenium, mg/l, Max | APHA 24th edition IS 3025,part 56:2003, B 2016, 3500-Se D | <0.007 | 0.007-0.0 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max | IS 3025,part 37:1988, B 2019, APHA 24th edition 3500-As D | <0.006 | 0.006-0.0 | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/l, Max | IS 3025 Part 52:2003, R:2019,EPA-Para APHA 24th edition, 3500-Cr B | <0.01 | 0.01-0.02 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/l, Max | IS 3025 Part 54 : 2003 R : 2019, APHA 24th edition, 3111 B | <0.005 | 0.005-0.0 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/l, Max | IS 3025, 24th Edition 2021, 3111 B Method | <0.02 | 0.02-0.03 | 0.02 | 0.1 | 0.3 |

***All units in mg/l unless specified otherwise

**Grab sampling carried out for water samples. *LDL-Indicates Lower Detection Level, & HDL-Indicates Higher Detection Level

[Illegible]

[Kumar Vaibhav]

**REVIEWED BY**

[Illegible]

[Amit Rai Mishra]

**Authorised Signatory**

***ANALYSED BY***

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.

CMPDI, R-II
KOYLA BHAWAN COMPLEX
DHANBAD, 826001
Phone 0326-210 456
email: rd1@cmpdi@coalindia.in

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

## Environment Laboratory, Regional Institute-II

## GROUND WATER ANALYSIS TEST REPORT

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | BH 26 | | |
| Customer | Environment Programmers, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (A unit of [illegible]) | | | Date of Issue | 28/06/2024 |
| Project | Bansgarh Coalfield | Sample Ref. No. | RI-II/ENV/GW/BH/065/24-25/538 | Sampling Method | CMPDI/RI-II/EPM 11(3)-2025/Part-11 |
| Sampling Distance | Lakhimpur | Date of Sampling | | Sample Collected in 1 Lit. bottle, Color as observed in transparent | |
| | | | Period of Analysis | | 1hr |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | 28/6/24 | Range Of Testing | LDL | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max.) |
| 1 | Colour (Hazen unit) | APHA, 24th, edition, 2550-c, Spectrophotometric Single Wavelength Method 2023 | 1 | 1-70Hz0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1992 R-2014,EDTA Titrimetric Method & APHA Method | 64 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, R-2019 Argentometric Method | 40 | 2.0-1500.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, SPADNS Method | 0.05 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) :2003, R : 2019 , ASV Flame Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B, Calculation Method | 20 | 0.5-150 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 29.34 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2017 Electrometric pH Value Method | 7.77 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S Turbidity Method | 2.40 | 0.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA,24th edition, 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23, 1986 R 2014 Titration Method | 370 | 4.0-2000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984 R 2023 Gravimetric method | 241 | 25.0-7000.0 | 25 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 220 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R 2017 Nephelometric Turbidimeter Method | 1.0 | 1.0-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R 2019, ASV Flame Method | <0.1 | 0.10 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.

[illegible]
(Kumar Vaibhav)
**REVIEWED BY**

[illegible]
(Amit Rai Mishra)
**Authorised Signatory**

**ANALYSED BY**

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

## GROUND WATER ANALYSIS TEST REPORT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | [illegible] | | | | |
| Customer | [illegible] | | | | | Date of Dispatch | 30.06.2024 |
| Project | [illegible] | Sample Ref. No. | [illegible] | | Sampling Method | CMPDI/RI-II/EPM 11.2/0.3025/Part-2.1 | |
| Sampling Stations | [illegible] | Date of Sampling | | Sample Collected on 5 Litre Jerrycan , Color as observed in transparent | | | |
| | | | Period of Analysis | | | to | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-01 | Range (If Testing) | Unit | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 3 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 4 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 5 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 7 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 8 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 9 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

***All units in mg/L unless specified otherwise

**Grab sampling carried out for water samples. *1.0 indicates Lower Detection Limit & ND indicates Below Detection Limit

[illegible]

[Kumar Vaibhav]

ANALYSED BY

REVIEWED BY

[illegible]

[Amit Rai Mishra]

Authorised Signatory

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II

# GROUND WATER ANALYSIS TEST REPORT

(CMPDI, R-I)
KOYLA BHAWAN COMPLEX
DHANBAD - 826001
Phone:0326-229 850
email: rilcmpdi@cmpdibe.in

| Month & Year | June 2024 | Dug Well No | BW 27 | | |
|---|---|---|---|---|---|
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E. mail: gmenv.bcclhq@coalindia.in) | | | Date of Issue | 28/06/2024 |
| Project | Baseline Monitoring | Sample Ref. No | BCCL/ENVIRON/CMPDI/2024-25/538 | Sampling Method | CMPDI/RI-II/EPM 11(3)-2025/Part-11 |
| Sampling Station | Bhatia | Date of Sampling | | Sample Collected in 5 Lit Jerrycan, Color as observed in transparent | |
| | | | Period of Analysis | | to |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | DWell | Range Of Testing | LDL | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour, Hazen unit | APHA, 23rd, edition, 2120-A, Spectrophotometric Single Wavelength Method 2017 | 2 | 1-70Hzn | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 R-2019,EDTA Titrimetric Method & APHA Method | 54 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988] R-2019 , Argentometric Method | 64 | 2.0-2500.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.56 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS:3025 (Part 53) :2003 R - 2019 , ASS Flame Method | <0.1 | 0.2-10 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition 3500-Mg B, Calculation Method | 45 | 1.0-750 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, UV Spectrophotometric Method | 3.10 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2019 Electrometric pH Value Method | 7.56 | 2-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S , Turbidite Method | 50 | 5.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA,24th edition,2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23: 1986 R 2019 Titration Method | 226 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Hardness (as CaCO3 mg/l | IS 3025, Part 21: 1983 R 2019 Complexometric method | 428 | 20.0-2000.0 | 20 | 300 | 1000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 R2019 Method | 426 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2023 Nephelometric Turbidimeter Method | 2.9 | 1-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,R-2019, ASS Flame Method | <0.1 | 0.05 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise

*Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit

(Kanhaiya Vaishnav)
**REVIEWED BY**

(Amit Raj Mishra)
**Authorised Signatory**

**ANALYSED BY**

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Environment Laboratory, Regional Institute-II

## GROUND WATER ANALYSIS TEST REPORT

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June (2024) | Drg/Work No. | WB 27 | | |
| Customer | Environment Department, Bhurkunda Colliery (BCCL), Bagdu Bhawan, Dhanbad (E-mail: ghosesr.hq@bcclindia.co.in) | | | Date of Issue | 08.08.2024 |
| Project | Bansgarai Coalfield | Sample Ref. No. | BY-R/EPD/BCK/2024/JUNE/2/24-25 ASW | Sampling Method | CMPDI/RI-II/EPM-11/(Dt 2023/Part - 1) |
| Sampling Business | Public | Date of Sampling | | Sample Collected in 1 Ltr Borosilicate Colour as observed in transparent | |
| | | | Period of Analysis | | to |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW03 | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/L Max. | APHA, 24th edition, 4 cerbicar | <0.1 | 0.2-59 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/L Max. | IS 3025 Part 42 : 2002 R : 2019, US Plants APHA, 24th edition, 3111 CFA | <0.01 | 0.01-3.02 | 0.01 | 0.05 | 1.5 |
| 3 | Iron Residual (Dissolved), mg/L Max. | APHA, 23rd Edition, 3500-Fe B (Colorimetric Method-II) | <0.04 | 0.04-5 | 0.04 | 0.3 | 1 |
| 4 | Lead (as Pb), mg/L Max. | IS 3025/Part 47 : 2003 (Reaffirmed 2019) APHA, 24th edition, 3111-CFA | <0.005 | 0.005-10 | 0.005 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as C6H5OH), mg/L Max. | APHA, 24th Edition,5-Amino-Antipyrine | <0.001 | 0.001-10 | 0.001 | 0.001 | 0.002 |
| 6 | Selenium, mg/L Max. | APHA 24th edition IS 3025/part 56:2003 & 3111-C, ASC-CFA | <0.007 | 0.007-10 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/L Max. | IS 3025/part 37:1988 R-2019/ APHA 24th edition 3500-As B | <0.004 | 0.004-10 | 0.004 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/L Max. | IS 3025 Part 52 :2003, R-2019, 3500 Plasma APHA, 24th edition, 3111-CFA | <0.01 | 0.01-3.01 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/L Max. | IS 3025 Part 54 : 2003 R : 2019, 3500 Plasma APHA, 24th edition, 3111-CFA | <0.005 | 0.005-10 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/L Max. | APHA, 24th Edition,3111-Atomic CFA Method | <0.01 | 0.01-3.01 | 0.01 | 0.1 | 0.3 |

***All units in mg/L unless specified otherwise

**Grab sampling carried out for water samples, *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit

(Kumar Vaibhav)

**ANALYSED BY** **REVIEWED BY**

(Amrit Raj Minhra)

**Authorised Signatory**

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CMPDI, R-II
KOYLA BHAWAN COMPLEX
DHANBAD, 826001
Phone 0326-210 456
email: rdlcmpdi@coalindia.in

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

# GROUND WATER ANALYSIS TEST REPORT

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | GW 29 | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E. mail: gmenv.bccl@coalindia.in) | | | Date of Issue | 28/06/2024 |
| Project | BCF | Sample Ref. No. | BCK/EE(ENV)/GW/24-25/GW/ | Sampling Method | CMPDI/RI-II/EPM 11(3)-2025/Part-11 |
| Sampling Station | Kalyanki | Date of Sampling | | Sample Collected in 1 Lit Container, Color as observed in transparent | |
| | | | Parcel of Analysis | | No. |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-01 | Range Of Testing | Lim | Acceptable Limit (Max) | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour (Hazen unit) | APHA, 24th, edition, 2550-A, Spectrophotometric Single Wavelength Method 2023 | 2 | 1-5(Hz) | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1992 R-2014,EDTA Titrimetric Method & APHA Method | 126 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, R-2019 Argentometric Method | 104 | 2.0-2500.0 | 1 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, SPADNS Method | 0.59 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) :2003, R - 2019 , ASV Flame Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B (Calculation Method) | 51 | 0.5-150 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, UV-Spectrophotometric Method | 6.37 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2017 Electrometric pH Value Method | 7.93 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S Turbidity Method | 73 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA,24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23, 1986 R 2014 Titration Method | 247 | 4.0-1000.0 | 4 | 200 | 600 |
| 13 | Total Residual Solids, mg/l | IS 3025, Part 15, 1984 R 2017 Gravimetric method | 442 | 25.0-5000.0 | 25 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 330 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R 2017 Nephelometric Turbidimeter Method | 2.6 | 1.0-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R 2019, ASV Flame Method | 0.1 | 0.10 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.

(Kumar Vaibhav)

**ANALYSED BY** **REVIEWED BY**

(Amit Rai Mishra)

**Authorised Signatory**

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | [illegible] | | | |
| Customer | [illegible] | | | | Date of Dispatch | [illegible] |
| Project | [illegible] | Sample Ref. No. | [illegible] | Sampling Method | CMPDI/RI-II/LPM 11/IS 3025/Part-1) | |
| Sampling Status | Released | Date of Sampling | | Sample Collected on 11 Lit Sample , Color as observed in transparent | | |
| | | | Period of Analysis | | to | |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | Value | Range in Testing | Unit | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/L Max | APHA 24th edition, Carmine | <0.2 | 0.2-0.6 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/L Max | IS 3025 Part 42 : 1992 R : 2019, Cl.9 Para APHA, 24th edition, 3500-Cu B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/L Min | APHA, 23rd Edition, 4500-Cl-B Iodometric Method II | <0.04 | 0.06-0.3 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/L Max | IS 3025(Part 47): 1994 (Reaffirmed 2019), APHA, 24th edition, 3500-Cl B | <0.005 | 0.005-0.01 | 0.005 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as C6H5OH), mg/L Max | APHA, 24th Edition,5-Amino Antipyrine | <0.001 | 0.001-0.01 | 0.001 | 0.002 | 0.002 |
| 6 | Selenium, mg/L Max | APHA 24th edition IS 3025,part 56:2003, R 2019, 3500-Se D | <0.01 | 0.02-0.04 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/L Max | IS 3025,part 37 1988, R 2019, APHA 24th edition 3500-As D | <0.001 | 0.002-0.01 | 0.001 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/L Max | IS 3025 Part 52 2003, R 2019 APHA, 24th edition, 3500-Cr B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/L Max | IS 3025 Part 54 : 2003 R : 2019, APHA, 24th edition, 3500-Ni B | <0.005 | 0.005-0.01 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/L Max | APHA, 24th Edition (2023 Addition), 3214 Method | <0.02 | 0.02-0.03 | 0.02 | 0.1 | 0.3 |

***All Limits in mg/L unless specified otherwise

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Level & HDL indicates Higher Detection Level

[Kumar Vaibhav]
***ANALYSED BY*** ***REVIEWED BY***

[Amit Rai Mishra]
***Authorised Signatory***

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | GW-04 | | |
| Customer | Environment Programmes, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (Jharkhand) | | | Date of Issue | 28/06/2024 |
| Project | Baragarh Coalfield | Sample Ref. No. | RI-II/ENVIRON/GW/2024-25/GW/ | Sampling Method | CMPDI/RI-II/EPM/1129/2025/Part-II |
| Sampling Station | Bandhaurah | Date of Sampling | | | |
| | | Period of Analysis | | to | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-04 | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour (Hazen unit) | APHA, 24th edition, 2120 C, Spectrophotometric Single Wavelength Method, 2023 | 3 | 1-200 Hz | 1 | 5 | 15 |
| 2 | Odour, mg/l | IS 3025, (Part 49): 2021, R-2019 & 2019,EAC-Ocular Method & EDTA Method | 342 | 114-800.0 | 2 | 75 | 300 |
| 3 | Chloride, mg/l | IS 3025(Part 32):1988, R-2019 , Argentometric Method | 75 | 25-250.0 | 5 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA 24th Edition, SPADNS Method | 0.77 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53): 2003 R - 2019 , SPC Phen Method | 0.56 | 0.2-2.00 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 45 | 6.0-730 | 6 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 28.7 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 R 2021 Electrometric pH Value Method | 7.08 | 2-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA - 24th edition, 4500- S Turbidity Method | 111 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3), mg/l | IS 3025, Part 23: 1986, R 2019 Titration Method | 272 | 4.0-2040.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16: 1984 & 2023 Gravimetric method | 710 | 210-2400.0 | 10 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025 (Part 21): 2009 EDTA Method | 440 | 4.0-2040.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2023 Nephelometric Turbidimeter Method | 2.3 | 1-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,R 2019, ASV Plane Method | 0.12 | 0.10 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise

**Grab sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit

(Kumar Vaibhav)
**REVIEWED BY**

(Amit Rai Mishra)
**Authorised Signatory**

**ANALYSED BY**

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

# GROUND WATER ANALYSIS TEST REPORT

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| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | DW-04 | | | |
| Customer | Environment Department, Mineral Linking Unit Limited (MLUL), Kusta Bhawan, Dhanbad (Jharkhand) | | | | Date of Dispatch | 08.08.2024 |
| Project | Sangpur Coal Block | Sample Ref. No. | RI/ENVIRO/GW/2024-25/DW/ | Sampling Method | CMPDI/RI-II/LPM 11/19:2022/Part-1) | |
| Sampling Station | Bandarsali | Date of Sampling | | Sample Collected in 5 Lit. bottle/can , Color as observed in transparent | | |

Period of Analysis: [redacted] to [redacted]

| Sl. No | Parameter | Method of Analysis | Observed Values | | | As per IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-04 | Range in Testing | Unit | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/L Max | APHA 24th edition, Carmine | <0.2 | 0.2-0.6 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/L Max | IS 3025 Part 42 : 1992 R : 2019, ASTM D1688 APHA 24th edition, 3500-Cu B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/L Min | APHA 23rd Edition, 4500-Cl-B (Iodometric Method I) | <0.04 | 0.06-0.3 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/L Max | IS 3025(Part 47): 1994 (Reaffirmed 2019), APHA 24th edition, 3500-Cl B | <0.005 | 0.005-0.0 | 0.005 | 0.01 | No relaxation |
| 5 | Fluoride, manganese (as Cl/100), mg/L Max | EPA, 1983, Edition-II, Annex-Antigenic | <0.001 | 0.001-0.0 | 0.001 | 0.002 | 0.002 |
| 6 | Selenium, mg/L Max | APHA 24th edition IS 3025,part 56:2003 & 2015, 3500-Se D | <0.007 | 0.007-0.0 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/L Max | IS 3025,part 37 1988 & 2015, APHA 24th edition 3500-As D | <0.006 | 0.006-0.0 | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/L Max | IS 3025 Part 52 2003, ASTM D1687-17 APHA 24th edition, 3500-Cr B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/L Max | IS 3025 Part 54 : 2003 R : 2019, APHA 24th edition, 3500-Ni B | <0.005 | 0.005-0.0 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/L Max | APHA 24th Edition (2023 Addition), 3214 Method | 0.02 | 0.02-0.03 | 0.02 | 0.1 | 0.3 |

*All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & MDL indicates Method Detection Limit.

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[Kumar Vaibhav]

**REVIEWED BY**

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[Amit Raj Mishra]

**Authorised Signatory**

**ANALYSED BY**

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.



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Environment Laboratory, Regional Institute-II
CMPDI, RI-II
SONELA BHAWAN COMPLEX
CHAIBASA - 833001
Phone 0326-223 400
email: rdr2cmpdi@rediffmail.com

# GROUND WATER ANALYSIS TEST REPORT

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | GW-06 | | |
| Customer | Environment Programmer, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (Jharkhand) | | | Date of Issue | 28/06/2024 |
| Project | Bansgarh Coalfield | Sample Ref. No. | RI-II/EE(ENV)/GW/24-25/GW/ | Sampling Method | CMPDI/RI-II/EPM 11(2)-2025/Part-11 |
| Sampling Distance | Latitude | Date of Sampling | | Sample Collected in 1 Lit. bottle, Color as observed in transparent | |
| | | Period of Analysis | 11.05.2024 | to | 07.06.2024 |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | DWLT | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour (Hazen unit) | APHA, 24th, edition, 2550-A, Spectrophotometric Single Wavelength Method 2023 | 2 | 1-50nm | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 R-2019,EDTA Titrimetric Method | 132 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, R-2019 Argentometric Method | 68 | 2.0-1500.0 | 1 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, SPADNS Method | 0.59 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) :2003, R - 2019, ASV/Flame Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B, Calculation Method | 97 | 0.5-750 | 1 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 Spectrophotometric Method | 12.24 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2017 Electrometric pH Value Method | 7.06 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S Turbidity Method | 142 | 0.5-400.0 | 0.5 | 200 | 400 |
| 11 | Taste | APHA,24th edition, 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3 mg/l) Max | IS 3025, Part 23, 1986 R 2019 Titration Method | 170 | 4.0-2000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984 R 2023 Gravimetric method | 804 | 10.0-5000.0 | 10 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 760 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R-2017 Nephelometric Turbidimeter Method | 2.5 | 1.0-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R-2019, ASV/Flame Method | <0.1 | 0.10 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

| ANALYSED BY | REVIEWED BY | Authorised Signatory |
|---|---|---|
| | (Kumar Vaibhav) | (Amit Rai Mishra) |

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GROUND WATER ANALYSIS TEST REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | DW-39 | | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (Jharkhand) | | | | Date of Dispatch | 08.08.2024 |
| Project | Bansgarh Coalfield | Sample Ref. No. | BCCL/ENVT/CMPDI/RI-II/2024-25/GW/1 | Sampling Method | CMPDI/BCCL/EPR-11/2012/Part-II | |
| Sampling Distance | Jalandih | Date of Sampling | | Sample Collected on 11th September, Collection Witnessed by Environment | | |
| | | | Period of Analysis | 11.06.2024 | to | 07.08.2024 |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | DW-39 | Range in Testing | Unit | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/L Max | APHA 24th edition, Carmine | <0.2 | 0.2-0.6 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/L Max | IS 3025 Part 42 : 1992 R : 2019, ASTM D1688 APHA 24th edition, 3500-Cu B | <0.01 | 0.02-0.03 | 0.02 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/L Min | APHA 23rd Edition, 4500-Cl-B (Iodometric Method-I) | <0.04 | 0.04-0.3 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/L Max | IS 3025(Part 47): 1994 (Reaffirmed 2019), APHA 24th edition, 3500-Cl B | <0.005 | 0.005-0.6 | 0.005 | 0.01 | No relaxation |
| 5 | Fluoride, manganese (as F), mg/L Max | EPA, 1983, Edition-II, Annex-Antigerite | <0.001 | 0.001-0.6 | 0.001 | 0.001 | 0.001 |
| 6 | Selenium, mg/L Max | APHA 24th edition IS 3025,part 56:2003 & 2014, 3500-Se B | <0.007 | 0.007-0.6 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/L Max | IS 3025,part 37 1988 & 2014, APHA 24th edition 3500-As B | <0.006 | 0.006-0.6 | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/L Max | IS 3025 Part 52 2003, R:2019 LASO Manual APHA 24th edition, 3500-Cr B | <0.01 | 0.02-0.03 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/L Max | IS 3025 Part 54 : 2003 R : 2019, APHA 24th edition, 3500-Ni B | <0.005 | 0.005-0.6 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/L Max | APHA 24th Edition (2023 Addition), 3214 Method | <0.02 | 0.02-0.03 | 0.02 | 0.1 | 0.3 |

***All units in mg/L unless specified otherwise

**Grab sampling carried out for water samples. *IS: Indicates Lower Desirable Limit & BIS: Indicates Below Detection Limit

[redacted]
[Kumar Vaibhav]
REVIEWED BY

[redacted]
[Amit Rai Mishra]
Authorised Signatory

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**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | GW-XV | | |
| Customer | Environment Programmer, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E. Govt. sector, Jharkhand-India) | | | Date of Issue | 28/06/2024 |
| Project | Baragarh Coalfield | Sample Ref. No. | BCCL/EE(EMD)/GW/24-25/GW/ | Sampling Method | CMPDI/RI-II/EPM 11(3)-2025/Part-11 |
| Sampling Distance | Pandra | Date of Sampling | | Sample Collected in 1 Lit. bottle, Color as observed in transparent | |
| | | Period of Analysis | 06.06.2024 | to | 07.06.2024 |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW-XV | Range Of Testing | LOD | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Colour, Hazen unit | APHA, 24th, edition, 2550-c, Spectrophotometric Single Wavelength Method 2023 | 0 | 1-70Hz-0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1992 R-2014,EDTA Titrimetric Method | 220 | 2.0-400.0 | 2 | 75 | 200 |
| 3 | Chlorides, mg/l | IS:3025(Part 32):1988, R-2019 Argentometric Method | 84 | 2.0-2500.0 | 1 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500(D) Method | 0.90 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) :2003, R : 2019 , ASV Flame Method | <0.1 | 0.1-10 | 0.1 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th edition, 3500-Mg B Calculation Method | 75 | 0.5-150 | 5 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3- Spectrophotometric Method | 9.74 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH Value | IS 3025, Part 11 : 1983 R 2017 Electrometric pH Value Method | 8.09 | 1-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA -24th edition, 4500 S Turbidity Method | 75 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA,24th edition, 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity (as CaCO3), mg/l Max | IS 3025, Part 23, 1986 R 2014 Titration Method | 204 | 4.0-2000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16, 1984 R 2017 Gravimetric method | 740 | 20.0-5000.0 | 20 | 500 | 2000 |
| 14 | Total Hardness, mg/l | IS 3025, (Part 21): 2009 EDTA Method | 600 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R 2017 Nephelometric Turbidimeter Method | 2.1 | 1.0-800 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49): 1994,R 2019, ASV Flame Method | 0.10 | 0.10 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise.

**Grab sampling carried out for water samples. *LOD indicates Lower Detection Limit & BDL indicates Below Detection Limit.

(Kumar Vaibhav)
**REVIEWED BY**

(Amit Rai Mishra)
**Authorised Signatory**

**ANALYSED BY**

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**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug Well No | DW-31 | | | |
| Customer | Environment Department, Mineral Linking Unit Limited (MLUL), Kusta Bhawan, Dhanbad (Jharkhand) | | | | Date of Dispatch | 08.08.2024 |
| Project | Bangwar Coal Block | Sample Ref. No. | RI/ENVIRO/GW(DW)/24-25/DW/ | Sampling Method | CMPDI/RI-II/LPM 11/19-2022/Part-1) | |
| Sampling Stations | Piezo's | Date of Sampling | | Sample Collected on 5 Ltr Jerrycan , Color as observed in transparent | | |
| | | | Period of Analysis | 06.07.2024 | to | 07.08.2024 |

| Sl. No | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | Value in mg/Lit | Range in Testing | Unit | Acceptable Limit (Max.)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/L Max | APHA 3500-Boron, Carmine | <0.2 | 0.2-0.6 | 0.2 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/L Max | IS 3025 Part 42 : 1992 R : 2019, ASTM D1688 APHA 3500-Copper, B&C (CPA) | <0.01 | 0.02-0.03 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/L Min | APHA 4500- Cl G (DPD Colorimetric Method) | <0.04 | 0.04-0.3 | 0.04 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/L Max | IS 3025(Part 47): 1994 (Reaffirmed 2019), APHA 3500-Pb B&C (CPA) | <0.005 | 0.005-0.01 | 0.005 | 0.01 | No relaxation |
| 5 | Fluoride, manganese (as F), mg/L Max | APHA 4500-F-D Zirconium Alizarin | <0.001 | 0.001-0.01 | 0.001 | 0.001 | 0.001 |
| 6 | Selenium, mg/L Max | APHA 3500-Se(C) IS 3025(part 56):2003 & 2014), ASC-PCG | <0.007 | 0.007-0.01 | 0.007 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/L Max | IS 3025(part 37:1988 & 2014) APHA 3500-Arsenic ASC-PCG | <0.006 | 0.006-0.01 | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/L Max | IS 3025 Part 52:2003 & 2014) APHA 3500-Cr B&C (CPA) | <0.01 | 0.02-0.03 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel as Ni, mg/L Max | IS 3025 Part 54 : 2003 R : 2019, ASTM D1688 APHA 3500-Nickel, B&C (CPA) | <0.005 | 0.005-0.01 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/L Max | ASTM D 5673-05Mod (2010) AAS-ICP-B Method | <0.01 | 0.02-0.03 | 0.02 | 0.1 | 0.3 |

***All Limits in mg/L unless specified otherwise

**Grab sampling carried out for water samples. *LOL-Indicates Lower Detection Level & HDL-Indicates Higher Detection Level

[redacted]
[Kumar Vaibhav]
**REVIEWED BY**

[redacted]
[Amit Rai Mishra]
**Authorised Signatory**

**ANALYSED BY**

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CMPDI, R-II
KOYLA BHAWAN COMPLEX
DHANBAD - 826001
Phone:0326-229 859
email: rdlcmpdi@coalindia.in

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

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# GROUND WATER ANALYSIS TEST REPORT

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | R-12 | | |
| Customer | Environment Department, Mineral Linking Unit Limited (MLUL), Kusha Bhawan, Dhanbad (E. mail: [illegible]) | | | Date of Issue | 28/06/2024 |
| Project | Sonepur Coalfields | Sample Ref. No. | RI-II/ENV/GW/2024-25/GW/1 | Sampling Method | CMPDI/RI-II/LAB/ 1128/ 2023/Part-II |
| Sampling Stations | Dilaura | Date of Sampling | | Sample Collected in 5 Lit borosilicate, Colour less vibrantwell is transparent | |
| | | | Period of Analysis | to | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
|---|---|---|---|---|---|---|---|
| | | | GW/1 | Range Of Testing | LOD | | |
| 1 | Colour (Hazen unit) | APHA, 24th edition, 2120-C, Spectrophotometric Single Wavelength Method, 2023 | 1 | 1-100.0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Titrimetric Method & 3025 (Part 40): 1991 RA 2019 Method | 72 | 2.0-400.0 | 1 | 75 | 200 |
| 3 | Chloride, mg/l | IS 3025(Part 32):1988 RA 2019, Argentometric Method | 44 | 2.0-2500.0 | 1 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, 4500-F C Method | 0.71 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003 RA 2019, ASS Flame Method | <0.2 | 0.2-50 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th Edition, 3500-Mg B Calculation Method | 75 | 4.0-750 | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 B Spectrophotometric Method | 3.60 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 24th Edition, 2150 C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 2022 RA 2023 Electrometric pH Meter Method | 8.41 | 2-14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA 24th edition, 4500 E, Turbidity Method | <1 | 1.0-400.0 | 1 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160 C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity as CaCO3 Mg/l | IS 3025, Part 23: 1986 RA 2019 Titration Method | 220 | 4.0-2500.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16: 1984 RA 2023 Gravimetric method | 391 | 25.0-5000.0 | 25 | 500 | 2000 |
| 14 | Total Hardness as CaCO3 | IS 3025, (Part 21): 2009 RA 2019 Method | 400 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, RA 2023 Nephelometric/Turbidimeter Method | 2.6 | 1.000 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,RA 2019 ASS Flame Method | <0.1 | 0.10 - 10.0 | 0.1 | 5 | 15 |

***All units in mg/L unless specified otherwise

**Grab sampling carried out for water samples. *LOD- Indicates Lower Detection Limit & BDL indicates Below Detection Limit.

[illegible]
(Kumar Vaibhav)
REVIEWED BY

[illegible]
(Amit Raj Mishra)
Authorised Signatory

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Environment Laboratory, Regional Institute-II

**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June 2024 | Dkg/Work No. | R-11 | | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: ghosesk.bccl@cmpdiindia.co.in) | | | | Date of Issue | 08.08.2024 |
| Project | Bansgarh Coalfield | | Sample Ref. No. | BI: R/EPSR/R-II/01/GW/24-25/CMPDI | Sampling Method | CMPDI/BI-II/EPM-11/20-2025/Part-11 |
| Sampling Business | Bilaspur | Date of Sampling | | Sample Collected in 5 Lit Jerrycan, Color as observed in transparent | | |
| | | | Period of Analysis | | As | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | GW/01 | Range Of Testing | Unit | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Screen (at 25) mg/l, Max | APHA, 24th edition, Currimbo | <0.1 | 0.1-AP | 0.1 | 0.3 | 1 |
| 2 | Copper (as Cu) mg/l, Max | IS 3025 Part 42 : 1992 (R : 2003), with Errata APHA, 24th edition, and ATSA | <0.01 | 0.01-0.02 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA, 23rd Edition, 4500-Cl-B (Iodometric Method-I) | <0.06 | 0.06-0 | 0.06 | 0.2 | 1 |
| 4 | Lead (as Pb) mg/l, Max | IS 3025(Part 47): 1994 (Reaffirmed 2012) APHA, 24th edition, 3120 ICP-S | <0.005 | 0.005-LD | 0.005 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as C6H5OH), mg/l, Max | APHA, 24th Edition 6-Annex Acetylene | <0.002 | 0.002-DF | 0.002 | 0.002 | 0.002 |
| 6 | Selenium, mg/l, Max | APHA 24th edition 3120 ICP, part 5a 2021, & 3113 b, 3120 ICP-S | <0.001 | 0.001-DF | 0.001 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max | IS 3025 part 37 1988, R-2015/ APHA 24th edition 3120 ICP-S | <0.006 | 0.006-DF | 0.006 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/l, Max | IS 3025 Part 52 2003, R2019 Multi Flame APHA 24th edition, 3120 ICP-S | <0.01 | 0.01-0.02 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel (as Ni) mg/l Max | IS 3025 Part 54 : 2003 R : 2019, with Errata APHA, 24th edition, 3120 ICP-S | <0.005 | 0.005-DF | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn mg/l, Max | APHA, 24 th Edition 2021 3120 ICP-S Method | <0.02 | 0.02-DF | 0.02 | 0.1 | 0.3 |

*All values in mg/l, unless specified otherwise.

**Grab sampling carried out for water samples. *LDL-Indicates Lower Detection Limit & BDL-Indicates Below Detection Limit.

[Kumar Vaibhav]

**ANALYSED BY** **REVIEWED BY**

[Amit Raj Mishra]

**Authorised Signatory**

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.



---- End of Report ----

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | June 2024 | Dug/Bore No. | S-19 | | |
| Customer | Environment Department, Mineral Linking Unit Limited (MLU), Kusha Bhawan, Dhanbad (Jh. Govt. agency for CSR/Coalbelt) | | | Date of Issue | 28/06/2024 |
| Project | Baseline Condition | Sample Ref. No. | RI-II/ENV/GW/2024-25/GW/ | Sampling Method | CMPDI/RI-II/LPW-11/20-21/GW/ IS:7(Part-1) |
| Sampling Station | Mahisatta | Date of Sampling | | Sample Collected in 1 Ltr Jerrycans , Color as observed is transparent | |
| | | | Period of Analysis | | 1hr |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | Acceptable Limit (Max)* | IS 10500: 2012 Permissible Limit in the Absence of Alternate Source (Max) |
|---|---|---|---|---|---|---|---|
| | | | MRSS | Range Of Testing | LOD | | |
| 1 | Colour (Hazen unit) | APHA, 24th edition, 2120-C, Spectrophotometric Single Wavelength Method, 2023 | 2 | 1-100.0 | 1 | 5 | 15 |
| 2 | Calcium, mg/l | IS 3025, (Part 40): 1991 RA 2019 EDTA Titrimetric Method & 3025 (Part 40) Method | 42 | 2.0-400.0 | 1 | 75 | 200 |
| 3 | Chlorides, mg/l | IS 3025(Part 32): 1988, RA 2019 , Argentometric Method | 50 | 2.0-2500.0 | 1 | 250 | 1000 |
| 4 | Fluoride, mg/l | APHA, 24th Edition, SPADNS Method | 0.76 | 0.2-2.00 | 0.2 | 1 | 1.5 |
| 5 | Iron, mg/l | IS 3025 (Part 53) : 2003 R : 2014 , ASV Flame Method | <0.2 | 0.2-50 | 0.2 | 1 | No relaxation |
| 6 | Magnesium | APHA 24th Edition, 3500-Mg B Calculation Method | 44 | 4.0-750 | 4 | 30 | 100 |
| 7 | Nitrate, mg/l | APHA, 24th edition, 4500-NO3 B Spectrophotometric Method | 24.51 | 0.5-45.0 | 0.5 | 45 | No relaxation |
| 8 | Odour | APHA 23rd Edition, 2150-C | Agreeable | Qualitative | Qualitative | Agreeable | Agreeable |
| 9 | pH value | IS 3025, Part 11 : 1983 R: 2022 Electrometric pH Meter Method | 7.24 | 2.14 | 0.1 | 6.5-8.5 | No relaxation |
| 10 | Sulphate, mg/l | APHA 24th edition, 4500 E , Turbidity Method | 191 | 10.0-400.0 | 10 | 200 | 400 |
| 11 | Taste | APHA 24th edition, 2160-C | Acceptable | Qualitative | Qualitative | Acceptable | Agreeable |
| 12 | Total Alkalinity as CaCO3 Mg/l Max | IS 3025, Part 23: 1986 R: 2019 Titration Method | 225 | 4.0-2000.0 | 4 | 200 | 600 |
| 13 | Total Dissolved Solids, mg/l | IS 3025, Part 16: 1984 R: 2023 Gravimetric method | 450 | 25.0-5000.0 | 25 | 500 | 2000 |
| 14 | Total Hardness mg/l | IS 3025, (Part 21): 2009 RA 2014 Method | 320 | 4.0-2000.0 | 4 | 200 | 600 |
| 15 | Turbidity, NTU | IS 3025, (Part 10):1984, R:2023 Nephelometric/Turbidimeter Method | 1.73 | 1.000 | 0.1 | 1 | 5 |
| 16 | Zinc, mg/l | IS 3025(Part 49) : 1994,R:2019 ASV/Flame Method | <0.1 | 0.10 - 5.00 | 0.1 | 5 | 15 |

***All units in mg/l, unless specified otherwise.

**Only sampling carried out for water samples. *If DL exceeds Lower Detection Limit & BDL indicates Below Detection Limit.

[Kumar Vaibhav]
**REVIEWED BY**

[Amit Raj Mishra]
**Authorised Signatory**

**ANALYSED BY**

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.



---End of Report---

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

**GROUND WATER ANALYSIS TEST REPORT**

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | June (2024) | Dkg/Work No. | R-39 | | | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: ghosesr.bcclf@cmpdilimited.in) | | | | Date of Issue | 08.08.2024 |
| Project | BCF | | Sample Ref. No. | BI: R/EPSR/R-II/BCCL/GW/24-25/438 | Sampling Method | CMPDI/BI-II/EPM-11(2)-2023/Part-1) |
| Sampling Statistic | Realizable | Date of Sampling | | Sample Collected in 5 Lit Jerrycan, Color as observed in transparent | | |
| | | | Period of Analysis | 11.07.2024 | to | 07.08.2024 |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | | IS 10500: 2012 | |
|---|---|---|---|---|---|---|---|
| | | | G/W-01 | Range Of Testing | Unit | Acceptable Limit (Max)* | Permissible Limit in the Absence of Alternate Source (Max) |
| 1 | Boron (as B), mg/l, Max | APHA, 24th edition, Carmine | <0.1 | 0.1-1.0 | 0.1 | 0.5 | 1 |
| 2 | Copper (as Cu), mg/l, Max | IS 3025 Part 42 : 1992 (R : 2003), edn 2 Reaf APHA, 24th edition, 3111 ATA | <0.01 | 0.01-10.0 | 0.01 | 0.05 | 1.5 |
| 3 | Free Residual Chlorine, mg/l, Min | APHA 23rd Edition, 4500-Cl-B (Iodometric Method-I) | <0.05 | 0.05-5 | 0.05 | 0.2 | 1 |
| 4 | Lead (as Pb), mg/l, Max | IS 3025(Part 47): 1994 (Reaffirmed 2012) APHA, 24th edition, 3111 ATA | <0.005 | 0.005-10 | 0.005 | 0.01 | No relaxation |
| 5 | Phenolic compounds (as C6H5OH), mg/l, Max | APHA, 24th Edition, 6-Amino antipyrine | <0.001 | 0.001-10 | 0.001 | 0.001 | 0.002 |
| 6 | Selenium, mg/l, Max | APHA 24th edition IS 3025 Part 56 2003, 3114 C, 3111 ATA | <0.001 | 0.001-10 | 0.001 | 0.01 | No relaxation |
| 7 | Total Arsenic (as As), mg/l, Max | IS 3025 part 37 1988, R-2019 APHA 24th edition 3500 ASA | <0.001 | 0.001-10 | 0.001 | 0.01 | 0.05 |
| 8 | Total Chromium (as Cr), mg/l, Max | IS 3025 Part 52 2003, R2019 Multi Range APHA 24th edition, 3111 ATA | <0.01 | 0.01-10.0 | 0.01 | 0.05 | No relaxation |
| 9 | Nickel (as Ni), mg/l Max | IS 3025 Part 54 : 2003 (R : 2019, edn 2 Reaf APHA, 24th edition, 3111 ATA | <0.005 | 0.005-10 | 0.005 | 0.02 | No relaxation |
| 10 | Manganese as Mn, mg/l, Max | APHA, 23rd Edition 2017, 3500-B Method | <0.02 | 0.02-10.0 | 0.02 | 0.1 | 0.3 |
| | | | | | | | |

*All values in mg/l, unless specified otherwise.

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.

[Kumar Vaibhav]
REVIEWED BY

[Amit Raj Mishra]
Authorised Signatory

ANALYSED BY

**Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Envt), CMPDI, RI-II.

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---- End of Report ----

## Abbreviations

Abn.: Abandoned
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

# PLATES

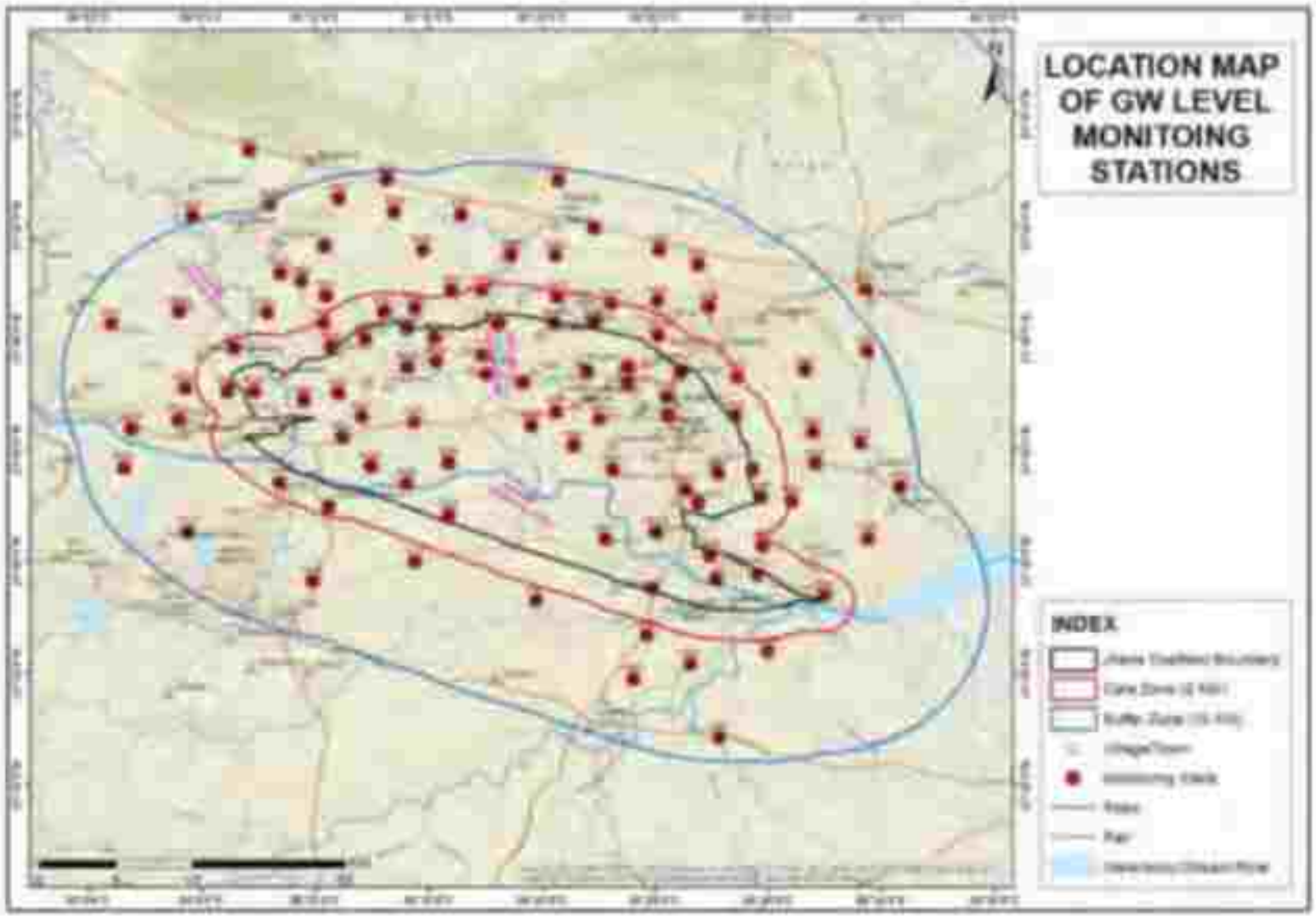


**Plate- I: Location Map of Groundwater Level Monitoring stations**

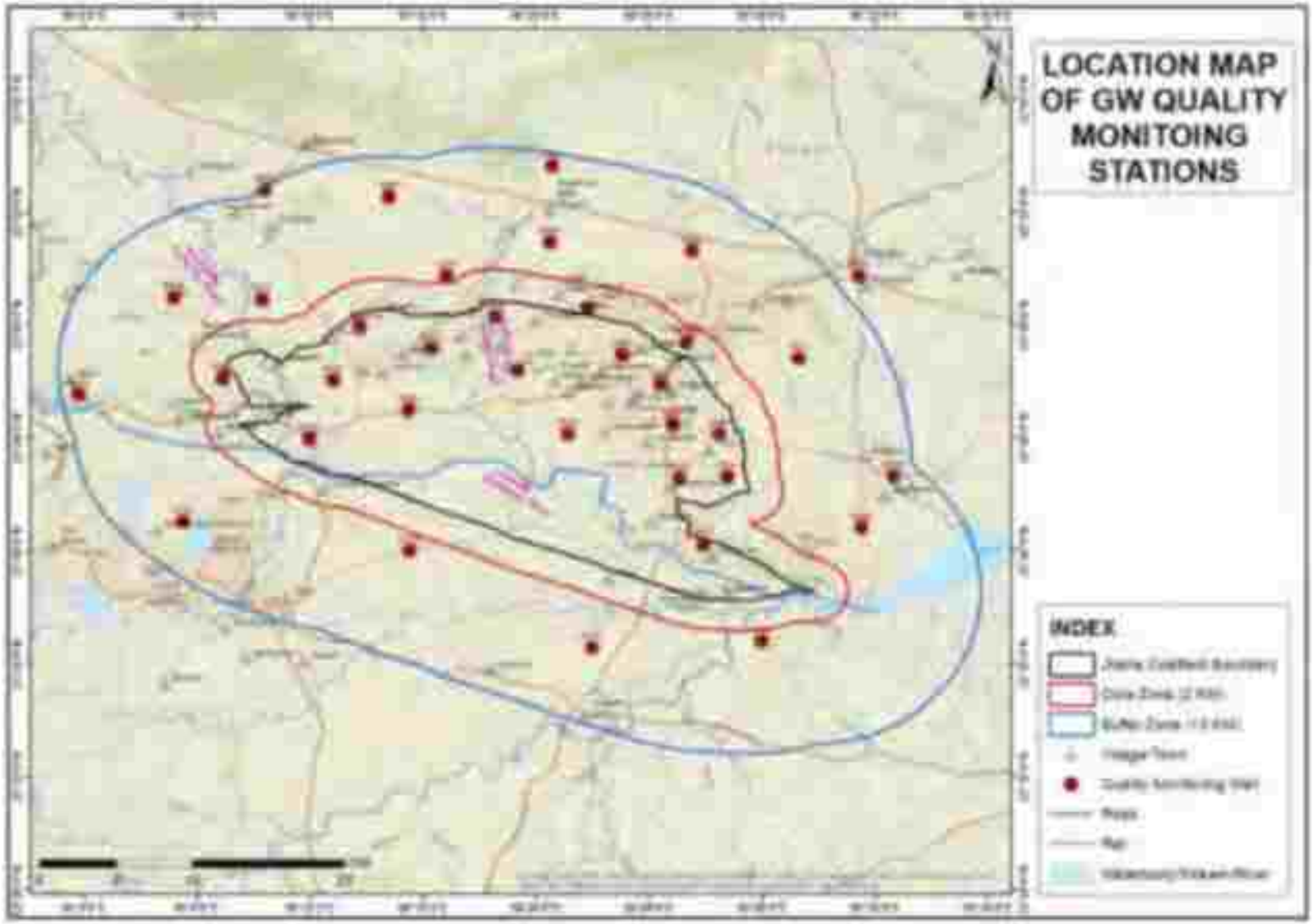


**Plate- II: Location Map of Groundwater Quality Monitoring stations**

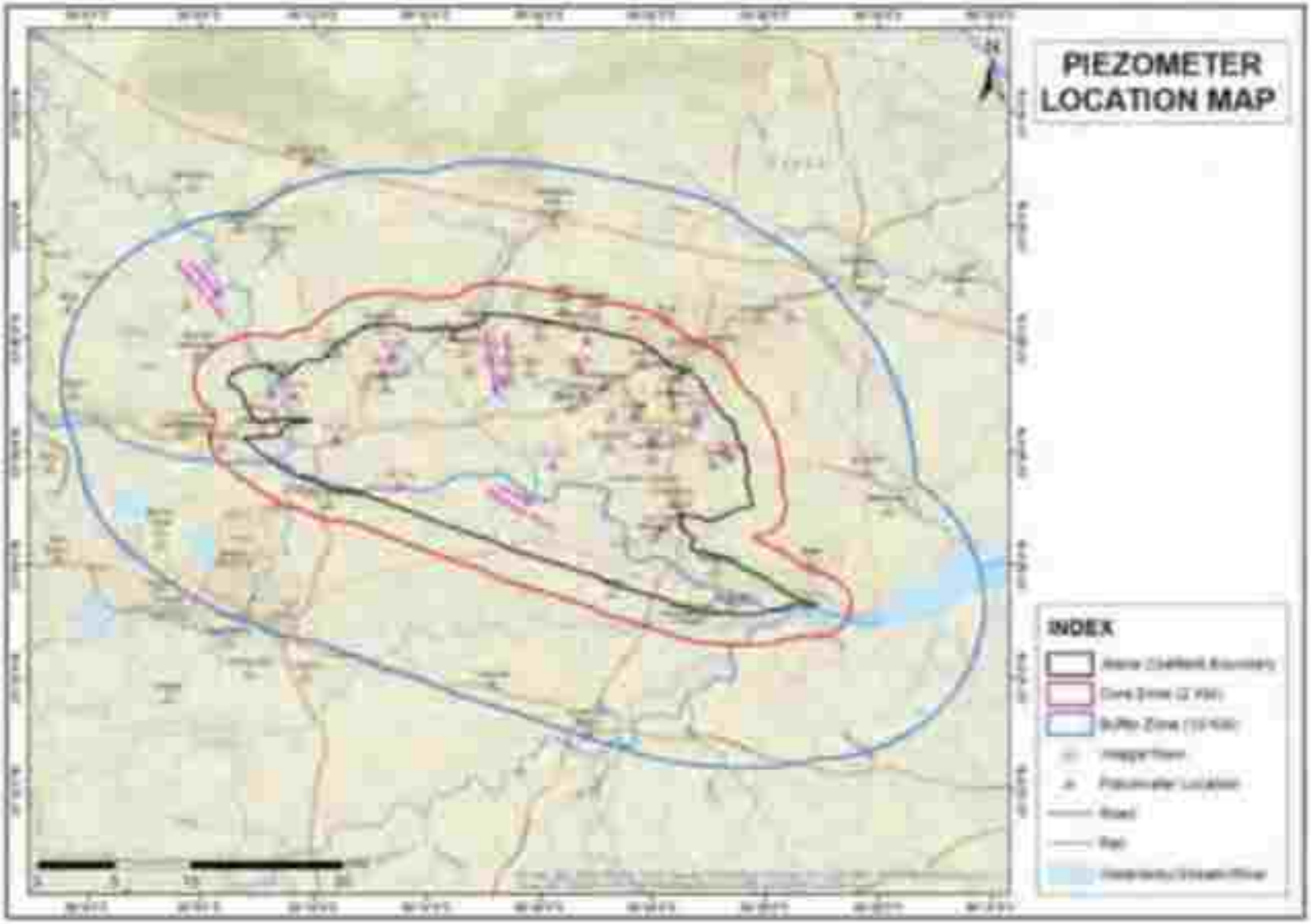


**Plate- III: Location Map of Piezometers**

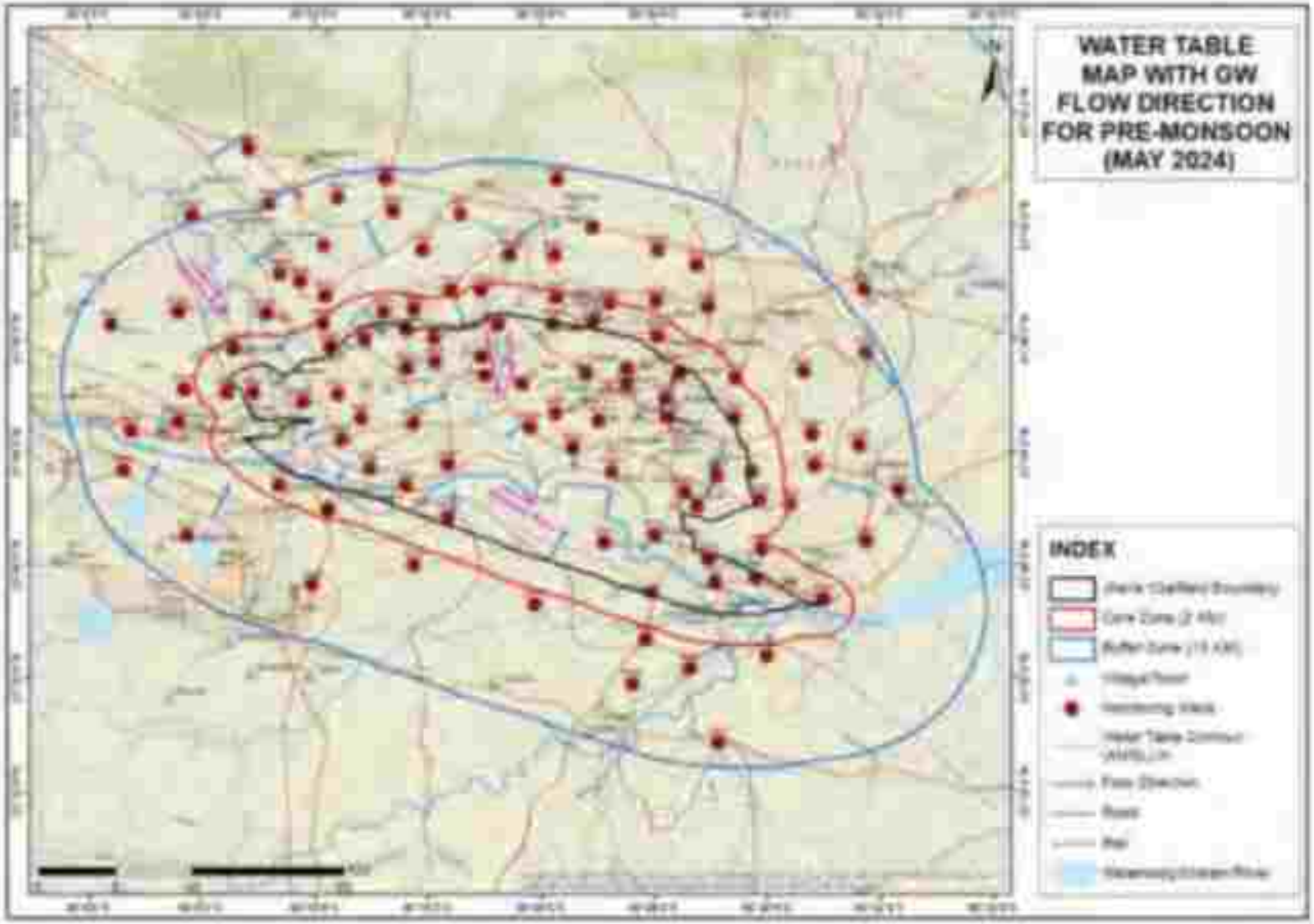


Plate- IVA: Water table Contour Map of JCF, Pre Monsoon (May'24)

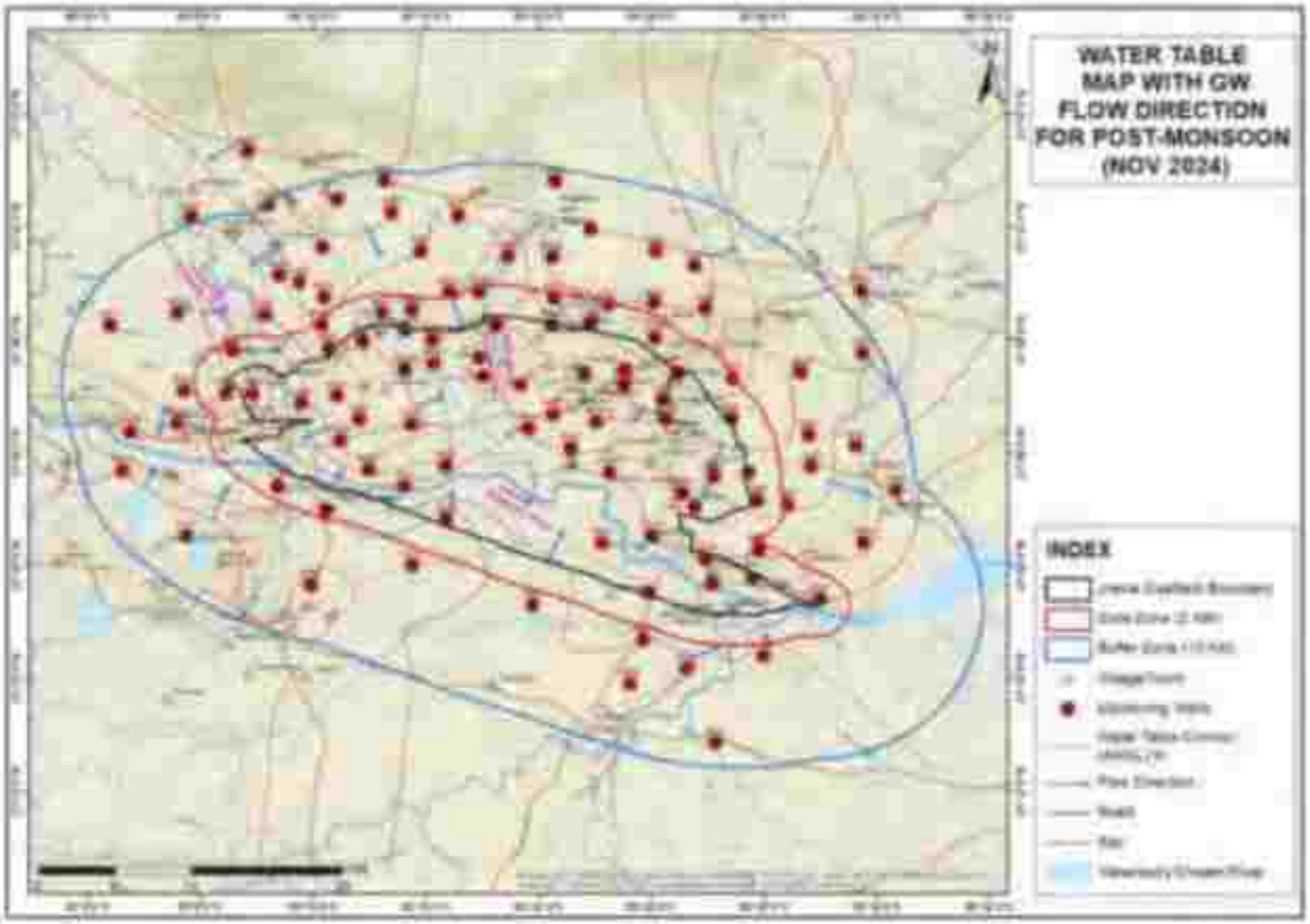


**Plate- IVB: Water table Contour Map of JCF, Post Monsoon (Nov'24)**

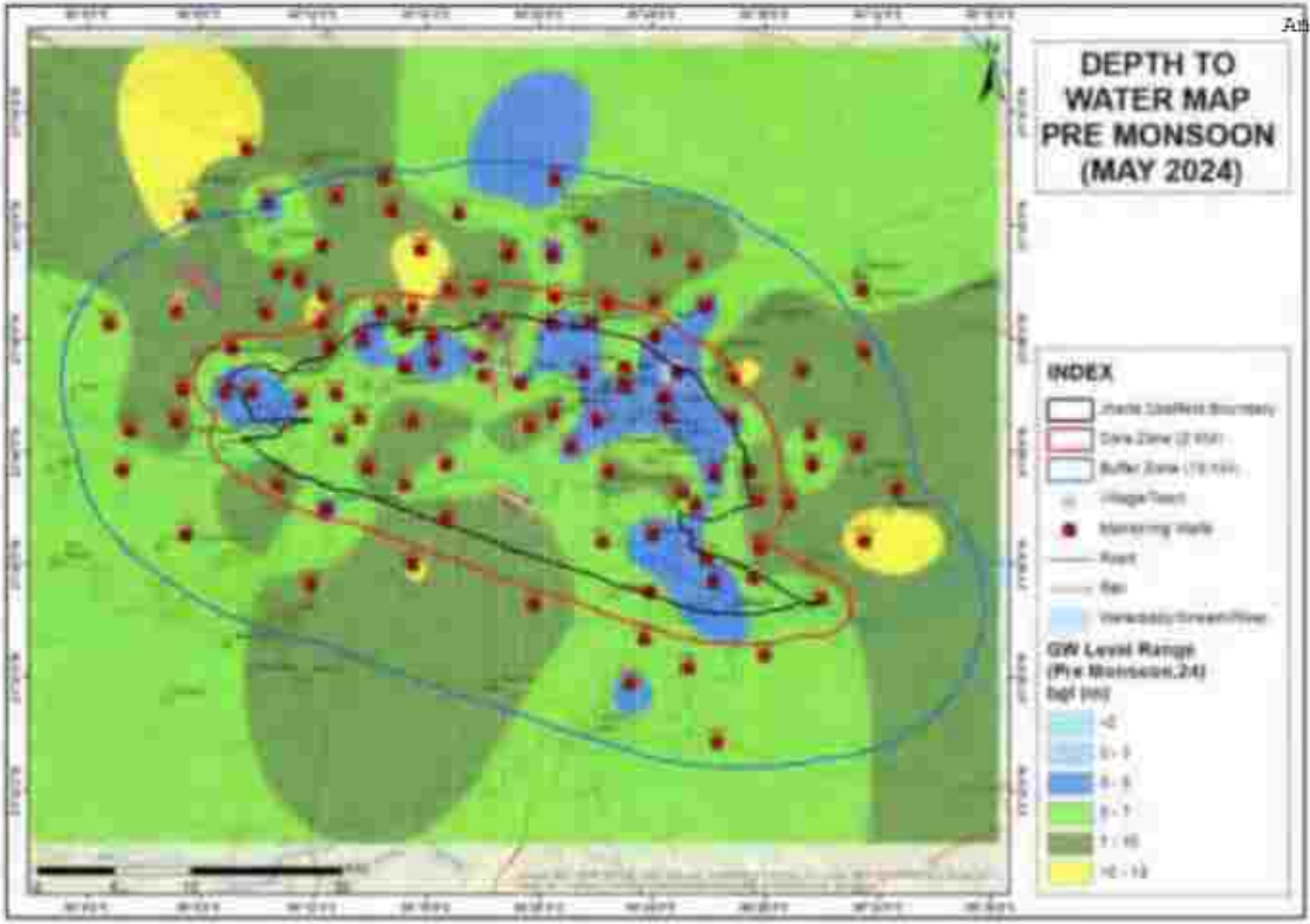


Plate- VA: Depth to Groundwater Level map of JCF, Pre Monsoon (May'24)

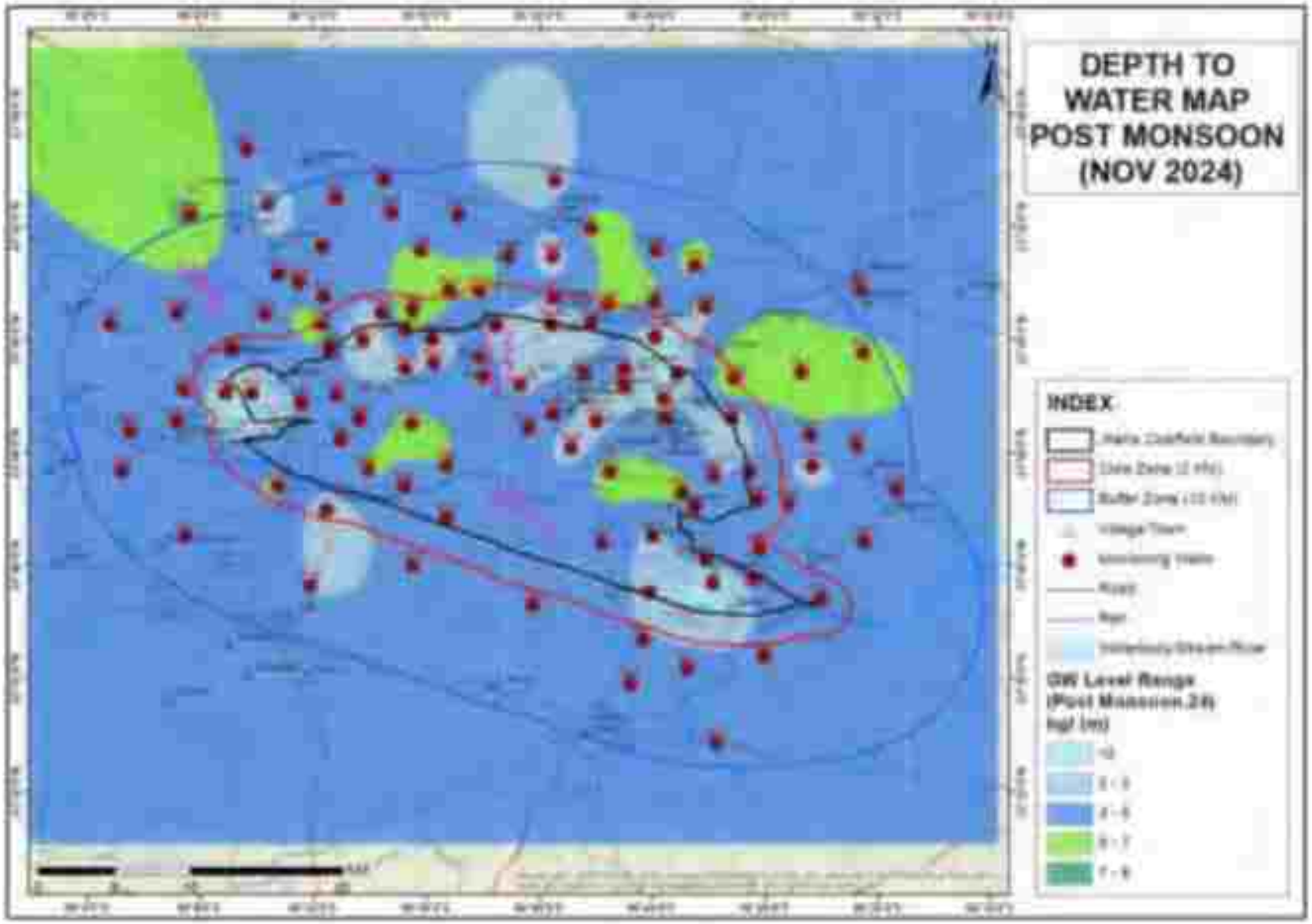


Plate- VB: Depth to Groundwater Level map of JCF, Post Monsoon (Nov'24)

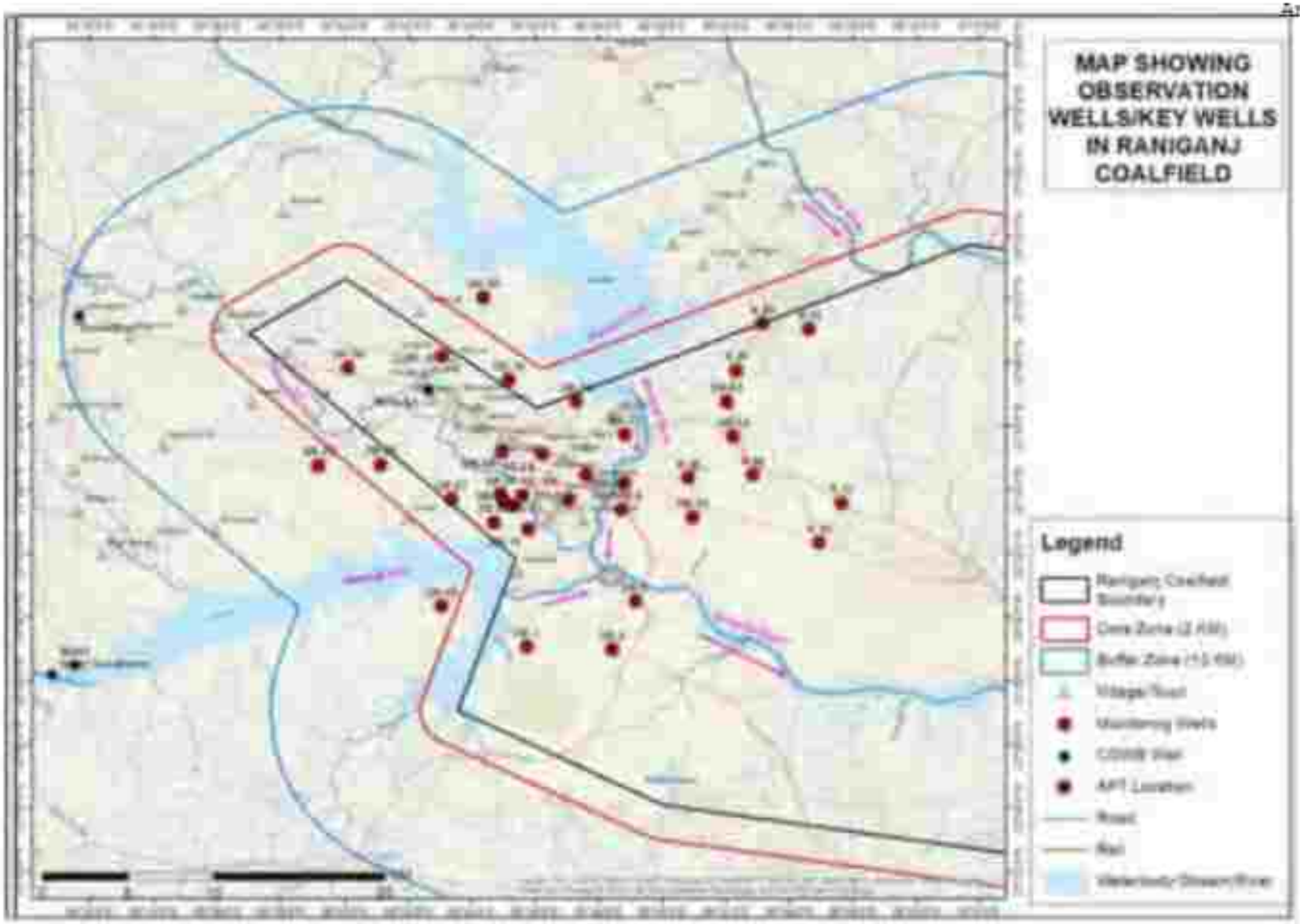


Plate- VI: Drainage Map (Part of RCF Coalfield under BCCL Command Area)

## Annexure XVI

Gmail — Environment Lodna Area <enviodna@gmail.com>

**Submission of Ground Level and Quality Report (Assessment Year 2021-22)**
1 message

**Environment Lodna Area** <enviodna@gmail.com> — 13 May 2022 at 10:59
To: ROR MoEFCC <ro.ranchi-mef@gov.in>, ccb.cpcb@nic.in, ranchijspcb@gmail.com, dhanbadjspcb@gmail.com
Cc: HOD Environment <envbccl2020@gmail.com>

Dear Sir,
As per Specific condition no. XXXII of environment Clearance granted on dated: 21.05.2013, We are submitting herewith Ground Water Level and Quality Report (Assessment Year 2021-22) in respect of Cluster IX.

This is for your kind information

with regards,
Environment department
Cluster IX

2021-22.pdf
13318K

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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 – IX

**(FOR THE MONTH AUGUST 2025)**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

# WATER QUALITY MONITORING

## 3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) **Mine Discharge of Jeenagora (MW9)**
ii) **Mine Discharge of LODNA (MW18)**
iii) **Mine Discharge of JOY RAMPUR (MW19)**
iv) **Mine Discharge of NT ST (MW20)**
v) **Mine Discharge of BARAREE (MW21)**
vi) **Mine Discharge of JEALGORA (MW22**

## 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.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# Test Report for Mine Effluent samples

| | | | | | | |
|---|---|---|---|---|---|---|
| Month & Year | 08/2025 | Cluster | Cluster IX | ULR No. | | TC1432125000002022F |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | Date of Issue | 05.09.2025 |
| Project | | Sampling Ref. No. | REM/BCCL/2025/08 | Sampling Method | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | |
| Sampling Stations | (I) | Jeenagora | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | |
| | | | Date of Sampling | 11.08.2025 | 25.08.2025 | PERIOD OF ANALYSIS 11.08.2025 TO 30.08.2025 |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1674 | M1701 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 41 | 38 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.72 | 7.77 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 44 | 36 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY*** (Gaurav Kant) ***REVIEWED BY*** (Kumar Vaibhav) ***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*



Annexure XXVII

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
## Environment Laboratory, Regional Institute-II
## MINE EFFLUENT TEST REPORT

**Test Report for Mine Effluent samples**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **08/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | TC143212500000202 2F | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)** | | | | | **Date of Issue** | **05.09.2025** |
| **Project** | **LODNA** | **Sampling Ref. No.** | **REM/BCCL/2025/08** | **Sampling Method** | **IS 3025 (Part-1) CMPDI/RI-II/LPM 13** | | |
| **Sampling Stations** | **(I)** | **Mine Discharge of LODNA** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | **04.08.2025 TO 30.08.25** |
| | | | **Date of Sampling** | | 04.08.2025 18.08.2025 | | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | M1664 | M1691 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 41 | 36 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.66 | 7.69 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 40 | 44 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise. **Grab sampling carried out for water samples.*

***ANALYSED BY*** (Gaurav Kant) ***REVIEWED BY*** (Kumar Vaibhav) ***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*



Annexure XXVII

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 08/2025 | Cluster | Cluster IX | ULR No. | | TC1432125000002022F | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 05.09.2025 |
| Project | JOYRAMPUR | Sampling Ref. No. | REM/BCCL/2025/08 | Sampling Method | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | | |
| Sampling Stations | (i) | Mine Discharge of JOYRAMPUR | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | Period of Analysis | |
| | | | Date of Sampling | 11.08.2025 | 25.08.2025 | 11.08.2025 TO 30.08.2025 | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1683 | M1710 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 35 | 36 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 8.01 | 8.02 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 40 | 36 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*

***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

| ANALYSED BY | (Gaurav Kant) REVIEWED BY | (Kumar Vaibhav) Authorised Signatory |
|---|---|---|

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **08/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | **TC1432125000002022F** | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)** | | | | | **Date of Issue** | **05.09.2025** |
| **Project** | **NTST** | **Sampling Ref. No.** | **REM/BCCL/2025/08** | **Sampling Method** | **IS 3025 (Part-1) CMPDI/RI-II/LPM 13** | | |
| **Sampling Stations** | **(i)** | **Mine Discharge of NTST** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | **04.08.2025 TO 30.08.2025** |
| | | | **Date of Sampling** | **04.08.2025** | **18.08.2025** | | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | M1659 | M1686 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 42 | 40 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.89 | 7.85 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 32 | 36 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*
***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY*** (Gaurav Kant) ***REVIEWED BY*** (Kumar Vaibhav) ***Authorised Signatory***

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*---- End of Report ----*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **08/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | **TC143212500000202 2F** | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)** | | | | | **Date of Issue** | **05.09.2025** |
| **Project** | **BARAREE** | **Sampling Ref. No.** | **REM/BCCL/2025/08** | **Sampling Method** | | **IS 3025 (Part-1)** | **CMPDI/RI-II/LPM 13** |
| **Sampling Stations** | **(i)** | **Mine Discharge of BARAREE** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | **04.08.25 TO 30.08.2025** |
| | | | **Date of Sampling** | 04.08.2025 | 18.08.2025 | | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** M1669 | M1696 | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 36 | 34 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.83 | 7.88 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 32 | 36 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise. **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Gaurav Kant)
***REVIEWED BY***

(Kumar Vaibhav)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*



Annexure XXVII

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-650
email: rdrl2cmpdi@coalindia.in

**Test Report for Mine Effluent samples**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **08/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | **TC1432125000002022F** | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenvbccl@coalindia.in)** | | | | | **Date of Issue** | **05.09.2025** |
| **Project** | **JEALGORA** | **Sampling Ref. No.** | **REM/BCCL/2025/08** | **Sampling Method** | | **IS 3025 (Part-1)** | **CMPDI/RI-II/LPM 13** |
| **Sampling Stations** | **(I)** | **Mine Discharge of JEALGORA** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | |
| | | | **Date of Sampling** | **11.08.2025** | **25.08.2025** | **11.08.2025 TO 30.08.2025** | |

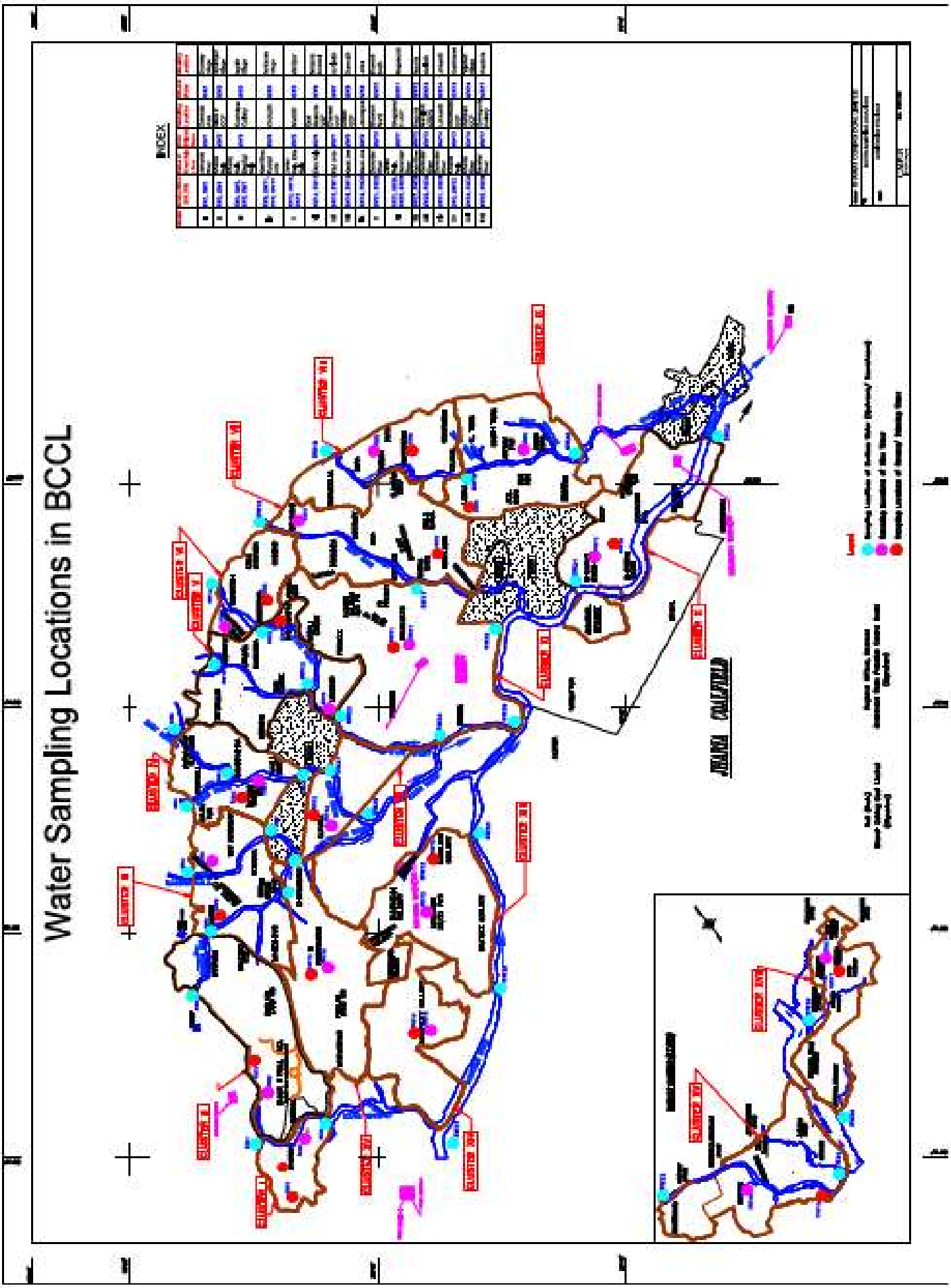
| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | M1670 | M1697 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 41 | 40 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.98 | 8.02 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 44 | 40 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*
***Grab sampling carried out for water samples.*
***All units in mg/L unless specified otherwise.*

***ANALYSED BY*** (Gaurav Kant) ***REVIEWED BY*** (Kumar Vaibhav) ***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Envi) , CMPDI, RI-II.*

*---- End of Report ----*


Water Sampling Locations in BCCL
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# ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER – IX

**(FOR THE MONTH JULY 2025)**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

# WATER QUALITY MONITORING

## 3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) **Mine Discharge of Jeenagora (MW9)**
ii) **Mine Discharge of LODNA (MW18)**
iii) **Mine Discharge of JOY RAMPUR (MW19)**
iv) **Mine Discharge of NT ST (MW20)**
v) **Mine Discharge of BARAREE (MW21)**
vi) **Mine Discharge of JEALGORA (MW22**

## 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.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **07/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | TC1432125000001970F | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)** | | | | | **Date of Issue** | 21.08.2025 |
| **Project** | | **Sampling Ref. No.** | **REM/BCCL/2025/07** | **Sampling Method** | **IS 3025 (Part-1) CMPDI/RI-II/LPM 13** | | |
| **Sampling Stations** | **(I)** | **Jeenagora** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | | |
| | | | **Date of Sampling** | 07.07.25 | 28.07.25 | **PERIOD OF ANALYSIS** 07.07.2025 TO 31.07.2025 | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | **M1625** | **M1652** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 41 | 45 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.49 | 7.53 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 40 | 44 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*



Annexure XXVII

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
## Environment Laboratory, Regional Institute-II
## MINE EFFLUENT TEST REPORT

**Test Report for Mine Effluent samples**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | 07/2025 | **Cluster** | **Cluster IX** | **ULR No.** | | TC1432125000001970F | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)** | | | | | **Date of Issue** | **21.08.2025** |
| **Project** | **LODNA** | **Sampling Ref. No.** | **REM/BCCL/2025/07** | **Sampling Method** | **IS 3025 (Part-1) CMPDI/RI-II/LPM 13** | | |
| **Sampling Stations** | **(i)** | **Mine Discharge of LODNA** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | **07.07.2025 TO 31.07.2025** |
| | | | **Date of Sampling** | **07.07.25** | **28.07.25** | | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | **M1627** | **M1654** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 45 | 44 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 8.03 | 7.99 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 32 | 36 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*
***All units in mg/L unless specified otherwise. **Grab sampling carried out for water samples.*

***ANALYSED BY*** (Kumar Vaibhav) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 07/2025 | Cluster | Cluster IX | ULR No. | | TC1432125000001970F | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 21.07.2025 |
| Project | JOYRAMPUR | Sampling Ref. No. | REM/BCCL/2025/07 | Sampling Method | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | | |
| Sampling Stations | (I) | Mine Discharge of JOYRAMPUR | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | Period of Analysis | |
| | | | Date of Sampling | 07.07.25 | 28.07.25 | 07.07.2025 TO 31.07.2025 | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1628 | M1655 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 42 | 43 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.64 | 7.61 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 40 | 32 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

**ANALYSED BY**

(Kumar Vaibhav)
**REVIEWED BY**

(Amit Raj Mishra)
**Authorised Signatory**

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*--- End of Report ---*

*Page -1 of 1*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **07/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | **TC14321250000001970F** | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)** | | | | | **Date of Issue** | **31.07.2025** |
| **Project** | **NTST** | **Sampling Ref. No.** | **REM/BCCL/2025/07** | **Sampling Method** | **IS 3025 (Part-1) CMPDI/RI-II/LPM 13** | | |
| **Sampling Stations** | **(I)** | **Mine Discharge of NTST** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | **07.07.2025 TO 31.07.2025** |
| | | | **Date of Sampling** | *07.07.25* | *22.07.25* | | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | **M1622** | **M1649** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 46 | 42 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.94 | 7.95 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 44 | 40 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples,*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 07/2025 | Cluster | Cluster IX | ULR No. | | TC1432125000001970F | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 31.07.2025 |
| Project | BARAREE | Sampling Ref. No. | REM/BCCL/2025/07 | Sampling Method | | IS 3025 (Part-1) | CMPDI/RI-II/LPM 13 |
| Sampling Stations | (i) | Mine Discharge of BARAREE | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | Period of Analysis | 01.07.25 TO 31.07.2025 |
| | | | Date of Sampling | 01.07.25 | 21.07.25 | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1615 | M1642 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 33 | 32 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.69 | 7.66 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 36 | 44 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise. **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*--- End of Report ---*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-650
email: rdrl2cmpdi@coalindia.in

**Test Report for Mine Effluent samples**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **07/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | **TC143212500001970F** | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenvbccl@coalindia.in)** | | | | | **Date of Issue** | **31.07.2025** |
| **Project** | **JEALGORA** | **Sampling Ref. No.** | **REM/BCCL/2025/07** | **Sampling Method** | | **IS 3025 (Part-1)** | **CMPDI/RI-II/LPM 13** |
| **Sampling Stations** | **(I)** | **Mine Discharge of JEALGORA** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | |
| | | | **Date of Sampling** | 01.07.25 | 21.07.25 | 01.07.25 TO 31.07.2025 | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | **M1616** | **M1643** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 41 | 44 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 8.02 | 7.98 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 36 | 32 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*
***Grab sampling carried out for water samples.*
***All units in mg/L unless specified otherwise.*

*ANALYSED BY*

(Kumar Vaibhav)
*REVIEWED BY*

(Amit Raj Mishra)
*Authorised Signatory*

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

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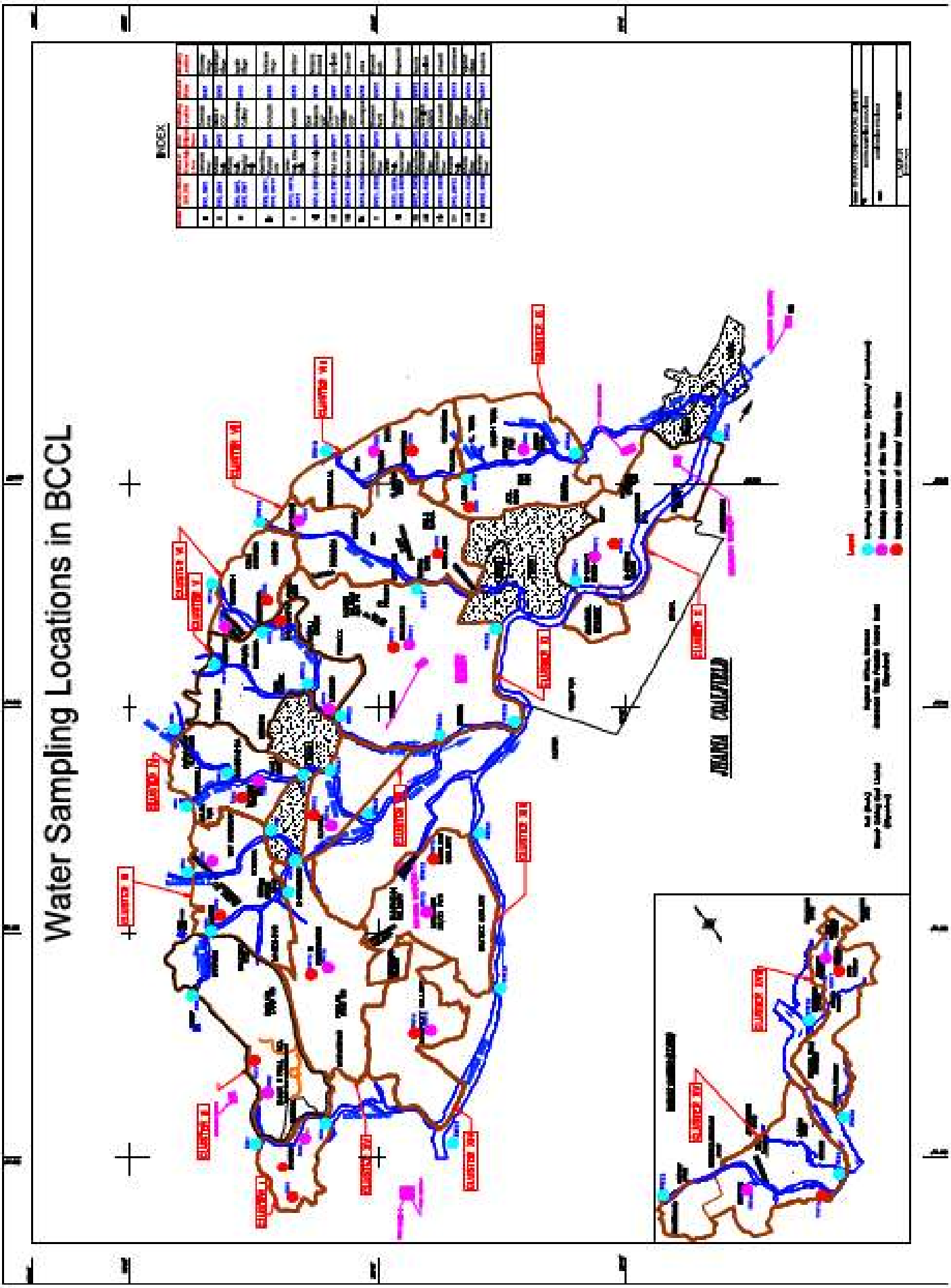
Annexure XXVII


Water Sampling Locations in BCCL
INDEX

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# ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER – IX

(FOR THE MONTH JUNE, 2025)

**E. C. no. J-11015/307/2010-IA.II (M) dated 01.03.2018**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

# WATER QUALITY MONITORING

## 3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) **Mine Discharge of Jeenagora (MW9)**
ii) **Mine Discharge of LODNA (MW18)**
iii) **Mine Discharge of JOY RAMPUR (MW19)**
iv) **Mine Discharge of NT ST (MW20)**
v) **Mine Discharge of BARAREE (MW21)**
vi) **Mine Discharge of JEALGORA (MW22**

## 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.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 06/2025 | Cluster | Cluster IX | ULR No. | | TC1432125000001918F | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 11.08.25 |
| Project | | Sampling Ref. No. | REM/BCCL/2025/06 | Sampling Method | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | | |
| Sampling Stations | (I) | Jeenagora | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | | |
| | | | Date of Sampling | 09.06.25 | 23.06.25 | PERIOD OF ANALYSIS | |

| SL No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1568 | M1595 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 32 | 35 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.61 | 7.62 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 40 | 44 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*



Annexure XXVII

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Mine Effluent samples**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **06/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | TC1432125000001916F | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)** | | | | | **Date of Issue** | **11.08.2025** |
| **Project** | **LODNA** | **Sampling Ref. No.** | **REM/BCCL/2025/06** | **Sampling Method** | **IS 3025 (Part-1) CMPDI/RI-II/LPM 13** | | |
| **Sampling Stations** | **(I)** | **Mine Discharge of LODNA** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | **02.06.25 TO 30.06.25** |
| | | | **Date of Sampling** | | 02.06.25 16.06.25 | | |
| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** | |
| | | | M1551 | M1578 | | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 46 | 47 | *100 (Max)* | 10 | |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.59 | 7.61 | *5.5 - 9.0* | 0.2 | |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 | |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 36 | 40 | *250 (Max)* | 4 | |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*
***All units in mg/l. unless specified otherwise. **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 06/2025 | Cluster | Cluster IX | ULR No. | | TC143212500000191 6F | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 11.08.2025 |
| Project | JOYRAMPUR | Sampling Ref. No. | REM/BCCL./2025/06 | Sampling Method | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | | |
| Sampling Stations | (i) | Mine Discharge of JOYRAMPUR | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | Period of Analysis | |
| | | | Date of Sampling | 02.06.25 | 16.06.25 | 02.06.25 TO 30.06.2025 | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1552 | M1579 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 34 | 35 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.98 | 7.99 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 44 | 48 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit.*

***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

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*Page -1 of 1*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | 06/2025 | **Cluster** | **Cluster IX** | **ULR No.** | | TC143212500000191 6F | |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | **Date of Issue** | 11.08.2025 |
| **Project** | NTST | **Sampling Ref. No.** | REM/BCCL/2025/06 | **Sampling Method** | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | | |
| **Sampling Stations** | (I) | **Mine Discharge of NTST** | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | **Period of Analysis** | 09.06.25 TO 30.06.25 |
| | | | **Date of Sampling** | 09.06.25 | 23.06.25 | | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** M1577 | **Observed Values** M1604 | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 51 | 56 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 8.02 | 7.98 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 36 | 32 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples,*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

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*---- End of Report ----*

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Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDI, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 05/2025 | Cluster | Cluster IX | ULR No. | | TC143212500000191 6F | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 11.08.2025 |
| Project | BARAREE | Sampling Ref. No. | REM/BCCL/2025/06 | Sampling Method | | IS 3025 (Part-1) | CMPDI/RI-II/LPM 13 |
| Sampling Stations | (i) | Mine Discharge of BARAREE | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | Period of Analysis | 02.06.2025 TO 30.06.2025 |
| | | | Date of Sampling | 02.06.25 | 16.06.25 | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1553 | M1580 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 50 | 49 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 8.04 | 8.09 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 44 | 40 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise. **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

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CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-650
email: rdrl2cmpdi@coalindia.in

**Test Report for Mine Effluent samples**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Month & Year** | **06/2025** | **Cluster** | **Cluster IX** | **ULR No.** | **TC143212500000191 6F** | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenvJbccl@coalindia.in)** | | | | **Date of Issue** | **11.08.2025** |
| **Project** | **JEALGORA** | **Sampling Ref. No.** | **REM/BCCL/2025/06** | **Sampling Method** | **IS 3025 (Part-1)** | **CMPDI/RI-II/LPM 13** |
| **Sampling Stations** | **(I)** | **Mine Discharge of JEALGORA** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | **Period of Analysis** | |
| | | | **Date of Sampling** | 02.06.25 16.06.25 | 02.06.25 TO 30.06.25 | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | **M1554** | **M1581** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 41 | 42 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 8.01 | 8.02 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 36 | 36 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*
***Grab sampling carried out for water samples.*
***All units in mg/L unless specified otherwise.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

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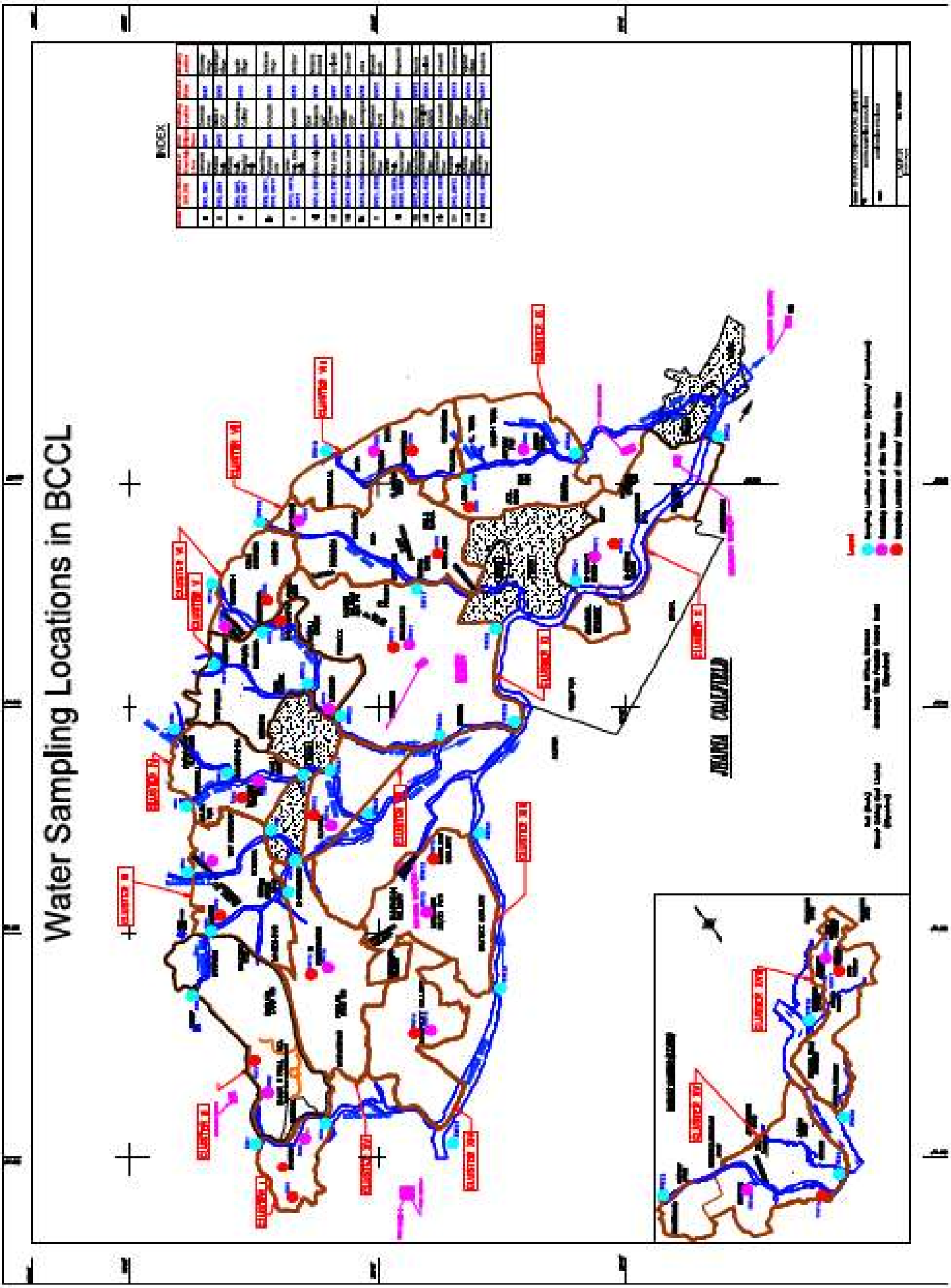
Water Sampling Locations in BCCL
INDEX

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# ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER – IX

**(FOR THE MONTH MAY, 2025)**

**E. C. no. J-11015/307/2010-IA.II (M) dated 01.03.2018**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

# WATER QUALITY MONITORING

## 3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) **Mine Discharge of Jeenagora (MW9)**
ii) **Mine Discharge of LODNA (MW18)**
iii) **Mine Discharge of JOY RAMPUR (MW19)**
iv) **Mine Discharge of NT ST (MW20)**
v) **Mine Discharge of BARAREE (MW21)**
vi) **Mine Discharge of JEALGORA (MW22**

## 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.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | **05/2025** | **Cluster** | **Cluster IX** | **ULR No.** | TC1432125000001862F |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)** | | | **Date of Issue** | 24.06.2025 |
| **Project** | | **Sampling Ref. No.** | **REM/BCCL/2025/05** | **Sampling Method** | **IS 3025 (Part-1) CMPDI/RI-II/LPM 13** |
| **Sampling Stations** | **(i)** | **Jeenagora** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | |
| | | | **Date of Sampling** | 05.05.25 20.05.25 | **PERIOD OF ANALYSIS** 05.05.25 TO 31.05.2025 |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | **M1513** | **M1540** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 36 | 39 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.91 | 7.85 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 44 | 40 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit,*

***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY*** (Kumar Vaibhav) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

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*Page -1 of 1*

Annexure XXVII

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Mine Effluent samples**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | 05/2025 | **Cluster** | **Cluster IX** | **ULR No.** | | TC1432125000001862F | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)** | | | | | **Date of Issue** | 24.06.2025 |
| **Project** | LODNA | **Sampling Ref. No.** | REM/BCCL/2025/05 | **Sampling Method** | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | | |
| **Sampling Stations** | (I) | **Mine Discharge of LODNA** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | 13.05.25 TO 31.05.25 |
| | | | **Date of Sampling** | 13.05.25 | 26.05.25 | | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | **M1519** | **M1546** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 49 | 47 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.72 | 7.77 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 32 | 36 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit.*
***All units in mg/L unless specified otherwise. **Grab sampling carried out for water samples.*

***ANALYSED BY*** (Kumar Vaibhav) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

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CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 05/2025 | Cluster | Cluster IX | ULR No. | | TC1432125000001862F | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 24.06.2025 |
| Project | JOYRAMPUR | Sampling Ref. No. | REM/BCCL/2025/05 | Sampling Method | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | | |
| Sampling Stations | (i) | Mine Discharge of JOYRAMPUR | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | Period of Analysis | |
| | | | Date of Sampling | 13.05.25 | 26.05.25 | 13.05.25 TO 31.05.2025 | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1520 | M1547 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 42 | 44 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 8.07 | 8.05 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 40 | 36 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit.*

***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
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MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | 05/2025 | **Cluster** | **Cluster IX** | **ULR No.** | | TC143212500000018 62F | |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | **Date of Issue** | 24.06.2025 |
| **Project** | NTST | **Sampling Ref. No.** | REM/BCCL/2025/05 | **Sampling Method** | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | | |
| **Sampling Stations** | (i) | **Mine Discharge of NTST** | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | **Period of Analysis** | 13.05.2025 TO 31.05.2025 |
| | | | **Date of Sampling** | 13.05.25 | 26.05.25 | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | **M1518** | **M1545** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 36 | 38 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.91 | 7.92 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 40 | 44 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*
***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

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CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 05/2025 | Cluster | Cluster IX | ULR No. | | TC143212500000001862F | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 24.06.2025 |
| Project | BARAREE | Sampling Ref. No. | REM/BCCL/2025/05 | Sampling Method | | IS 3025 (Part-1) | CMPDI/RI-II/LPM 13 |
| Sampling Stations | (i) | Mine Discharge of BARAREE | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | Period of Analysis | 13.05.25 TO 31.05.25 |
| | | | Date of Sampling | 13.05.25 | 26.05.25 | | |

| SL No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1521 | M1548 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 41 | 42 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.79 | 7.75 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 36 | 40 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit.*
***All units in mg/L unless specified otherwise. **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*



Annexure XXVII

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-650
email: rdrl2cmpdi@coalindia.in

**Test Report for Mine Effluent samples**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **05/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | **TC14321250000001862F** | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenvJbccl@coalindia.in)** | | | | | **Date of Issue** | **24.06.2025** |
| **Project** | **JEALGORA** | **Sampling Ref. No.** | **REM/BCCL/2025/05** | **Sampling Method** | | **IS 3025 (Part-1)** | **CMPDI/RI-II/LPM 13** |
| **Sampling Stations** | **(i)** | **Mine Discharge of JEALGORA** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | |
| | | | **Date of Sampling** | 13.05.25 | 26.05.25 | 13.05.25 TO 31.05.2025 | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | **M1522** | **M1549** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 44 | 43 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.94 | 7.93 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 32 | 36 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit.*
***Grab sampling carried out for water samples.*
***All units in mg/L unless specified otherwise.*

*ANALYSED BY*

(Kumar Vaibhav)
*REVIEWED BY*

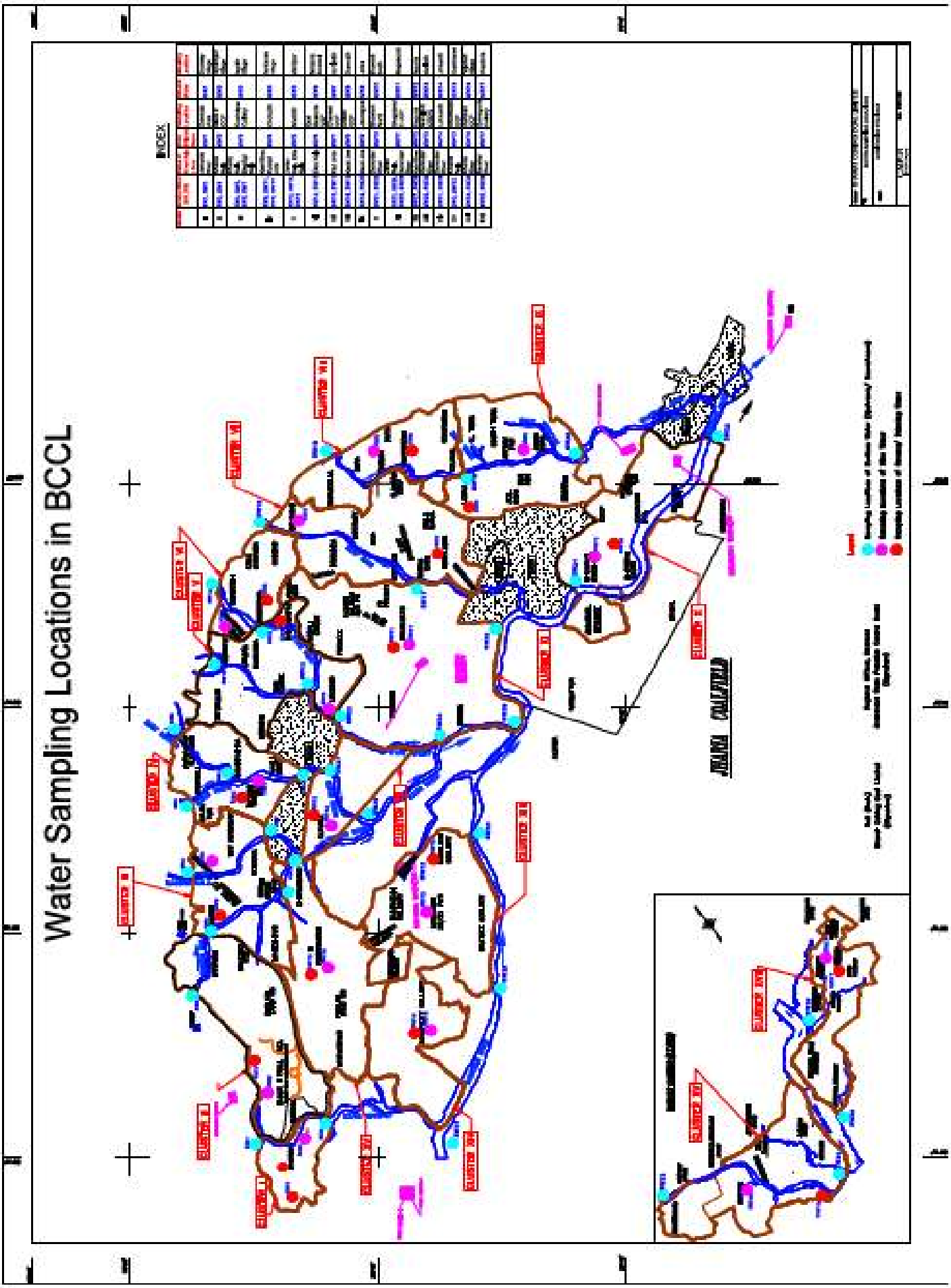
(Amit Raj Mishra)
*Authorised Signatory*

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*



Annexure XXVII


Water Sampling Locations in BCCL
INDEX

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# ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER – IX

**(FOR THE MONTH APRIL, 2025)**

**E. C. no. J-11015/307/2010-IA.II (M) dated 01.03.2018**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

# WATER QUALITY MONITORING

## 3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) **Mine Discharge of Jeenagora (MW9)**
ii) **Mine Discharge of LODNA (MW18)**
iii) **Mine Discharge of JOY RAMPUR (MW19)**
iv) **Mine Discharge of NT ST (MW20)**
v) **Mine Discharge of BARAREE (MW21)**
vi) **Mine Discharge of JEALGORA (MW22**

## 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.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# Test Report for Mine Effluent samples

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | 04/2025 | Cluster | Cluster IX | ULR No. | TC1432125000001810F |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | Date of Issue | 30.05.2025 |
| Project | | Sampling Ref. No. | REM/BCCL/2025/04 | Sampling Method | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 |
| Sampling Stations | (i) | Jeenagora | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | |
| | | | Date of Sampling | 01.04.25 to 21.04.2025 | PERIOD OF ANALYSIS 01.04.25 to 30.04.2025 |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1445 | M1482 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 36 | 34 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.79 | 7.78 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 36 | 36 | *250 (Max)* | 4 |

**LDL Indicates Lower Detection Limit & BDL Indicates Below Detection Limit.*
***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY*** (Kumar Vaibhav) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II*

*---- End of Report ----*



Annexure XXVII

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Mine Effluent samples**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **04/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | TC1432125000001810F | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)** | | | | | **Date of Issue** | 30.05.2025 |
| **Project** | **LODNA** | **Sampling Ref. No.** | **REM/BCCL/2025/04** | **Sampling Method** | **IS 3025 (Part-1) CMPDI/RI-II/LPM 13** | | |
| **Sampling Stations** | **(I)** | **Mine Discharge of LODNA** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | 07.04.2025 to 30.04.2025 |
| | | | **Date of Sampling** | 07.04.2025 | 28.04.2025 | | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | **M1451** | **M1488** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R -2017, Gravimetric | 36 | 34 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.64 | 7.59 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 32 | 36 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*
***All units in mg/L unless specified otherwise. **Grab sampling carried out for water samples.*

***ANALYSED BY*** (Kumar Vaibhav) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

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*---- End of Report ----*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

# Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 04/2025 | Cluster | Cluster IX | ULR No. | | TC14321250000001810F | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 30.05.2025 |
| Project | JOYRAMPUR | Sampling Ref. No. | REM/BCCL/2025/04 | Sampling Method | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | | |
| Sampling Stations | (i) | Mine Discharge of JOYRAMPUR | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | Period of Analysis | |
| | | | Date of Sampling | 07.04.2025 | 21.04.2025 | 07.04.2025 to 30.04.2025 | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1452 | M1475 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 31 | 29 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.56 | 7.54 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 40 | 44 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*

***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*

*Page -1 of 1*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | 04/2025 | **Cluster** | **Cluster IX** | **ULR No.** | | TC14321250000001810F | |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | **Date of Issue** | 30.05.2025 |
| **Project** | NTST | **Sampling Ref. No.** | REM/BCCL/2025/04 | **Sampling Method** | IS 3025 (Part-1) CMPDI/RI-II/LPM 13 | | |
| **Sampling Stations** | (I) | **Mine Discharge of NTST** | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | **Period of Analysis** | 07.04.2025 to 30.04.2025 |
| | | | **Date of Sampling** | 07.04.2025 | 28.04.2025 | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1450 | M1487 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 41 | 39 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.44 | 7.43 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 48 | 44 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*
***All units in mg/L unless specified otherwise **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*--- End of Report ---*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

## Test Report for Mine Effluent samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 04/2025 | Cluster | Cluster IX | ULR No. | | TC14321250000001810F | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 30.05.2025 |
| Project | BARAREE | Sampling Ref. No. | REM/BCCL/2025/04 | Sampling Method | | IS 3025 (Part-1) | CMPDI/RI-II/LPM 13 |
| Sampling Stations | (i) | Mine Discharge of BARAREE | Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent | | | Period of Analysis | 07.04.2025 to 30.04.2025 |
| | | | Date of Sampling | 07.04.2025 | 21.04.2025 | | |

| Sl. No. | Parameter | Method of Analysis | Observed Values | | STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) | LDL |
|---|---|---|---|---|---|---|
| | | | M1453 | M1476 | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 42 | 41 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.81 | 7.82 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 48 | 40 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*
***All units in mg/L unless specified otherwise. **Grab sampling carried out for water samples.*

***ANALYSED BY***

(Kumar Vaibhav)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*--- End of Report ---*



Annexure XXVII

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-650
email: rdrl2cmpdi@coalindia.in

**Test Report for Mine Effluent samples**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Month & Year** | **04/2025** | **Cluster** | **Cluster IX** | **ULR No.** | | **TC14321250000001810F** | |
| **Customer** | **Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenvbccl@coalindia.in)** | | | | | **Date of Issue** | **30.05.2025** |
| **Project** | **JEALGORA** | **Sampling Ref. No.** | **REM/BCCL/2025/04** | **Sampling Method** | | **IS 3025 (Part-1)** | **CMPDI/RI-II/LPM 13** |
| **Sampling Stations** | **(i)** | **Mine Discharge of JEALGORA** | **Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent** | | | **Period of Analysis** | |
| | | | **Date of Sampling** | | 07.04.2025 21.04.2025 | 07.04.2025 to 30.04.2025 | |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values** | | **STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)** | **LDL** |
|---|---|---|---|---|---|---|
| | | | **M1454** | **M1477** | | |
| 1 | Total Suspended Solids | IS 3025/17:1984, R :2017, Gravimetric | 43 | 45 | *100 (Max)* | 10 |
| 2 | pH | IS-3025/11:1983, R-2017, Electrometric | 7.52 | 7.57 | *5.5 - 9.0* | 0.2 |
| 3 | Oil & Grease | IS 3025/39:1991, R : 2019, Partition Gravimetric | <4.0 | <4.0 | *10 (Max)* | 2 |
| 4 | COD | APHA 23rd Edition 5220 C Titrimetric Method | 44 | 40 | *250 (Max)* | 4 |

**LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit.*
***Grab sampling carried out for water samples.*
***All units in mg/L unless specified otherwise.*

*ANALYSED BY*

(Kumar Vaibhav)
*REVIEWED BY*

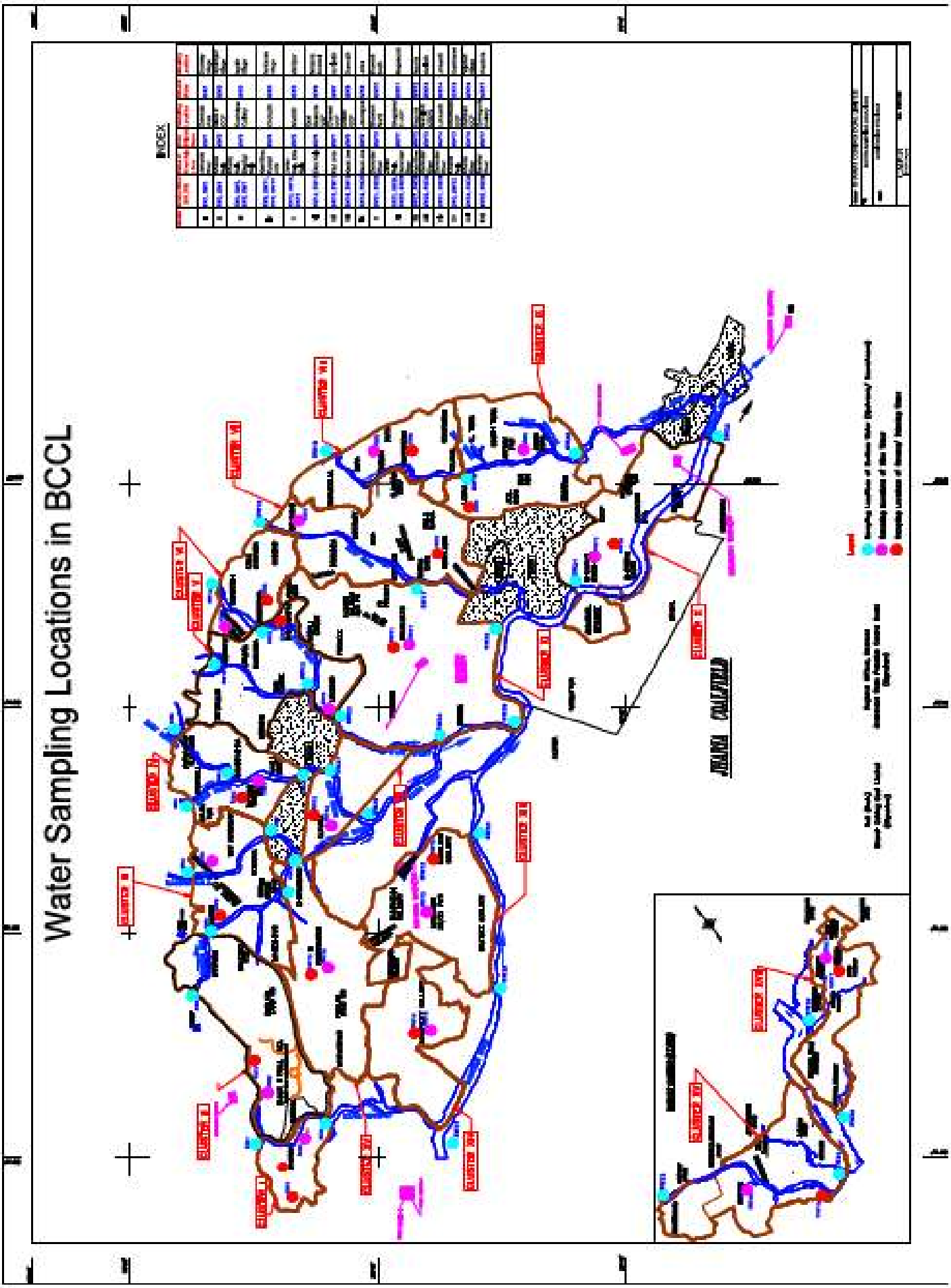
(Amit Raj Mishra)
*Authorised Signatory*

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*



Annexure XXVII


Water Sampling Locations in BCCL
INDEX

**Annexure XVIII**

# Letter and subsidence monitoring report

**BHARAT COKING COAL LIMITED**
*(A subsidiary of CIL)*
*REGD. Office: Koyla Bhawan, Koyla Nagar, Dhanbad-826005*
*CIN No. U10101JH1972GOI000918*
*Office of the Project Officer*
*Amalgamated Joyrampur Colony*
*Lodna Area*

**To whom it may concern**

This is to certify that there is no mining induced subsidence movement over and around the working area of Cluster IX Coal mining Projects, Lodna Area, namely Amalgamated Joyrampur Colliery (OC) and NT-ST (Expansion) OCP after obtaining Environmental Clearance granted on 21.05.2013.

Project Officer
NT-ST (Expansion) OCP

28/12/2021
Manager/Project Officer
Amal. Joyrampur Colliery

Colliery surveyor
Amal. Joyrampur Colliery

SUBSIDENCE RECORD
LOCATION:- JOYRAMPUR, Bhosh Mode

| STN. | Date of Measur- 4/11/21 R.L | Date of Meas.- 7/2/22 R.L. | Subsidence R.L |
|---|---|---|---|
| S. 93 | 174. 082 | 174. 082 | 0 |
| S. 94 | 174. 277 | 174. 277 | 0 |
| S. 95 | 174. 503 | 174. 503 | 0 |
| S. 96 | 174. 839 | 174. 839 | 0 |
| S. 97 | 175. 255 | 175. 255 | 0 |
| S. 98 | 175. 753 | 175. 753 | 0 |
| S. 99 | 176. 355 | 176. 355 | 0 |
| S. 100 | 177. 024 | 177. 024 | 0 |
| S. 114 | 172. 959 | 172. 959 | 0 |
| S. 115 | 173. 091 | 173. 091 | 0 |
| S. 116 | 173. 285 | 173. 285 | 0 |
| S. 117 | 173. 502 | 173. 502 | 0 |
| S. 118 | 173. 638 | 173. 638 | 0 |
| S. 119 | 173. 796 | 173. 796 | 0 |
| S. 120 | 173. 988 | 173. 988 | 0 |
| S. 121 | 174. 205 | 174. 205 | 0 |
| S. 122 | 174. 512 | 174. 512 | 0 |
| S. 123 | 174. 791 | 174. 791 | 0 |
| S. 124 | 175. 172 | 175. 172 | 0 |
| S. 125 | 175. 636 | 175. 636 | 0 |
| S. 126 | 176. 165 | 176. 165 | 0 |
| S. 127 | 176. 856 | 176. 856 | 0 |
| S. 128 | 177. 262 | 177. 262 | 0 |
| S. 129 | 174. 74 | 174. 74 | 0 |
| S. 130 | 178. 392 | 178. 392 | 0 |
| S. 141 | 172. 846 | 172. 846 | 0 |
| S. 142 | 172. 712 | 172. 712. | 0 |

Surveyor 4/11/21 S.O. Surveyor 7/2/22 S.O.

| Date STN. | 4/11/21 R.L | 7/2/22 R.L. | Subsidence R.L |
|---|---|---|---|
| S. 143 | 172. 95 | 172. 95 | 0 |
| S. 144 | 173. 401 | 173. 401 | 0 |
| S. 145 | 173. 598 | 173. 598 | 0 |
| S. 146 | 173. 758 | 173. 758 | 0 |
| S. 147 | 174. 027 | 174. 027 | 0 |
| S. 148 | 174. 341 | 174. 341 | 0 |
| S. 149 | 174. 618 | 174. 618 | 0 |
| S. 150 | 174. 859 | 174. 859 | 0 |
| S. 151 | 175. 095 | 175. 095 | 0 |
| S. 152 | 175. 419 | 175. 419 | 0 |
| S. 153 | 175. 681 | 175. 681 | 0 |
| S. 154 | 176. 326 | 176. 326 | 0 |
| S. 155 | 176. 972 | 176. 972 | 0 |
| S. 156 | 177. 486 | 177. 486 | 0 |
| S. 157 | 177. 97 | 177. 97 | 0 |
| S. 169 | 172. 573 | 172. 573 | 0 |
| S. 170 | 172. 962 | 172. 962 | 0 |
| S. 171 | 173. 417 | 173. 417 | 0 |
| S. 172 | 173. 602 | 173. 602 | 0 |
| S. 173 | 173. 77 | 173. 77 | 0 |
| S. 174 | 174. 12 | 174. 12 | 0 |
| S. 175 | 174. 506 | 174. 506 | 0 |
| S. 176 | 174. 71 | 174. 71 | 0 |
| S. 177 | 174. 907 | 174. 907 | 0 |
| S. 178 | 175. 057 | 175. 057 | 0 |
| S. 179 | 175. 236 | 175. 236 | 0 |
| S. 180 | 175. 424 | 175. 424 | 0 |
| S. 181 | 175. 768 | 175. 768 | 0 |

Surveyor 4/11/21 S.O. Surveyor 7/2/22 S.O.

Scanned with CamScanner

| Date STN. | 4/11/21 R.L | 7/2/22 R.L. | Subsidence R.L |
|---|---|---|---|
| S. 182 | 176. 357 | 176. 357 | 0 |
| S. 183 | 176. 918 | 176. 918 | 0 |
| S. 184 | 177. 274 | 177. 274 | 0 |
| S. 185 | 178. 614 | 178. 614 | 0 |
| S. 196 | 172. 591 | 172. 591 | 0 |
| S. 197 | 172. 942 | 172. 942 | 0 |
| S. 198 | 173. 38 | 173. 38 | 0 |
| S. 199 | 173. 563 | 173. 563 | 0 |
| S. 200 | 173. 876 | 173. 876 | 0 |
| S. 201 | 174. 29 | 174. 29 | 0 |
| S. 202 | 174. 616 | 174. 616 | 0 |
| S. 203 | 174. 773 | 174. 773 | 0 |
| S. 204 | 174. 876 | 174. 876 | 0 |
| S. 205 | 175. 049 | 175. 049 | 0 |
| S. 206 | 175. 242 | 175. 242 | 0 |
| S. 207 | 175. 454 | 175. 454 | 0 |
| S. 208 | 175. 749 | 175. 749 | 0 |
| S. 209 | 176. 003 | 176. 003 | 0 |
| S. 210 | 176. 26 | 176. 26 | 0 |
| S. 211 | 176. 882 | 176. 882 | 0 |
| S. 212 | 177. 373 | 177. 373 | 0 |
| S. 225 | 173. 149 | 173. 149 | 0 |
| S. 226 | 173. 547 | 173. 547 | 0 |
| S. 227 | 173. 993 | 173. 993 | 0 |
| S. 228 | 174. 449 | 174. 449 | 0 |
| S. 229 | 174. 744 | 174. 744 | 0 |

4/11/21 SURVEYOR S.O. 7/2/22 SURVEYOR S.O.

Scanned with CamScanner

**Annexure XIX**

## 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. | *Syzizion cuminii* | Jamun |
| 23. | *Azadirachta indica* | Neem |
| 24. | *Holoptelea integrifolia* | Indian elm |
| 25. | *Butea monosperma* | Palash /dhak |

वैज्ञानिक / Scientist
वन पारितंत्रकीवी 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 मिनी रत्न कंपनी'
(कोल इंडिया का एक अंग)
महाप्रबंधक का कार्यालय
लोदना क्षेत्र ,पो.-भागा
धनबाद -828301,(झारखंड)
वेबसाइट :www.bcclweb.in
ईमेल :gmlodna.bccl@coalindia.in
सी.आई.एन.:U10101JH1972GO1000918

Bharat Coking Coal Limited
*A Mini Ratan Company*
(A Subsidiary of Coal India Limited)
Office of the General Manager
Lodna Area , PO-Bhaga
Dhanbad-828301 (Jharkhand).
Website: www.bcclweb.in
Email: gmlodna.bccl@coalindia.in
CIN:U10101JH1972GO1000918

**OFFICE OF GENERAL MANAGER, LODNA AREA-X**

Ref. No.- BCCL/LA/GM/Envt/2025-26/ 604 Date: 27/11/25

# UNDERTAKING

This is to certify that no depillaring operation is being carried our below the township/ colony under Cluster IX.

27/11/25

General Manager
Lodna Area (Cluster IX)
BCCL

## Annexure XXI

### Transportation Plan for Conveyor


सेंट्रल माईन प्लानिंग एण्ड डिज़ाइन इंस्टीच्यूट 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


cmpdi
A Mini Ratna Company

पत्रांकः आर.आई.-2/पर्यावरण/एम-30/1150

(Envt.) Envt Dept. Dy. No. 1502(1) Dated 12/6/15 BCCL

दिनांकः 20.06.2015

सेवा में,
उप महाप्रबंधक (पर्यावरण)
बी. सी. सी. एल.
कोयला भवन
धनबाद ।

**विषयः Study of installation of Rail-cum-Conveyor System in BCCL for transportation of coal.**

महोदय,

This has reference to your letter no. BCCL/GM(Env.)/F-EC/13/622, dated 25.05.2013 for conducting the study and preparation of plan for installation of Rail-cum-Conveyor System for coal transportation in BCCL as a part of compliance of environmental clearance (EC) conditions stipulated by MoEF & CC in EC orders of different clusters. In this regard, we would like to inform you the following:

a. As per EC clearance order transportation plan for Rail-cum-Conveyor system should dovetailed with Jharia Action Plan (Master Plan). The system of transportation is required to be installed in 2nd phase of EC implementation i.e. after completion of Master Plan (10 years) and 5 years of gestation period.

b. JRDA has issued direction to RITES for traffic survey and data collection to initiate feasibility study regarding Diversion of Railway lines from fire affected and subsidence prone areas

c. Coal transportation route / conveyor installation layout will be finalized after liquidation of coal mine fire, rehabilitation of 595 unstable sites, road and rail route alignment and location of Rly. Sidings of BCCL.

CMPDI will be able to submit the plan / study for installation of Rail-cum-Conveyor System in BCCL for transportation of coal only after diversions and re-alignments of roads and railway lines and relocation of railway sidings

This is for your kind information.

भवदीय

( वि. कु. सिंह ) 12/6/15
क्षेत्रीय निदेशक

Sri Awadhesh Jee
For compliance pl pse.
23/6/15


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

# Impact Assessment of CSR projects undertaken by Bharat Coking Coal Limited, Dhanbad FY(2015-16)

**By**
**National CSR Hub**
**Tata Institute of Social Sciences, Mumbai**

# RESEARCH TEAM AT NATIONAL CSR HUB

**Project Director**

Prof. B. Venkatesh Kumar

**Senior Consultant**

Ms. Dilnavaz Munshi

**Project Co-ordinator**

Ms. Dipty Nisha

**Data collection, Analysis & Report Writing**

Ms. Prachi Kathuria

Mr. Sumit Jagtap

**Research Investigators**

Mr. Monu Kumar

Mr. Ajay Kumar Singh

Mr. Dinesh Kumar

Mr. Suraj Kumar

**Secretariat Support**

Ms. Vaishali Gajbiye

Ms. Rajisha Ramankutty

Ms. Sushma Kir

## ACKNOWLEDGEMENT

This Impact Assessment Study of CSR project of Bharat Coking Coal Limited, Dhanbad for the FY 2015-16 has been undertaken by National CSR Hub, Tata Institute of Social Sciences (TISS) as a part of the MoU with CIL and TISS.

At the outset, we would like to thank BCCL for granting this project to National CSR Hub, TISS. We express heartfelt gratitude to Director (Personnel), BCCL for giving us the opportunity to carry out the Impact Assessment study of CSR projects for the FY 2015-16. We express our gratitude to the General Manager, CSR and the entire CSR department of BCCL for their continuous support and guidance to the research team of NCSR Hub.

We also extend our gratefulness to respective area General Managers, Medical Officers (Health Department) and concerned project in-charge appointed by BCCL (CSR officials) for making all the arrangements for the study and making us comfortable with their warm hospitality.

Prof. B. Venkatesh Kumar
Director
National Corporate Social Responsibility Hub
TISS, Mumbai

## EXECUTIVE SUMMARY

Bharat Coking Coal Limited is a subsidiary of Coal India Limited, a Maharatna Company. The company is currently operating in 12 administrative areas in Jharia Coalfields encompassing around 226 peripheral villages mainly in the District of Dhanbad, Jharkhand and in some part of West Bengal. The Strategic CSR of BCCL states that the company's main objective is to improve the quality of life of people living in and around its command areas. The key areas of CSR invention are rural development, livelihood generation and skill development. It has a long history of philanthropic activities which were converged to align with the Corporate Social Responsibility mandate of the Companies Act 2013. Rural development, livelihood generation and skill development are thrust areas of the BCCL's CSR interventions. As per the CSR guideline, BCCL has partnered with Tata Institute of Social Sciences to conduct evaluation studies for the completed CSR projects.

For the purpose of this report, impact assessment studies were carried out for four projects, namely, Scheme for Multi-Purpose Utilisation of Mine Water, Mobile Medical Van, Village Adoption and Construction of PCC/Bituminous Road.

The primary data collection for the impact assessment studies was completed in September 2017 by a six member team from TISS. Mixed research methodology was used while In-Depth Interviews, Household Surveys and focused group discussions were the main methods implemented to collect data. 1000 samples were collected from 13 operational areas of BCCL for the impact assessment study.

The objectives of the impact assessment were:

(i) To assess if the objectives of individual projects have been met;

(ii) To understand the continued relevance of the individual projects in their respective contexts; and

(iii) To identify issues in programmatic implementation and provide recommendation to fulfill the objectives efficiently.

Mobile Medical Van has aimed to provide quality health services to the rural poor residing in the operational areas of BCCL. The impact of the project on the community has been remarkable as it provides doorstep medical services to the poor, reduces the medical expenditures, reached the most remote villages and awareness generation. Limited health services, awareness campaigns and limited regularity are the major drawbacks of the project.

In the project Scheme for Multi-Purpose Utilisation of Mine Water, 352 samples were collected, 13 FGDs and 4 Key Informant Interviews (KII) were conducted. There is strong demand for the supply of mine water in the renovated ponds especially during water scarcity periods, which have been stopped for the last couple of months. The mine water is used for household and cattle consumption. Livelihood generation activities have not commenced as yet.

BCCL also adopted Lahbera village, situated in Jharia block of Dhanbad district and committed to the holistic development of the village. Various infrastructural and economic projects were implemented in the village. Although the project has been a huge success, a lapse in monitoring, incomplete projects and limited resources for employment generation have inhibited the successful completion of the project.

BCCL also constructed roads at 7 locations across Dhanbad districts. The roads had led to improved connectivity and enhanced hygienic living conditions, but lack of monitoring, limited connectivity and lack of participatory approach have been some of the shortcomings of the project.

TISS has also provided recommendation such as regular monitoring, creation of employment generation activities, the formation of SHGs etc. for efficient execution of future projects.

## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| **ADC** | - | Adult Education Center |
| **BCCL** | - | Bharat Coking Coal Limited |
| **CHC** | - | Community Healthcare Center |
| **CSR** | - | Social Corporate Responsibility |
| **CTP** | - | Computer Training Program |
| **FGD** | - | Focused Group Discussion |
| **GM** | - | General Manager |
| **HHI** | - | Household Interviews |
| **IDI** | - | In – depth Interviews |
| **IT** | - | Information and Technology |
| **KII** | - | Key Informant Interviews |
| **LVA** | - | Lahbera – Village Adoption |
| **MMV** | - | Mobile Medical Van |
| **MUMW** | - | Scheme for multipurpose utilization of abandoned mine water |
| **PCC** | - | Plain Cement Concrete |
| **PHC** | - | Primary Health Care Center |
| **SHG** | - | Self Help Group |
| **ST** | - | Schedule Tribes |
| **STC** | - | Sewing Training Centre |
| **STP** | - | Sewing Training Program |
| **EJ** | – | Eastern Jharia |
| **WJ** | – | Western Jahria |
| **WWD** | _ | Western Washery Division |
| **CV** | – | Chanch Victora |

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# CHAPTER 1 - INTRODUCTION

Businesses are the most powerful constituents of the society, and they do not operate in isolation; there is an increased realization that not only can companies affect society at large, but they are also in a unique position to influence society and a make positive impact.

> "The Organization for Economic Co-operation and Development[1] (OECD) established a set of guidelines for multinational enterprises in 1976 and was thus a pioneer in developing the concept of CSR. The purpose of these guidelines was to improve the 'investment' climate and encourage the positive contribution multinational enterprises can make to economic and social progress".

An evaluation is 'the systematic and objective assessment of an on-going or completed project, programme or policy, its design, implementation and results. The aim is to determine the relevance and fulfilment of objectives, development efficiency, effectiveness, impact and sustainability. An evaluation should provide information that is credible and useful, enabling the incorporation of lessons learned into the decision-making process of both recipient and donors.' (OECD Publications, 2010)

### 1.1. About Bharat Coking Coal Limited

Bharat Coking Coal Limited (BCCL) is a subsidiary of Coal India Limited, a Maharatna Company. The company is operating in 12 administrative areas in Jharia Coalfields encompassing around 226 peripheral villages mainly in the District of Dhanbad, Jharkhand and in some part of West Bengal. The Strategic CSR of BCCL states that the company's main objective is to improve the quality of life of people living in and around its command areas. Towards achieving this objective and understand the interest levels of the local community, BCCL has undertaken a departmental baseline survey cum Skill Gap Analysis study at some locations. The recommendations from the study would form the basis for the design and deployment of the various skill development initiatives to be planned.

[1] http://www.oecd.org/about/

### 1.2 About National Corporate Social Responsibility Hub, TISS

National Corporate Social Responsibility Hub, (NCSR Hub) was established in 2011 by the Department of Public Enterprises to enable the Public Sector Enterprises to design and implement holistic and rights-based CSR initiatives. Tata Institute of Social Sciences (TISS), Mumbai and Department of Public Enterprises (DPE), Government of India had come to realize that there is a need to have a centralized system where core functions of CSR including learning and knowledge dissemination take place. The core activities of the Hub are:

- Vision and strategic direction setting for Policy and Programme
- Advisory role for PSEs on Policy and Programme implementation
- Research and development and 'evidence-based' policy advocacy
- Capacity building of PSEs, partners and civil society institution
- Impact assessment, monitoring and evaluation
- Empanelment and partner management

### 1.3 Project Backgrounds

Bharat Coking Coal Limited (BCCL) sanctioned impact evaluation studies for four projects in different stages of completion which were carried out by National CSR Hub in August-September 2017. The following report details the evaluation of projects undertaken by Bharat Coking Coal Limited in accordance with their CSR policy laid out in 2014. A cogent CSR policy is a requirement laid out in the Companies (CSR Policy) Rules, 2014 conferred under the Companies Act, 2013.

As stated above, for this report four projects were evaluated namely: *Mobile Medical Van, Scheme for multipurpose utilisation of abandoned mine water, Village adoption program and construction of PCC/Bituminous road.*

a) **Mobile Medical Van (*Swastha Ratha*) -** The service of Mobile Medical Van for villagers under command areas of BCCL started in 2009 with the help of 2 Mobile Medical Vans. Now BCCL has fourteen Medical Mobile Vans (MMVs) equipped with doctors, paramedical staff serving different 203 villages situated in and around the mining areas on working days. The villagers are examined by the experienced clinicians

and medicines are dispensed free of cost to them. This provision has been made by BCCL exclusively under CSR activities for the benefit of villagers by providing them free medical assistance.

**Objective:** To provide health services in peripheral villages in and around BCCL command area to provide medical facilities with a focused service on identification, screening, diagnosis and treatment to provide free medical; assistance.

**Location of implementation:** 203 villages in the peripheral areas of BCCL

b) **Scheme for multipurpose utilisation of abandoned mine water -** BCCL since inception has felt the importance of water and endeavoured for effective and gainful utilisation of mine water from abandoned mines which has to be taken out compulsorily in the course of the mining process. For harnessing such water, BCCL has taken upon the task of holding the mine water into the water bodies by restricting them to flow into the natural drainage course like village reservoirs which gets dried during summers by laying out a pipeline network of approximately 45 km.

**Objective of the project:** Harnessing mine water for its gainful multipurpose utilisation in the peripheral villages of BCCL command area.

**Location:** Two reservoirs are situated in Khonathi and Behrakudar villages of Baghmara block of Dhanbad district.

c) **Lahbera Village Adoption Program** - In order to develop peripheral villages of BCCL in an integrated manner, including their economic development, infrastructure upliftment, providing opportunities for social empowerment and other aspects of overall human development. i.e. education, health, drinking water supply, providing training and tools for self-employment etc. This would include economic development, infrastructure development and other aspects of human development, i.e. education, health, drinking water supply and credit linkage.

**Objective of the project:** The objective of Village Adoption Programme is to develop the selected village in an integrated manner ensuring the holistic and integrated development of village through capacity building and participation of local people and institutions.

**Location:** Lahbera Village in Jharia block of Dhanbad district

d) **Construction of PCC/Bituminous road -** Understanding the importance of Road BCCL had Constructed PCC Roads in and around eight villages of the BCCL command area. Roads are of vital importance to make a nation grow and develop. In addition, providing access to employment, social, health and education services makes a road network crucial in fighting against poverty. They open up areas of economic and social development.

**Objective of the project**: Enabling and increasing the connectivity from semi-rural to urban areas by constructing PCC Road.

**Location:**

| SN | Name of Village/Area | Construction in Km/Meters |
|---|---|---|
| 1 | Kacharra Arah Tola , Hatudih Panchayat | 400 meters |
| 2 | Lahbera Village | 1.5 Km |
| 3 | Aamtal Village, Aamtal Panchayat (Kusunda) | 1.5 km |
| 4 | Satitand Village, Bauakala Panchayat (Kusunda) | 500 meters |
| 5 | Padugora Village, Padugora Panchayat (WJ area) | 400 meters |
| 6 | Kandra Village, Kandrta Panchayat | 500 meters |
| 7 | Bakaspura Village, Luti Pahari Panchayat | 400 meters |

# CHAPTER 2 – RESEARCH METHODOLOGY

Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In it, one studies the various steps that are adopted by a researcher in studying his research problem along with the logic behind them (Kothari, 2004). This chapter outlines the research methodology and also examines the objectives of the study and the research question. The chapter also includes the research design, methods, and level of engagement for data collection, on and off the field. The stage of data collection has also been explained in the chapter with a subsequently the steps utilized to analyze the data that is already collected from the field.

**2.1 Objective of Study**

The very purpose of the research is to discover answers to the question through the application of the scientific procedures (Kothari, 2004). The aim of the study was to understand the extent of the impact of projects on the socio-economic conditions of the targeted beneficiaries.

The Impact Assessment was conducted on four major projects namely:

1. Mobile Medical Van (MMV),
2. Scheme for multipurpose utilization of abandoned mine water (MUMW),
3. Road Construction, and
4. Labhera village adoption project (LVA)

Therefore the objective of each project has some variation from the other even though having that the main objectives were as follows:

i. To Analyzed the key impact areas of the project
ii. To Analyzed the extent of impact on the beneficiaries
iii. To suggest recommendation for improvement for the project.

**2.2 Research Design**

The research design refers to the overall strategy that one choose to integrate the different components of the study in a coherent and logical way, thereby, ensuring one will effectively address the research problem; it constitutes the blueprint for the collection, measurement, and analysis of data (De Vaus, 2001)

This study is an **Evaluation** research study as it is designed to assess the outcomes of an intervention so that the findings will provide insights useful for the organizations that have funded and implemented the project. The study is an end line evaluation study, which implies that the findings would be useful if the Company intent to reintroduce the project.

The project undertaken for impact assessment studies were those which are implemented by the BCCL CSR and which covers a mixed chunk of populate spread across the BCCL Command area. As there were four projects that required studying, the research team had developed two research designs based on the project objectives and population covered. This study employs a mixture of Quantitative and Qualitative research methods to evaluate the key aspects of the two projects namely; MMV and MUMV. If one has to define mixed method research it can be 'In general, mixed methods research represents research that involves collecting, analyzing, and interpreting quantitative and qualitative data in a single study or in a series of studies that investigate the same underlying phenomenon.' (Leech N, Onwuegbuzie A, 2008). The study has attempted not just to generate summary statistics that reveal the overall performance of the projects but has also attempted to delve into the individual stories, histories, life experiences and psyche of the beneficiaries through intensive beneficiary-specific case studies (of selected beneficiaries. While conducting the study of MMV and MUMW the research team used two major tools for data collection mainly: Focused Group Discussion (FGD) and Household Survey (HH). These methods were felt appropriate by the research team as it helped in fulfilling the appropriate size and appropriate response.

Simultaneously a different research design was formed for studying the impact of LVA and Road Construction. The qualitative research design enabled the research team to understand the impact of project in their daily life. Along with it, the project had limited beneficiaries that provided the research team with the opportunity to study and to understand the lived narratives of the beneficiaries and also the impact of LVA and road in their day to day life.

**2.3 Tools for Data Collection**

The tool is one of the essential components of a research study. It is an instrument that helps the researcher to meet the objectives of the research. There are various kinds of tools that are utilized based on the needs and objectives of the research. In the current study the research team undertook certain sets of tool they are listed below;

Major tools involved in the study were:

i. **i. House Hold Interview (Survey) (HHI)**: As a few projects had greater coverage in terms of area and population the household survey was used to get details from the identified villages and areas/panchayats
ii. **ii. Focused Group Discussion (FGD):** FGDs where conducted in all the four project, and the interviewers for the FGD was the village members, Ward/Gram Panchayat Representative, ASHA, Women Representative, SHGs Group Women's, Youth group member etc.
iii. **iii. In-depth Interviews (IDI):** Similarly IDI was conducted with village members who were directly affected by the project
iv. **iv. Case studies:** Case studies were used to get life narratives of the beneficiaries and to understand the impact of the project on their socio-economic and cultural lives
v.

**2.4 Data collection methods**

The sampling type used for data collection was stratified random sampling method. **The primary data** was collected using the following methods, selected as per the above-explained research design:

a. Survey of beneficiaries through questionnaire
b. Semi-structured interview (using interview schedule) and In-depth interviews. The in-depth interviews were open-ended with complete scope for probing and getting detailed information from the participants.
c. Participatory research methods such as transect walk
d. Document analysis (review of project reports)
e. Direct observation (home visit, village/town visit and institution visit)

### 2.5 Participants of Data Collection

This study emphasizes the obtaining of perspectives from multiple stakeholders. Accordingly, the following participants and stakeholders were covered through the data collection done in this study:

i. Beneficiaries, i.e. people impacted by the project

i. ii. Higher authorities of BCCL, Area GM, Medical Officers

ii. iii. Village level stakeholders (Community Leaders):, Sarpanch, ward members and former Sarpanch

iii. iv. Project In-charge appointed by BCCL (CSR officials) – the monitoring authority involved in the project

### 2.6 Sampling with Location for Data Collection

Table 1 – Showing sampling of Multipurpose Utilization of Mine Water (MUMW) through Household Survey

| Sr No | Village Name | Block | District | Sample Achieved |
|---|---|---|---|---|
| 1 | Darda | Baghmara | Dhanbad | 82 |
| 2 | Sidhwatand | Baghmara | Dhanbad | 65 |
| 3 | Behrakhurd | Baghmara | Dhanbad | 34 |
| 4 | Nisithpur | Baghmara | Dhanbad | 82 |
| 5 | Konati | Baghmara | Dhanbad | 93 |
| | | | **Total** | **356** |

Table 2 – Showing sampling of Mobile Medical Van (MMV) through Household Survey

| Sr No | Village Name | Block | District | Sample Achieved |
|---|---|---|---|---|
| 1 | Karma Tand | Chandrapura | Bokaro | 13 |
| 2 | Patra Kuli | Chandrapura | Bokaro | 8 |
| 3 | Uper Devghara | Baghmara | Dhanbad | 15 |
| 4 | Chhatawad Kailudih | Baghmara | Dhanbad | 10 |

| | | | | |
|---|---|---|---|---|
| 5 | Power House | Dhanbad | Dhanbad | 26 |
| 6 | Madhuban | Baghmara | Dhanbad | 13 |
| 7 | Rathtand | Baghmara | Dhanbad | 10 |
| 8 | Chanchpotri | Agra Khurd | Dhanbad | 12 |
| 9 | Barora | Kulti | Bangal | 25 |
| 10 | Mohlidih | Katras | Dhanbad | 20 |
| 11 | Khanodih | Baghmara | Dhanbad | 6 |
| 12 | Bhim Kanali | Baghmara | Dhanbad | 3 |
| 13 | Bakaspura | Baghmara | Dhanbad | 10 |
| 14 | Bhagabandh | Dhanbad | Dhanbad | 19 |
| 15 | Manjhla Dih | Dhanbad | Dhanbad | 19 |
| 16 | Bhatdih | Jhariya | Dhanbad | 19 |
| 17 | Manpur | Chandan Kyari | Bokaro | 19 |
| 18 | Amlabad | Chandan Kyari | Bokaro | 19 |
| 19 | Sona Nagar | Baghmara | Dhanbad | 14 |
| 20 | Mandal Kedwari | Baghmara | Dhanbad | 9 |
| 21 | Gudri Bera | Baghmara | Dhanbad | 18 |
| 22 | Southari | Dhanbad | Dhanbad | 19 |
| 23 | Betenga bandh | Dhanbad | Dhanbad | 12 |
| 24 | Kari Tand | Dhanbad | Dhanbad | 7 |
| 25 | Basjoda | Dhanbad | Dhanbad | 24 |
| 26 | Lavera Manjhi Tola | Jhariya | Dhanbad | 20 |
| 27 | Ranguni | Baghmara | Dhanbad | 18 |
| 28 | Bangali Kothi | Baliyapur | Dhanbad | 20 |
| 29 | Aamtalbauritola | Baliyapur | Dhanbad | 18 |
| 30 | Nunudih | Jhariya | Dhanbad | 20 |

| | | | | |
|---|---|---|---|---|
| 31 | Idgah Pathar tola | Jhariya | Dhanbad | 20 |
| 32 | Pathaldih(Pandiya Tola) | Jhariya | Dhanbad | 18 |
| | | | **Total** | **503** |

The Data collection for Lebhara and Road construction were through FGD where the research team intend to capture the live narrative of the beneficiaries impacted by the project, therefore in FDG the interviews mostly consisted of Sarpanch, Village members, Women Representative, Senior citizen, Children, youths and BCCL higher authorities

**2.7 Data Analysis**

As previously mentioned, this study employs a mixture of qualitative and quantitative methods. Accordingly, SPSS was used for the quantitative data analysis of the study (such as the analysis of the responses of closed-ended questions in the questionnaires). The responses from the in-depth interviews and the other qualitative data were subjected to coding for detecting patterns. The data from interviews and discussions were analyzed **thematically,** and the data from all the sources was integrated as per the responses to understand, assess and evaluate the entire process of implementation. Being a qualitative study, there was an emphasis on understanding and analyzing the perceptions, views and experiences of the beneficiaries and other key stakeholders with respect to the scholarship project.

**2.8 Challenges of the study**

1. **Language Barrier:** The major hurdle in data collection was the language barriers, few of the villagers were speaking Bengali, and few were oddia.

2. **Limited documentation:** The Limited documentation of CSR project was another hurdle faced by the research team as it had to completely rely on primary data. Most of the employees working on the projects were mostly retrained and even in a few projects, documentation was not available.

# CHAPTER 3 –MOBILE MEDICAL VAN (SWASTHA RATH)

### 3.1 Introduction

Health is an important aspect of human life; it plays a very vital role in our social, economic and other spheres of our life. The better the health, the better the other factors. Mobile Medical Van or Swastha Rath was one of the popular projects that aimed at treating the general illness in the command area population of BCCL. The project was initiated with only 2 Mobile Medical Van in 2009, had now covered more than 203 villages with 14 Mobile Medical Vans. The staffs in the van consist of the doctor, paramedical staff and a driver to provide free consultancy and medicine for general illness.

### 3.2 Objectives of the Project

The objective of the project was to provide medical health facilities with a focus on identification, screening, diagnosis and treatment of general illness by providing free consultancy and medicine.

### 3.3 Locations of project

The project location covers the command area of BCCL. This includes rural, semi-rural and urban areas. Following is the list of villages and town where the Swastha rath facility is being provided.

Table 3 – Showing list of villages covered under Mobile Medical Van services (Swastha Rath)

| SN | Name of Area | Name of Village |
|---|---|---|
| 1 | BARORA | 1. PatraKulh 2. Karmatand 3. Manpur 4. Amlabad |
| 2 | BLOCK-II | 1. Rath Tand Basti 2 Bakaspur Basti 3. Mahato Tola Bhim Canali Basti 4. Khanudih Basti |
| 3 | GOVINDPUR | 1. Chhatawad Kailudih, 2. Uper Devghara |
| 4 | EJ | 1. Lavera Manjhi Tola 2. Idgah Pathar tola |
| 5 | WJ | 1. Moonidih Basti 2. Bhawardaha Basti |
| 6 | WWD | 1. Southari 2. Betenga bandh 3. Kari Tand |
| 7 | KATRAS | 1. Alakdiha 2. Mohlidih |
| 8 | SIJUA | 1. Pandeydih Basti |
| 9 | KUSUNDA | 1. Lahbera Basti 2. Rawani Basti |
| 10 | BASTACOLLA | 1. Sonar Basti. 2. Amtal Basti 3. Bangali Kothi |
| 11 | PB | 1. Surguja Basti 2. Kaligarh Basti |
| 12 | LODNA | 1. Nunudih Basti 2. Bhatdih |
| 13 | CV | 1. Bhatnidih 2. Dispur Basti |

### 3.4 Impact of the project on community

#### i. Door to door accessibility of health service

Due to the lack and poor health services most of the people in the command face difficulties in accessing the health services as services in government CHC, PHC are not up to the mark. The people used to do self-diagnosis and just randomly take medicine from the pharmacist without any proper consent from the doctor and which

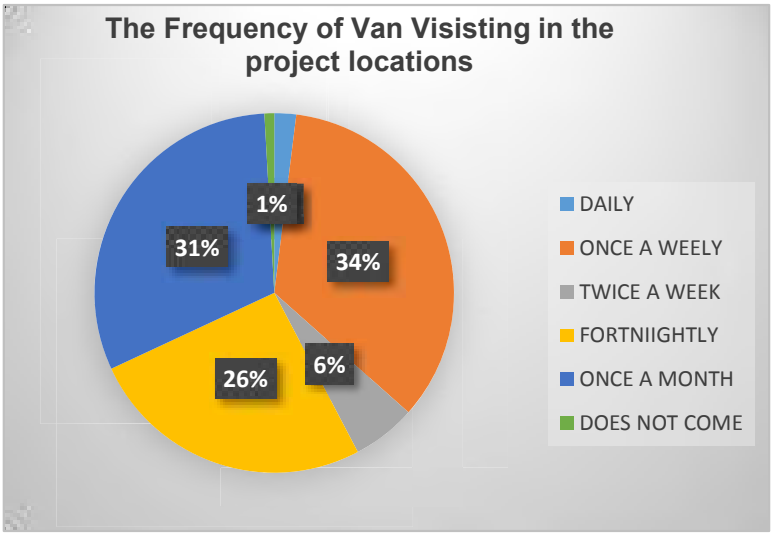



Figure 1 – Frequency of Van Visiting in the project locations

eventually seems to be one of the major cause for the adverse impact on their health. To avoid this and provide basic health care service to the people in the command area of BCCL, Swastha Rath was introduced. The Swastha Rath used to visit at least twice in each village. The respond gathered from the respondent through FGD and HH shows positive impacts of the project on the people in terms of the door to door accessibility of the project.

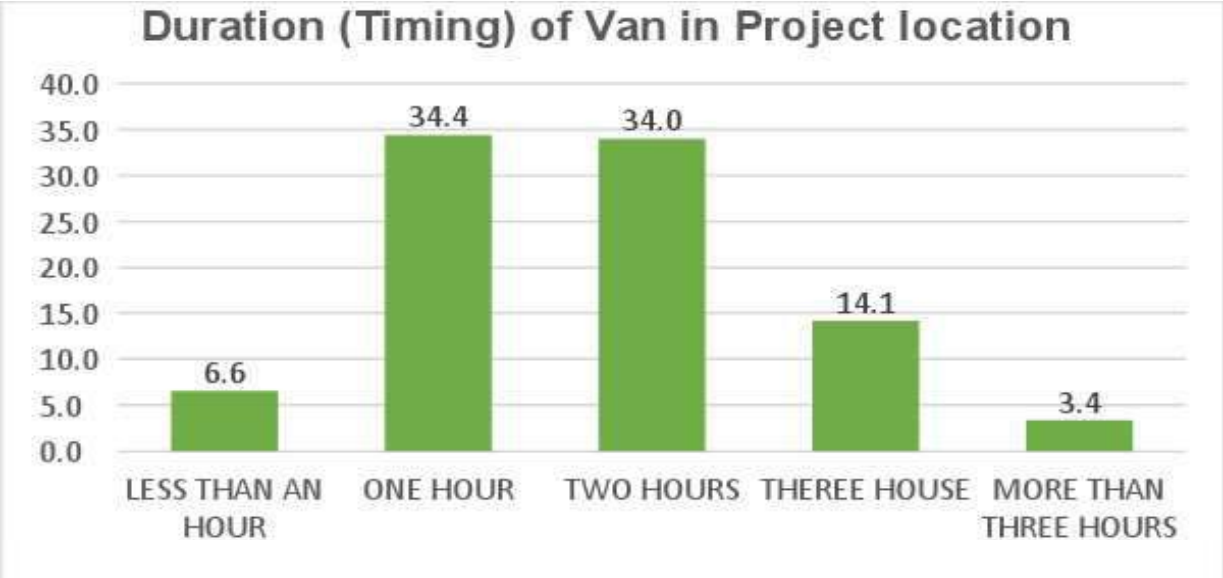



Figure 2 – Duration (Timing) of Van in project location

When interviewed, out of 503 respondents, 93.4 per cent responded that the medical van used to halt on fixed locations. Around 54.9 per cent people reported that the Medical Van had fixed timing and date of visits, which was informed by the Mobile Medical Team prior to its arrival. The locations were selected by keeping in mind the centre point of the villages or near the vital resource area of the villages such as Samaj Mandir, panchayat office etc. 70 % of respondent reported that the Swastha Rath used to wait at least 1 to 2 hours in each village making sure that all the people approaching them are checked and medicines were provided.

When interviewed people regarding the satisfaction of the duration of stay of van in their villages, 47.9 per cent people reported that they are satisfied by the duration (Time) of the van in their villages. Whereas, around 44.1 per cent people responded that they are not satisfied by the timing of the van. Similarly, around 92.8 per cent respondent reported that the location of Swastha rath was easily accessible by them as well as by their family members.

ii. **Filling the gap in health service**

Health is a primary and essential need of human being. It plays an important role in human life. The government hospital lacks in quality health care, infrastructure and accessibility because of which people mostly avoid going to the government-run hospital. To avoid this and provide basic health services, BCCL started Swastha Rath which aims in providing basic health service at the doorstep. Also, the service has enabled people to get access to basic health services at free of cost. Thus the service was a boon to the villagers.

**Availability of health services**

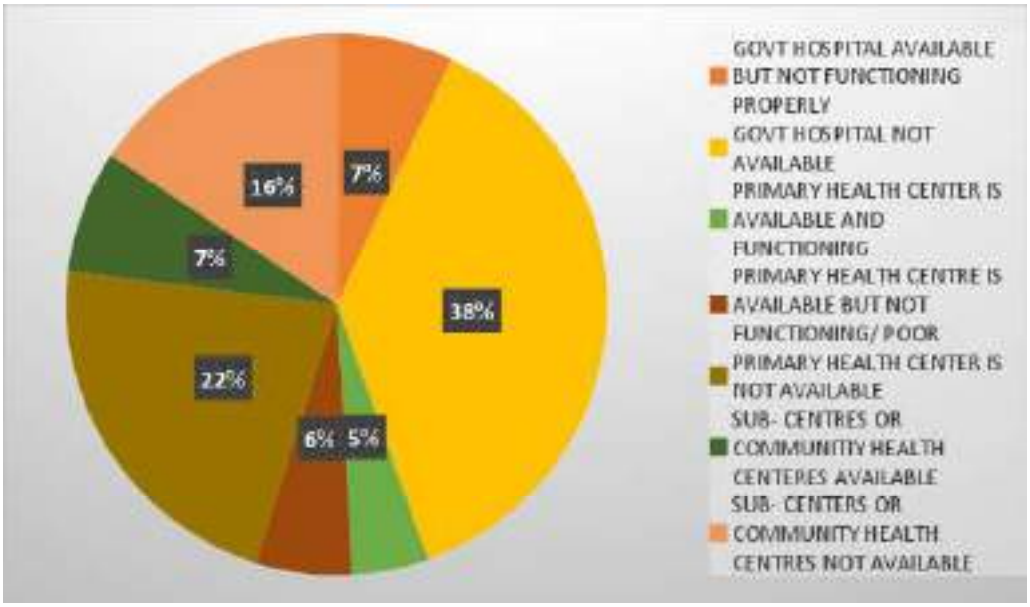



Figure 3 – Availability of health services

The above figure was derived by interviewing 505 households, out of which 38 per cent beneficiaries reported that government hospitals are not available, 22 per cent reported non-availability of primary health center and 16 per cent reported government hospital available but not functioning. Around 90 per cent respondent responded saying the nearest government heath care center is around 6 to 8 km away from their villages. Besides that, one of the major hurdles in reaching the health centre is the non-availability of adequate road infrastructure.

Around 95 per cent of people reported that the roads leading to the PHCs, CHC and Government hospital are mainly kaccha and thus is inaccessible. Therefore by understanding and analyzing the needs of the people regarding health services, BCCL felt the need of starting the Mobile

Medical Van called *Swastha Rathi* that would aim at providing primary health care service to these needy and disadvantaged group on their door step at free of cost.

**iii. Awareness about health and hygiene :**

Awareness generation was one of the core aspects of Swastha Rath. The MMV team used to provide information regarding healthy surrounding, general cleanness, tuberculosis, maternal and child health care, hygienic water consumption and hygienic sanitation. Many respondent also reported that the team used to practice healthy habits so that people can easily understand. Besides that around 95 per cent people knew that the swastha rath was run by BCCL. And in that around 29 per cent people reported that they came to know about this by seeing the BCCL name on the van.

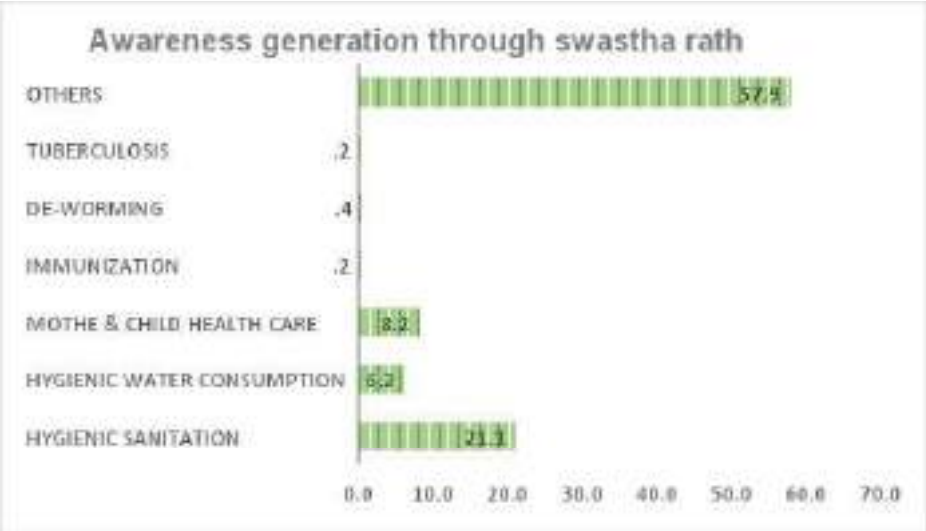



Figure 4 – Awareness generation through swastha Rath

**iv. Reduce Economic Burden**

Most common disease reported in the region is fever, cough, cold, anaemia, diarrhoea, and skin infection. Since there is no availability of medical services in the entire region, the villagers have to suffer a lot. The average income of the household were not good as the villagers are mainly engaged in agricultural work or work as a labourer. So, their

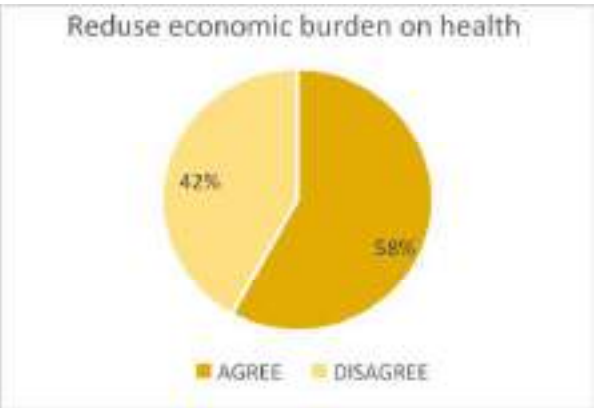



Figure 5 – Reduction in economic burden on health

earning is not sufficient and somehow people manage to survive and fulfil their basic needs. And if someone from family falls ill, then it's a significant economic burden on them to buy medicines because they have to go private hospitals or privately run clinics to purchase medicines even for normal fever or a cough and cold. Therefore, they are thankful to Swastha Rath for providing them medicines and eventually reducing their economic burden.

### v. Addressing the health needs of people

Health care services in the entire region are dismal in terms of accessibility, infrastructure and quality. There are only a few Sub Health Centres in the entire area which is functional, but due to lack of such basic medical facilities, people were forced to travel at least 5 to 10 km to avail such medical facilities. Besides that, the transportation system is also very expensive and so accessing the existing health care facilities, which is at a quite long distance, becomes a crucial issue for the villagers. So, Swastha Rath was great hope for them as they are getting services at their doorstep without paying a single penny; in fact, it's saving their money and time as they are getting free services and medicines and also saving their travelling time and transportation cost.

**Major ailments in the families**

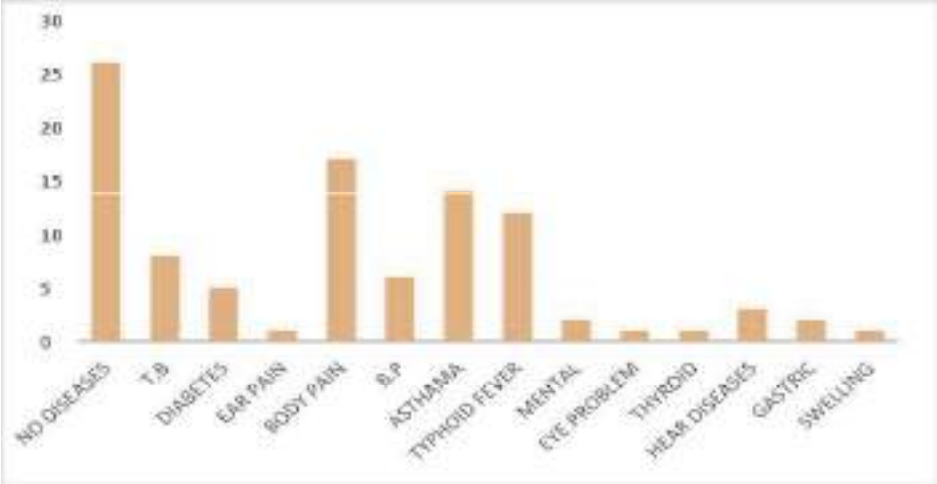



Figure 6 – Major ailments in the families

The major ailments that were reported by the respondent were Body pain, Asthma and Typhoid. When asked further, the respondents replied saying that the working environment and the pollution caused by the open cast mining illness such as respiratory tract infections have had an adverse impact on their health.

### vi. Reduction in sickness

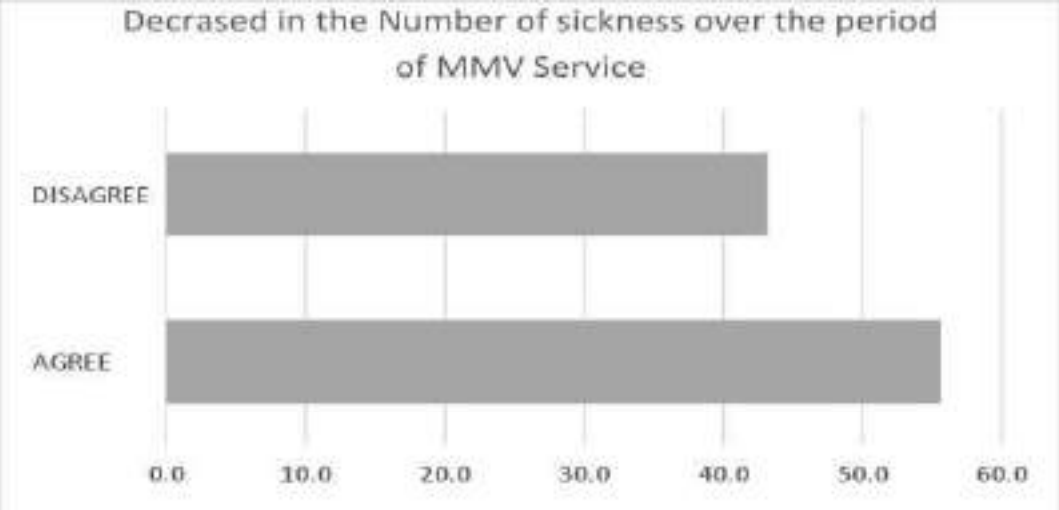



Figure 7 – Decrease in number of sicknesses over the period of MMV service

The above graph shows that 56% of the beneficiaries agreed about the fact that there was decrease in occurrence of sickness over the period of MMV services. While 44% beneficiaries disagreed about this fact.

## 3.5 Gap identified in the project

### a. Limited Regularity of Swastha Rath

Even though the intention of the project was noble, but the regularity was the big hurdle in proper implementation of the project. The Swastha Rath had the target to visit the villages at least twice a month, but during the study it was identified that a few of the places were kept untouched by the project and these areas were mostly near to the colliery areas. As mentioned above around 34 per cent people reported that the Swastha Rath visits once in a week and 31 per cent people reported that it used to report once in a month. The reason for the same reported by medical team of BCCL was availability of limited number of vans. Each BCCL area had only 1 to 2 Swastha Rath. It becomes difficult for the doctors and also to the staffs to reach all the

villages, as each area only gets a van for only 15 days and thus this also limits their accessibility in terms of reaching all the villages.

### b. Limited Awareness campaign

In spite of having awareness campaign as the core idea of swastha rath around 93 per cent of people reported that no such awareness campaign has been done by the Swastha Rath. Whereas only 7 per cent of people reported that awareness campaign has been conducted by the Swastha Rath

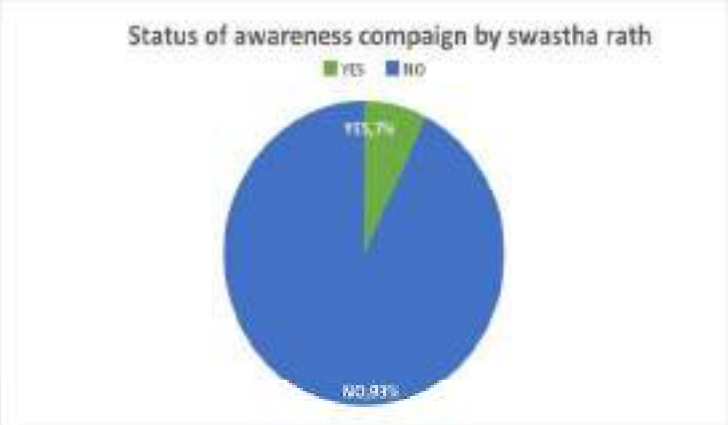



Figure 8 – Status of awareness campaign by Swastha Rath

### c. Limited Health Services

The Basic/Primary health services is very limited that is only free health checkup and medicine supply. In some villages, it was also found that the doctor used to visit sometimes and only the pharmacist and the driver use to go and distribute the medicine without any proper diagnosis process being followed. In addition to that blood pressure check and weight checkup were not conducted. At the village level, there was no appointed person who could look after the health services in absences of Swastha Rath. Around 99 per cent people raised the concerns stating that there is scope for improvement and enhancement of the Swastha Rath. 3.6

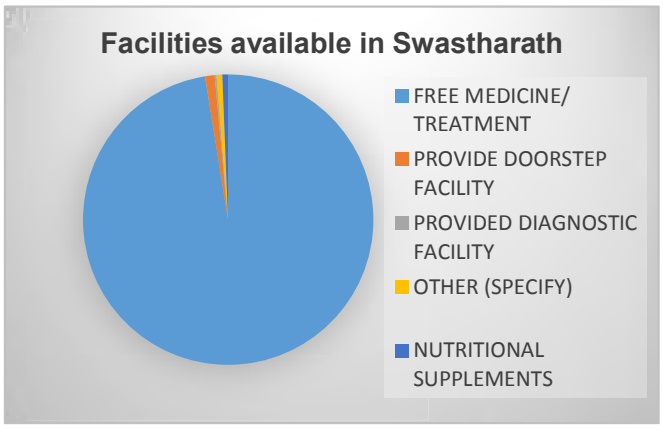



Figure 9 – Facilities available in Swastha Rath

**Multi-stakeholder Perspective on Swastha Rath**

a. **BCCL Officials:** BCCL being a responsible corporate in Dhanbad region had always been active in providing basic health services to the people of the company's command area since a long time. Therefore BCCL started Swastha Rath with the intention of providing basic health care service in the remote areas for those who are unable to access them or afford them. Besides that, the company aims at creating general awareness about health and hygiene. The Project was run in 206 villages and has targeted more than 2 lakhs people.

b. **Village People:** The Swastha Rath was very useful. It has helped the villagers in many ways. The accessibility of health care has increased as medicines and treatments are being provided free of cost at their doorstep. The economic burden has been reduced. Now people neither travel nor go to the private hospitals and clinics. At the same time, the cost of the travelling is also being saved. Along with this various awareness campaign are conducted wherein the people are being provided with the informations regarding health and hygiene.

**3.6 Beneficiaries' point of view on Swastha Rath**

*3.6.1 Vinay Bhal, 49 year old: a resident of fulwar basti is a laborer in coal mine says "Since the time Swastha Rath had started coming we are very happy because we are staying here for a very long time and health is the major problem that we are facing. The nearest Sub-centre is around 8 km away and that too is not in good condition. It was difficult for us to travel so long, with no other option left, we used to go to local pharmacy and tell them our sickness, and accordingly they use to give us the medicine, and we use to have it. Swastha Rath comes in the village twice a month and provides us medicines free of cost. They treat us all. The doctor behaviour is good. He checks us and also make us aware of the health and hygienic conditions in we should dwell. Since Swastha Rath started coming to our village, our money is being saved and also the medicines are effective".*

*3.6.2 Meena Rahman 25 year old, resident of Amlabad village says: "Coming from a poor background we are unable to afford to go to private clinics or hospitals. The nearest government Sub-centre is around 7 km away. From where do we bring the money? We work as a wage earner. There is no guarantee of the job. We would get tomorrow or not, we don't know. Thanks to BCCL Swastha Rath! Since the time it has started coming to the village, the economic burden of health has been reduced. We get free treatment and medicines. The van comes twice a month and check all of us. Now we don't get worried so much as the van comes and check us and treat us for free."*

### 3.7 Recommendation of the project

1. **Frequency of the Swasth Rath Should be Increased**

One of the most important demands that came from the public was that the frequency of the Rath should be increased. As it was supposed to visit the targeted villages twice a month, but as mentioned previously that the Rath was unable to visit a few villages. Similarly in many villages, the Rath only visited once in two to three months. Therefore the frequency of the Rath should be increased and should be available in the areas/ villages where it is needed the most and also the availability should be increased.

**Frequency of Swastha Rath in Village**

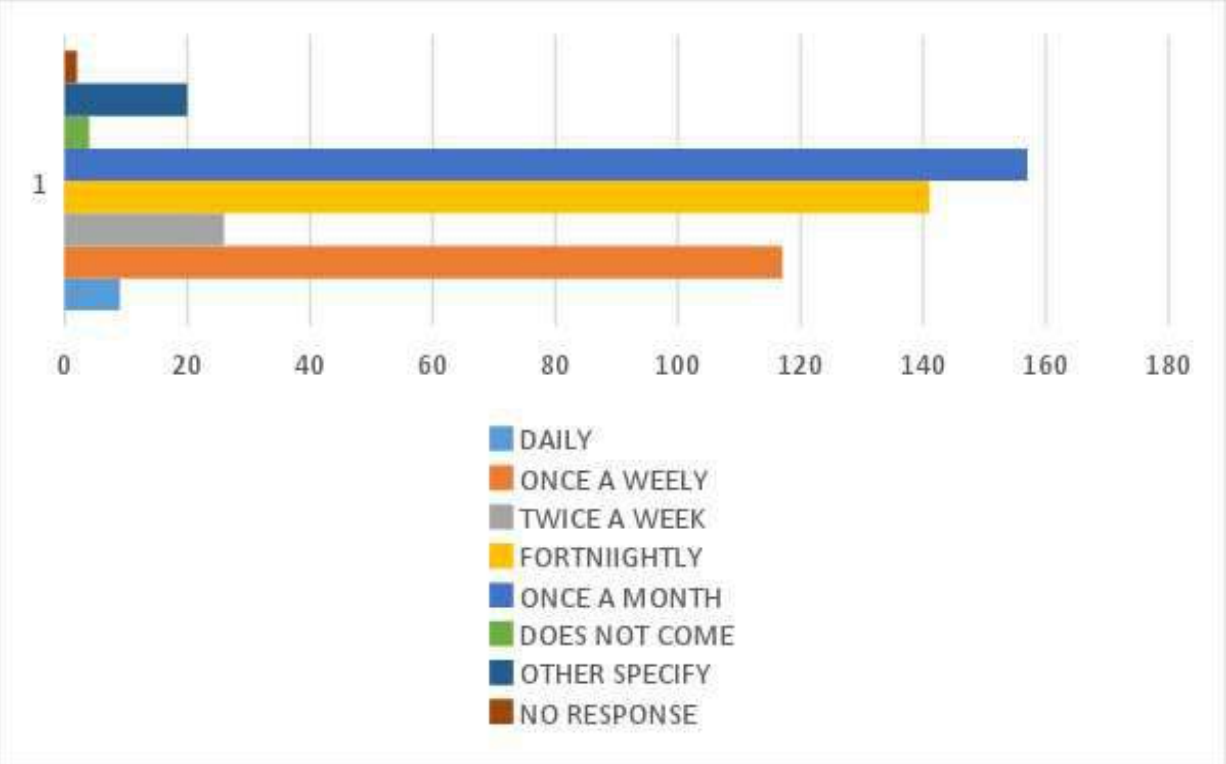



Figure 10 – Frequency of Swastha Rath

The above graph highlights that the frequency of Swastha Rath in the targeted village. Around 157 people responded that the Swastha Rath came once in a month, whereas 141 respondents reported that the Swastha Rath used to come once in fortnight. Again, around 117 people reported that every once a week the Swastha Rath used to come.

**2. Need for female doctor and nurse**

It was highlighted by the statistical data that out of 500 samples 99.8 per cent reported that there is a need for female doctors and nurses in the Swastha Rath as the women feel uncomfortable to open up their sicknesses in front of male doctors.

**3. Need of a health worker at the village level**

It is recommended that there should be a health worker appointed at the village level that would look after the health services and status of the village and subsequently could report to the nearest BCCL regional or area hospital. At the same time, medical stock should be provided to this appointed health worker, who in times of emergency could provide necessary medicines as per the need of the villagers.

ii. **4. Necessary Provision for Emergency**

Around 98.5 per cent of people responded the need of emergency services in Swastha Rath, and this could be done by printing the emergency helpline number on the van so that during the emergency the people can avail the services.

iii. **5. Need of Additional Services**

Additional services such as blood pressure check, BMI, Weight test and malnutrition test should be conducted and if significant issues found in the test results, then further treatment should also be provided to the beneficiaries by referring them to the nearby BCCL area hospitals.

# CHAPTER 4 – MULTIPURPOSE UTILIZATION OF MINE WATER

## 4.1 Background of the project

Since its inception, BCCL has felt the importance of water and endeavoured for effective and gainful utilisation of mine water from abandoned mines which has to be taken out of course of mining process necessarily. For harnessing such water, BCCL has taken upon the task of holding the mine water into the water bodies by restricting them to flow into the natural drainage course like village reservoirs which gets dried during summers, by laying out a pipeline network of approximately 45 km.

With the help of this scheme, approximately 47 million gallon surplus mine water is presently being discharged into natural water courses from the mines of Barora, Block-II & Govindpur areas of BCCL. This water is being stored in two reservoirs situated in Khonathi and Behrakudar villages with storage capacities 16 million gallon & 31 million gallon and with area of about 4.0 ha & 4.5 ha respectively.

Under this scheme of BCCL, the farmers residing nearby and having their cultivation fields in reasonable proximity will benefit in carrying out their agricultural works, in all seasons, which at present is totally dependent on rainwater in monsoon.

This provision will certainly enhance the Socio-Economic status of the area and will also result in more opportunities in secondary & tertiary fields of employment. This water could also be used for drinking purposes after required treatment. In these reservoirs, Pisciculture could also be adopted with the help of self-help groups for their livelihood.

### 4.2 Objective of the project

To harness mine water for its gainful multipurpose utilisation in the peripheral villages of BCCL command area.

### 4.3 Location of Implementation

Two reservoirs situated in Khonathi and Behrakudar villages of Baghmara block of Dhanbad district.

### 4.4 Study sample details

Out of the 352 samples collected by the research team in the villages near the two ponds in Baghmara block, 72 per cent respondents belong to the OBC category while SC makes up 10.5 per cent of the sample studied. Again, 8.2 per cent are Scheduled Tribe and 7.4 per cent belong to the General category. Apart from these categories, a few samples from Nomadic Tribe and Denotified Tribe (around 0.9% each) were also taken into consideration for the study.

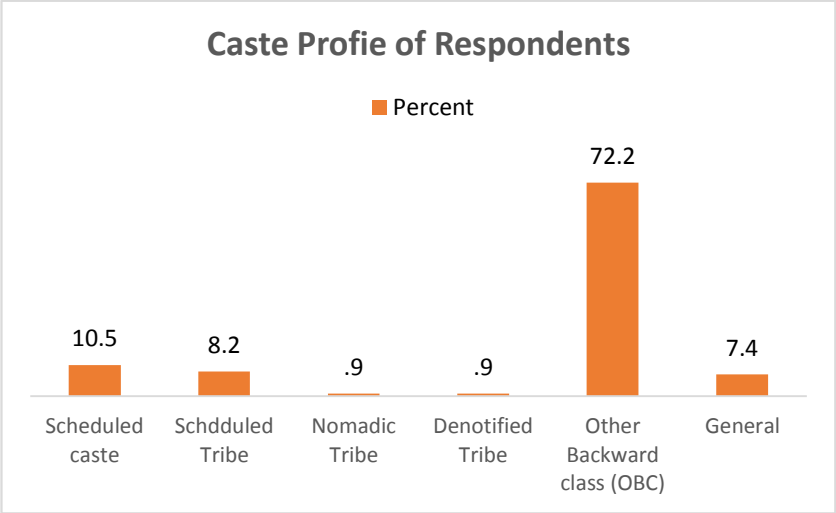



Figure 11 – Caste profile of respondents

42.3 per cent respondents reside in 'pucca' houses while 34.1 per cent resides in semi-pucca houses. 15.3 per cent respondents owned kutcha houses, and 8.2 per cent of the respondents reside in huts. Focused Group Discussions revealed that houses in the villages were not accurate depictions of income and wealth of respondents as the most of the houses were inherited which housed two to three families dwelling together, i.e. 10-15 people in a two bedroom house. Therefore, the respondents staying in houses made of brick and mortar do not necessarily have high-income sources. Electrification of the villages has been a success as 92.9 per cent of the respondents' houses were electrified although the electricity is supplied for 3-4 hours daily. Open defecation is an overarching phenomenon in the villages with 51.7 per cent of respondents opt for this option while 41.5 per cent use their pit toilets.

Private sources of water are scarce as 45.2 per cent of respondents rely on community hand-pump for their potable water needs. While the quality of water could not be ascertained, 38.6 per cent respondents boil the water as a method of water purification, 16.5 per cent respondents sieve the water, and 6.3 per cent do not do anything for water purification.

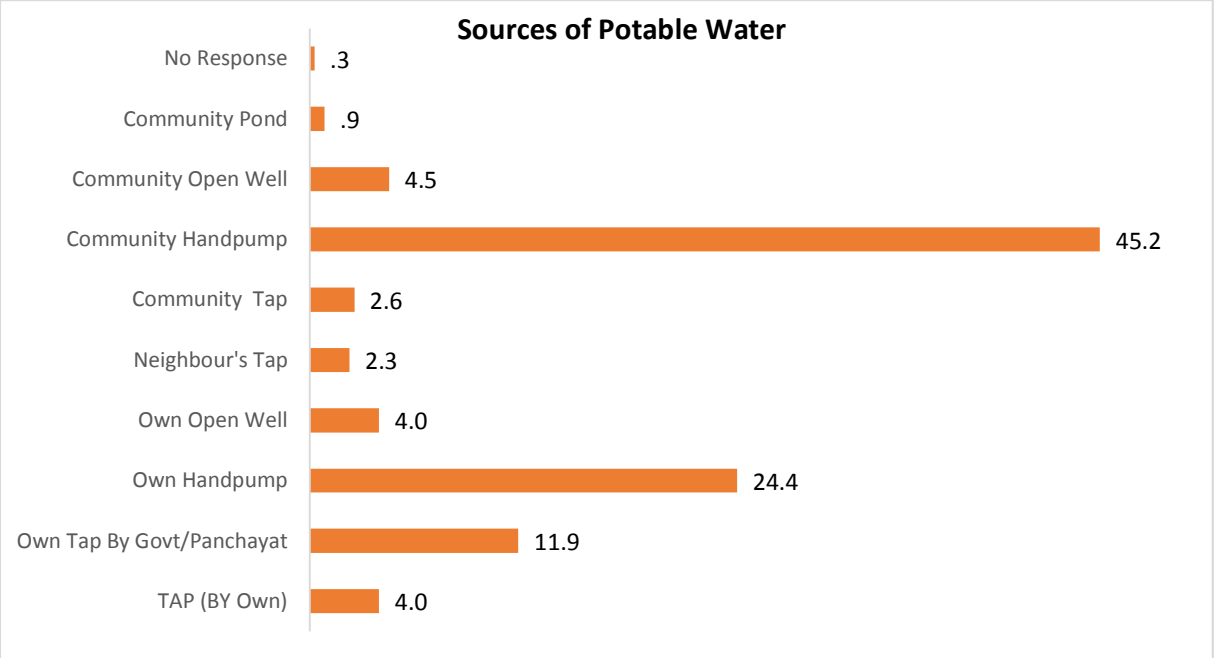



Figure 12 – Sources of potable water

## 4.5 Impact on the community

### i. Use of Mine water supply for filling ponds

The respondents are compelled to use whatever water is available to them for their daily needs. To wash clothes, 49.4 per cent respondents use the mine water ponds while only 0.3 per cent respondents use the ponds for agricultural activities.

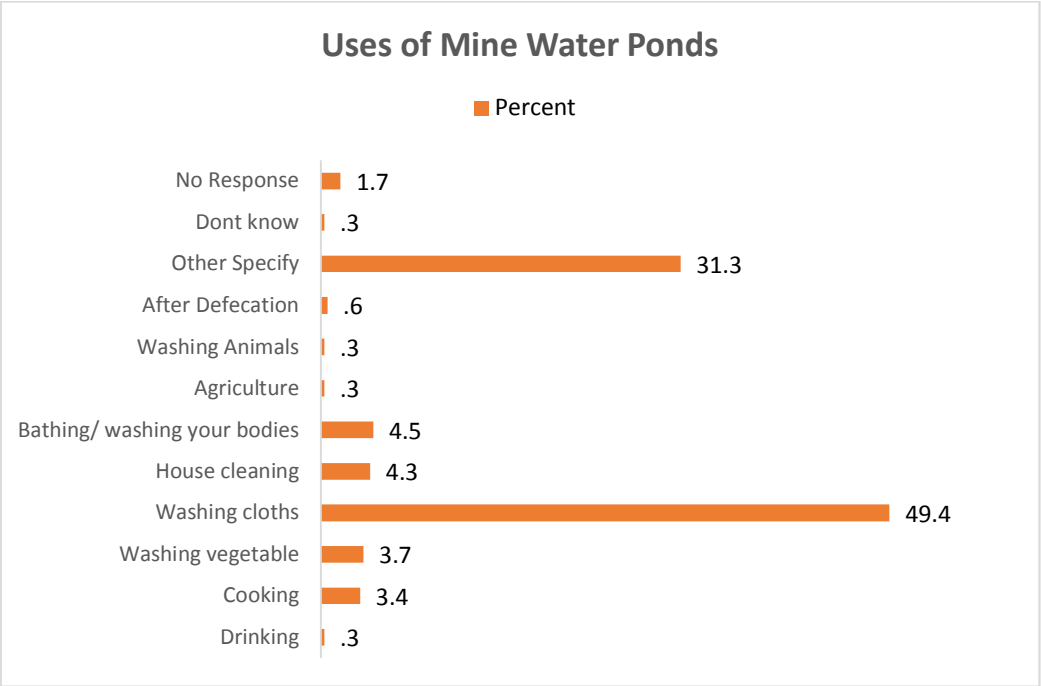



Figure 13 – Uses of mine water ponds

### ii. Land holdings and irrigation sources

64.5 per cent respondents claimed they owned agricultural land while 35.5 per cent were found landless. According to the landed respondents, 35.5 per cent of them use the mine water pond for irrigation while 4 per cent have no sources of irrigation. Borewells near the farmland are another source of irrigation which is depicted in the 'other' category in figure no 14. The major crops grown by the respondents are paddy (65.3 per cent), vegetables (21 per cent) and maize (11.3 per cent).

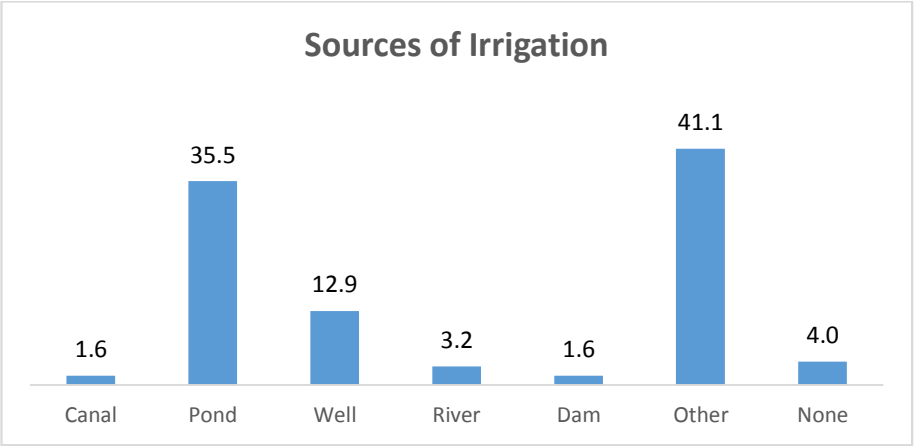



Figure 14 – Sources of irrigation

### iii. Renovation activities of the ponds:

For the impact assessment study, it is primarily important to gauge the opinions and perceptions of the beneficiaries about the mine water ponds. BCCL has been operational in the Baghmara block for several years and has created a rapport with the residents of the villages. Therefore 59.1 per cent respondents knew that the mine water was drained into ponds. The respondents were enquired about the activities done by BCCL for the pond. 54.3 per cent of them knew that embankment or stone pitching was done around the bank, while 17 per cent knew that the *ghats*/stairs were constructed. 16.8 per cent respondents did not knew any of these activities, mainly due to the farther distance from the pond or not being present at the time, etc.

Table 4 – Beneficiaries awareness about activities done by BCCL for the pond

| Activity | Percentage of respondent responses |
|---|---|
| **Embankment or stone pitching around the bank** | 54.3 |
| **Inlet and Outlets** | 2.6 |
| **Ghats/Stairs** | 17.0 |
| **Repair** | 8.5 |
| **Don't know any of the above** | 16.2 |
| **Don't know** | .6 |
| **No Response** | .9 |
| **Total** | 100.0 |

Approximately 70 per cent of beneficiaries came to know about the renovation of the pond by physically observing the activities while 9.1 per cent came to know through the display boards put up by BCCL. Only 2.3 per cent were informed in the *gram sabha*.

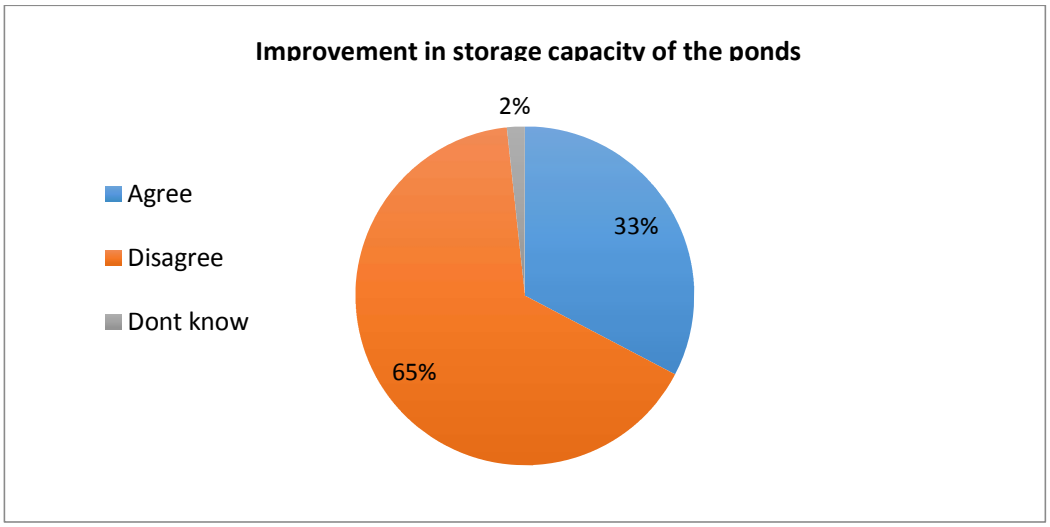



Figure 15 – Improvement in storage capacity of the ponds

It is of great importance that the beneficiaries are being involved in the planning process of a project so that their needs and problems are accounted during the intervention.

During FGDs it was found that heavy machinery such as excavators, loaders and trucks were used to finish the work in less than ten days as manual labour would have extended the time of completion of work to 30-35 days. It was also mentioned that the work in one of the ponds was proposed to be carried out in monsoon. But due to monsoon, the pond was full of water and therefore many areas in the pond was left unexcavated.

## 4.6 Gaps Identified

### i. Minimal improvement in storage capacity

During the discussions, it was discovered that the ponds lie in the natural catchment area of rainwater, therefore, the water in the ponds did not dried up during the summer season before the renovation.

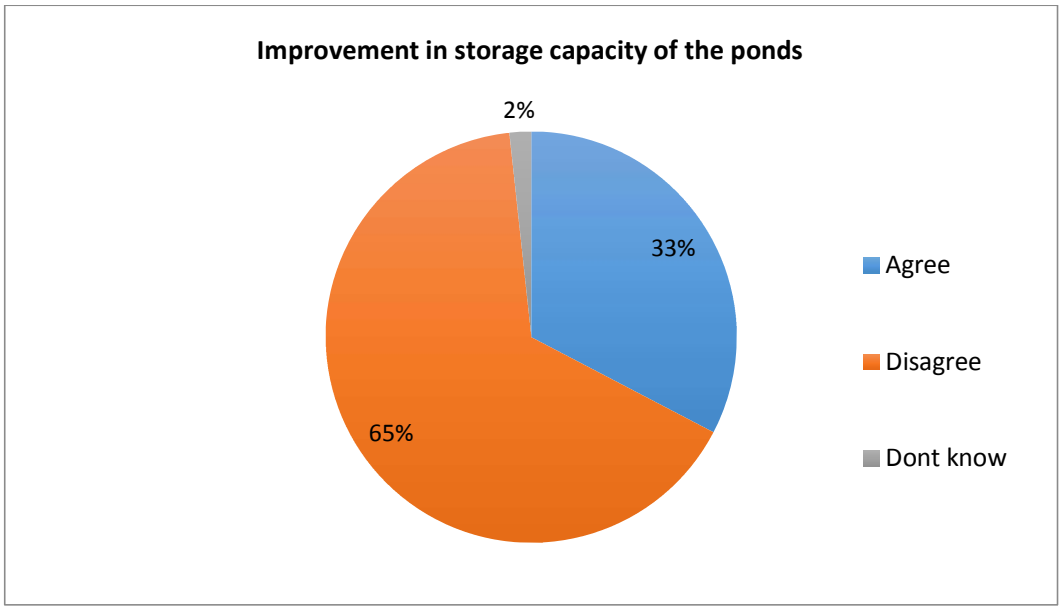



Figure 16 - Improvement in storage capacity of the ponds

Even though the ponds do not dry up, the water is scarce and the population depending on it for routine activities is increasing every year. Respondents also shared that they have to skip bathing for many days so as to preserve water for cooking and drinking. Therefore, 65.6 per cent of the respondents disagreed when asked about the improvement in storage capacity after the renovation of ponds. Also, as evident in Figure 17, 69.3 per cent respondents states that the scarcity of water has not reduced.

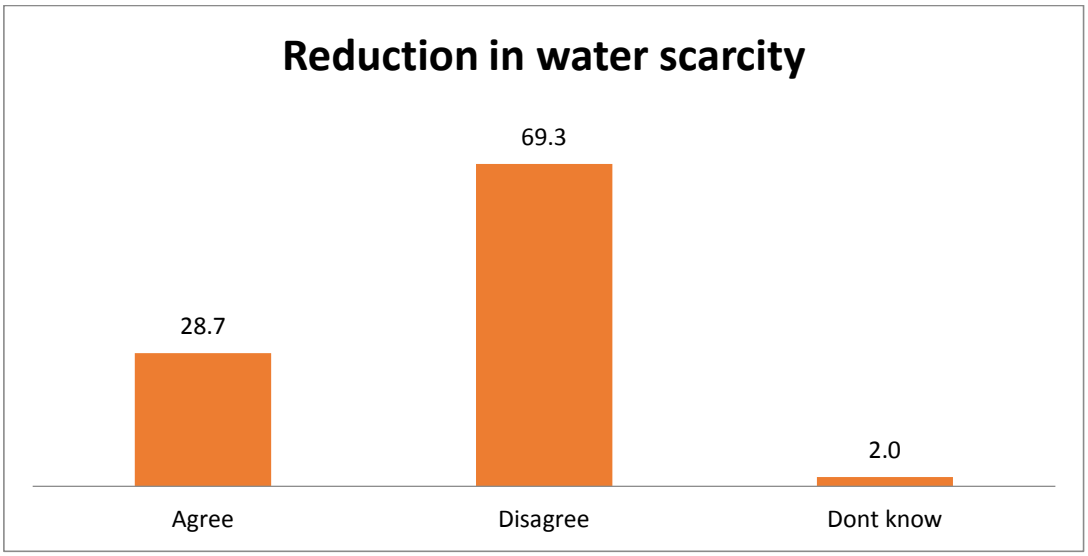



Figure 17 – Reduction in water scarcity

### ii. Lack of employment generation activities

Employment generation would have been an important gainful use from the ponds as duckery and fishery activities were proposed in the project. But 92.3 per cent respondents feel that no new job opportunities have been created with the renovation of the ponds.

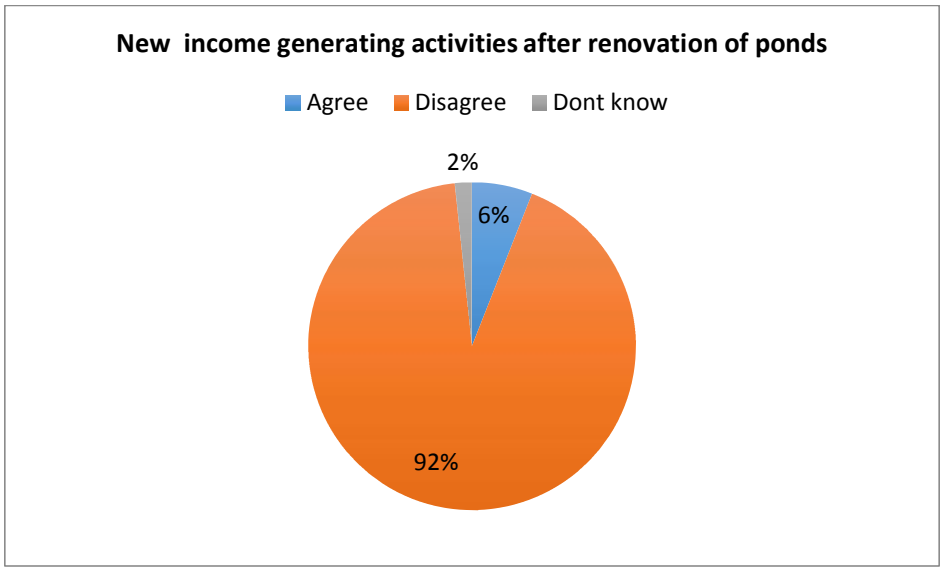



Figure 18 - New income generating activities after renovation of ponds

The respondents also stated their concern to the research team that these gainful activities are being carried out by contractors for their profits, and therefore, the villagers are unofficially banned from carrying out these activities.

### iii. Minimal increase in agricultural production

Further, 86.6 per cent respondents believe that the pond has not aided in critical irrigation requirements as there are farmlands of hardly four to five farmers near the pond. Most of th e farmlands are significantly at greater distances. In such cases, the cost of machinery to lift the water to these far away farms is high that residents avoid taking water for irrigation from these ponds. Therefore, the number of crops grown per year by most of the respondents has also remained unchanged after the renovation of ponds.

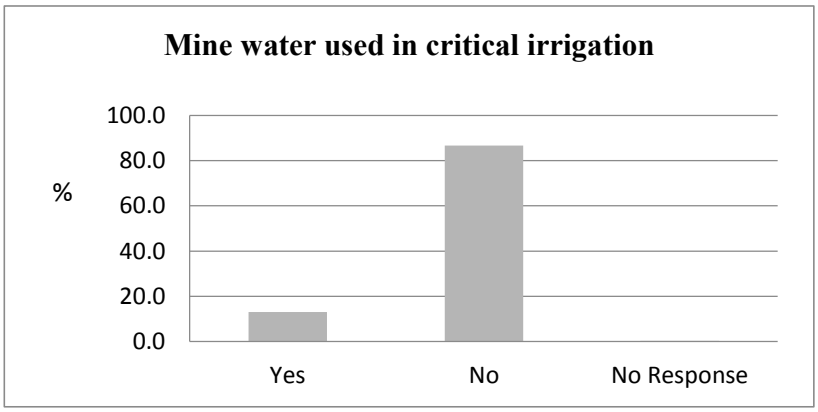



Figure 19 – Mine water used in critical irrigation

As per 90.3 respondents, agricultural production does not happen beyond personal consumption. As a result, the small and marginal farmers go to cities in search of work at least 15 days a month in order to feed their families.

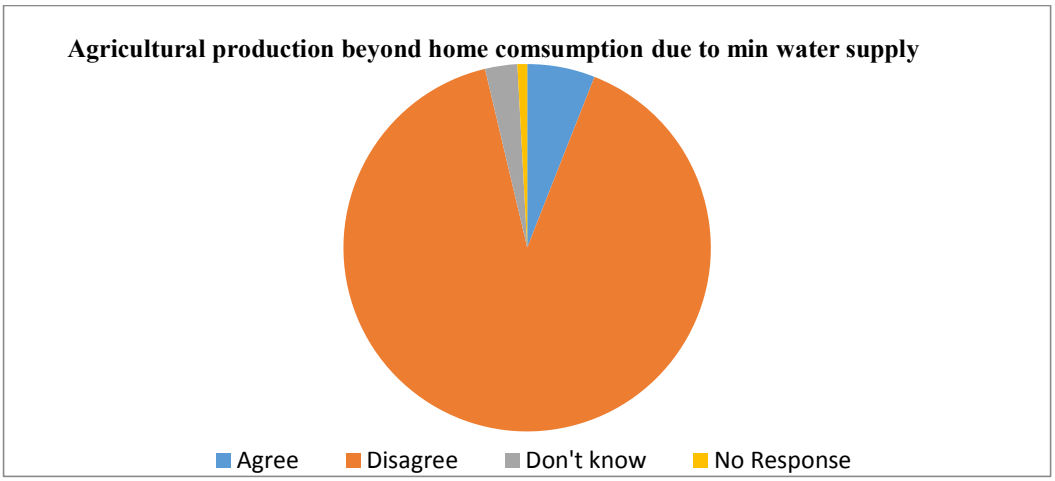



Figure 20 - Agricultural production beyond home consumption due to min water supply

Therefore, when asked if there has been a cumulative increase in the income of the household post- renovation of ponds, 94.9 per cent of the respondents replied negatively.

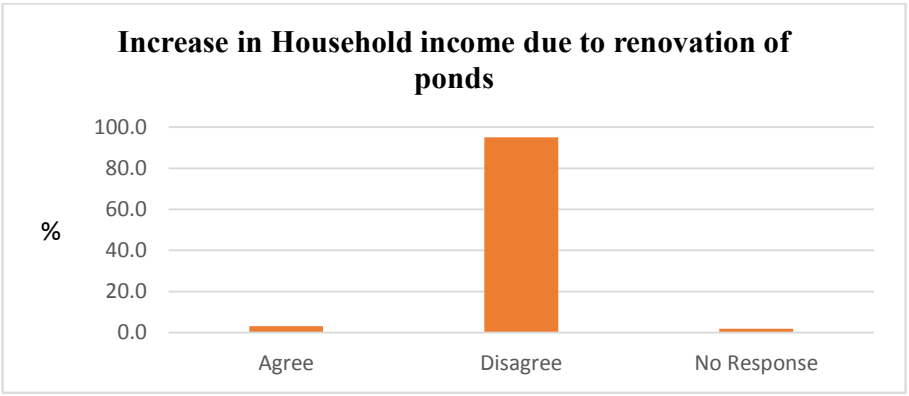



Figure 21 - Increase in Household income due to renovation of ponds

### iv. Irregular supply of mine water

Another motive of conducting the impact assessment of this project was to find out from the beneficiaries whether there is any need of improvement in the projects and in which areas. In FGDs, respondents overwhelming suggested that there is an urgent need for improvement in the project in terms of mine water supply. Officially, 70 per cent respondents did not know how often the mine water is being supplied, but 83.2 per cent respondents agreed that there should be a timely supply of mine water.

### v. Lack of participatory planning

94.3 per cent respondents claim that no village meeting was conducted before the supply of mine water in the ponds. This highlights the lack of participatory nature of the activity. It can further be showcased when the respondents were asked regarding their participation through *shramdaan* (voluntary labour) and 84.9 per cent responded negatively. Apart from these concerns, 51.1 per cent of the respondents did not know who carries out repair and maintenance of ponds, while 8.8 per cent claimed that BCCL is responsible for the same.

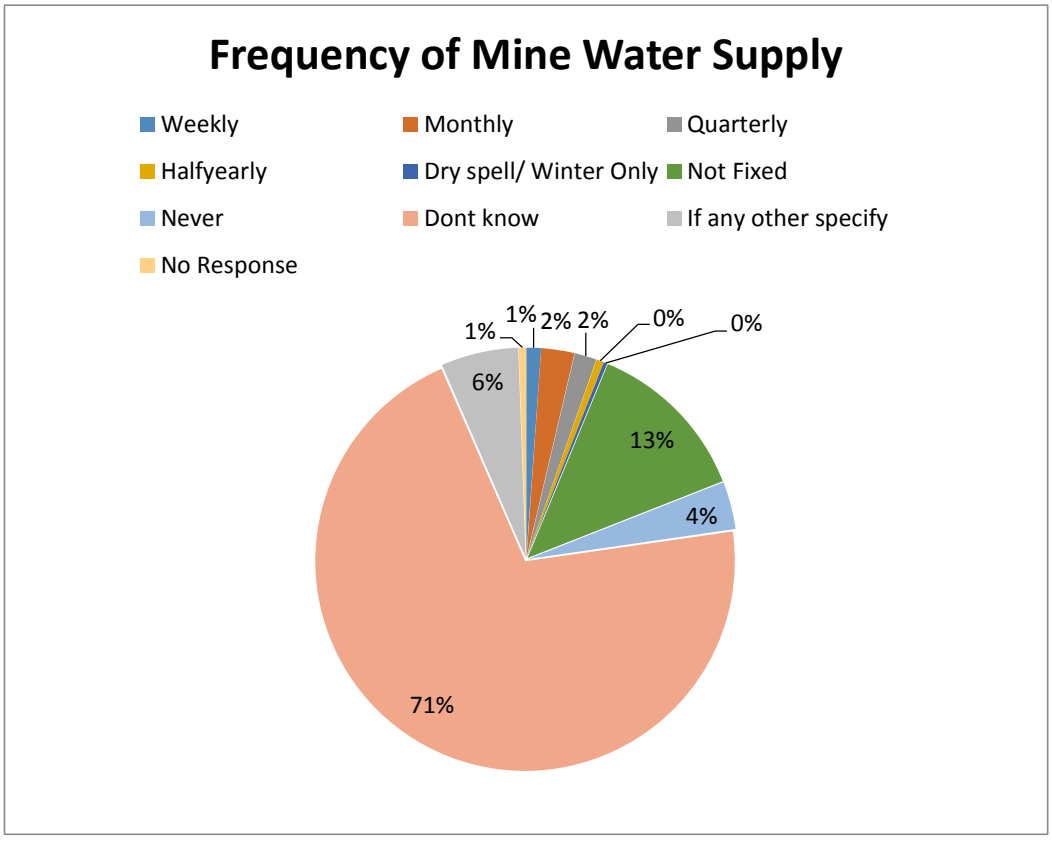



Figure 22 – Frequency of mine water supply

The respondents stated that since the renovation of the pond had taken place, only two or three times the mine water had been supplied. And eventually it was not sufficient for consumption by all the beneficiaries of the ponds.

Table 5 – Beneficiaries response on last supply of mine water.

| Last supply of mine water | Percentage |
|---|---|
| Last three months | .6 |
| Last six months | 1.7 |
| Last one year | 9.1 |
| More than a Year | 47.2 |
| Don't know | 40.1 |
| No Response | 1.4 |
| Total | 100.0 |

It is of utmost importance to note that 94.3 per cent of the respondents want BCCL to resume supplying mine water to the ponds as they believe that even though there may be no short-term benefits of the project, long-term benefits will help the future generations in leading a better quality of life.

### 4.7 Recommendations

Due to various reasons, mine water supply to both the ponds has been halted for the past one year. According to the beneficiaries, they have not been able to reap any benefits from the projects. In the project proposal, 25000+ beneficiaries were identified who would be able to avail the benefits of the mine water supply project. However, it was found that only around 1000 families were able to use the ponds. Also, the project proposal had stated further highlighting that the beneficiaries would see a marked improvement in the household income after the pond renovation as they will be able to carry out multiple income generating activities. But as of now, the beneficiaries uses the ponds for only household consumption which was the case prior to the pond renovation as well. Overall, they insist that the mine water project was a fruitful venture but the supply of mine water is insufficient to bring about a change in their income or general quality of life.

**Following are the main recommendations for the improvement of the Mine Water supply project:**

- Participatory approach: Participatory project development is necessary to gauge the perception and needs of the beneficiarie,s and hence the project needs to be modelled around that.
- Pond upkeep: Repairs and maintenance of the ponds need to be carried out regularly with an immediate attention to Khonati pond as one of the pipes laid near this pond has been damaged.
- Sharing of information: For proper dissemination of the information regarding project cost, project details and maps, boards need to be put up at various locations so that damage to the pipelines could be avoided.
- Focus on employment generation: A plan needs to be developed to ensure effective utilisation of the mine water supplied to the ponds which would subsequently lead to augmentation of household incomes of the beneficiaries.
- BCCL should conduct a cost-benefit analysis as well as Social Return on Investments (SROI) analysis in such large-scale projects.

# CHAPTER 5 - VILLAGE ADOPTION PROJECT (LAHBERA)

### 5.1 Introduction

Lahbera, a village situated in Jharia block of Dhanbad district, Jharkhand is one of the centers attraction of BCCL CSR activities. The village mainly consists of the tribal population of 392 people with 63 households. The charm of this project lies in many facts, one of which is the integrated module of development experimented by the BCCL. The BCCL adopted the village in the year 2009 with an intention of integrated development of tribal for their economic and social development through various schemes and program run by them. As the part of the CSR activities, various infrastructural and economic projects were set up that could help the villagers in their economic development.

### 5.2 Objectives of the Study

The main objectives of the project is to develop the selected village in an integrated manner ensuring its holistic and integrated development through capacity building and participation of local people and institutions, and this is done through establishing and creating various infrastructures such as:

a. *Construction of Primary School*
b. *Masala Chakki,*
c. *Health Centre*
d. *Sewing Training Centre*
e. *Multipurpose Hall*
f. *Adult Education Centre*
g. *Pipeline for water supplies*
h. *PCC Road and Drainage lines*
i. *Solar lights*
j. *Playground*

*5.3* **Projects and their Impacts**

**I. Multipurpose Hall**

The hall as its name suggest was used for multiple reasons. It was constructed in the year 2009. It is located in the premises of playground and having the area of approx 800 – 1000 sq ft. The amount invested in this infrastructure was Rs.650851/-. The hall is used for various programs such as conducting health camps, adult education centre, village meetings, social gatherings, marriages, family functions and various other programs. The hall was equipped with tube lights, fans and toilet facilities that have impressed the people, utilizing it for various purposes.

**Beneficiaries' viewpoint**

*Meera Marandi, a residence of labhera village says: 'this hall has helped us a lot, especially during our adult education centre; we use to come here daily at 4 pm and study till 6 pm. Not only this, we also used hall for various occasions such as marriages, meetings and other family functions. She also added further admitting that her brother marriage was also fixed here. When we were small, our family used to have functions in our aangana. But after the hall was constructed we are utilizing it for many purposes, and it does not cost us anything as it is free for us. When asked for maintenance, Meera said that usually BCCL looks into it. But she feels it's also her's responsibility to take care of the hall as it is very beneficial for them.*

## II. Adult Education Centre

The Center started in the year 2009 and was run by the two mentors which were appointed to teach by the BCCL. The aim of the Centre was to provide basic and primary education skill sets to those who were unable to get benefit from the regular education system but were dedicated to learn. The classes were held in the hall where 150 students including young girls and married women were taught in one batch, from 4 pm to 6 pm, for five days a week. The course design was from simple to complex or from known to unknown. The classes include subjects that were related to the daily life of people such as basic mathematics and hindi. Besides that, subject such as English was also encouraged. The session on gender sensitization and human biology were also being taught. Teaching and writing skills to the women was one of the important aspects of the AEC. Girls and women used to like the classes and the mentor's way of teaching.

**Beneficiaries' viewpoint**

*Rani, a construal laborer in a mine and also the residences of lahbera village says: 'from the time the classes had started, I used to come here for studying. Coming from a poor family, I was unable to get school education as I had to assist my parents in coal mines. I wanted to study, but my family condition didn't allow me. Then through BCCL, we got this education centre, where the master used to teach us - how to speak, read and write. In the beginning, I was very shy but then the master always used to motivate me and call me in front and asked me to talk about myself. I used to be very shy and reluctant. But gradually I started speaking and slowly writing and reading too. Now, I also understand basic maths that helps me to calculate the numbers of days my friends and I work and the salary we deserve for it.Earlier we used to be paid less. Because of these classes, I feel empowered and confident now. I can directly speak to my malik*

*(Boss) and other people.' Rani now feels she is empowered and also has the courage. She also motivates other girls like her to come and join the classes. But it is unfortunate that the classes are not running now as the salary of a few of the mentors has not been paid yet by the BCCL. Hence, the mentors have stopped coming to teach.*

### III. Health Centre

The Health Centre was also established in the year 2009 and was operation till 2015. The aim of this project was to provide primary health care services to the people of lahbera village. The total cost of construction of health centre was Rs.373096/-. The Health Centre was used to run with the help of the Kusuda Area Medical team. The team consisting of doctors and nurses used to visit the hospital on a regular basis. The health team used to provide services such as consultations and medicine free of cost to all the villagers. Besides that, services such as blood pressure checking and weight measurement were also been provided. In addition to these services, awareness generation on health and hygiene was also provided periodically. The timing of the hospital was mostly 11 am to 2 pm. In case of emergency, the case was transferred to

Kusuma area hospital for further treatment. Health camps were also organized in the village whereby services such as eye checkup and other primary health care treatment were provided. When the research team asked the people about the medical services, a common replay come from all of them was that, 'the health centre must start again'. The impact of this health services was not only limited to the lahbera village, but it was also beneficial for the people from the nearby villages. From the response that the team got from the people states that medicines were mostly provided on general and seasonal illness. And for terminal sickness, the patients were recommended to visit the regional hospitals or the central hospital in Dhanbad.

**Beneficiaries' viewpoint**

*Ravi Mhatto, a residence of lahbera says: 'the health centre was very helpful for us. In the older days we have walk a few kilometres to get access to the health services. Most of the people use to just go to the medical shop and ask for the medicines, and the shopkeeper just used to give them medicines without any knowledge about the sickness. But, when the health centre started, people started coming here. They used to get free treatment and medicines. The doctor's behaviour was also good and kind. But from past few years, the health centre is closed. Since then, it's the same condition as before.' He added: 'we are adopted village and health is the most basic things that we need. We request BCCL that they should start the health centre once again'.*

### IV. Masala Chakki

Masala Chakki was one of the economic empowerment projects of BCCL. BCCL had provided the Masala Chakki to the villages. The total cost spend on the masala chakki project was Rs.394918/-, and it was run by the group formed by the villagers itself, consisting both male and female members of villages. The aim of Masala Chakki project was to provide self-employment and develop entrepreneurship at the village level. The Masala Chakki was operational only for a few weeks after which the group stopped it. The reasons highlighted for the same was that there was no market linkages, no proper monitoring and no guidance to run the Chakki and even no proper financial management. Hence, it was nonfunctional project as said by the people.

## V. Sewing Training Centre

The Sewing Training Centre was another economic empowerment activity of BCCL which intended to provide sewing skills sets to young girls and women through practical teaching. The course was started in the year 2009. The investment made by the BCCL CSR was Rs.378459/-.

The centre was run in collaboration with BCCL CSR and Nari Shakti Samiti, a branch of women development of BCCL. The training was provided to girls and women from the lahbera village which was free of cost but for other participants from nearby villagers was Rs.50/- for admission and Rs.25/- as monthly fees. The training was taught by the two mentors appointed by the BCCL and Nari Shakti Samiti. The training consisted of sewing training of various types such as dress, fall biding, bed sheets and a few others. The total batches run till now were two with the targeted beneficiaries of 156. After the completion of course, a certificate was also issued to the participants. The duration of the first batch was for nine months and for the second batch was six months. The training program also had the practical exam whereby the participants were told to demonstrate the skills that they had learned during the sewing classes.

**Beneficiaries' viewpoint**

*'I did not know what is called sewing', says Nelam Marandi, a girl of 18 years coming from a poor family. She only got a chance to educate herself till STD 4 after which she was told to assist her family by working with them in coal mines. Nelam was very much fond of clothes, especially designing and sewing. But due to no proper skill sets she used to get disappointed. Since the sewing course had started, she joined in. She was the student of the first batch. Over a period of months she started enjoying the training program as it was something that she liked. She learned about different type of fabric cloth, stitching, dress designs and much more. Over the period, she was empowered. Her skills in sewing was improved considerably, along with that her confidence too! After completing the course, she got a job of the assistant tailor in a tailor shop where she experimented her skills and also gathered enough money to buy a new sewing machine for her'. She says, 'I was working hard, saved the money which I got from my job and bought a machine for me. Now, I work from home and I earn around Rs.2000/- a month from this'. She was very thankful to the training centre and also motivated many others like her.*

## VI. Solar Lights

As on paper, 20 stands of solar lights were to be installed in and around village. But on field, it was observed that only 6 solar lights were present and that too around the corner of the park. Also, the batteries of these 6 solar lights stands were stolen and thus it was not functioning.

## VII. Primary School Building

One of the major infrastructural developments in Lahbera was the primary school building. As per the information obtained from the residents, the school was constructed in 2014 but not yet inaugurated. The school intended in providing primary education to the children of lahbera village and other nearby villages. Since the construction had been completed, the school building is not being inaugurated and thus left abandoned.

## VIII. Computer Training Center

The centre was started in collaboration with Nari Shakti Samiti and BCCL CSR. Around eight computers were provided to Lehbera CTP. The purpose of the project was to develope IT skills among the youths of Lahbera. The project was functional only for a few months, without any expected outcome.

## IX. Drainage line and PCC Road

The Construction of Drainage line and PCC Road in Lahbera covered only a particular region of the whole village. The drainage line physically observed was less than 400 metres, and half the work of the drainage system had been left incomplete. Same was the case with the PCC road construction. A few areas of the village had incomplete road construction as well as unrepaired kaccha roads. The amount of money spent on drainage line and PCC road was Rs.7, 27,949/-.

## X. Water supply

Before the village had been adopted, it was facing water scarcity issues. The villagers had to walk a few kilometres to fetch water. The situation didn't change even after the adoption. BCCL installed only three water pipelines that were observed on the field against the population of 392 peoples. As observed on the field, the water flow was very slow and also the water supply was only for 3 hours a day. In place of taps, BCCL had just provided a pipe with no proper measures to control the flow of water and to avoid the wastage of water. The total cost spent on the project seems to be more considering the negligible impact caused by it.

### 5.4 Multi-stakeholder Perspectives on village Adoption project

Table 6 – Multi – stakeholder perspectives on village adoption project

| Projects | Villagers | BCCL |
|---|---|---|
| **Multipurpose Hall** | The Hall was very useful for them as it is easily accessible and can be used for both, personal and community functions purposes. | The BCCL was aware of the need of community hall as it was used for important purpose, both at personal and community level. |
| **Health Center** | The Health centre was useful as it was providing medical treatment free of cost. But now disappointed as the centre is closed from past two years and even the MMV project has been stopped. So people now depend upon the privately run clinics. | As a part of adoption project, health was seen as an important aspect. Thus the Health Centre was constructed. |
| **School Building** | The school building is constructed. However, it has not yet started and thus need to start. | BCCL was aware of the educational problem of villagers and so they constructed the school. But the school has not started yet as the procurement is under process. |
| **Masala Chakki** | The people were upset as it had provided employment only for a few weeks. | Intention was to generate employment opportunity by providing the required infrastructure. |
| **AEC** | The centre was very useful as it had helped many girls and women to learn basic reading and writing skills and hence villagers demanded to start it once again. | Intention was to provide basic skills of writing and learning. |
| **STC** | The Training was useful, but at times there was discrimination among the girls as the girls from Lahbera were | The intention was to provide entrepreneur skills to the girls and women by providing them sewing |

| | | |
|---|---|---|
| | given preferences, and girls from other villages were not allowed to use the machine in spite of paying the fees. | training skillsets. |
| **Drainage line and PCC Road** | The project was good as it had reduced the mosquito breeding spots and has made the communication with main road easy. But the construction is left incomplete and only a few lanes have PCC road and drainage system. | The intention was to increase the communication and reduce the unhygienic condition in Lahbera |
| **Water Connection** | The scarcity of water prevailed before, and even now the villagers bring water from outskirts. Only three pipelines are being installed for the whole village which is not sufficient. | Intended to provide water for the entire village by providing pipeline supply system. |
| **CTP** | It was useful but was shut down after some time. reason was not to know | Intended to develop IT skills among the student of Lahbera village. |
| **Solar Lights** | It was not useful for people, as it is only limited to a few spots. The villagers get electricity connection through state supply electricity connection. | The intention was to provide electrification to the village. |

### 5.5 Gaps and Scope for Improvement

i. **Lack Monitoring:** The proposed project intented towards the integrated development of Lahbera village. But since past few years, no monitoring has been done by the BCCL and that had led to the ineffectiveness of the projects. Some of the projects have been unsuccessful, namely Health Center, STP, CTP, and AEC, due to lack of monitoring.

ii. **Unfinished projects: A** Few of the projects/infrastructures such as school building, road and drainage lines, solar light stands and water connection is partially done and that had created a negative image of the company in the eyes of villagers.

iii. **Lack of Execution:** Among nine projects that were aimed at developing the village four projects have been unsuccessful, namely Water pipeline connection, Solar Stand Lights, School and Masala chakki**.**

iv. **Limited Resources in training centre:** The resource supply in training centre especially STP was very limited. The number of students in a batch was more than 50 but the sewing machines available were only 4. A few batchmates even complaint for not allowing them to use the machines.

v. **No Scope for employment generation:** One of the common gaps found among the STP and the Computer centre was that there was no scope for the students, neither for future training nor employment generation, as this centre only provided basic training. In case of masala chakki, no market linkages were made for the production and sale of masala.

vi. **Limited growth through training program:** The training programs such as STP, AEC, and CTP had very limited growth outcome as teachers/mentors teaching the courses were not upgraded, and also the salaries of the mentors were not paid. Thus, it was reflected in their teaching. In case of STP and CTP, no linkages were created.

### 5.6 Recommendations

i. **Creating a local sustainable mechanism to look over the monitoring of the projects:** It is essential that a village development committee consisting of BCCL officials, village members and the panchayat representative should be formed. This committee must be autonomous and should monitor and recommend projects that are essential for the developing Lehbera as an ideal village. At the same time, periodic training should be provided to the villagers for increasing their skills sets and capability.

ii. **Formation of SHGs:** Self Help Groups have played an important role in development of individual and as well as the community. Therefore, SHGs especially of women and youth should be formed, and they should be provided training on capacity building and entrepreneur skills rather than just providing infrastructure.

iii. **Need Base Assessment should be done:** The demand for a particular project or infrastructure should come from the voices of people rather than from the BCCL. Therefore, proper need base assessment should be done.

iv. **Creating Jobs and Market linkages:** Linkages should be created for jobs so that after the training the students can get jobs. At the same time, market linkages such as textile and spice market should be created, might be within BCCL, where the product produced by the villagers could be sold.

v. **Rejuvenating the existing project:** The projects such as CTP, ADC, STP, and Health Centre should be rejuvenated, as these projects had created good impacts on the villagers. At the same time, it is essential that required resources and periodic upgradation should be done. Emergency medical vans should be made available. A female doctor should be available in the health centre.

vi. **Linking the villages with existing government schemes:** It was evident during the field visit that most of the villagers belong to the ST community. Hence, they could be linked with various government schemes and services that are available for them by creating awareness generation for the same.

# CHAPTER 6 - CONSTRUCTION OF PCC ROAD

### 6.1 Introduction

Roads are primary mean of transportation. These provide human access to different places. Roads make a crucial contribution to economic development and growth and bring important social benefits. They are of vital importance in order to make a nation grow and develop. In addition, providing access to employment, social, health and education services makes a road network crucial in fighting against poverty. Roads open up more areas and stimulate economic and social development. Hence understanding the importance of Road BCCL had Constructed PCC Roads in and around eight villages of the BCCL command area.

### 6.2 Objective of the project

Enabling and increasing the connectivity from semi-rural to urban areas by constructing PCC Road.

### 6.3 Location of implementation

Table 7 – Location of implementation of road projects in various areas

| SN | Name of Village/Area | Construction in Km/Meters |
|---|---|---|
| 1 | Kacharra Arah Tola , Hatudih Panchayat | 400 meters |
| 2 | Lahbera Village | 1.5 Km |
| 3 | Aamtal Village, Aamtal Panchayat (Kusunda) | 1.5 km |
| 4 | Satitand Village, Bauakala Panchayat (Kusunda) | 500 meters |
| 5 | Padugora Village, Padugora Panchayat (WJ area) | 400 meters |
| 6 | Kandra Village, Kandrta Panchayat | 500 meters |
| 7 | Bakaspura Village, Luti Pahari Panchayat | 400 meters |

## 6.4 Impact of Road on Community

### 1. Improved Connectivity

The most important aspect of this project is improved connectivity of people from both rural and urban area to the main town or urban world. The road has helped these communities by increasing their accessibility and communication to various vital resources centres such as health, market, schools and employment places. Hence people have now been easily accessing this place without any difficulty.

**Beneficiaries' viewpoint**

*Sunil Mahato Resident of Kahcharra arah Tola, Hadudih Panchayat says: 'the road has helped us. The connectivity has increased. Health centre, schools and marketplaces are now easily accessible. Besides that, there is increase in the rate of vehicles after completion of the road.'*

## 2. Enhanced Hygienic Living Condition

The Construction of Road has enhanced hygienic living condition. PCC road had reduced the risk of getting malaria and other vector-borne diseases. Besides that, there is also improvement in communication from one part to another part of village and also to the other vital resources centres

**Beneficiaries' viewpoint**

*'The road has improved our living condition. We had Kaccha road in rainy season. There was always water logging and slushy pathways that made all of us difficult to walk, Children use to fall on the road. Besides that, due to the slushy pathways we also faced health issues such as malaria. Mosquitos were all around, especially in rainy season. But, since the PCC road has been constructed, it has prevented water logging and slushy pathways and even had reduced the mosquito breeding spots. Thus our health issues are also being reduced'; says Krishna Singh, Resident of Amtal Village.*

### 6.5 Gaps identified in the project

**i. Inferior Quality of Road Construction**

Almost all the road constructed under the CSR project was of inferior quality. The quality of the road had started diminishing after a few months from its construction. In many places, potholes and cracks were found by the research team. It was reported by the community that the construction of the road involved several unscrupulous means.

**ii. Limited Connectivity**

Most of the road constructed had limited connectivity. The road which was constructed was the internal road, which at some places was not even connecting to the main road. For example, the road constructed in lahbera was mostly internal and no connection was made with the main road. Thus, the people highlighted regarding its limited social value. A few of the road constructions were left incomplete. Besides that, lack of maintenance was also reported by the people.

**iii. Participatory Approach**

It was reported by the people that the participatory approach was neither utilized before nor during the construction of the road. Opinion and views of the people should be taken into consideration. The people reported that consent during infrastructure development such as in road was mostly avoided.

**iv. Lack of monitoring from the BCCL**

All the villages and areas where the road had been constructed, people reported that no monitoring or follow-up was done after the construction of the road. It was also told to the research team that after the construction of the road that is after two to three years, it is only now that the BCCL officials have come to inspect the road, along with the research team. People reported that they were highly unsatisfied for the negligence of BCCL officials in terms of monitoring and inspection.

### 6.6 Multi-stakeholder Perspective

**i. BCCL officials -** The aim of the project was to provide connectivity, connecting the small villages to the main town or main road that would subsequently enhance the productivity of the people and also the standard of living.

ii. **Villagers -** The road is useful to villagers in many ways. For example, it has increased the accessibility of vital resource centres such as schools, market, hospitals, etc. It has also increased the communication from one village to another and also from the village to the main town.

### 6.7 Recommendations

i. **Periodic monitoring** should be conducted by the BCCL. This would enable the company to identify the gaps in implementation of project, and at the same time while doing this; the creditability of the organization will also increase among the people/community.

ii. **Considering People's opinion and view** will enable the BCCL to implement the project in more effectively. Besides that good rapport will develope between both the parties.

iii. **Regular Maintenances** should be done by the BCCL. Similarly expansion should be done based on the needs and demands of the people/community.

iv. **Improvisation of road quality** by tendering the project to a contractor with better credibility and good quality work record in the past.

**v. Participation of community** should be encouraged before as well as during the construction of road as it would provide an opportunity to the villagers to monitor and supervise the construction process in terms of higher transparency, accountability and sustainability.

# ANNEXURE

Confidential (for research purpose only- property of TISS)

## HOUSEHOLD QUESTIONNAIRE

**Project - Mobile Medical Van (*Swasth Rath*)**

(As this questionnaire requires input from male and female members of household, it should be administered to head of household in the presence of other responsible adult male and female members.)

**IDENTIFICATION PARTICULARS**

**Before Starting Interview**

Name of District _____Code:_____
Name of Taluka _____Code:_____
Name of Block _____Code:_____
Gram Panchayat _____Code:_____
Name of the village_____Code:_____

Name of the Mining Area _____

Date of Interview (DD/MM/YY): _____/_____/_____
Time of starting Interview (HH.MM): _____. _____ AM/PM

**After Ending Interview**

Time of ending interview (HH.MM): _____. _____ AM/PM
Names of Respondents 1: _____ MID: _____
2: _____ MID: _____
3: _____ MID: _____
Name of Interviewer: _____ Code: _____

**After Checking/Editing Questionnaire**

Name of Supervisor: _____Code: _____
Name of Editor: _____Code:
_____

**A: HOUSEHOLD PROFILE AND HEALTH SEEKING BEHAVIOR**

| Qn. | QUESTIONS AND FILTERS | CODING CATEGORIES | SKIP |
|---|---|---|---|
| A01 | What is your religion? | HINDU……..1<br>MUSLIM……..2<br>CHRISTIAN……..3<br>SIKH……..4<br>BUDHHIST……..5<br>JAIN……..6<br>OTHER _____7<br>NO RELIGION……..8 | |
| A02 | Do you come under scheduled caste, scheduled tribe, nomadic tribe, or other backward class? Which one? | SCHEDULED CASTE……..1<br>SCHEDULED TRIBE……..2<br>NOMADIC TRIBE……..3<br>DENOTIFIED TRIBE……..4<br>OTHER BACKWARD CLASS (OBC)……..5<br>GENERAL……..6<br>DON'T KNOW……..7 | |
| A03 | From where do you fetch water for your household?<br>(ask for all sources) | TAP (BY OWN).....1<br>OWN TAP BY GOVT/PANCHAYAT .....2<br>OWN HANDPUMP.....3<br>OWN OPEN WELL.....4<br>NEIGHBOUR'S TAP.....5<br>COMMUNITY TAP.....6<br>COMMUNITY HANDPUMP.....7<br>COMMUNITY OPEN WELL.....8<br>OTHER(SPECIFY)_____9 | |
| A04 | If household members fall sick, where do you go or whom do you consult first? | TRADITIONAL HEALER/DAI.....1<br>LOCAL DOCTOR/RMP.....2<br>CHEMIST SHOP.....3<br>MOBILE CLINIC OF JHARKHAND GOVERNMENT.....4<br>SHC/ASHA/ANGANWADI.....5<br>PHC/CHC.....6<br>GOVT HOSPITAL.....7<br>PRIVATE CLINIC.....8<br>PRIVATE HOSPITAL.....9<br>COMPANY/AIDED HOSPITAL.....10<br>SEEK NO TREATMENT.....11<br>DEPENDS ON AILMENT.....12<br>MOBILE MEDICAL VAN OF BCCL....13 | |

| | | | |
|---|---|---|---|
| | | OTHER_____14 | |
| A05 | During the last 12 months, which are the agencies did you/your household members visit for consultation and/or treatment?<br><br>(ASK FOR ALL SOURCES) | TRADITIONAL HEALER/DAI.....1<br>LOCAL DOCTOR/RMP.....2<br>CHEMIST SHOP.....3<br>MOBILE CLINIC.....4<br>SHC/ASHA/ANGANWADI.....5<br>PHC/CHC.....6<br>GOVT HOSPITAL.....7<br>PRIVATE CLINIC.....8<br>PRIVATE HOSPITAL.....9<br>COMPANY/AIDED HOSPITAL.....10<br>MOBILE MEDICAL VAN OF BCCL.....11<br>MOBILE CLINIC OF JHARKHAND GOVERNMENT.....12<br>OTHER_____13<br>NO TREATMENT.....14<br>NOBODY FELL SICK.....15 | |
| A06 | How the purification techniques followed at household level? | BOIL THE WATER.....1<br>ADD BLEACH/CHLORINE.....2<br>SIEVE IT THROUGH CLOTH.....3<br>WATER FILTER (CERAMIC, SAND, COMPOSITE, ETC.).....4<br>LET IT STAND AND SETTLE.....5<br>OTHER _____6<br>DON'T KNOW.....7 | |
| A07 | What type of toilet facility do you have? | FLUSH TOILET (OWN).....1<br>PIT TOILET(OWN).....2<br>FLUSH TOILET(COMMUNITY).....3<br>PIT TOILET(COMMUNITY).....4<br>OTHER _____5<br>GO FOR OPEN DEFECATION.....6 | |
| A08 | Do you wash hand properly after defecation? | YES.....1<br>NO.....2 | |
| A09 | What is the status of health infrastructures availability in the villages or nearest location in terms of government services? | GOVT HOSPITAL AVAILABLE BUT NOT FUNCTIONING PROPERLY.....1<br>GOVT HOSPITAL NOT AVAILABLE.....2<br>PRIMARY HEALTH CENTER IS AVAILABLE AND FUNCTIONING.....3<br>PRIMARY HEALTH CENTER IS AVAILABLE BUT NOT | |

| | | | |
|---|---|---|---|
| | | FUNCTIONING/POOR.....4<br>PRIMARY HEALTH CENTER IS NOT AVAILABLE.....5<br>SUB-CENTRES OR COMMUNITY HEALTH CENTRES AVAILABLE .....6<br>SUB-CENTRES OR COMMUNITY HEALTH CENTRES NOT AVAILABLE.....7 | |
| A10 | How is the access to health facilities in terms of connectivity to/from villages, type of approach road? | KUCCHA ROAD.....1<br>PACCA ROAD IN GOOD CONDITION....2<br>PACCA ROAD IN BAD CONDITION.....3<br>ROAD INSIE THE VILLAGE IS GOOD..4<br>ROAD INSIDE THE VILLAGE IS NOT GOOD.....5 | |
| A11 | What are the major Ailments in your family? | COUGH & COLD.....1<br>SKIN DISEASES (ITCHING ETC.)....2<br>WATER BORNE DISEASE .....3<br>MALARIA/ DENGUE.....4<br>OTHER (SPECIFY)_____5 | |
| A12 | What is the mode of transport used for referral cases? | AMBULANCE.....1<br>HIRED VAN/TRAKER/TAXI/AUTO RICKSHAW.....2<br>JUTE COT (KHATIA).....3<br>MAN DRIVEN RIKSHAW.....4<br>OTHER(SPECIFY) _____5 | |

**B. SERVICES OF MOBILE MEDICAL VAN (*Swastha Rath*)**

| Qn. | QUESTIONS AND FILTERS | CODING CATEGORIES | SKIP |
|---|---|---|---|
| B01 | Are you aware that Mobile Medical Van (Swastha Rath) is sponsored by BCCL? | YES.....1<br>NO.....2 | |
| B02 | How long back the van been coming? | MORE THAN FIVE YEARS.....1<br>FIVE YEARS.....2<br>FOUR YEARS.....3<br>THREE YEARS.....4<br>TWO YEARS.....5<br>ONE YEARS.....6<br>DON'T KNOW/REMEMBER.....7 | |
| B03 | How does the BCCL plan to publicize and make the communities in the village aware of their visits as they have a set a time for their visits | ANNOUNCEMENT BY MUKHIYA IN GRAM SABHA.....1<br>ANNOUNCEMENT THOUGH LOUDSPEAKER BY BCCL.....2<br>BY ASHA WORKER/VILLAGE VOLUNTEERS.....3<br>BCCL REPRESENTATIVES CALL FOR VILLAGE MEETING.....4 | |

| | | | |
|---|---|---|---|
| | | OTHER MEANS(SPECIFY)_____5 | |
| B04 | Do you think the van comes frequently enough? | DAILY.....1<br>ONCE A WEEKLY.....2<br>TWICE A WEEK.....3<br>FORTNIIGHTLY.....4<br>ONCE A MONTH.....5<br>DOES NOT COME.....6<br>OTHER SPECIFY.....7 | |
| B05 | Is there a fixed point where the van comes and waits? | YES.....1<br>NO.....2<br>DON'T KNOW.....3 | |
| B06 | If yes, specify: | | |
| B07 | Does fixed date and time of visit is maintained by the Mobile Medical Van? | YES.....1<br>NO.....2<br>DON'T KNOW.....3 | |
| B08 | How long does the van wait in the village? | LESS THAN AN HOUR.....1<br>ONE HOUR.....2<br>TWO HOURS.....3<br>THREE HOURS.....4<br>MORE THAN THREE HOURS.....5<br>DON'T KNOW.....6 | |
| B09 | Do you think this time is enough? | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |
| B10 | If no, how much longer should it wait?<br>(Write as it is) | | |
| B11 | How is the priority in beneficiary selection governed? | FIRST COME FIRST SERVE.....1<br>AGED PERSONS.....2<br>INFANTS/CHILDREN.....3<br>DIFFERENTLY ABLED.....4<br>PREGNANT WOMEN.....5<br>RANDOM, NO PRIORITY AS SUCH....6<br>VISIBLY VERY UNWELL PERSON.....7 | |

| | | | |
|---|---|---|---|
| B12 | Facilities available in the van | FREE MEDICINE/ TREATMENT.....1<br>PROVIDE DOORSTEP FACILITIES....2<br>PROVIDE DIAGNOSTIC FACILITY....3<br>PROVIDE ALL THE FACILITIES THAT ARE PROVIDED IN A HOSPITAL.....4<br>OTHER(SPECIFY)_____5 | |
| B13 | Does the medical team give awareness about the followings? | HYGIENIC SANITATION.....1<br>HYGIENIC WATER CONSUMPTION.....2<br>MOTHER & CHILD HEALTH CARE.....3<br>IMMUNIZATION.....4<br>ANAEMIA.....5<br>DE-WORMING.....6<br>VECTOR BORNE DISEASES.....7<br>HEPATITIS.....8<br>TYPHOID.....9<br>COMMON CARDIAC PROBLEMS.....10<br>HIV.....11<br>DIABETES.....12<br>SNAKE BITE.....13<br>TUBERCULOSIS.....14<br>OTHERS_____15 | |
| B14 | Does the medical team diagnose the following? | BLOOD PRESSURE.....1<br>HEMOGLOBIN LEVELS.....2<br>OXYGEN SATURATION.....3<br>MALARIA.....4<br>HEPATITIS.....5<br>DENGUE.....6<br>TYPHOID.....7<br>DIABETES.....8<br>OTHERS_____9 | |
| B15 | What kind of services do you get from the van as far as cure is concern? | MEDICINES.....1<br>NUTRITIONAL SUPPLEMENTS.....2<br>DE-WORMING.....3<br>TONICS.....4<br>OTHERS_____5 | |
| B16 | Is it convenient for your family to reach the MMV point? (Ask specific to women, children, senior citizen, and differently abled if any in the family). | WOMEN.....YES(1)<br>NO(2)<br>CHILDREN.....YES(1)<br>NO(2)<br>SENIOR CITIZEN.....YES(1)<br>NO(2) | |

| | | | |
|---|---|---|---|
| | | PWD.....YES(1)<br>NO(2) | |
| B17 | If no, then what is the difficulty? | LONG DISTANCE.....1<br>NO INTERNAL ROAD.....2<br>NO APPROACH ROAD.....3<br>NO CONNECTING BRIDGE.....4<br>KUTTCHA ROAD.....5<br>NO MODE OF TRANSPORTATION.....6<br>INCONVINIENT TIMING OF THE MMV.7<br>OTHERS SPECIFY_____8 | |
| B18 | Who are present in the Mobile Medical Van of BCCL? | DOCTOR.....1<br>COMPOUNDER/PHARMACIST.....2<br>NURSE/ANM.....3<br>DRIVER.....4<br>ALL THE ABOVE.....5<br>OTHER(SPECIFY)_____6 | |
| B19 | What is the availability of doctor in the Van? | ALWAYS PRESENT .....1<br>SOMETIMES PRESENT.....2<br>NEVER PRESENT.....3 | |
| B20 | If no, then who facilitate the service? (Write as it is) | | |
| B21 | Do you able to convey your problems to the Doctor/pharmacist?<br>(probe behavior of the medical team) | YES.....1<br>NO.....2 | |
| B22 | What if a person falls ill in the period when Van is not visiting? (Write as it is) | VISIT PRIVATE PRACTIONER.....1<br>VISIT RMP.....2<br>NEAREST HEALTH GOVERNMENT HEALTH CENTER.....3<br>NEAREST PRIVATE CLINIC/HOSPITAL..4<br>WAIT FOR MMV FOR NEXT VISIT.....5<br>OTHERS(SPECIFY)_____6 | |
| B23 | Does the medical team provide awareness campaign? | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |
| B24 | If yes, what are they? | HIV/AIDS/SMOKING/ALCHOLISM.....1<br>PUBLICITY AND SENSITIZATION CAMPAIGN.....2<br>CLEANINESS AND HYGIEN.....3 | |

| | | | |
|---|---|---|---|
| | | MATERNITY CARE.....4<br>OTHER(SPECIFY)_____5 | |

**C. BENEFICIARIES' FEEDBACK ON MMV SERVICE**

| Qn. | QUESTIONS AND FILTERS | CODING CATEGORIES | SKIP |
|---|---|---|---|
| C01 | Do you think the frequency of doctor's visit to private clinic/hospital or government health center has been reduced due to service of MMV provided by BCCL? | AGREE.....1<br>DISAGREE.....2<br>CAN'T SAY.....3 | |
| C02 | Do you think monthly expenditure on health checkups /medicine has been reduced due to the service of MMV provided by BCCL? | AGREE.....1<br>DISAGREE.....2<br>CAN'T SAY.....3 | |
| C03 | Do you think that your time has been saved due to the service of MMV provided by BCCL? | AGREE.....1<br>DISAGREE.....2<br>CAN'T SAY.....3 | |
| C04 | Do you think travelling cost has been saved due to service provided by MMV of BCCL? | AGREE.....1<br>DISAGREE.....2<br>CAN'T SAY.....3 | |
| C05 | Do you think you get free advice by a qualified trained/ qualified doctors at your door step? | AGREE.....1<br>DISAGREE.....2<br>CAN'T SAY.....3 | |
| C06 | Do you think major ailments in your family have been reduced due to awareness given by the medical team of BCCL through MMV? OR your family is healthier than before? | AGREE.....1<br>DISAGREE.....2<br>CAN'T SAY.....3 | |
| C07 | Is there any scope of improvement in MMV? If yes, answer the question from **C08 to C12** | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |
| C08 | MMV should reach on time/ time should be fixed | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |
| C09 | There should be fixed/ convenient time of reaching the MMV (any) | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |
| C10 | Quantity/ variety of medicines should be increased (any) | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |

| | | | |
|---|---|---|---|
| C11 | Frequency/coverage of MMV should be increased (any) | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |
| C12 | Requirement of a lady doctor/nurse | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |
| C13 | How would you rate (out of 5) the service of Mobile Medical Van provide by BCCL. | POOR(1/5).....1<br>BELOW AVERAGE(2/5).....2<br>AVERAGE(3/5).....3<br>GOOD(4/5).....4<br>EXCELLENT(5/5).....5 | |
| C14 | Do you think this service by BCCL should be continued? | AGREE.....1<br>DISAGREE.....2<br>CAN'T SAY.....3 | |

# HOUSEHOLD QUESTIONNAIRE

**Project - Scheme for multipurpose utilization of abandoned mine water**

(As this questionnaire requires input from male and female members of household, it should be administered to head of household in the presence of other responsible adult male and female members.)

## IDENTIFICATION PARTICULARS

### Before Starting Interview

Name of District

_____Code:_____

Name of Taluka

_____Code:_____

Name of Block

_____Code:_____

Gram Panchayat

_____Code:_____

Name of the

village_____Code:_____

Pond Name_____

Date of Interview (DD/MM/YY): _____/_____/_____

Time of starting Interview (HH.MM): _____. _____

AM/PM

### After Ending Interview

Time of ending interview (HH.MM): _____. _____

AM/PM

**A: HOUSEHOLD PROFILE AND AGRICULTURE AND WATER AVAILABILITY**

| Qn. | QUESTIONS AND FILTERS | CODING CATEGORIES | SKIP |
|---|---|---|---|
| A01 | What is your religion? | HINDU……1<br>MUSLIM……2<br>CHRISTIAN……3<br>SIKH……4<br>BUDHHIST……5<br>JAIN……6<br>OTHER _____7<br>NO RELIGION……8 | |
| A02 | Do you come under scheduled caste, scheduled tribe, nomadic tribe, or other backward class? Which one? | SCHEDULED CASTE……1<br>SCHEDULED TRIBE……2<br>NOMADIC TRIBE……3<br>DENOTIFIED TRIBE……4<br>OTHER BACKWARD CLASS (OBC)……5<br>GENERAL……6<br>DON'T KNOW……7 | |
| A03 | Type of house<br>(record as per guidelines based on type of wall,<br>roof and floor) | RCC .....1<br>PUCCA .....2<br>SEMI-PUCCA .....3<br>KUCHCHA .....4<br>HUT .....5<br>TENT (MAKESHIFT).....6 | |
| A04 | House electrified? | YES.....1<br>NO.....2 | |
| A05 | From where do you fetch potable water for your household?<br>(ask for all sources) | TAP (BY OWN).....1<br>OWN TAP BY GOVT/PANCHAYAT .....2<br>OWN HANDPUMP.....3<br>OWN OPEN WELL.....4<br>NEIGHBOUR'S TAP.....5<br>COMMUNITY TAP.....6<br>COMMUNITY HANDPUMP.....7<br>COMMUNITY OPEN WELL.....8<br>COMMUNITY POND.....9<br>OTHER(SPECIFY)_____10 | |
| A06 | How far is the water source from your household? | JUST OUTSIDE.....1<br>WITHIN 1/2 KM.....2<br>WITHIN 1 KM.....3<br>MORE THAN 1 KM.....4 | |

| | | | |
|---|---|---|---|
| A07 | If it is used for drinking, what is purification techniques followed at household level? | BOIL THE WATER.....1<br>ADD BLEACH/CHLORINE.....2<br>SIEVE IT THROUGH CLOTH.....3<br>WATER FILTER (CERAMIC, SAND, COMPOSITE, ETC).....4<br>LET IT STAND AND SETTLE .....5<br>OTHER (SPECIFY).....6<br>DON'T KNOW.....7 | |
| A08 | What is the purpose of mine water utilization through pond? | DRINKING.....1<br>COOKING.....2<br>WASHING VEGETABLES .....3<br>WASHING CLOTHES.....4<br>HOUSE CLEANING.....5<br>BATHING/WASHING YOUR BODIES....6<br>AGRICULTURE.....7<br>WASHING ANIAMLS.....8<br>AFTER DEFECATION.....9<br>OTHER(SPECIFY) .....10 | |
| A09 | What type of toilet facility do you have? | FLUSH TOILET (OWN).....1<br>PIT TOILET(OWN).....2<br>FLUSH TOILET(COMMUNITY).....3<br>PIT TOILET(COMMUNITY).....4<br>OTHER _____5<br>GO FOR OPEN DEFECATION.....6 | |
| A10 | Do you use pond water after open defecation? | YES.....1<br>NO.....2 | |
| A11 | Does your household own any agricultural land including any plantation land? | YES.....1<br>NO.....2 | |
| A12 | How much agriculture land do you own? | _____ACRS<br>_____(LOCALE MEASUREMENT SCALE) | |
| A13 | How much of the land cultivated by you is irrigated? | NIL..... 0<br>_____ACRS<br>_____(LOCALE MEASUREMENT SCALE) | |
| A14 | What are the sources of irrigation?<br>Do not record rain as a method of irrigation<br>(ASK FOR ALL SOURCES) | CANAL.....1<br>POND.....2<br>WELL.....3<br>RIVER.....4<br>MOTOR PUMP.....5<br>TUBE WELL.....6 | |

| | | | |
|---|---|---|---|
| | | BORE WELL.....7<br>DAM.....8<br>OTHER_____9<br>NONE.....10 | |
| C15 | What is the lift irrigation equipment used by you to draw water from pond to agriculture field? | DIESEL ENGINE/PUMP.....1<br>ELECRIC MOTOR..... .....2<br>SUBMERGIBLE PUMP.....3<br>OTHER (SPECILFY)_____4 | |
| A16 | Major crops grown | 1) _____<br>2) _____<br>3) _____<br>4) _____<br>5) _____ | |

**B. AWARENESS ABOUT MINE WATER SUPPY, REPAIRS, RENOVATION & RESTORATION OF THE PONDS AT KHONATHI AND BEHRAKUDAR BY BCCL**

| Qn. | QUESTIONS AND FILTERS | CODING CATEGORIES | SKIP |
|---|---|---|---|
| B01 | Do you know that BCCL is supplying mine water to the pond? | YES.....1<br>NO.....2 | |
| B02 | Do you know about the activities done by BCCL for the pond? | EMBANKMENT OR STONE PITCHNG AROUND THE BANK .....1<br>INLET AND OUTLETS.....2<br>GHATS/STAIRS .....3<br>REPAIRE.....4<br>INCREASED THE CATCHMENT/RESTORATION.....5<br>DON'T KNOW ANY OF THE ABOVE.....6 | |
| B03 | How you come to know that BCCL has renovated the pond? | DISPLAY BOARD BY BCCL.....1<br>GRAM SABHA.....2<br>OBSERVED RENOVATION WAS GOING.....3<br>OTHER SOURCE (PLEASE MENTION)..4<br>_____ | |
| B04 | Whether BCCL conducted any village meeting along with Mukhiya before supplying mine water to the pond? | YES.....1<br>NO.....2<br>DON'T KNOW.....3 | |

| | | | |
|---|---|---|---|
| B05 | When and how many meetings were held?<br>(Specify the number with month and year) | | |
| B06 | Does the pond dry up initially during summer? | YES.....1<br>NO.....2<br>DON'T KNOW.....3 | |
| B07 | How often the mine water is supplied to the village pond by BCCL? | WEEKLY.....1<br>MONTHLY.....2<br>QUARTERLY.....3<br>HALFYEARLY.....4<br>DRY SPELL/WINTER ONLY.....5<br>NOT FIXED.....6<br>NEVER..... .....7<br>DON'T KNOW.....8<br>IF ANY OTHER, SPECIFY.....9 | |
| B08 | How many hours/day is water supplied? | 30 MINUTES.....1<br>45 MINUTES.....2<br>ONE HOUR.....3<br>TWO HOURS.....4<br>MORE THAN TWO HOURS.....5 | |
| B09 | Is the quantity of water supplied sufficient for your village? | YES.....1<br>NO.....2<br>DON'T KNOW.....3 | |
| B10 | Has there been any case of illness die to poor water quality? If yes, please specify | NO<br>YES (SPECIFY)<br>_____<br>_____ | |
| B11 | What is alternative source of water in case the existing facility is damaged? (Specify) | | |
| B12 | When was the last mine water supplied by BCCL? | LAST MONTH.....1<br>LAST THREE MONTHS.....2<br>LAST SIX MONTHS.....3<br>LAST ONE YEAR.....4<br>MORE THAN A YEAR(HOW LONG,SPECIFY)<br>_____5 | |

| | | | |
|---|---|---|---|
| B13 | When was the last monitoring done by BCCL regarding utilization of mine water? | LAST MONTH……1<br>LAST THREE MONTHS……2<br>LAST SIX MONTHS……3<br>LAST ONE YEAR……4<br>MORE THAN A YEAR(HOW LONG,SPECIFY)<br>_____5<br>NEVER.....6<br>DON'T KNOW.....7 | |

**C. IMPACT AFTER THE INTERVENTION ON UTILIZATION OF MINE WATER FOR DOMENSTIC AND AGRICULTURAL USE**

| Qn. | QUESTIONS AND FILTERS | CODING CATEGORIES | SKIP |
|---|---|---|---|
| C01 | Is water available throughout the year? | YES.....1<br>NO.....2 | |
| C02 | What you think, the availability of water in the pond throughout the year is due to? | MINE WATER SUPPLIED BY BCCL...1<br>NATURALLY DUE TO RAIN WATER...2<br>GROUND WATER REGENERATION.....3<br>DON'T KNOW.....4<br>OTHER REASONS(SPECIFY)_____<br>_____5 | |
| C03 | Is there any improvement in water storage capacity or catchment areas of tank seen after the renovation of pond by BCCL? | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |
| C04 | Do you think that water scarcity has reduced during dry spell/winter due to mine water supply provided by BCCL? | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |
| C05 | Do you find adequate quantity of water during summer/winter due to mine water supply provided by BCCL? | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |
| C06 | Do you think the impact of flood has been reduced during monsoon due to renovation of pond by BCCL? | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |
| C07 | Do you think the distance of water availability has been reduced for animals especially for those who can't go long distance to drink water due to mine water supply of BCCL? | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |

| | | | |
|---|---|---|---|
| C08 | Do you think you get water for household easily and timely due to mine water supply of BCCL? | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |
| C09 | Do you think that villages has developed new job opportunity like duckery and fishery in dry season and use their time better than before? | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |
| C10 | Do you utilize pond water for critical irrigation? | YES.....1<br>NO.....2 | |
| C11 | Do you think you are able to produce two crops (Winter crops) in a year due to mine water supply of BCCL | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |
| C12 | Do you think you produce beyond your home consumption and get money to be used for different purposes due to mine water supply of BCCL? | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |
| C13 | Are any new crops grown due to this intervention, which were not sown before due to unavailability of water during winter/dry spell? | YES.....1<br>NO.....2 | |
| C14 | The new crops grown are | 1)_____<br>2)_____<br>3)_____<br>4)_____<br>5)_____ | |
| C15 | Was any increase in land under irrigation seen? | YES.....1<br>NO.....2 | |
| C16 | How much land under irrigation increased? | _____ACRS<br>_____(LOCALE MEASUREMENT SCALE) | |
| C17 | Do you think your income has been increased due to pond renovation and mine water supply? | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |
| C18 | Do you think your agricultural production has been increased due to pond renovation and mine water supply? | AGREE.....1<br>DISAGREE.....2<br>DON'T KNOW.....4 | |
| C19 | Have you used pond for fishery or duckery | YES.....1<br>NO.....2 | |
| C20 | How much income have you gained? | RS._____/MONTH | |

| | | | |
|---|---|---|---|
| C21 | Do you think there is scope for improvement with regards to mine water supply?<br>If yes, answer **C22 to C24** | YES.....1<br>NO.....2 | |
| C22 | Mine water should be reached on time/ time should be fixed | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |
| C23 | Frequency of mine water supply should be increased | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |
| C24 | Quantity and quantity of water should be improved | YES.....1<br>NO.....2<br>CAN'T SAY.....3 | |
| C25 | How would you rate (out of 5) the quantity of water service provide by BCCL. | POOR(1/5).....1<br>BELOW AVERAGE(2/5).....2<br>AVERAGE(3/5).....3<br>GOOD(4/5).....4<br>EXCELLENT(5/5).....5 | |
| C26 | How would you rate (out of 5) the quality of water service provide by BCCL. | POOR(1/5).....1<br>BELOW AVERAGE(2/5).....2<br>AVERAGE(3/5).....3<br>GOOD(4/5).....4<br>EXCELLENT(5/5).....5 | |
| C27 | Do you think BCCL should continue supplying Mine water? | YES.....1<br>NO.....2 | |

**D. MANAGEMENT OF POND**

| Qn. | QUESTIONS AND FILTERS | CODING CATEGORIES | SKIP |
|---|---|---|---|
| D01 | Have community participated during pond renovation through *"shramdaan"*? | YES.....1<br>NO.....2<br>DON'T KNOW.....3 | |
| D02 | Is there any evidence that the pond has been recently undergone maintenance/ de-silting? | YES.....1<br>NO.....2<br>DON'T KNOW.....3 | |
| D03 | Does community also participate in maintenance/ de-silting? | YES.....1<br>NO.....2<br>DON'T KNOW.....3 | |

| | | | |
|---|---|---|---|
| D04 | If the BCCL water supply facility gets damaged, who repair it? (write as it is) | | |
| D05 | Maintenance is carried out? | FUND RAISED BY COMMUNITY(*CHANDA*) .....1<br>MUKHIYA DEVELOPMENT FUND.....2<br>BCCL CSR FUND.....3<br>MP/MLA FUND.....4<br>OTHER(SPECIFY)_____5 | |
| D06 | Constraint in O & M | **INEFFECTIVE COORDINATION AMONG USERS**.....1<br>**LACK OF FUND REHABILITAION**....2<br>NEGELGENCE OF LOCAL AUTHORITY.3<br>OTHER(SPECIFY)_____4 | |

**QUESTIONNAIRE**
**VILLAGE ADOPTION PROGRAMME (Lahbera, Dhanbad)**

1. Date Time

2. Village:
   Panchayat:
   Block:
   District:
   State:

3. Mukhiya/Sarpanch/Ward member/Participant:
   Name:
   Contact No.:

4. Population:

***Multipurpose hall***

**Questions**

| | |
|---|---|
| 1. | When was the hall built? How much time did the construction take? |
| 2. | Who built it? (Mention implementing agency). Who provided the land for the same. |
| 3. | Why was the need felt to build this hall? |
| 4. | Were the villagers consulted before constructing the hall? |
| 5. | What is the cost of the building? (How many respondents know?) |
| 6. | Was there any board displayed during/after the construction of the hall providing information related to it? |
| 7. | Is the hall useful? |
| 8. | What is the hall used for?<br>• SHG Meetings<br>• Wage Payments<br>• Bank related details<br>• Gram Sabha<br>• Awareness Campaigns<br>• Meetings with BCCL<br>• Trainings<br>• Functions (community)<br>• Functions (individuals)<br>• Livelihood activities<br>• Fairs<br>• Lodging<br>• Others (Please specify) |
| 9. | Is the access to multi-purpose hall affected by any factor?<br>• Caste<br>• Religion<br>• PRI Members<br>• Gender<br>• Gram Sachiv<br>• Other govt. employee<br>• Others (Please specify) |
| 10. | Who has the control over or authority related to the multi-purpose hall?<br>• Gram Sabha<br>• Sarpanch<br>• Specific committee/group<br>• Individual (Please specify)<br>• BCCL<br>• Others |
| 11. | What is the procedure to use the hall for any purpose? Is there a system devised? If yes, please specify. |
| 12. | How can this hall be better utilized? |

***Masala Chakki:***

**Questions for Beneficiaries**

| | |
|---|---|
| 1. | When was the Masala Chakki made operational? How much time did the process of operationalization take? |
| 2. | Who installed it? (Mention implementing agency). Who provided the land/building for the same? |
| 3. | Why was the need felt to start this initiative? |

4. Were the villagers consulted before starting this initiative?
5. What is the cost of the initiative? (How many respondents know?)
6. Was there any board displayed during/after the installation and operationalization of the Masala Chakki providing information related to it?
7. Is the Masala Chakki useful?
   - Enhancing livelihood
   - Making grinding easier
   - Others (Mention)
8. What is the impact of this initiative for participants?
   - Tangible (income)
     - Earnings of individual workers
     - Collective income of the community
     - Profit by owners
     - Others
   - Intangible
     - Services/sales/production increase or decrease
     - Empowerment
     - Drudgery Reduction
     - Negative impacts if any (pollution/disputes/others)
     - Are they now able to make Investment in areas like:
       - Health
       - Education
       - Malnutrition
       - Transportation
       - Other (Specify)
     - Others (Mention)
9. What is the mechanism of selling the products? Where are the masalas sold? How is the demand in market?
10. What is the technical support provided for production as well as marketing? What more is expected?
11. How can we make this initiative better?
    - To enhance positive impacts
    - To reduce negative impact
12. Are impacts overall positive or negative? For whom?
13. What are the most important impacts? According to whom?
14. How significant are they? In what way?
15. Do changes alter livelihood strategies and security, or do they just add one element (a coping strategy) within existing approaches? Can impacts be summarised in terms of changes in livelihood security or robustness?

***Health Centre*:**

**Questions**

1. What was the scenario before the Health Centre was started?
   - Doctors
   - Health workers
   - Nearest Health Centre
   - Access to medicines
   - Access to screening tests
   - Others (Mention)
2. Why was the health centre set up in the village?
3. Were people of the village involved in the decision making?
   - Need Assessment
   - Location of Health Centre
   - Others (Specify)
4. What is the basic infrastructure available?
   - Electricity
   - Water
   - Drinking water
   - Ambulance
   - Others (Mention)
5. What is the human resource deployed at the health Centre?
   - Doctor (qualification)
   - Nurse/ANM
   - Pharmacist
   - Lab-technician
   - Others (Specify)
6. How is the behaviour of the staff?

| |
|---|
| 7. Population Coverage by the Health Centre |
| 8. How is the utilization of the medical services at the Health centre? |
| 9. Institutional Deliveries<br>• Vaccination<br>• First Aid<br>• General Check ups<br>• Ante natal services<br>• Others |
| 10. What diseases do people generally suffer from? |
| 11. Name the diseases/symptoms. Also mention if they receive treatment for the mentioned diseases at the health centre |
| 12. Are referral services provided? |
| 13. What are the timings of the Health Centre? |
| 14. How are emergencies handled? |
| 15. Are people satisfied with the health Centre? If yes provide reasons. |
| 16. What are people dissatisfied about?<br>• Staff unavailable<br>• Non-examination by staff<br>• Improper attention<br>• Centre not clean<br>• Medicines not available<br>• Others (Mention) |
| 17. Are the services provided for free? If not, how much do they pay for treatment/medicines? |
| 18. Is education/awareness provided at the health centre? |
| 19. Complaints/Improvement suggestion for health centre. |

**Sewing Training Centre**

**Question**

| |
|---|
| 1. Why was the Sewing Machine initiative started? |
| 2. Who use the Sewing Machine Initiative? Name the stakeholders.<br>• Direct Participants<br>o Owners<br>o Workers<br>o Customers<br>• Non-participants (local residents)<br>• Others<br>o Government<br>o NGO<br>o CBO<br>o PRI<br>o Co-operatives |
| 3. What is the criterion to be a part of this initiative? |
| 4. Who is not a part of it or stays out of it? |
| 5. Specify who and the reason. Following maybe the reasons:<br>• Gender<br>• Power Dynamics<br>• Education<br>• Poverty<br>• Disability<br>• Other |
| 6. How can participation be encouraged? |
| 7. How is it beneficial? |
| 8. What is the impact of livelihoods for participants?<br>• Tangible (income)<br>o Earnings of individual workers<br>o Collective income of the community<br>o Profit by owners<br>• Intangible (empowerment)<br>• Direct (services/sales/production)<br>• Positive<br>• Negative<br>• Intended<br>• Unintended |

| |
|---|
| 9. What impact does it have on the quality of life? |
| 10. How has the investment pattern changed?<br>• Health<br>• Education<br>• Malnutrition<br>• Transportation<br>• Other (Specify) |
| 11. What is sown or stitched? Where are the clothes sold? How is the demand in market? |
| 12. What is the technical support provided for production as well as marketing? What more is expected? |
| 13. How can we make this initiative better?<br>• To enhance positive impacts<br>• To reduce negative impact |
| 14. What are the most important impacts? According to whom? |
| 15. How significant are they? In what way? |
| 16. Why did only 6 women start earning? How can that be improved? |

***Adult Education Centre:***

**Questions:**

| |
|---|
| 1. What is the literacy percentage of the village? Male and female both. |
| 2. Why did the need to have arisen to have the adult education centre? |
| 3. How long has it been functional? |
| 4. What subjects are taught? |
| 5. How many students are enrolled? How many attend |
| 6. How is the attendance of the students? Do they enjoy coming? |
| 7. Anyone who has dropped out from the Adult Education centre? If yes, Why? |
| 8. Why are only women studying? What is the selection criterion? |
| 9. What is the impact of the initiative on the following?<br>• Employment<br>• Basic Reading Skills<br>• Health<br>• Personal Goals<br>• Further Education<br>• Skill Development<br>• Other outcomes |
| 10. How can we encourage participation of enrolling illiterate people irrespective of barriers? What are the barriers? How can we overcome them? |
| 11. Who is the teacher? How does he/she evaluate the progress? |
| 12. Any complaints |
| 13. Any success story |

***Primary School building:***

***Questions***

| |
|---|
| 1. When was the school constructed? Since when is it functional? |
| 2. How many students study in school? Male/Female |
| 3. What is the human resource and the respective strength in the school? |
| 4. What is the average number of students in a class? |
| 5. What is the infrastructure at the primary school?<br>• Classrooms<br>• Benches<br>• Electricity<br>• Lights<br>• Fans<br>• Toilets and water supply<br>• Drinking Water<br>• Other (mention) |
| 6. Are teachers good? What is the learning level of children?<br>• Good 4-5<br>• Average 2-3<br>• Bad-0-1 |
| 7. Do children enjoy going to school? |
| 8. Are children benefitting from the school? In what ways (Mention)? |
| 9. Any complaints? |

***Water supply***

**Questions**

| |
|---|
| 1. What difficulties were faced by the villagers before the intervention? |
| 2. How far are the other water sources from the village? |
| 3. Why did the need of laying down pipelines arise? |
| 4. Who all were involved in the decision making process? |
| 5. Where is the water supplied (individual households/common storage)? If it is a common storage how do people take it home for use? |
| 6. How many people benefit from this? |
| 7. What do the people use the water for? |
| 8. How does it affect their life?<br>• Education<br>• Livelihood<br>• Sanitation<br>• Commercial<br>• Domestic affairs<br>• Others |
| 9. What are the areas with water deficit? How does this initiative benefit those areas? |
| 10. Any complaints? |
| 11. How can this be improved? |

***Drainage:***

| **Questions** |
|---|
| 1. How was the drainage managed before the initiative? |
| 2. What is the drainage for? |
| 3. What are benefits that are reaped by the people after the initiative? |
| 4. Where is the waste water directed to? |
| 5. Does it have an impact on health?<br>• Positives<br>• Negatives |
| 6. Were people of the village provided information before implementing the project? |

***Solar Lights:***

**Questions**

| |
|---|
| 1. How is the supply of electricity in the village? |
| 2. What were the issues faced by the villagers before the solar light intervention? |
| 3. What is the use of the installed solar lights? |
| 4. Why are the provided for public usage and not for individual usage? |
| 5. Success stories |
| 6. Complaints |

**QUESTIONNAIRE**

***CONSTRUCTION OF PCC/ BITUMINOUS ROAD FOR THE COMMUNITY***

5. Date Time

6. Village:
   Panchayat:
   Block:
   District:
   State:

7. Mukhiya/Sarpanch/Ward member/Participant:
   Name:
   Contact No.:

8. Population:

| | |
|---|---|
| **1.** | When was this road constructed? |
| **2.** | Do you know the agency who created this road?<br>a. BCCL<br>b. State Government<br>c. Local MLA<br>d. MP<br>e. Others - |
| **3.** | If BCCL, How you know about this fact?<br>a. Display board by BCCL<br>b. Gram Sabha/Village Meeting<br>c. Witnessed/passing while construction was going<br>d. Villages<br>e. Others |
| **4.** | What is the length of the road? (In kms.) |
| **5.** | What was the condition before the construction of the road?<br>a. Pucca<br>b. PCC but damaged |
| **6.** | What is the condition after the construction of the road? |
| **7.** | How far is the road from your place? (in kms) |
| **8.** | How many villages or towns does this road connect? (The geographical scale, names of the villages) |
| **9.** | Has this road been benefitted or affected your situation? Please elaborate. |
| **10.** | Please state <u>your</u> uses of this road. |
| **11.** | Did the community contribute in any way during the construction? If yes, how? |
| **12.** | Do you know anyone who was directly involved in the construction of road?<br>a. Yes, who?<br>b. No |
| **13.** | How has this road improved the quality of the life in this particular area?<br>the following questions mark YES or NO. If yes, kindly elaborate. |
| | a. Has there been an increase in amount (volume/proportion) of the commercial profit agricultural production in the area? |

| | |
|---|---|
| | b. Has it become easier to reach the markets with the produce of the area? |
| | c. Have you noticed an increase employment of people in this area? |
| | d. Are more people engaging in the non-agricultural employment like businesses,eg. groceries, artisans, labourers,etc.? |
| **14.** | Has this road improved the connectivity of this area to other places, causing decrease in transportation cost and time to reach places? If yes, how? |
| | For the following questions mark YES or NO. If yes, kindly elaborate. |
| | Education: |
| | a. Has it helped to access the educational institutes more easily? Does it take less time to reach them?<br>b. Has there been an increase in attendance in primary and high schools of the area after the construction? |
| | c. How far are the high schools from here? |
| | d. Has it become more convenient to reach them now? |
| | e. Are more children from this area going to school now? |
| | f. Can you use transports like cycles or rickshaws to reach these places now? |
| | Health: |
| | a. Is there any health care facility in your area?<br>i. Primary Health Centre<br>ii. Community Health Centre<br>iii. Referral Hospital<br>iv. Private Nursing home/Dispensary<br>v. Others |
| | b. How far is the closest healthcarefacility or hospital?<br>i. Less than half Km<br>ii. Less than 1 Km<br>iii. More than 1 Km<br>iv. More than 5 Kms.<br>v. Others |
| | c. Has road made it more convenient to access these centres now? |
| | d. Are you provided with MMV services here? |
| | e. How often?<br>i. Weekly:<br>ii. Monthly: |
| | f. Have you seen an overall improvement of health because of this? |
| | g. Has there been an increase in the utilization of hospitals or healthcare centres after the construction of road? |
| | h. Has the maternal health improved since the construction of the road? |
| | i. Do you see any improvement in rates institutional delivery of infants in this area? |
| **15.** | Has there been any repairs or upkeep after the construction of the road? If yes, who is responsible for the upkeep?<br>a. Fund raising in the villages<br>b. Mukhiya Fund<br>c. Others: |
| **16.** | How does this road serve you during rains? |

| | |
|---|---|
| **17.** | Have you faced any problems after the construction? If yes, what? Please elaborate. |
| **18.** | How the village does contributes to the upkeeping of the road? |
| **19.** | How would rate the quality and viability of this road on a scale<br>a. Very poor<br>b. Poor<br>c. Average<br>d. Good<br>e. Excellent |
| **20.** | Kindly provide any additional comments, concerns and/or observations/suggestions to improve this project? |

सेन्ट्रल माईन प्लानिंग एण्ड डिजाइन इन्स्टीच्यूट लिमिटेड
(कोल इण्डिया लिमिटेड की सहायक कम्पनी / भारत सरकार का एक लोक उपक्रम)
गोन्डवाना प्लेस, कांके रोड, राँची - 834 031, झारखण्ड (भारत)
Central Mine Planning & Design Institute Limited
(A Subsidiary of Coal India Limited / Govt. of India Public Sector Undertaking)
Gondwana Place, Kanke Road, Ranchi - 834 031, Jharkhand (INDIA)
CORPORATE IDENTITY NUMBER - U14292JH1975GOI001233

स्पीड पोस्ट द्वारा

संख्याः सियोम आर एस सी-24/ 782

दिनांक 20.03.2023

सेवा में,
विभागाध्यक्ष (पर्यावरण),
भारत कोकिंग कोल लिमिटेड
कोयला भवन, कोयला नगर
धनबाद – 826 005
Tel:0326-2230028

विषयः Report on "Land Use / Vegetation cover mapping of Jharia Coalfield based on satellite data of the year 2022"

संदर्भः Work order No.CIL/ENVT/2022-23/W.O./10699 dated 06.07.2022

महोदय,

In pursuance of the above work order, three copies of the report titled "Land Use / Vegetation cover mapping of Jharia Coalfield based on satellite data of the year 2022" are enclosed. The softcopy is sent via email.

Kindly acknowledge the receipt of the same and arrange to upload the report on website of BCCL.

भवदीय,

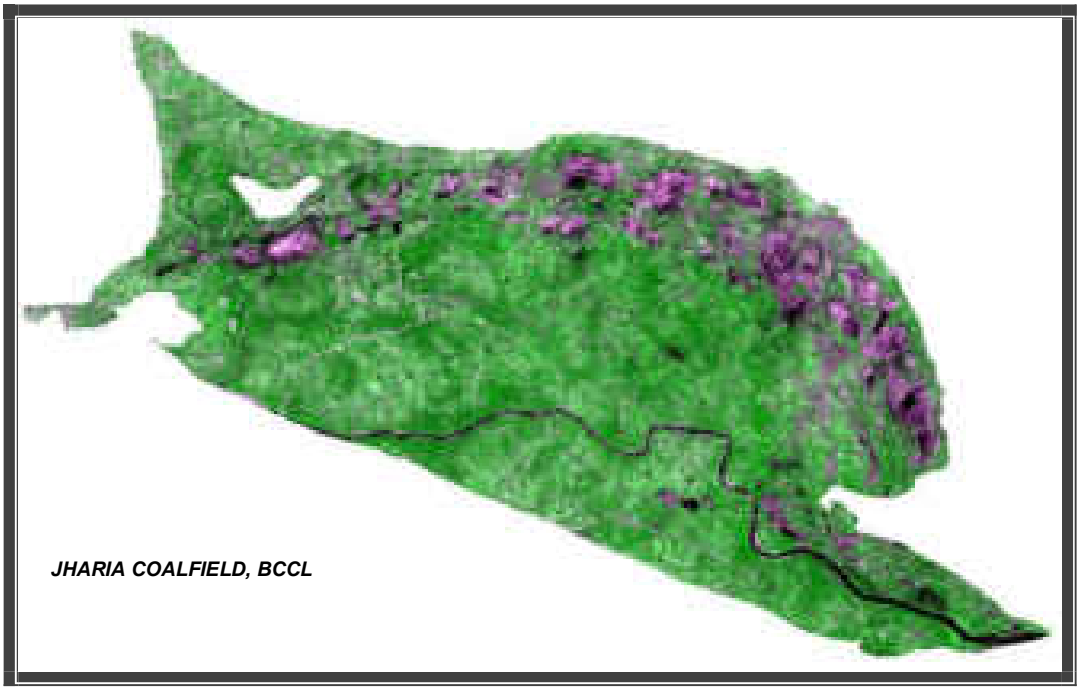
Encl.: As above.

महाप्रबंधक(Geomatics)

Copy by Speed Post to:
(1) The General Manager (ENV), CIL, Kolkata – *for kind information.*
(2) The Regional Director, Regional Institute-II, CMPDI, Koyla Nagar, Koyla Bhawan, Dhanbad – 826 005 – *along with a copy of the report.* ***Tel:0326-2230789***

फोन नम्बर/Phone No.:
फैक्स नम्बर/Fax No. :
ई-मेल/E-mail:
वेब साईट/Website

# Report on
# Land Use / Vegetation Cover Mapping of Jharia Coalfield based on Satellite Data of the Year 2022




*Submitted to*

**Bharat Coking Coal Ltd (BCCL)**

**Dhanbad**

**March 2023**

# Report on
# Land Use / Vegetation Cover Mapping of Jharia Coalfield based on Satellite Data of the Year- 2022

**March 2023**

**Remote Sensing Cell**
**Geomatics Division**
**CMPDI, Ranchi**

## Document Control Sheet

| | |
|---|---|
| (1) Job No. | RSC/564922120 |
| (2) Publication Date | March 2023 |
| (3) Number of Pages | 37 |
| (4) Number of Figures | 6 |
| (5) Number of Tables | 6 |
| (6) Number of Plates | 2 |
| (7) Title of Report | Land use / Vegetation cover mapping of Jharia Coalfield based on satellite data for the year 2022. |
| (8) Aim of the Report | To prepare Land use and vegetation cover map of Jharia Coalfield on 1:50000 scale based on satellite data for monitoring the impact of coal mining on land use pattern and vegetation cover. |
| (9) Executing Unit | Remote Sensing Cell,<br>Geomatics Division<br>Central Mine Planning & Design Institute Limited,<br>Gondwana Place, Kanke Road, Ranchi 834008 |
| (10) User Agency | Coal India Ltd. (CIL) / Bharat Coking Coal Ltd. (BCCL) |
| (11) Authors | Smt. Ayesha Parida, Manager (Geology)<br>Shri Rajneesh Kumar, General Manager (Geomatics) |
| (12) Security Restriction | Restricted Circulation |
| (13) No. of Copies | 5 |
| (14) Distribution Statement | Official |

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# Chapter 1

# Introduction

## 1.1 Project Reference

To monitor the regional impact of coal mining on land use pattern and vegetation cover in the 19 major coalfields at regular interval of three years based on remote sensing satellite data, Coal India Ltd. issued a work order to CMPDI vide letter no. CIL/WBP/ENV/2011/4706 dated 12.10.12 for the period 2012-13 to 2016-17 which was subsequently followed by another work order vide letter no. CIL/WBP/Env/2017/DP/8477 dated 21.09.2017 from Coal India Limited for the period 2017-18 to 2021-22 for land reclamation monitoring of opencast projects and vegetation cover monitoring of 19 major coalfields including Jharia Coalfield as per a defined plan for monitoring the impact of mining on Vegetation Cover. Further, a revised work order was issued vide letter no. CIL/ENVT/2022-23/W.O/10899 dated 06.07.2022 from Coal India Limited for the period 2022-23 to 2023-24. According to this work order vegetation cover mapping of 06 coalfields including Jharia Coalfield, BCCL for the year 2022-23 is carried out. The present study is based on the satellite data of the year 2022.

## 1.2 Project Background

Bharat Coking Coal Limited, one of the oldest coal producing company in the country is also dedicated for maintaining the ecological balance in the region and has initiated plantation programme on backfilled area, OB dumps and wasteland. The advent of high resolution, multispectral satellite data has opened a new avenue in the field of mapping and monitoring of vegetation cover. The present study has been taken up to access the impact of coal mining on land use and vegetation cover in Jharia Coalfield with respect to the earlier studies carried out in the year 2008, 2013, 2016 and 2019.

## 1.3 Objective

The objective of the present study is to prepare a regional land use and vegetation cover map of Jharia coalfield on 1:50,000 scale based on satellite data of the year 2022, using digital image processing technique for monitoring the impact of coal mining and other industrial activities on land use and vegetation cover in the coalfield area in period of last three years.

## 1.4 Location of the Area & Accessibility

The Jharia Coalfield (JCF) is located in the north east part of the State of Jharkhand, approximately 260 km west of Kolkata. It is linked to Kolkata and Delhi through NH 2, which is the part of Golden Quadrilateral highway network of India. The coalfield contains proven coal reserves of approximately one billion tonnes in a crescent-shaped basin. Jharia coalfield covers an area of about 440.25 sq km. it is bounded by Lat $23^0$49'0.63"N and $23^0$38'36.50"N and Long $86^0$08'49.91"E and $86^0$25'54.92E. The major part of coalfield lies in Dhanbad district of Jharkhand. Coalfield is connected by Major Highways road with Ranchi (117 km), Asansol (60 km), Jamshedpur (108 km) and Dhanbad (8 km). The nearest major railway station is Dhanbad, located on Delhi-Howrah Grand Chord line oh East Central Railway which passes parallel to northern boundary of the coalfield.

## 1.5 Physiography and Geology

Jharia coalfield is characterized by gently undulating to a rolling topography with an overall slope towards east-southeast. The coalfield is roughly sickle shaped on plan and occurs as a basin with its axis trending broadly east-west and plunging towards the west. The southern flank is truncated by a major Boundary Fault. The general dip of the formation is 10 to 15 degrees. Flatter dips have also been noted at places. The entire southern part of Jharia coalfield in the vicinity of the Boundary Fault, however shows generally steep dipping beds with amounts increasing even up to 70 degrees.

The drainage pattern in the Jharia coalfield is dendritic in nature. This may be due to more or less homogeneous lithology and structural controls. Damodar River is the main control of drainage system along the Jharia coalfield. It is a fourth order stream to which a number of third to first order streams, viz. Jamunia, Khudia, Katri, Ekra, Tisra, Chatkari etc. join. Damodar River flows along the southern periphery of the coalfield and is guided by the Main Boundary Fault. The main flow direction is from west to east.

The strike of the formation is generally WSW to ENE in the western part and WNW to ESE in the southern part of the coalfield. This gradually swings to EW in the centre of the coalfield and then to NS further east. In the south-eastern part the strike is generally WNW-ESE. Besides the boundary part the coalfield is traversed by a number of other major and minor faults.

The Barakar formation contains 18 standard coal horizons (numbered I to XVIII). Of the Barakar formations, the coal seams XIII and above are generally thin and of relatively superior quality. Seams XII to IX/X are of medium to superior quality and attain sizable thickness at places. The V, VI, VII, IV, III & II are generally thick seams of inferior quality. The bottom most seam I is of superior medium coking quality in the eastern part of the coalfield.

A map of India showing the location of Jharia Coalfield is given in Fig1.1.

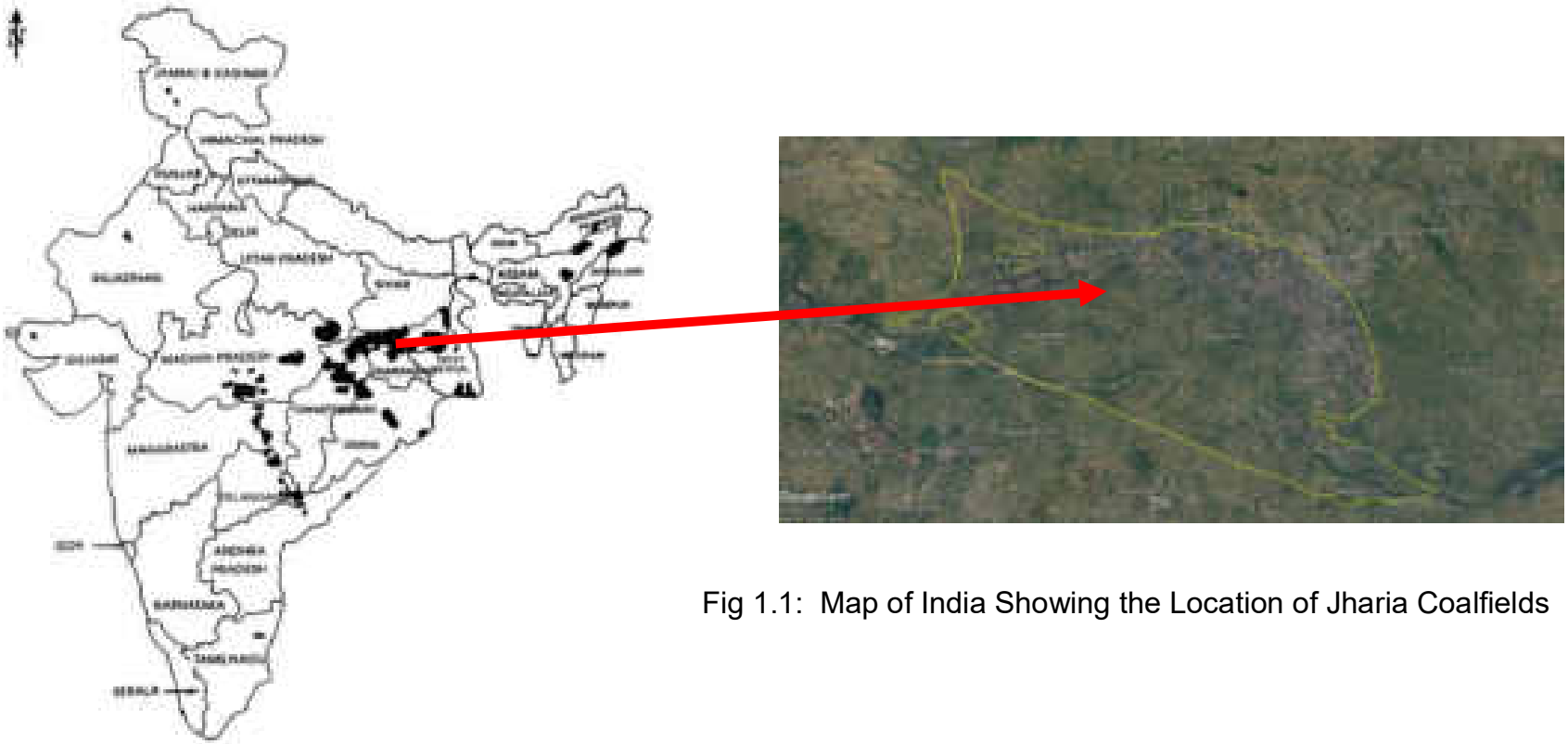

Fig 1.1: Map of India Showing the Location of Jharia Coalfields

# Chapter 2

# Remote Sensing Concepts and Methodology

## 2.1 Remote Sensing

Remote sensing is the science and art of obtaining information about an object or area through the analysis of data acquired by a device that is not in physical contact with the object or area under investigation. The term *remote sensing* is commonly restricted to methods that employ electro-magnetic energy (such as light, heat and radio waves) as the means of detecting and measuring object characteristics.

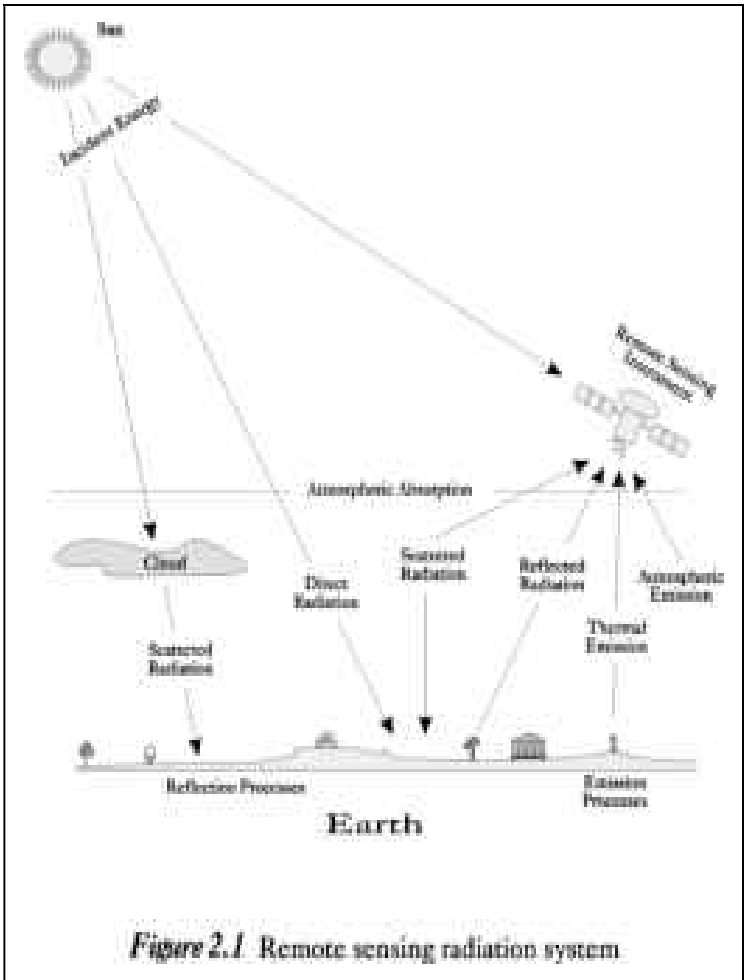


*Figure 2.1* Remote sensing radiation system

All physical objects on the earth surface continuously emit electromagnetic radiation because of the oscillations of their atomic particles. Remote sensing is largely concerned with the measurement of electro-magnetic energy from the *SUN*, which is reflected, scattered or emitted by the objects on the surface of the earth. Figure 2.1 schematically illustrate the generalised processes involved in electromagnetic remote sensing of the earth resources.

## 2.2 Electromagnetic Spectrum

The electromagnetic (EM) spectrum is the continuum of energy that ranges from meters to nanometres in wavelength and travels at the speed of light. Different objects on the earth surface reflect different amounts of energy in various wavelengths of the EM spectrum.

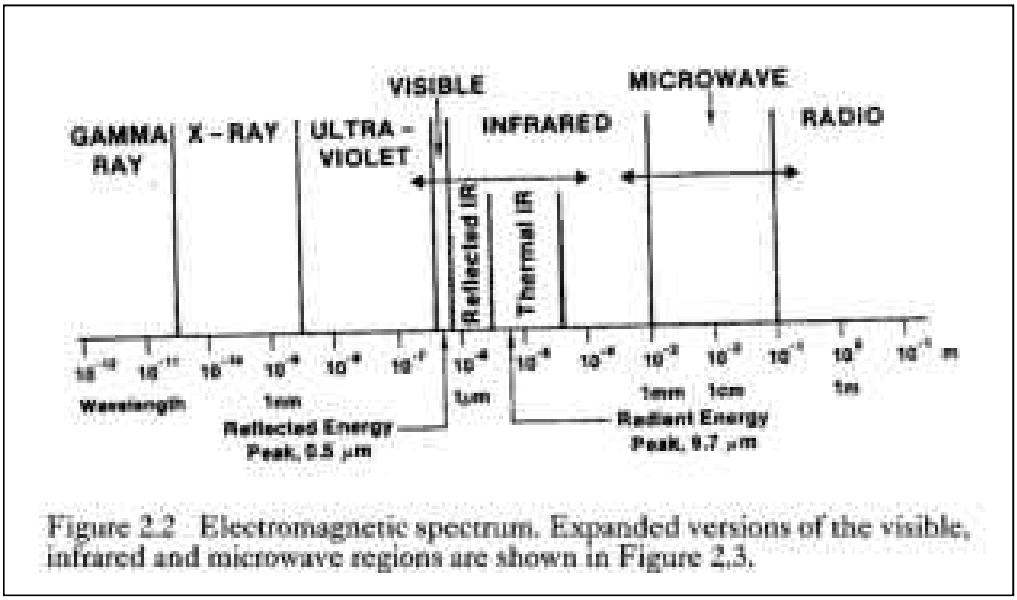


Figure 2.2 Electromagnetic spectrum. Expanded versions of the visible, infrared and microwave regions are shown in Figure 2.3.

Figure 2.2 shows the electromagnetic spectrum, which is divided on the basis of wavelength into different regions that are described in Table 2.1. The EM spectrum ranges from the very short wavelengths of the gamma-ray region to the long wavelengths of the radio region. The visible region (0.4-0.7μm wavelengths) occupies only a small portion of the entire EM spectrum.

Energy reflected from the objects on the surface of the earth is recorded as a function of wavelength. During daytime, the maximum amount of energy is reflected at 0.5μm wavelengths, which corresponds to the green band of the visible region, and is called the *reflected energy peak* (Figure 2.2). The earth also radiates energy both day and night, with the maximum energy 9.7μm wavelength. This *radiant energy peak* occurs in the thermal band of the IR region.

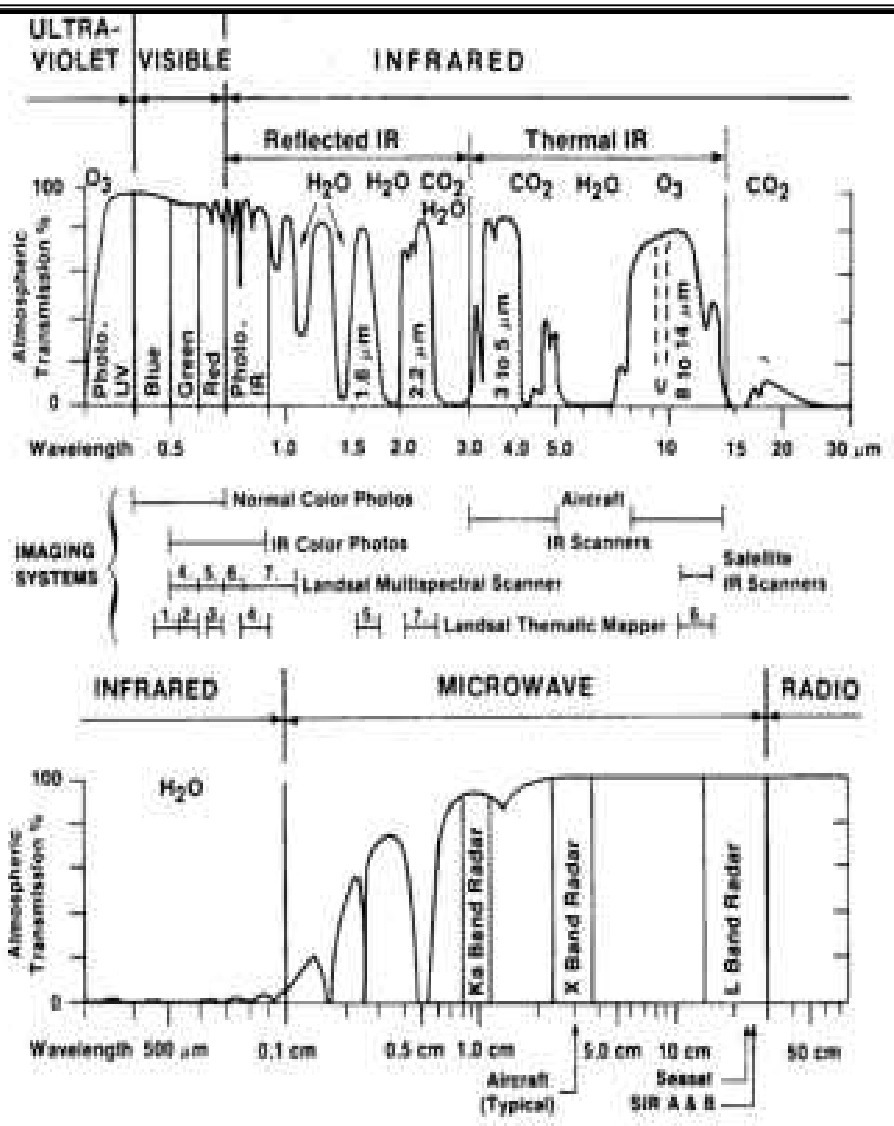


*Figure 2.3* Expanded diagrams of the visible and infrared regions (upper) and the microwave regions (lower) showing atmospheric windows. Wavelength bands of commonly used remote sensing systems are indicated. Gases responsible for atmospheric absorption are shown.

**Table 2.1 Electromagnetic spectral regions**

| Region | Wavelength | | | | Remarks |
|---|---|---|---|---|---|
| *Gamma ray* | | < | 0.03 | **nm** | Incoming radiation is completely absorbed by the upper atmosphere and is not available for remote sensing. |
| *X-ray* | 0.03 | to | 3.00 | **nm** | Completely absorbed by atmosphere. Not employed in remote sensing. |
| *Ultraviolet* | 0.03 | to | 0.40 | **µm** | Incoming wavelengths less than 0.3mm are completely absorbed by Ozone in the upper atmosphere. |
| *Photographic UV band* | 0.30 | to | 0.40 | **µm** | Transmitted through atmosphere. Detectable with film and photo detectors, but atmospheric scattering is severe. |
| *Visible* | 0.40 | to | 0.70 | **µm** | Imaged with film and photo detectors. Includes reflected energy peak of earth at 0.5mm. |
| *Infrared* | 0.70 | to | 100.00 | **µm** | Interaction with matter varies with wavelength. Absorption bands separate atmospheric transmission windows. |
| *Reflected IR band* | 0.70 | to | 3.00 | **µm** | Reflected solar radiation that contains no information about thermal properties of materials. The band from 0.7-0.9mm is detectable with film and is called the *photographic IR band*. |
| *Thermal IR band* | 3.00<br>8.00 | to<br>to | 5.00<br>14.00 | **µm**<br>**µm** | Principal atmospheric windows in the thermal region. Images at these wavelengths are acquired by optical-mechanical scanners and special Videocon systems but not by film. |
| *Microwave* | 0.10 | to | 30.00 | **cm** | Longer wavelengths can penetrate clouds, fog and rain. Images may be acquired in the active or passive mode. |
| *Radar* | 0.10 | to | 30.00 | **cm** | Active form of microwave remote sensing. Radar images are acquired at various wavelength bands. |
| *Radio* | | > | 30.00 | **cm** | Longest wavelength portion of electromagnetic spectrum. Some classified radars with very long wavelength operate in this region. |

The earth's atmosphere absorbs energy in the gamma-ray, X-ray and most of the ultraviolet (UV) region; therefore, these regions are not used for remote sensing. Details of these regions are shown in Figure 2.3. The horizontal axes show wavelength on a logarithmic scale; the vertical axes show percent atmospheric transmission of EM energy. Wavelength regions with high transmission are called *atmospheric windows* and are used to acquire remote sensing data. The major remote sensing sensors record energy only in the visible, infrared and micro-wave regions. Detection and measurement of the recorded energy enables identification of surface objects (by their characteristic wavelength patterns or spectral signatures), both from air-borne and space-borne platforms.

## 2.3 Scanning System

The sensing device in a remotely placed platform (aircraft/satellite) records EM radiation using a *scanning system*. In scanning system, a *sensor*, with a narrow field of view is employed; this sweeps across the terrain to produce an image. The sensor receives electromagnetic energy radiated or reflected from the terrain and converts them into signal that is recorded as numerical data. In a remote sensing satellite, multiple arrays of linear sensors are used, with each array recording simultaneously a separate band of EM energy. The array of sensors employs a spectrometer to disperse the incoming energy into a spectrum. Sensors (or *detectors*) are positioned to record specific wavelength bands of energy. The information received by the sensor is suitably manipulated and transported back to the ground receiving station. The data are reconstructed on ground into digital images. The digital image data on *magnetic/optical media* consist of picture elements arranged in regular rows and columns. The position of any picture element, *pixel*, is determined on an x-y co-ordinate system. Each pixel has a numeric value, called digital number (DN), which records the intensity of electromagnetic energy measured for the ground resolution cell represented by that pixel. The range of digital numbers in an image data is controlled by the radiometric resolution of the satellite's sensor system. The digital image data are further processed to produce master images of the study area. By analysing the digital data/imagery, digitally/visually, it is possible to detect, identify and classify various objects and phenomenon on the earth surface.

Remote sensing technique provides an efficient, speedy and cost-effective method for assessing the changes in vegetation cover certain period of time due to its inherited capabilities of being multi-spectral, repetitive and synoptic aerial coverage.

## 2.4 Data Source

The following data are used in the present study:

- **Primary Data** –Raw satellite data, obtained from National Remote Sensing Centre (NRSC), Hyderabad, as follows, was used as primary data source for the study.

  IRS R2A/ L4FMX; Band 2, 3, 4, 5; Path # 106, Row # 055; Date of pass 07.02.2022.

  The detail specification of the data is also given in Table 2.2.

- **Secondary Data**

  Secondary (ancillary) and ground data constitute important baseline information in remote sensing, as they improve the interpretation accuracy and reliability of remotely sensed data by enabling verification of the interpreted details and by supplementing it with the information that cannot be obtained directly from the remotely sensed data.

## 2.5 Characteristics of Satellite/Sensor

The basic properties of a satellite's sensor system can be summarised as:

(a) Spectral coverage/resolution i.e. band locations/width;
(b) Spectral dimensionality: number of bands;
(c) Radiometric resolution: quantisation;
(d) Spatial resolution/instantaneous field of view or IFOV;
(e) Temporal resolution.

Table 2.2 illustrates the basic properties of IRS-R2A satellite/sensor that is used in the present study.

| Table 2.2 Characteristics of the satellite/sensor used in the present project work | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Platform** | **Sensor** | **Spectral Bands in µm** | | | | | **Radiometric Resolution** | **Spatial Resolution** | **Temporal Resolution** | **Country** |
| IRS- R-2A | LISS-IV | B2<br>B3<br>B4<br>B5 | 0.52<br>0.62<br>0.77<br>1.55 | -<br>-<br>-<br>- | 0.59<br>0.68<br>0.86<br>1.70 | Green<br>Red<br>NIR<br>MIR | 10 bits (7 bits transmitted with DPCM) | 5.8m | 24 days | India |
| NIR: Near Infra-Red MIR: Middle Infra-Red | | | | | | | | | | |

## 2.6 Data Processing

The methodology for data processing carried out in the present study is shown in Figure 2.4. The processing involves the following major steps:

(a) Geometric correction, rectification and geo-referencing;

(b) Image enhancement;

(c) Training set selection;

(d) Signature generation and classification;

(e) Creation/overlay of vector database;

(f) Validation of classified image;

(g) Layer wise theme extraction using GIS

(g) Final vegetation map preparation.

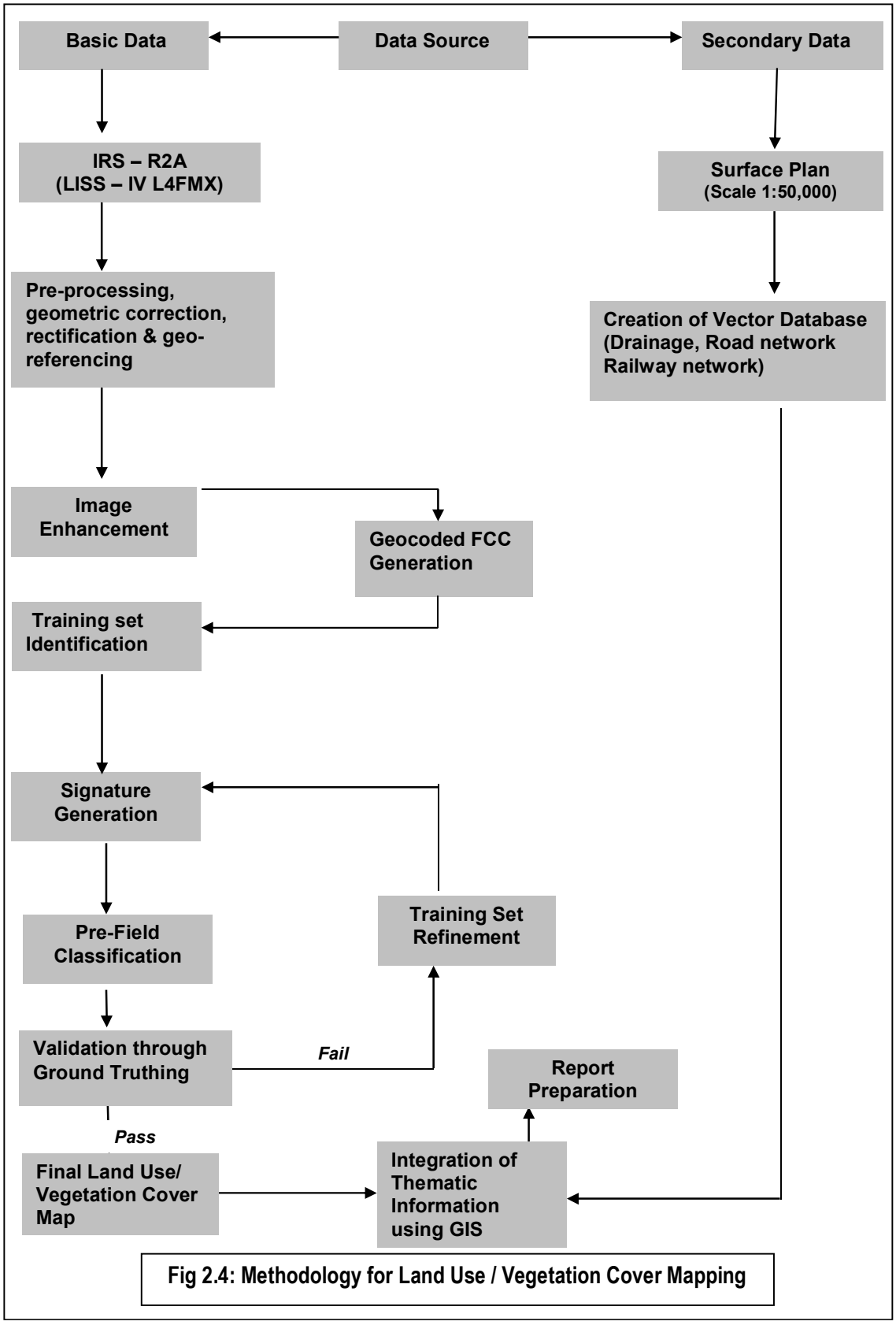


**Fig 2.4: Methodology for Land Use / Vegetation Cover Mapping**

### 2.6.1 Geometric correction, rectification and georeferencing

Inaccuracies in digital imagery may occur due to 'systematic errors' attributed to earth curvature and rotation as well as 'non-systematic errors' attributed to intermittent sensor malfunctions, etc. Systematic errors are corrected at the satellite receiving station itself while non-systematic errors/ random errors are corrected in pre-processing stage.

In spite of 'System / Bulk correction' carried out at supplier end; some residual errors in respect of attitude attributes still remains even after correction. Therefore, fine tuning is required for correcting the image geometrically using ground control points (GCP).

Raw digital images contain geometric distortions, which make them unusable as maps. A map is defined as a flat representation of part of the earth's spheroidal surface that should conform to an internationally accepted type of cartographic projection, so that any measurements made on the map will be accurate with those made on the ground. Any map has two basic characteristics: (a) scale and (b) projection. While *scale* is the ratio between reduced depiction of geographical features on a map and the geographical features in the real world, *projection* is the method of transforming map information from a sphere (round Earth) to a flat (map) sheet. Therefore, it is essential to transform the digital image data from a generic co-ordinate system (i.e. from line and pixel co-ordinates) to a projected co-ordinate system. In the present study geo-referencing was done with the help of Survey of India (SoI) topo-sheets so that information from various sources can be compared and integrated on a GIS platform, if required.

An understanding of the basics of projection system is required before selecting any transformation model. While maps are flat surfaces, Earth however is an irregular sphere, slightly flattened at the poles and bulging at the Equator. Map projections are systemic methods for "*flattening the orange peel*" in measurable ways. When transferring the Earth and its irregularities onto the plane surface of a map, the following three factors are involved: (a) geoid (b) ellipsoid and (c) projection. Figure 2.5 illustrates the relationship between these three factors. The *geoid* is the rendition of the irregular spheroidal shape of the Earth; here the variations in gravity are taken into account. The observation made on the geoid is then transferred to a regular geometric reference surface, the *ellipsoid*. Finally, the geographical relationships of the ellipsoid (in 3-D form) are transformed into the 2-D plane of a map by a transformation process called map projection. As shown in Figure 2.5, the vast majority of projections are based upon *cones*, *cylinders* and *planes*.

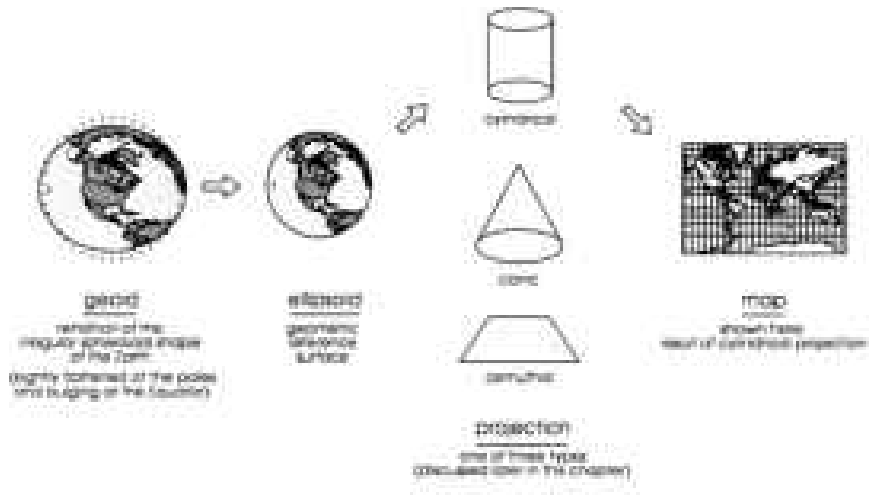


**Fig 2.5: Geoid – Ellipsoid – Projection Relationship**

In the present study, ***UTM projection*** *along with* ***WGS 84 model*** was used so as to prepare the map compatible with the SoI topo-sheets**.** UTM projection is used in SoI topo-sheets as it is best suited for small-scale mapping and larger area as well as for areas with North-South orientation (viz. India). Maps prepared using this projection is a compromise of many properties; it is neither conformal perspective nor equal area. Distances, areas and shapes are true only along central meridian. Distortion increases away from central meridian. Image transformation from generic co-ordinate system to a projected co-ordinate system was carried out using ERDAS Imagine 2022 digital image processing software.

### 2.6.2 Image enhancement

To improve the interpretability of the raw data, image enhancement is necessary. Most of the digital image enhancement techniques are categorised as either point or local operations. Point operations modify the value of each pixel in the image data independently. However, local operations modify the value of each pixel based on brightness value of neighbouring pixels. Contrast manipulations/stretching technique based on local operation were applied on the image data using ERDAS Imagine 2022 s/w. The enhanced and geocoded FCC (False colour composite) image of Jharia Coalfield is shown in Plate No. 1 for the year 2022.

### 2.6.3 Training set selection

The image data were 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. Based on the

variability of land use/cover condition and terrain characteristics and accessibility, 90 points were selected to generate the training sets.

### 2.6.4 Signature generation and classification

Image classification was carried out using the minimum distance 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 was 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. The aerial extent of each land use class in the coalfield was determined using ERDAS Imagine 2022 s/w. The classified image for the year 2022 for Jharia Coalfield is shown in Drawing No. HQREM222A102.

### 2.6.5 Creation /overlay of vector database in GIS

Plan showing leasehold areas of mining projects supplied by BCCL are superimposed on the image as vector layer in the GIS database. Road network, rail network and drainage network are digitised on different vector layers in GIS database. Layer wise theme extraction was carried out using Arc GIS s/w and imported the same on GIS platform for further analysis.

### 2.6.6 Validation of classified image

Ground truth survey was carried out for validation of the interpreted results from the study area. Based on the validation, classification accuracy matrix was prepared. The overall classification accuracy was found to be 85.28%.

### 2.6.7 Interpretation of Data

Final Land Use/vegetation cover maps (on 1:50,000 scale) were printed using HP DesignJet T 7200 Colour Plotter.

## Table 2.3: Classification Accuracy Matrix for Jharia Coalfield in the year 2022

| Sl.# | Vegetation\ Land use classes as observed in the field | Built-up land | Vegetation Cover | Agriculture | Wasteland | Mining Area | Water Bodies | Total no. of observation points (Z) | % of observation points | % of classification accuracy | % of omission |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Land use/vegetation cover Classes based on Satellite Data | | | | | | | | | |
| (b) | Vegetation Cover | | 17 | 3 | | | | 20 | 21.05 | **85.00** | 15.00 |
| (g) | Mining Area | | | | 1 | 8 | 1 | 10 | 10.53 | **80.00** | 20.00 |
| (c) | Agriculture | | 2 | 18 | | | | 20 | 21.05 | **90.00** | 10.00 |
| (d) | Wasteland | 1 | | | 18 | | 1 | 20 | 21.05 | **90.00** | 10.00 |
| (a) | Built-up land | 13 | | | 2 | | | 15 | 15.79 | **86.67** | 13.33 |
| (h) | Water Bodies | | | | | 2 | 8 | 10 | 10.53 | **80.00** | 20.00 |
| **Total no. of observation points (X)** | | 14 | 19 | 21 | 21 | 10 | 10 | 95 | - | **85.28** | - |
| **% of Commission** | | 7.14 | 10.53 | 14.29 | 14.29 | 20.00 | 20.00 | | | | |

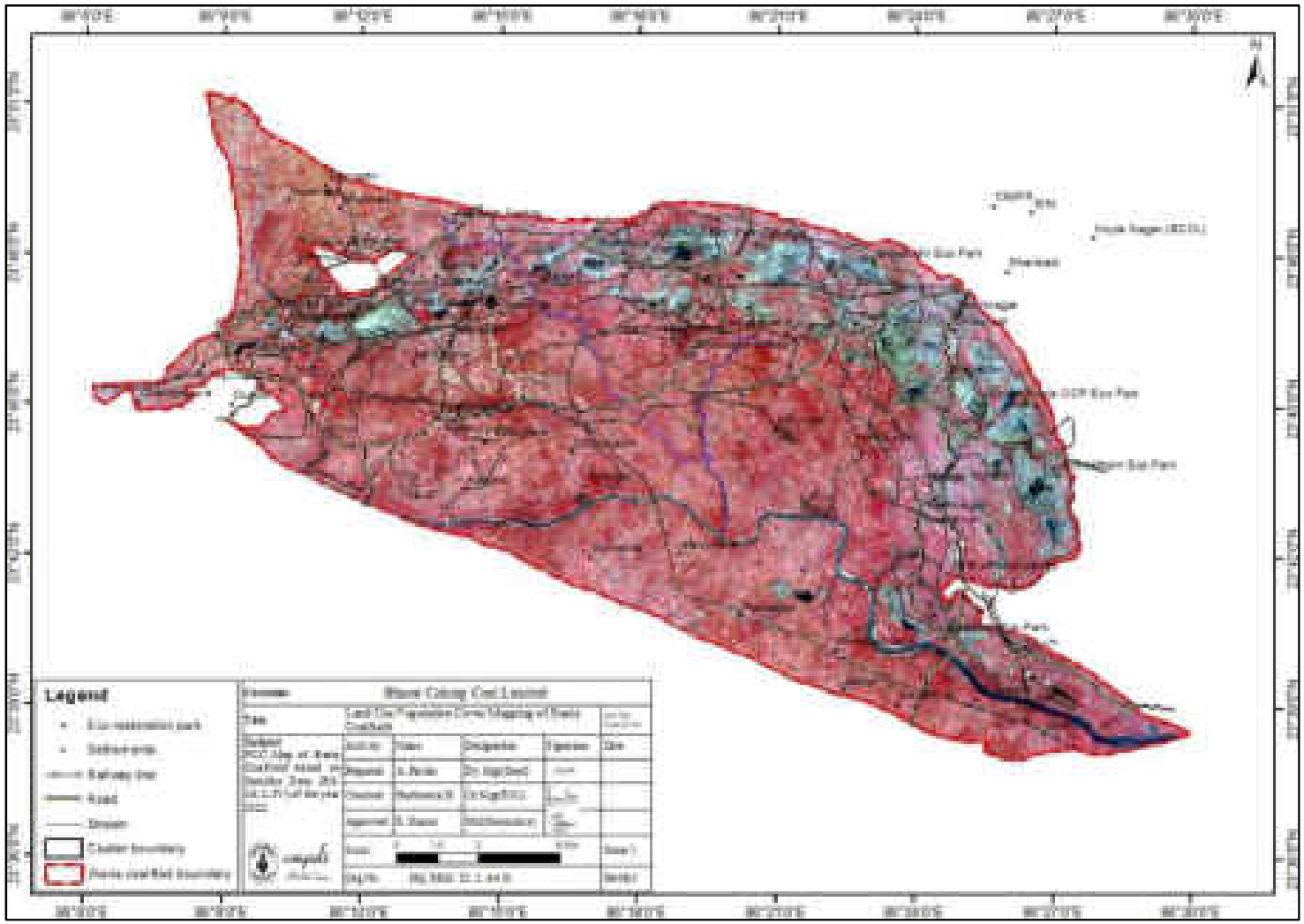


*Plate1: FCC Map (Band 3, 2, 1) of Jharia Coalfield based on IRS-R2A-L4FX Satellite Data of the year 2022*

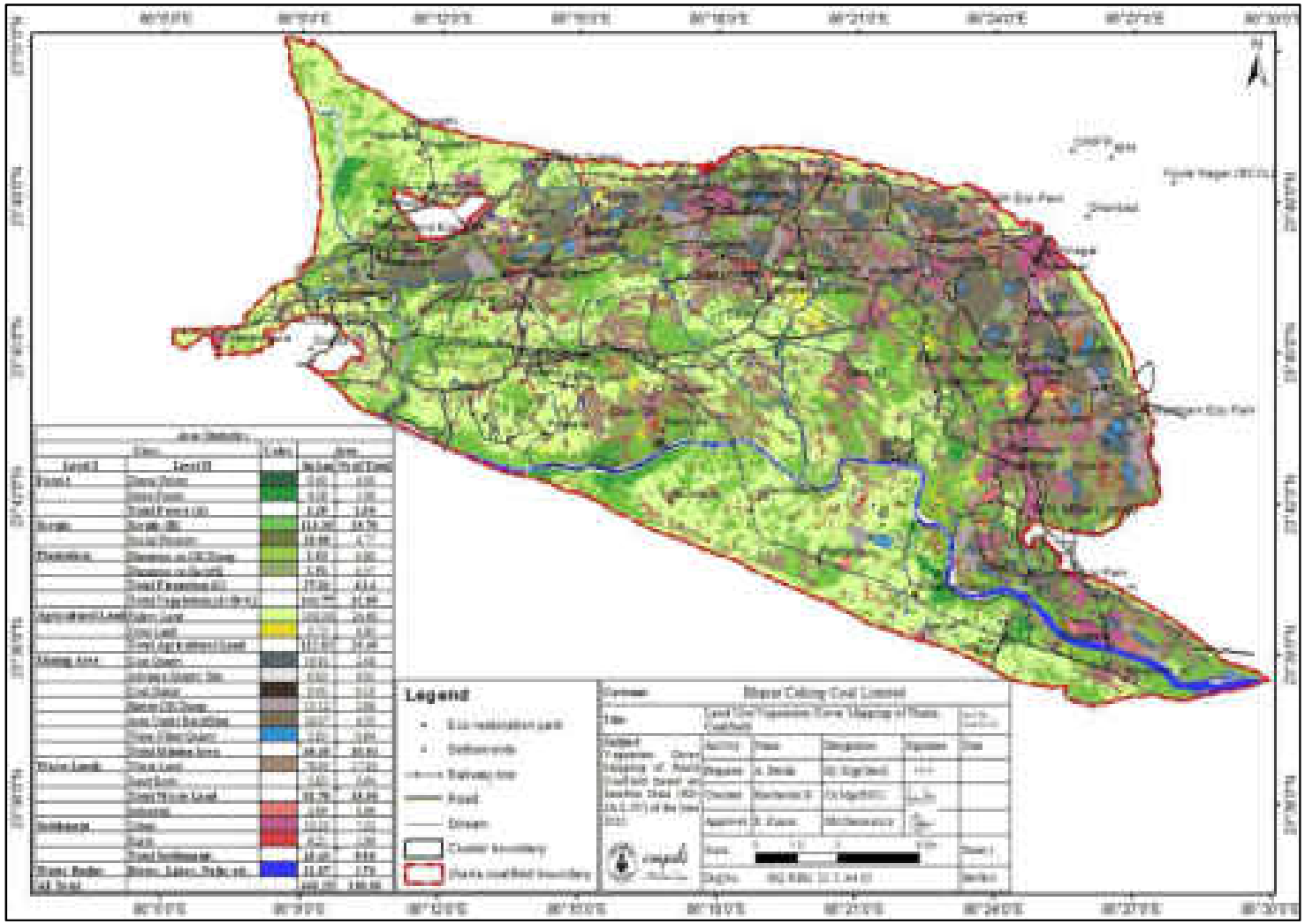


*Plate2: Classified Map of Jharia Coalfield based on IRS-R2A-L4FX Satellite Data of the year 2022*

# Chapter 3

# Land Use/ Vegetation Cover Monitoring

## 3.1 Introduction

Land is one of the most important natural resource on which all human activities are based. Therefore, knowledge on different type of lands as well as its spatial distribution in the form of map and statistical data is vital for its geospatial planning and management for optimal use of the land resources. In mining industry, the need for information on land use/ vegetation cover pattern has gained importance due to the all-round concern on environmental impact of mining. The information on land use/vegetation cover inventory that includes type, spatial distribution, aerial extent, location, rate and pattern of change of each category is of paramount importance for assessing the impact of coal mining on land use/ cover.

Remote sensing data with its various spectral and spatial resolution offers comprehensive and accurate information for mapping and monitoring of land use/cover pattern, dynamics of changing pattern and trends over a period of time. By analysing the data of different cut-off dates, impact of coal mining on land use and vegetation cover can be determined.

## 3.2 Land Use / Vegetation Cover Classification

The array of information available on land use/cover requires be arranging or grouping under a suitable framework in order to facilitate the creation of database. Further, to accommodate the changing land use/vegetation cover pattern, it becomes essential to develop a standardised classification system that is not only flexible in

nomenclature and definition, but also capable of incorporating information obtained from the satellite data and other different sources.

The present framework of land use/cover classification has been primarily based on the '***Manual of Nationwide Land Use/ Land Cover Mapping Using Satellite Imagery***' developed by National Remote Sensing Agency, Hyderabad, which has further been modified by CMPDI for coal mining areas. Land use/vegetation cover map was prepared on the basis of image interpretation carried out based on the satellite data for the year 2022. Following land use/cover classes are identified in the Jharia coalfield region (Table 3.1).

**Table 3.1**
**Land use / Vegetation Cover classes identified in Jharia Coalfield**

| | LEVEL – I | LEVEL-II |
|---|---|---|
| 1 | **Vegetation Cover** | 1.1 Dense Forest<br>1.2 Open Forest<br>1.3 Scrub<br>1.4 Plantation under Social Forestry<br>1.5 Plantation on Backfill<br>1.6 Plantation on OB Dumps |
| 2 | **Mining Area** | 2.1 Coal Quarry<br>2.2 Advance Quarry Site<br>2.3 Coal Dump<br>2.4 Area Under Backfilling<br>2.5 Barren OB Dump<br>2.6 Water Filled Quarry |
| 3 | **Agricultural Land** | 3.1 Crop Land<br>3.2 Fallow Land |
| 4 | **Wasteland** | 4.1 Waste upland with/without scrubs<br>4.2 Sand Body |
| 5 | **Settlements** | 5.1 Urban<br>5.2 Rural<br>5.3 Industrial |
| 6 | **Water Body** | 6.1 River / Streams / Reservoir / Nala etc. |

## 3.3 Data Analysis of Jharia Coalfield

Satellite data of the year 2022 was processed using ERDAS Imagine 2022 image processing s/w in order to interpret the various land use and vegetation cover classes present in Jharia coalfield. It is important to note that for the present report, analysis was carried out both for the updated coalfield boundary covering an area of 440.25 $Km^2$ *(Source: OCBIS) as well as* for the old coalfield boundary of Jharia Coalfield covering an area of 392.85 $Km^2$. The area statistics of Vegetation Cover mapping of Jharia Coalfield based on the updated coalfield boundary measuring 440.25 $Km^2$ is indicated in Table 3.2. For comparison purpose, area statistics based on the old coalfield boundary of Jharia Coalfield covering an area of 392.85 $Km^2$ was also calculated from the latest classified image. The comparative status of Land Use/Vegetation Cover of Jharia Coalfield between the year 2019 and 2022 is depicted in Table 3.3.

## TABLE – 3.2

## STATUS OF LAND USE & VEGETATION COVER PATTERN IN JHARIA COALFIELD IN THE YEAR 2022

*(Based on updated Jharia Coalfield Boundary)*

| LAND USE / VEGETATION COVER CLASSES | Area Statistics | |
|---|---|---|
| **VEGETATION COVER** | **Area** | **% of total** |
| Dense forest | 0.00 | 0.00 |
| Open Forest | 4.39 | 1.00 |
| Scrubs | 113.35 | 25.75 |
| Plantation under Social Forestry | 20.99 | 4.77 |
| Plantation on Backfill | 2.51 | 0.57 |
| Plantation on OB Dump | 3.53 | 0.80 |
| **Sub Total** | **144.77** | **32.89** |
| **MINING AREA** | | |
| Coal Quarry | 10.91 | 2.48 |
| Advance Quarry Site | 0.02 | 0.01 |
| Coal Dump | 0.45 | 0.10 |
| Area Under Backfilling | 19.07 | 4.33 |
| Barren OB Dump | 13.12 | 2.98 |
| Water Filled Quarry | 2.83 | 0.64 |
| **Sub Total** | **46.40** | **10.54** |
| **AGRICULTURAL LAND** | | |
| Crop Land | 3.72 | 0.85 |
| Fallow Land | 108.30 | 24.60 |
| **Sub Total** | **112.02** | **25.45** |
| **WASTELAND** | | |
| Waste upland | 78.93 | 17.92 |
| Sand Body | 2.83 | 0.64 |
| **Sub Total** | **81.76** | **18.56** |
| **SETTLEMENTS** | | |
| Urban | 32.23 | 7.32 |
| Rural | 8.21 | 1.86 |
| Industrial | 2.99 | 0.68 |
| **Sub Total** | **43.43** | **9.86** |
| **WATER BODIES** | **11.87** | **2.70** |
| **TOTAL** | **440.25** | **100.00** |

**TABLE – 3.3:**

**COMPARATIVE STATUS OF LAND USE & VEGETATION COVER PATTERN IN JHARIA COALFIELD IN THE YEAR 2019 & 2022**

*(Based on old Jharia Coalfield Boundary)*

***(Area in Km²)***

| LAND USE / VEGETATION COVER CLASSES | Year 2019 | | Year 2022 | | Changes w.r.t 2019 | | Remarks |
|---|---|---|---|---|---|---|---|
| **VEGETATION COVER** | **Area** | **% of total** | **Area** | **% of total** | **Area** | **% of total** | |
| Dense forest | 0.09 | 0.02 | 0.09 | 0.02 | 0.00 | 0.00 | Overall decrease in plantation is due to increase in mining and related industrial activities. |
| Open Forest | 4.30 | 1.10 | 4.09 | 1.04 | -0.21 | -0.06 | |
| Scrubs | 103.02 | 26.22 | 103.89 | 26.45 | 0.87 | 0.23 | |
| Plantation under Social Forestry | 21.65 | 5.51 | 21.65 | 5.51 | 0.00 | 0.00 | |
| Plantation on Backfill | 2.51 | 0.64 | 2.51 | 0.64 | 0.00 | 0.00 | |
| Plantation on OB Dump | 4.19 | 1.07 | 3.53 | 0.90 | -0.66 | -0.17 | |
| **Sub Total** | **135.76** | **34.56** | **135.76** | **34.56** | **0.00** | **0.00** | |
| **MINING AREA** | | | | | | | |
| Coal Quarry | 10.91 | 2.78 | 10.91 | 2.78 | 0.00 | 0.00 | Changes in mining area is due to expansion in both mining & reclamation activities. |
| Advance Quarry Site | 0.17 | 0.04 | 0.02 | 0.01 | -0.15 | -0.03 | |
| Coal Dump | 0.56 | 0.14 | 0.45 | 0.11 | -0.11 | -0.03 | |
| Area Under Backfilling | 17.92 | 4.56 | 19.07 | 4.85 | 1.15 | 0.29 | |
| Barren OB Dump | 13.37 | 3.40 | 13.12 | 3.34 | -0.25 | -0.06 | |
| Water Filled Quarry | 1.39 | 0.36 | 2.83 | 0.72 | 1.44 | 0.36 | |
| **Sub Total** | **44.32** | **11.28** | **46.40** | **11.81** | **2.08** | **0.53** | |
| **AGRICULTURAL LAND** | | | | | | | |
| Crop Land | 3.83 | 0.98 | 3.74 | 0.95 | -0.09 | -0.03 | |
| Fallow Land | 58.86 | 14.98 | 69.68 | 17.74 | 10.82 | 2.76 | |
| **Sub Total** | **62.69** | **15.96** | **73.42** | **18.69** | **10.73** | **2.73** | |
| **WASTELAND** | | | | | | | |
| Waste upland | 94.22 | 23.98 | 80.90 | 20.59 | -13.32 | -3.39 | Decrease of wasteland area as wasteland classes being converted/utilised into other classes such as mining, agriculture, settlements etc. |
| Sand Body | 5.44 | 1.39 | 3.03 | 0.77 | -2.41 | -0.62 | |
| **Sub Total** | **99.66** | **25.37** | **83.93** | **21.36** | **-15.73** | **-4.01** | |
| **SETTLEMENTS** | | | | | | | |
| Urban | 32.03 | 8.15 | 32.03 | 8.15 | 0.00 | 0.00 | Changes due to mining and associated industrialisation as well as other socio-economic reasons. |
| Rural | 7.56 | 1.92 | 7.68 | 1.96 | 0.12 | 0.04 | |
| Industrial | 2.83 | 0.72 | 2.78 | 0.71 | -0.05 | -0.01 | |
| **Sub Total** | **42.42** | **10.79** | **42.49** | **10.82** | **0.07** | **0.03** | |
| **WATER BODIES** | **8.00** | **2.04** | **10.85** | **2.76** | **2.85** | **0.72** | |
| **TOTAL** | **392.85** | **100.00** | **392.85** | **100.00** | | | |

### 3.3.1 Vegetation Cover

Vegetation cover is an association of trees and other vegetation type capable of producing timber and other forest produce. It is also defined as the percentage of soil which is covered by green vegetation. Leaf area index (LAI) is an alternative expression of the term vegetation cover which gives the area of leaves in $m^2$ corresponding to an area of one $m^2$ of ground. Primarily vegetation cover is classified into the following three sub-classes based on crown density as per modified FAO-1963 (Food & Agricultural Organisation of United Nations) norms: (a) dense forest (crown density more than 40%), (b) open/degraded forest (crown density between 10% to 40%), and (c) scrubs (crown density less than 10%). The plantation that has been carried out on wasteland along the roadside and on the overburden dumps / Backfilled areas is also included under vegetation cover as social forestry and plantation on over-burden dumps / backfill respectively. The percentage of vegetation cover shown in the analysis here are in terms of total land use cover only.

Analysis of the satellite data of the year 2022 (as per the updated coalfield boundary) indicate that vegetation cover in Jharia Coalfield boundary occupies 144.77 $km^2$ (32.89%). The analysis indicates that there is no Dense forest area within the updated Jharia coalfield Boundary due to change in its shape and coverage. *Open forest* covers area of 4.39 $km^2$ (1.00%); *Scrubs* has covered 113.35 $km^2$ (25.75%), *Plantation under social forestry* occupies 20.99 $km^2$ (4.77%), Plantation on OB dumps occupies 3.53 $km^2$ (0.80%) and *Plantation on backfilled areas* has 2.51 $km^2$ (0.57%) area under its influence *(Refer Table 3.2)*.

As per the old coalfield boundary that has been used in Vegetation Cover Mapping report for the year 2019, the analysis of the satellite data of the year 2022 indicated that vegetation cover in the Jharia Coalfield boundary occupies 135.76 $km^2$ (34.56%). Out of which, dense forest covers an area of 0.09 $km^2$ (0.02%), open forest covers area of 4.09 $Km^2$ (1.04%); Scrubs has covered an

area of 103.89 km$^2$ (26.45%), Plantation under social forestry occupies 21.65 Km$^2$ (5.51%), Plantation on OB dumps occupies 3.53 km$^2$ (0.90%) and Plantation on backfilled areas has 2.51 km$^2$ (0.64%) area under its influence as per the analysis of Satellite Data of the Year 2022. It has been observed that there is no change in total Vegetation Cover in Jharia Coalfield as compared to Year 2019 (Refer Table 3.3).

### 3.3.2 Mining Area

The mining area includes the area of existing quarries, old quarries filled with water, advance quarry sites, coal stock/dumps, area under backfilling, barren over-burden dumps and allied activities.

The mining area in Jharia Coalfield (as per the updated coalfield boundary) covers 46.40 km$^2$ (10.54%) in the year 2022. *Coal quarry* constitutes 10.91 km$^2$ (2.48%), *Advanced quarry site* constitutes 0.02 km$^2$ (0.01%), *Quarry filled with water* constitutes 2.83 km$^2$ (0.64%), *Coal dumps / stocks* constitute 0.45 km$^2$ (0.10%), *Area under backfilling* constitute 19.07 km$^2$ (4.33%) and *Barren over burden dumps* constitutes 13.12 km$^2$ (2.98%) *(Refer Table 3.2)*.

Area statistics based on the old Jharia Coalfield boundary indicates that mining area in Jharia Coalfield covers 46.40 km$^2$ (11.81%) in the year 2022. Coal quarry constitutes 10.91 Km$^2$ (2.78%), Advanced quarry site constitutes 0.02 Km$^2$ (0.01%), Coal dumps / stocks constitute 0.45 Km$^2$ (0.11%), Barren over burden dumps constitutes 13.12 Km$^2$ (3.34%), Barren Backfilled areas constitute 19.07 Km$^2$ (4.85%) and Quarry filled with water constitutes 2.83 km$^2$ (0.72%). There has been an increase of 2.08 Km$^2$ (0.53%) in Mining Area(s) in Jharia Coalfield as compared to Year 2019. (Refer Table 3.3)

### 3.3.3 Agricultural Land

Land primarily used for farming and production of food, fibre and other commercial and horticultural crops falls under this category. It includes crop land and fallow land. *Crop lands* are those agricultural lands where standing crop occurs on the date of satellite imagery or land is used for agricultural purposes during any season of the year. Crops may be either kharif or rabi. *Fallow lands* are also agricultural land which is taken up for cultivation but temporarily allowed to rest, un-cropped for one or more season. In this study, both crop land and fallow land has been combined in single class namely agricultural land.

Agriculture in Jharia Coalfield covers an area of 112.02 $km^2$ (25.45%) (as per the updated coalfield boundary). Analysis of the satellite data of the year 2022 indicated that agriculture coming under the coalfield boundary of Jharia was distributed between *Crop Land* (3.72 $km^2$; 0.85%), and *Fallow Land* (108.30 $km^2$; 24.60%) *(Refer Table 3.2).*

Area statistics based on the old Jharia Coalfield boundary indicates that Agricultural land in Jharia Coalfield covers an area of 73.42 $Km^2$ (18.69%). Analysis of the satellite data of the year 2022 indicated that this agricultural land under the old coalfield boundary of Jharia is distributed between Crop Land (3.74 $Km^2$; 0.95%), and Fallow Land (69.68 $Km^2$; 17.74%). It is also observed that there has been an increase of 10.73 $Km^2$ (2.73%) in Agricultural Land in Jharia Coalfield as compared to Year 2019. (Refer Table 3.3)

### 3.3.4 Wasteland

Wasteland is a degraded and under-utilised class of land that has deteriorated on account of natural causes or due to lack of appropriate water and soil management. Wasteland can result from inherent/imposed constraints such as location, environment, chemical and physical properties of the soil or financial or other management constraints (NWDB, 1987).

Analysis of satellite data of 2022 (as per the updated coalfield boundary) reveals that waste land in Jharia Coalfield occupies 81.76 $km^2$ (18.56%) out of which *Waste upland with or without scrubs* occupies 78.93 $km^2$ (17.92%), *Sand bodies* constitute 2.83 $km^2$ (0.64%) (Refer Table 3.2).

Area statistics based on the old Jharia Coalfield boundary indicates that waste land in Jharia Coalfield occupies 83.93 $Km^2$ (21.36%) area in the year 2022. Out of which Waste upland with or without scrubs occupies 80.90 $km^2$ (20.59%) and Sand bodies constitute 3.03 $km^2$ (0.77%). There has been a decrease of 15.73 $Km^2$ (4.01%) in Wasteland in Jharia Coalfield as compared to Year 2019. (Refer Table 3.3).

### 3.3.5 Settlements

All the man-made constructions covering the land surface are included under this category. Built-up land has been divided in to rural, urban and industrial classes based on availability of infrastructure facilities. In the present study, industrial settlement indicates only industrial complexes excluding residential facilities. The percentage of settlement shown in the analysis here is in terms of total land use/ cover only.

Settlements in Jharia Coalfield (as per the updated coalfield boundary) covers an area of 43.43 $km^2$ (9.86%) out of the total coalfield area of 440.25 $km^2$. Analysis of the satellite data of the year 2022 indicated that settlement coming under the coalfield boundary of Jharia was distributed between *Urban* (32.23 $km^2$; 7.32%), *Rural* (8.21 $km^2$; 1.86%) and *Industrial* (2.99 $km^2$; 0.68%) *(Refer Table 3.2)*.

As per the old coalfield boundary that has been used in Vegetation Cover Mapping report for the year 2019, settlements in Jharia Coalfield covers an area of 42.49 $Km^2$ (10.82%) out of the total coalfield area of 392.85 $Km^2$. Analysis of the satellite data of the year 2022 indicated that settlement coming under the old coalfield boundary of Jharia was distributed between Urban (32.03 $Km^2$;

8.15%), Rural (7.68 $Km^2$; 1.96%) and Industrial (2.78 $Km^2$; 0.71%). There has been an increase of 0.07 $Km^2$ (0.03%) under settlement class in Jharia Coalfield as compared to Year 2019. (Refer Table 3.3)

### 3.3.6 Water bodies

Analysis of satellite data of the year 2022 (as per the updated coalfield boundary) reveals that water bodies in Jharia coalfield occupy area of 11.87 $km^2$ (2.70%) *(Refer Table 3.2)*.

Area statistics based analysis of satellite data of the year 2022 using the old Jharia Coalfield boundary indicates that water bodies in Jharia Coalfield occupy area of 10.85 $km^2$ (2.76%) which indicates an increase of 2.85 $Km^2$ (0.72%) area under water bodies in Jharia Coalfield as compared to the year 2019. (Refer Table 3.3).

# Chapter 4

# Conclusion & Recommendations

## 4.1 Conclusion

In the present study, land use/vegetation cover map of Jharia coalfield is prepared based on Resourcesat–2A (IRS-R2A L4FX) Satellite data of February 2022 in order to monitor the changes in vegetation cover and land use pattern for effective natural resource management and its planning. The Land use/vegetation cover analysis will help to analyse and monitor the impact of mining and other industrial activities in the area.

Study reveals that with the updation of Jharia Coalfield Boundary, now it covers an area of about 440.25 $km^2$. Settlements coming under the coalfield boundary covers area of 43.43 $km^2$ which is 9.86% of the coalfield area. Vegetation cover constitutes 144.77 $km^2$ (32.89%), Mining activities is on 46.40 $km^2$ area which is 10.54% of the total Jharia Coalfield boundary area whereas agriculture and wasteland are on 112.02 $km^2$ (25.45%) and 81.76 $km^2$ (18.56%) respectively. Water bodies cover an area of 11.87 $km^2$ (2.70%) within Jharia Coalfield Boundary.

## 4.2 Recommendations

For eco-friendly sustainable coal mining in the Jharia Coalfield, it is recommended that;

a. Similar study should to be carried out regularly at interval of 3 years to monitor the change in land use/vegetation cover in the coalfield for assessing the impact of coal mining and to take the remedial measures required, if any.

b. Efforts for afforestation should be given thrust in the coalfield region especially on wasteland and mined out area to maintain the ecological balance in the region.

## *ABBREVIATIONS*

| | |
|---|---|
| SoI | Survey of India |
| MoEF & CC | Ministry of Environment, Forest & Climate Change |
| CIL | Coal India Limited |
| ECL | Eastern Coalfields Limited |
| BCCL | Bharat Coking Coal Limited |
| CCL | Central Coalfields Limited |
| WCL | Western Coalfields Limited |
| SECL | South Eastern Coalfields Limited |
| NCL | Northern Coalfields Limited |
| MCL | Mahanadi Coalfields Limited |
| NEC | North Eastern Coalfields |
| CMPDIL | Central Mine Planning & Design Institute Ltd |
| NRSC | National Remote Sensing Centre |
| R2/ R2A | ResourceSat Satellites |
| LISS - 4 | Linear Imaging and Self Scanning Sensor |
| FCC | False Colour Composite |
| OCP | Opencast Project |
| UGP | Underground Project |
| OB | Over Burden |
| GCP | Ground Control points |
| GIS | Geographic Information System |
| WGS-84 | World Geodetic System |
| UTM | Universal Transverse Mercator |

## *GLOSSARY*

| Sl. | Term | Definition |
|---|---|---|
| 1. | Land Reclamation | To manage, reclaim and restore mined out/ degraded land as close as possible to its original stage. |
| 2. | Over Burden | The material that lies above the coal seam/ deposit |
| 3. | Monitoring | A process of evaluation to check or keep record for a period of time. |
| 4. | Opencast Coal Mine | Open-pit mining, also known as opencast mining, is a surface mining technique that extracts minerals from an open pit in the ground. |
| 5. | Social Forestry | Social forestry is the management and protection of forests and afforestation of barren and deforested lands with the purpose of helping environmental, social and rural development. Plantation (Social/ Avenue or other) carried out outside mining area. |
| 6. | Biological Reclamation | Plantation on Backfilled areas (Stablised Internal Dumps) |
| 7. | Technical Reclamation | Area under backfilling (Over burden dumped inside the mine voids) in mining area. |
| 8. | Green Cover Generated | Total Plantation carried out in the lease area of Project. This includes Plantation on Backfill, Plantation on OB and Social Forestry. |
| 9. | Leasehold Area | The area, for which lease is granted for the purpose of undertaking mining and allied operations. |
| 10. | Excavated area | Mined out area which includes active mining, area under backfilling and plantation on backfilled areas |
| 11. | Active Mining | Mining areas which include Coal Quarry, Advance Quarry, Quarry Filled with Water etc. |
| 12. | Environmental Protection | It is the practice of protecting the natural environment by individuals, organizations and governments. Its objectives are to conserve natural resources and the existing natural environment and, where possible, to mitigate damage and reverse trends. |
| 13. | Remedial Measure | Any measure or action required or undertaken to investigate, monitor, clean up, remove, treat, prevent, contain or otherwise remediate the presence or release of any hazardous substance or activity. |
| 14. | Systematic Error | Every measurement differing from the true measurement in the same direction, and even by the same amount in some cases. |

| | | |
|---|---|---|
| 15. | Geometric Distortion | It refers to the improper positioning of any image with respect to their true geographic position when viewed in a properly scaled common image display plane. |
| 16. | Land Use/ Cover Class | Land cover is what covers the surface of the earth and land use describes how the land is used. |
| 17. | Accuracy | The closeness of agreement between a measured quantity value and a true quantity value. |
| 18. | Environmental Clearance | Environmental Clearance (EC) for any developmental projects like coal mining projects etc. has been made mandatory by the Ministry of Environment, Forests and Climate Change (MoEF & CC) through its Notification issued on 27.01.1994 under the provisions of Environment (Protection) Act, 1986. |
| 19. | Rectification and Geo-referencing | Geo-referencing is the assigning of absolute location of a data point or data points. Geo-rectification refers to the removal of geometric distortions between sets of data points, most often the removal of terrain, platform, and sensor induced distortions from remote sensing imagery. |
| 20. | Image Enhancement | It is the process of modifying digital images so that the results are more suitable for processing or further image analysis. |
| 21. | Training set selection | It is a portion of a data set used to fit or train a model for prediction or classification of values that are known in the training set, but unknown in other (future) data. |
| 22. | Image Classification | It refers to the task of extracting information classes from a multiband raster image. The resulting raster from image classification can be used to create thematic maps. |
| 23. | Temporal Changes | The 'temporal change' means the change in any entity with a period of time. |
| 24. | Ground Truthing | Collection of primary/ basic information from ground realities for satellite image interpretation and thematic mapping. |
| 25. | Cluster | Group of opencast and/ or underground mines clubbed together for administrative purposes. |
| 26. | Arc GIS | GIS Software used for Map preparation |
| 27. | ERDAS IMAGINE | Satellite Image Data Classification Software |

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

**Annexure XXIII**

# Land Reclamation/ Restoration Monitoring of five Clusters of (Opencast + Underground) Coal Mines of Bharat Coking Coal Limited based on Satellite Data of the Year 2020

*Submitted to*

**Bharat Coking Coal Limited**

cmpdi

# Land Reclamation/ Restoration Monitoring of five Clusters of (Opencast + Underground) Coal Mines of Bharat Coking Coal Limited based on Satellite Data of the Year 2020

March-2021

**Remote Sensing Cell**
**Geomatics Division**
**CMPDI, Ranchi**

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# Executive Summary

1. Project — Land reclamation/ restoration monitoring of five 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 land reclamation/ restoration 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

- Out of 5 Clusters of mines viz. III, V, VIII, IX and XVII considered for land reclamation monitoring during the year 2020-21; XVII cluster of mines is added during the year 2020-21. These clusters consist of mainly opencast mines.

- Out of the total mine leasehold area of 7988.22 Ha. of the 05 clusters producing less than 5mcm (Coal+OB) annually considered for monitoring during the year 2020-21; total excavated area is 1300.74 Ha. out of which 27.81 Ha. area (2.14%) has been planted on backfill (Biological Reclamation) and 657.49 Ha. area (50.55%) is under backfilling (Technical Reclamation) and 615.44 Ha. area (47.31%) under active mining. Cluster wise details of land reclamation of the above Clusters is given in Table-1.

- Total area under plantation (green cover) covers an area of 645.75 Ha. which is 8.08% of total leasehold area.

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

## Table 1

## Land Reclamation Status in five Clusters (Underground + Opencast Mines) of BCCL based on Satellite Data of the Year 2020

**Table - 1 Status of Land Reclamation in 5 clusters of BCCL based on Satellite Data of the Year 2020**

*(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 Generated in Leasehold) | | Total Area under Reclamation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Biological | | Other Plantations | | | | | | | | | | | |
| | | | | Area under Backfilling | | Plantation on Excavated / Backfilled Area | | Plantation on External OB 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)* | |
| | | 2017 | 2020 | 2017 | 2020 | 2017 | 2020 | 2017 | 2020 | 2017 | 2020 | 2017 | 2020 | 2017 | 2020 | 2017 | 2020 | 2017 | 2020 |
| 1 | Cluster III | 1552.53 | 1552.53 | 55.87 | 60.37 | 3.89 | 3.89 | 21.11 | 21.11 | 128.07 | 162.33 | 101.50 | 104.79 | 161.26 | 169.05 | 153.07 | 187.33 | 59.76 | 64.26 |
| | | | | 34.65% | 35.71% | 2.41% | 2.30% | | | | | 62.94% | 61.99% | | | 9.86% | 12.07% | 37.06% | 38.01% |
| 2 | Cluster V | 1724.52 | 1724.52 | 162.09 | 187.59 | 7.19 | 7.19 | 23.85 | 23.85 | 105.29 | 105.29 | 112.24 | 103.52 | 281.52 | 298.30 | 136.33 | 136.33 | 169.28 | 194.78 |
| | | | | 57.58% | 62.89% | 2.55% | 2.41% | | | | | 39.87% | 34.70% | | | 7.91% | 7.91% | 60.13% | 65.30% |
| 3 | Cluster VIII | 1331.95 | 1331.95 | 161.86 | 206.91 | 13.72 | 9.93 | 21.97 | 21.97 | 24.70 | 24.70 | 111.06 | 124.49 | 286.64 | 341.33 | 60.39 | 56.60 | 175.58 | 216.84 |
| | | | | 56.47% | 60.62% | 4.79% | 2.91% | | | | | 38.75% | 36.47% | | | 4.53% | 4.25% | 61.25% | 63.53% |
| 4 | Cluster IX | 1967.22 | 1967.22 | 77.53 | 77.53 | 6.80 | 6.80 | 41.79 | 41.79 | 168.58 | 168.58 | 181.85 | 217.24 | 266.18 | 301.57 | 217.17 | 217.17 | 84.33 | 84.33 |
| | | | | 29.13% | 25.71% | 2.55% | 2.25% | | | | | 68.32% | 72.04% | | | 11.04% | 11.04% | 31.68% | 27.96% |
| 5 | Cluster XVII | - | 1412.00 | - | 125.09 | - | 0.00 | - | 5.00 | - | 43.33 | - | 65.40 | - | 190.49 | - | 48.32 | - | 125.09 |
| | | | | | 65.67% | | 0.00% | | | | | | 34.33% | | | | 3.42% | | 65.67% |
| | **TOTAL** | **6576.22** | **7988.22** | **457.35** | **657.49** | **31.60** | **27.81** | **108.72** | **113.72** | **426.64** | **504.23** | **506.65** | **615.44** | **995.60** | **1300.74** | **566.96** | **645.75** | **488.95** | **685.30** |
| | | | | **45.94%** | **50.55%** | **3.17%** | **2.14%** | | | | | **50.89%** | **47.31%** | | | **8.62%** | **8.08%** | **49.11%** | **52.69%** |

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

Note: In reference of the above Table, different parameters are classified as follows: (Cluster XVII started from current year)

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"'.

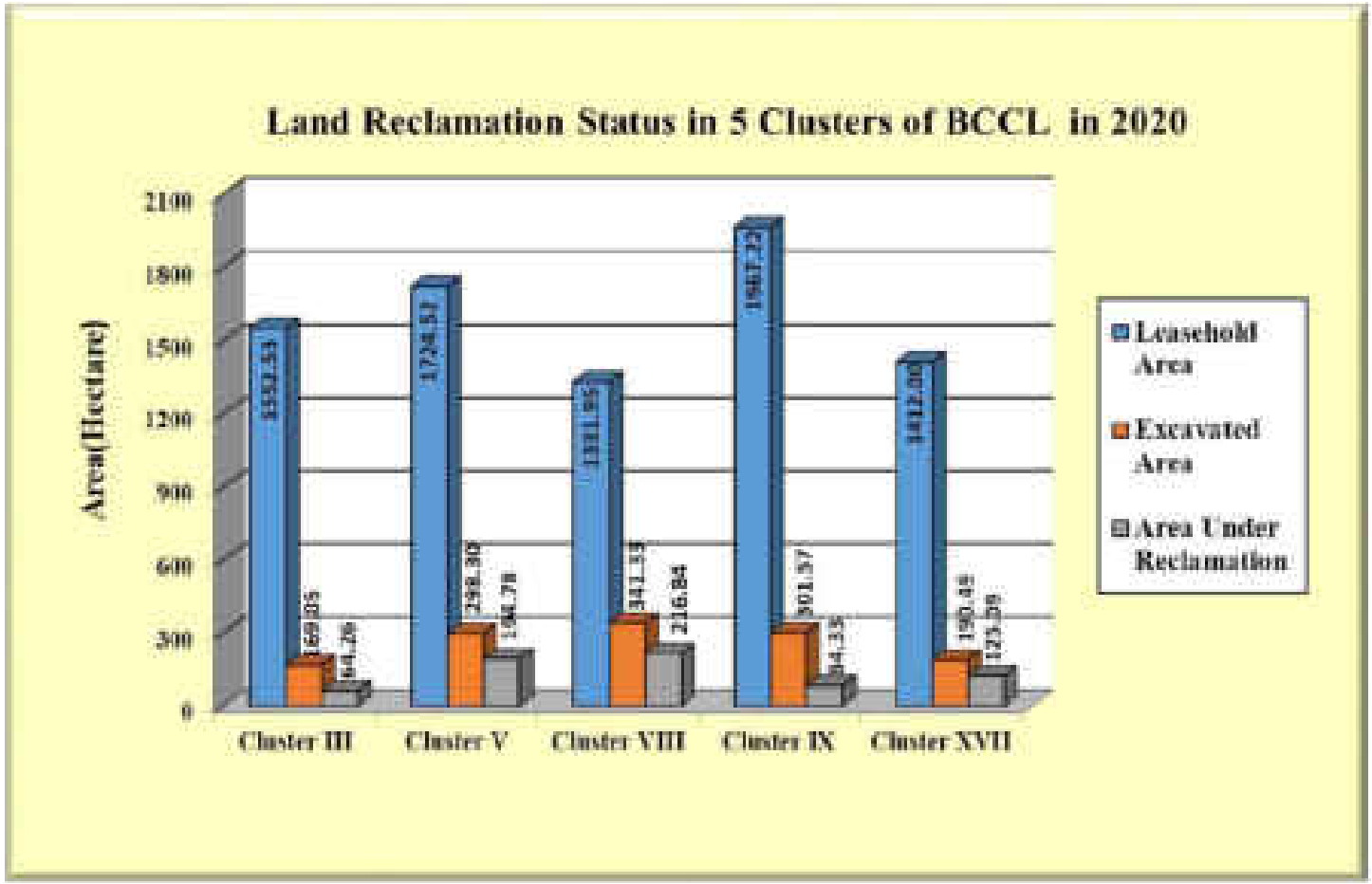



**Fig. 1: Cluster wise Land Reclamation Status in five Clusters - 2020 (BCCL)**

# 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 2017 the same was carried out cluster wise for mines of 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 & Climate Change (**MoEF&CC**). 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 2020 carried out for five 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:

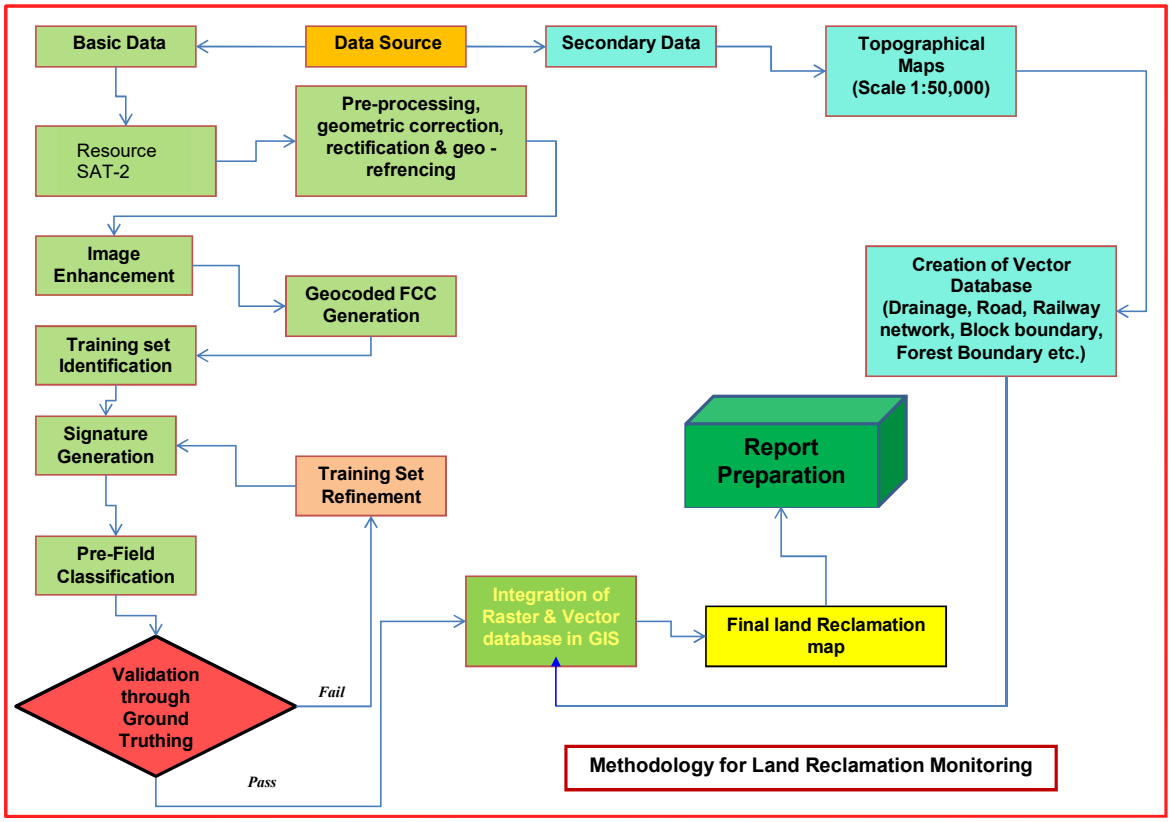



**Fig. 2: Methodology of Land Reclamation Monitoring**

**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 may 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 with the new series WGS-84 compatible 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. The database boundary shape files (.shp), kml files and the maps thus prepared confirm to the WGS-84 datum and UTM projected co-ordinate system.

## 4. Land Reclamation Status in Bharat Coking Coal Ltd.

**4.1** Following 5 clusters of mines comprising both underground and opencast projects of Bharat Coking Coal Ltd. have been taken up for land reclamation monitoring during the year 2020-21:

- Cluster III
- Cluster V
- Cluster VIII
- Cluster IX
- Cluster XVII

**4.2** Cluster wise Land Reclamation status of above mentioned clusters in BCCL is given in Table 1 and also shown graphically in Fig 1. Area statistics of different land use classes present in the mine leasehold of the above projects for the year 2020 are shown in Table 2. Land use maps derived from the satellite data are shown in Plate 1 - 5. Different land use classes based on satellite data are depicted in bar charts in Fig. 3 - 7.

**4.3** Study reveals that out of total mine leasehold area of 7988.22 ha. of the 5 clusters of mines (Underground + Opencast) of BCCL mentioned above taken for this study in 2020-21, total excavated area is 1300.74 ha. out of which 27.81 ha. (2.14%) has been planted (*Biologically Reclaimed*), 657.49 ha. (50.55%) is under backfilling (*Technically Reclaimed*) and balance 615.44 ha. (47.31%) is under active mining.

**4.4** Land reclamation monitoring for cluster XVII of BCCL is taken up for the first time in the year 2020-21. Hence comparison of this cluster in year 2020 has not been made with respect to year 2017. The data thus generated in the year 2020 will be considered as base data for comparison of land reclamation of this cluster of mines at the interval of every three year.

**4.5** Study reveals that out of five clusters of mines of BCCL considered for reclamation monitoring in 2020, the area under total plantation (Green Cover) is maximum in Cluster IX i.e 217.17 ha., followed by Cluster III with 187.33 ha., Cluster V with 136.33 ha., Cluster VIII with 56.60 ha. and Cluster XVII with 48.32 ha.

**4.6** Out of the 5 Clusters in BCCL considered for satellite data based land reclamation monitoring in 2020, Cluster XVII tops with 65.67% reclamation followed by Cluster V with 65.30%, Cluster VIII with 63.53%, Cluster III with 38.01% and Cluster IX with 27.96%.

**4.7** In Cluster VIII, it is revealed that area under plantation on backfill (Biological Reclamation) has decreased from 13.72 ha. in the year 2017 to 9.93 ha. in the year 2020. This decrease of 3.79 ha. area in Biological reclamation is due to rehandling of backfill. Hence total area under plantation on backfill has decreased from 31.60 ha. (Yr 2017) to 27.81 ha. (Yr 2020).

**4.8** On comparing the status of land reclamation for the year 2020 with respect to the year 2017 it is evident from the analysis that area under land reclamation has increased from 488.95 ha. (Yr 2017) to 685.30 ha. (Yr 2020). This increase of 196.35 ha. area under land reclamation is due to increase in reclamation activities in Cluster III, V & VIII as well as addition of Cluster XVII.

**4.9** This study will again be carried out after an interval of three years to assess the progress and changes in land reclamation in the above clusters.

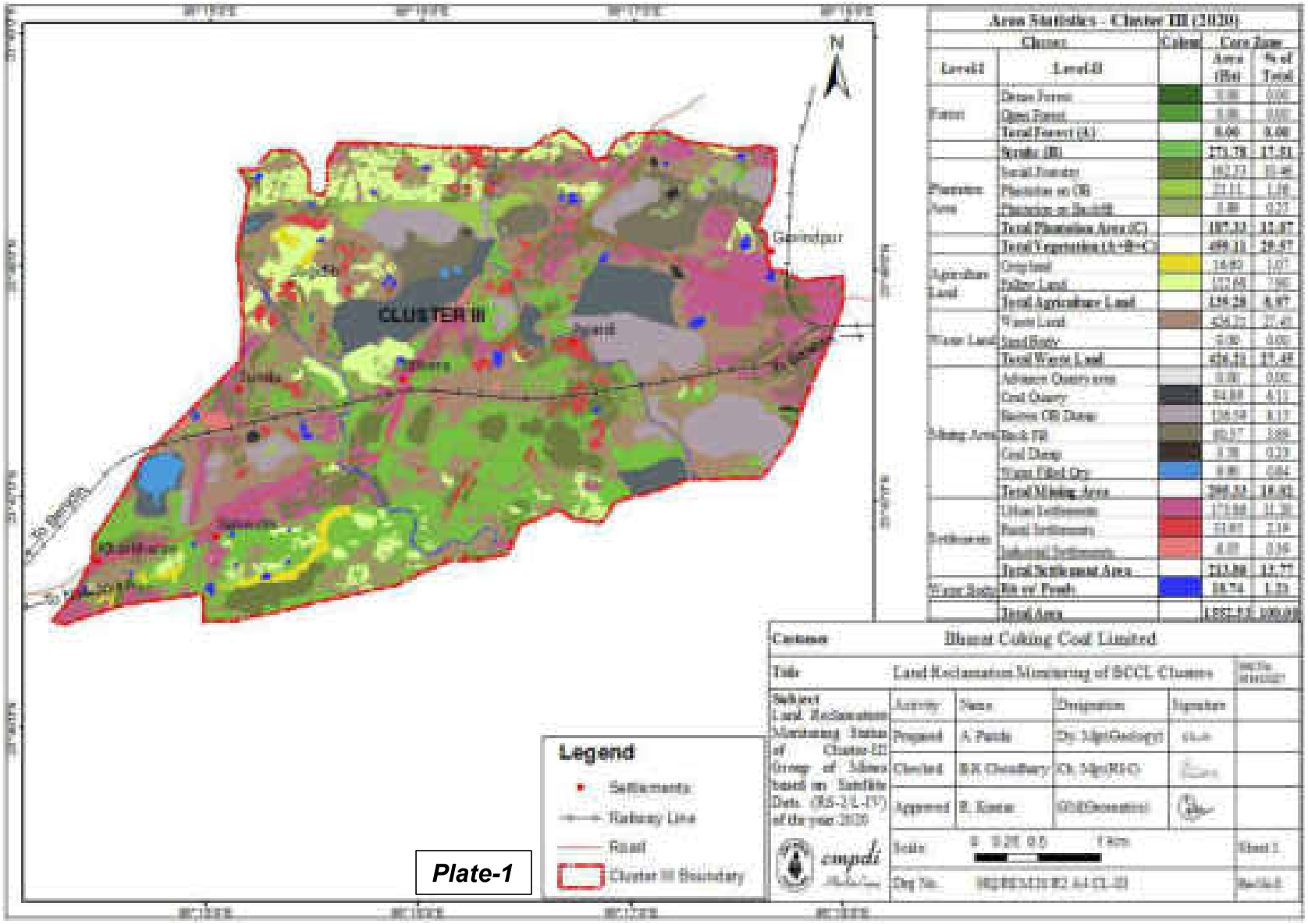
## Table 2

## Cluster wise Area Statistics of Land Use/ Cover classes in five Clusters of (OC+UG) mines of BCCL based on Satellite Data of the year 2020

**Status of Land Reclamation in 5 Clusters of (UG+OC) mines of Bharat Coking Coal Ltd. based on Satellite data of the Year 2020**

*(Area in Hectare)*

| | | CLUSTER III | | CLUSTER V | | CLUSTER VIII | | CLUSTER IX | | CLUSTER XVII | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Area | % | Area | % | Area | % | Area | % | Area | % | Area | % |
| FORESTS | Dense Forest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Open Forest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total Forest (A)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SCRUBS | **Scrubs (B)** | 271.78 | 17.51 | 320.90 | 18.61 | 157.58 | 11.83 | 346.67 | 17.62 | 178.99 | 12.68 | 1275.92 | 15.97 |
| PLANTATION | Social Forestry/Avenue Plantation | 162.33 | 10.46 | 105.29 | 6.11 | 24.70 | 1.85 | 168.58 | 8.57 | 43.33 | 3.07 | 504.23 | 6.31 |
| | Plantation on OB Dump | 21.11 | 1.36 | 23.85 | 1.38 | 21.97 | 1.65 | 41.79 | 2.12 | 5.00 | 0.35 | 113.72 | 1.42 |
| | Plantation on Backfill (Biological Reclamation) | 3.89 | 0.25 | 7.19 | 0.42 | 9.93 | 0.75 | 6.80 | 0.35 | 0.00 | 0.00 | 27.81 | 0.35 |
| | **Total Plantation (C)** | 187.33 | 12.07 | 136.33 | 7.91 | 56.60 | 4.25 | 217.17 | 11.04 | 48.32 | 3.42 | 645.75 | 8.08 |
| | **Total Vegetation (A+B+C)** | **459.11** | **29.57** | **457.23** | **26.51** | **214.18** | **16.08** | **563.84** | **28.66** | **227.31** | **16.10** | **1921.67** | **24.06** |
| | Coal Dump | 3.58 | 0.23 | 1.70 | 0.10 | 3.72 | 0.28 | 4.89 | 0.25 | 0.00 | 0.00 | 13.89 | 0.17 |
| ACTIVE MINING | Coal Quarry | 94.89 | 6.11 | 87.72 | 5.09 | 101.43 | 7.62 | 191.65 | 9.74 | 56.82 | 4.02 | 532.51 | 6.67 |
| | Advance Quarry Site | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Quarry Filled With Water | 9.90 | 0.64 | 15.80 | 0.92 | 23.06 | 1.73 | 25.59 | 1.30 | 8.58 | 0.61 | 82.93 | 1.04 |
| | **Total Area under *Active Mining*** | **104.79** | **6.75** | **103.52** | **6.00** | **124.49** | **9.35** | **217.24** | **11.04** | **65.40** | **4.63** | **615.44** | **7.70** |
| | Barren OB Dump | 126.59 | 8.15 | 174.62 | 10.13 | 152.06 | 11.42 | 166.03 | 8.44 | 44.48 | 3.15 | 663.78 | 8.31 |
| RECLAIMED | Area Under Backfilling (Technical Reclamation) | 60.37 | 3.89 | 187.59 | 10.88 | 206.91 | 15.53 | 77.53 | 3.94 | 125.09 | 8.86 | 657.49 | 8.23 |
| | **Total Area under Mine Operation** | **295.33** | **19.02** | **467.43** | **27.10** | **487.18** | **36.58** | **465.69** | **23.67** | **234.97** | **16.64** | **1950.60** | **24.42** |
| WASTELAND | Waste Lands | 426.21 | 27.45 | 472.92 | 27.42 | 373.70 | 28.06 | 581.57 | 29.56 | 112.68 | 7.98 | 1967.08 | 24.62 |
| | Fly Ash Pond / Sand Body | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.76 | 0.48 | 6.76 | 0.08 |
| | **Total Wasteland** | **426.21** | **27.45** | **472.92** | **27.42** | **373.70** | **28.06** | **581.57** | **29.56** | **119.44** | **8.46** | **1973.84** | **24.71** |
| WATERBODIES | Reservoir, Nallah, Ponds | 18.74 | 1.21 | 13.66 | 0.79 | 13.95 | 1.05 | 23.33 | 1.19 | 31.81 | 2.25 | 101.49 | 1.27 |
| | **Total Waterbodies** | **18.74** | **1.21** | **13.66** | **0.79** | **13.95** | **1.05** | **23.33** | **1.19** | **31.81** | **2.25** | **101.49** | **1.27** |
| AGRICULTURE | Crop Lands | 16.60 | 1.07 | 8.41 | 0.49 | 16.63 | 1.25 | 0.00 | 0.00 | 69.45 | 4.92 | 111.09 | 1.39 |
| | Fallow Lands | 122.68 | 7.90 | 58.64 | 3.40 | 58.63 | 4.40 | 43.56 | 2.21 | 472.71 | 33.48 | 756.22 | 9.47 |
| | **Total Agriculture** | **139.28** | **8.97** | **67.05** | **3.89** | **75.26** | **5.65** | **43.56** | **2.21** | **542.16** | **38.40** | **867.31** | **10.86** |
| SETTLEMENTS | Urban Settlement | 173.86 | 11.20 | 220.71 | 12.80 | 99.22 | 7.45 | 232.31 | 11.81 | 214.25 | 15.17 | 940.35 | 11.77 |
| | Rural Settlement | 33.95 | 2.19 | 13.97 | 0.81 | 60.71 | 4.56 | 47.79 | 2.43 | 31.36 | 2.22 | 187.78 | 2.35 |
| | Industrial Settlement | 6.05 | 0.39 | 11.55 | 0.67 | 7.75 | 0.58 | 9.13 | 0.46 | 10.69 | 0.76 | 45.17 | 0.57 |
| | **Total Settlements** | **213.86** | **13.77** | **246.23** | **14.28** | **167.68** | **12.59** | **289.23** | **14.70** | **256.31** | **18.15** | **1173.31** | **14.69** |
| | **Grand Total** | **1552.53** | **100.00** | **1724.52** | **100.00** | **1331.95** | **100.00** | **1967.22** | **100.00** | **1412.00** | **100.00** | **7988.22** | **100.00** |




Area Statistics - Cluster III (2020)

| Level1 | Level-II | Colour | Core Zone Area (Ha) | Core Zone % of Total |
|---|---|---|---|---|
| Forest | Dense Forest | | 0.00 | 0.00 |
| | Open Forest | | 0.00 | 0.00 |
| | Total Forest (A) | | 0.00 | 0.00 |
| Plantation Area | Scrubs (B) | | 374.78 | 17.51 |
| | Social Forestry | | 182.73 | 10.46 |
| | Plantation on OB | | 21.11 | 1.16 |
| | Plantation on Backfill | | 3.80 | 0.23 |
| | Total Plantation Area (C) | | 187.33 | 11.87 |
| | Total Vegetation (A+B+C) | | 499.11 | 28.57 |
| Agriculture Land | Cropland | | 14.69 | 1.07 |
| | Fallow Land | | 122.68 | 7.90 |
| | Total Agriculture Land | | 139.28 | 8.97 |
| Water Land | Waste Land | | 424.21 | 27.49 |
| | Sand Body | | 0.00 | 0.00 |
| | Total Waste Land | | 424.21 | 27.49 |
| Mining Area | Adjacent Quarry area | | 0.00 | 0.00 |
| | Coal Quarry | | 54.88 | 4.11 |
| | Barren OB Dump | | 126.59 | 8.17 |
| | Back Fill | | 60.57 | 3.88 |
| | Coal Dump | | 3.78 | 0.23 |
| | Water Filled Pit | | 0.80 | 0.04 |
| | Total Mining Area | | 246.53 | 16.43 |
| Settlements | Urban Settlements | | 171.68 | 11.20 |
| | Rural Settlements | | 33.87 | 2.19 |
| | Industrial Settlements | | 6.05 | 0.39 |
| | Total Settlement Area | | 211.60 | 13.77 |
| Water Body | Nala or Ponds | | 18.74 | 1.23 |
| | Total Area | | 1539.52 | 100.00 |

| | | | | |
|---|---|---|---|---|
| Subject: Land Reclamation Monitoring Status of Cluster-III Group of Mines based on Satellite Data (RS-2/L-IV) of the year 2020 | Activity | Name | Designation | Signature |
| | Prepared | A. Panda | Dy. Mgr(Geology) | |
| | Checked | B.K. Choudhary | Ch. Mgr(RS-G) | |
| | Approved | R. Kumar | GM(Geomatics) | |
| | Scale: 0 0.25 0.5 1 Km | | | Sheet 1 |
| | Drg No. | | | Rev No.0 |

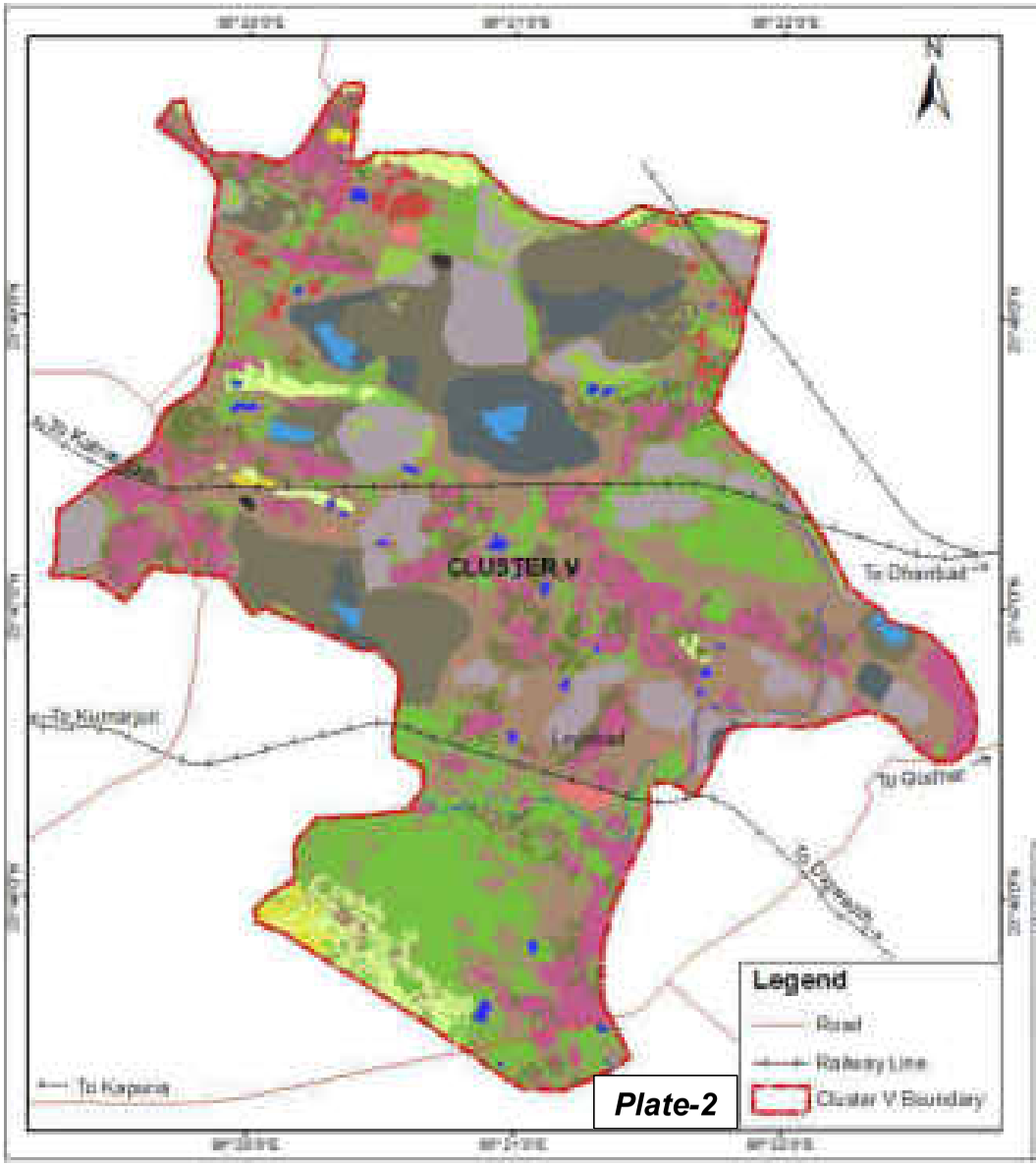



**Plate-2**

**Area Statistics - Cluster V (2020)**

| Classes | | Colour | Core Zone | |
|---|---|---|---|---|
| Level I | Level II | | Area (Ha) | %age Total |
| Forest | Dense Forest | | 0.00 | 0.00 |
| | Open Forest | | 0.00 | 0.00 |
| | Total Forest (A) | | 0.00 | 0.00 |
| | Scrubs (B) | | 320.89 | 18.63 |
| Plantation Area | Social Forestry | | 107.29 | 6.11 |
| | Plantation on OB | | 23.85 | 1.36 |
| | Plantation on Backfill | | 7.19 | 0.42 |
| | Total Plantation Area (C) | | 136.33 | 7.91 |
| | Total Vegetation (A+B+C) | | 457.22 | 26.53 |
| Agriculture Land | Crop land | | 1.41 | 0.08 |
| | Fallow Land | | 26.61 | 1.48 |
| | Total Agriculture Land | | 47.85 | 3.00 |
| Waste Land | Waste Land | | 472.92 | 27.42 |
| | Land Scaly | | 0.00 | 0.00 |
| | Total Waste Land | | 472.92 | 27.42 |
| Mining Area | Adhesive Quarry area | | 0.00 | 0.00 |
| | Coal Quarry | | 67.12 | 3.89 |
| | Barren OB Dump | | 174.82 | 10.13 |
| | Back Fill | | 187.59 | 10.88 |
| | Coal Dump | | 1.70 | 0.10 |
| | Water Filled Qry | | 17.00 | 0.97 |
| | Total Mining Area | | 447.43 | 27.19 |
| Settlements | Urban Settlements | | 220.71 | 12.80 |
| | Rural Settlements | | 11.67 | 0.81 |
| | Industrial Settlements | | 11.27 | 0.67 |
| | Total Settlement Area | | 246.25 | 14.28 |
| Water Body | River/ Roads | | 13.68 | 0.79 |
| | Total Area | | 1724.92 | 100.00 |

Bharat Coking Coal Limited

Title: Land Reclamation Monitoring of BCCL Clusters

Subject: Land Reclamation Monitoring Status of Cluster V Drawn as per Mines Board of Gazette Date 05-12-17 of the year 2020

| | Name | Designation | Signature |
|---|---|---|---|
| Prepared | A. Barik | Dy. Mgr(Geology) | |
| Checked | S.K.Choudhary | Dy. Mgr(RS) | |
| Approved | N. Kumar | GM(Geomatics) | |

Scale: 0 0.25 0.5 1 Km

Drg No: HQ/RSM/2021/Jul-CL-V

Sheet 1

| Area Statistics - Cluster VIII (2020) | | | | |
|---|---|---|---|---|
| Classes | | Colour | Core Zone | |
| Level-I | Level-II | | Area (Ha) | %of Total |
| Forest | Dense Forest | | 0.00 | 0.00 |
| | Open Forest | | 0.00 | 0.00 |
| | Total Forest (A) | | 0.00 | 0.00 |
| | Scrubs (B) | | 187.86 | 11.83 |
| Plantation Area | Social Forestry | | 24.70 | 1.85 |
| | Plantation on OB | | 21.97 | 1.65 |
| | Plantation on Backfill | | 9.83 | 0.73 |
| | Total Plantation Area (C) | | 56.60 | 4.25 |
| | Total Vegetation (A+B+C) | | 214.58 | 16.08 |
| Agriculture Land | Crop land | | 16.43 | 1.23 |
| | Fallow Land | | 58.83 | 4.40 |
| | Total Agriculture Land | | 75.26 | 5.65 |
| Waste Land | Waste Land | | 373.79 | 28.06 |
| | Land Body | | 0.00 | 0.00 |
| | Total Waste Land | | 373.79 | 28.06 |
| Mining Area | Advance Quarry area | | 0.00 | 0.00 |
| | Coal Quarry | | 101.43 | 7.62 |
| | Barren OB Dump | | 153.06 | 11.47 |
| | Back Fill | | 206.81 | 15.51 |
| | Coal Dump | | 3.72 | 0.28 |
| | Water Filled Qry | | 23.06 | 1.73 |
| | Total Mining Area | | 487.28 | 36.55 |
| Settlements | Urban Settlements | | 99.22 | 7.45 |
| | Rural Settlements | | 60.73 | 4.56 |
| | Industrial Settlements | | 7.75 | 0.58 |
| | Total Settlement Area | | 167.68 | 12.59 |
| Water Body | River/ Ponds | | 33.95 | 2.55 |
| | Total Area | | 1331.95 | 100.00 |

Owner: Bharat Coking Coal Limited

Title: Land Reclamation Monitoring of BCCL Clusters

| Subject: Land Reclamation Monitoring Status of Cluster-VIII Using of Multi Date Data (Nov-13,17) of Year 2020 | Activity | Name | Designation | Signature |
|---|---|---|---|---|
| | Prepared | | | |
| | Checked | | | |
| | Approved | | | |

Scale: 0 0.25 0.5 1 Km

Drg No:

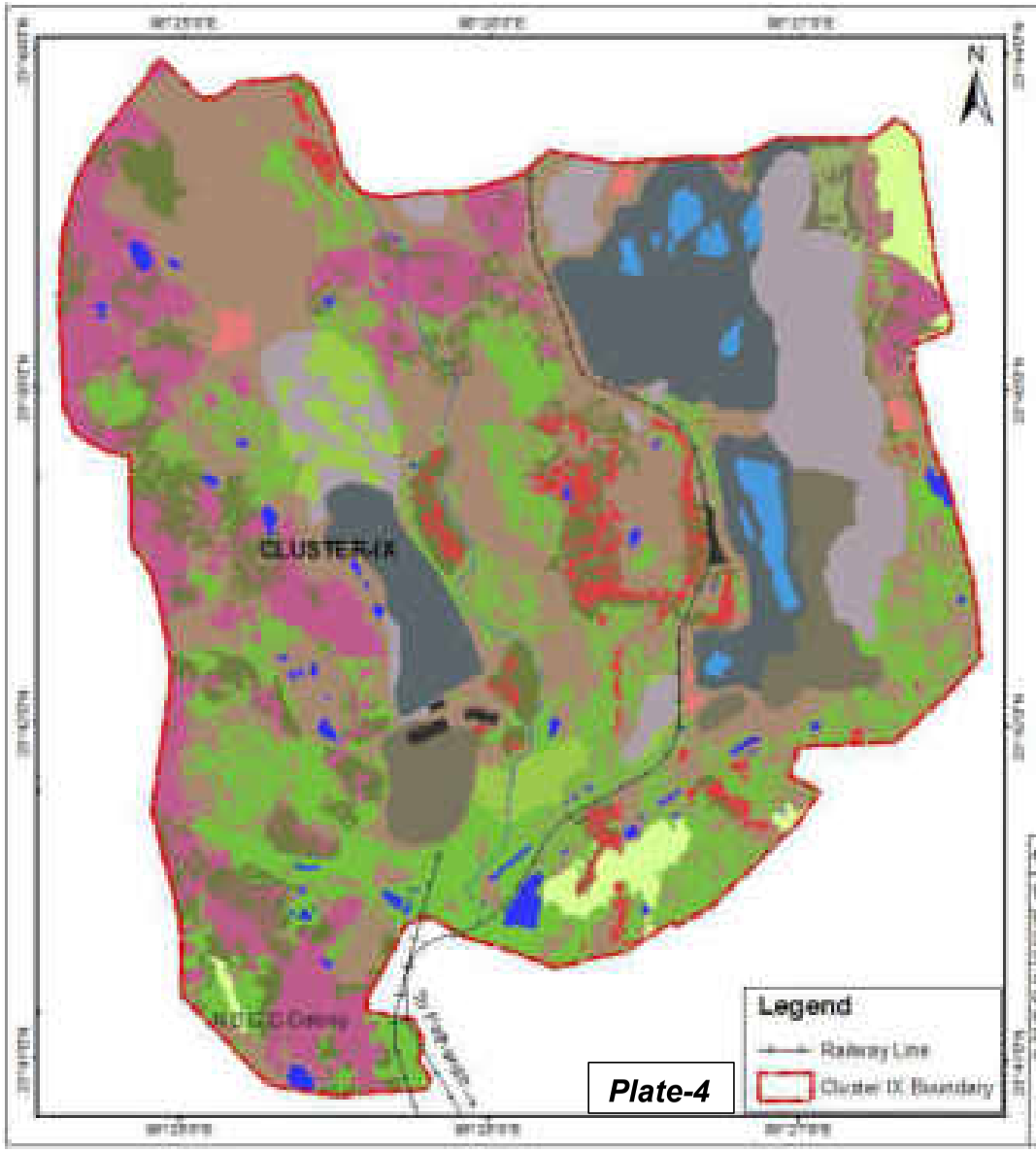
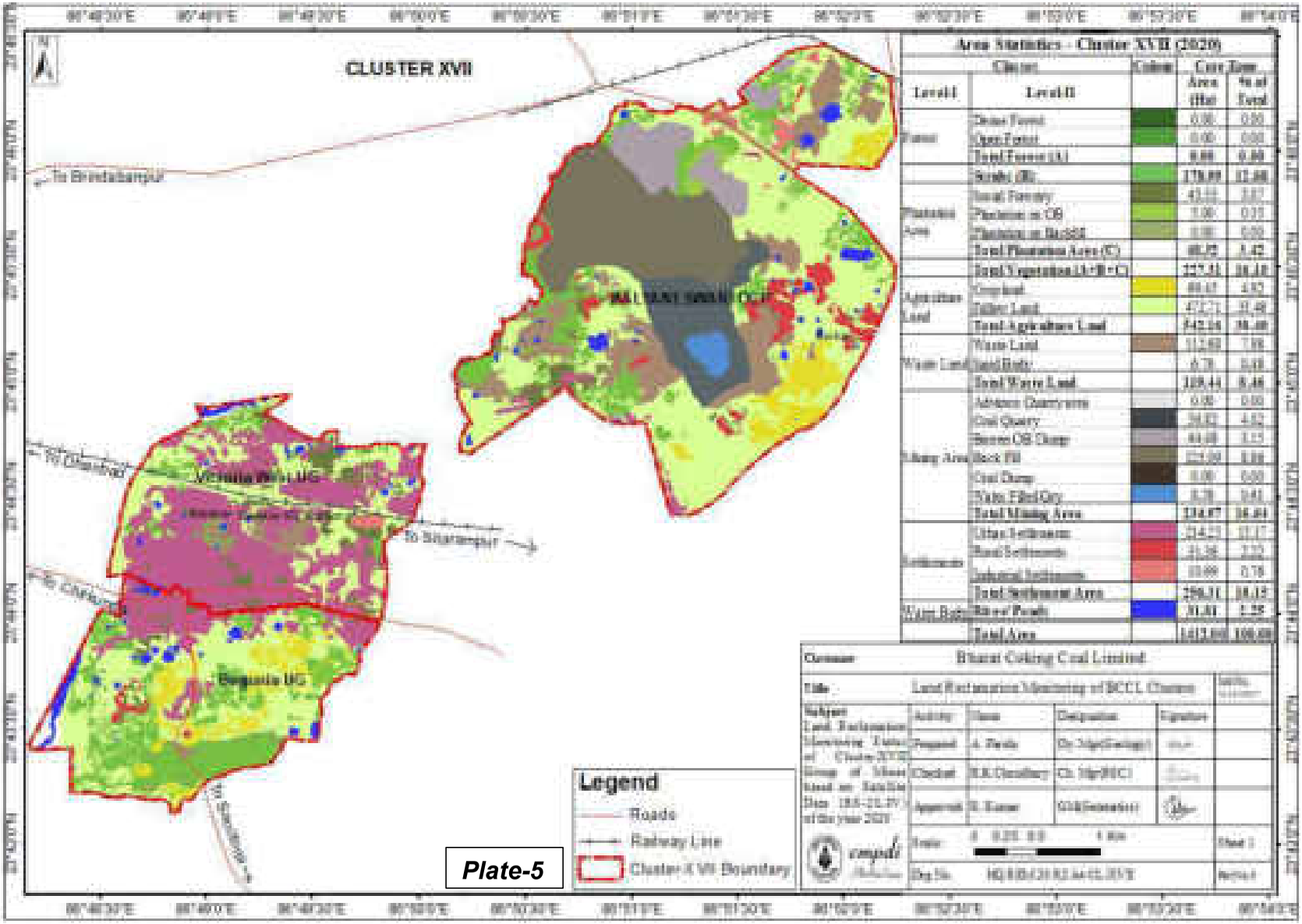



**Plate-4**

| Area Statistics - Cluster IX (2020) | | | | |
|---|---|---|---|---|
| Classes | | Colour | Core Zone | |
| Level-I | Level-II | | Area (Ha) | %of Total |
| Forest | Dense Forest | | 0.00 | 0.00 |
| | Open Forest | | 0.00 | 0.00 |
| | Total Forest (A) | | 0.00 | 0.00 |
| | Scrubs (B) | | 366.67 | 17.62 |
| Plantation Area | Social Forestry | | 169.59 | 8.57 |
| | Plantation on OB | | 43.79 | 2.22 |
| | Plantation on Backfill | | 8.80 | 0.23 |
| | Total Plantation Area (C) | | 217.17 | 11.04 |
| | Total Vegetation (A+B+C) | | 565.84 | 28.66 |
| Agriculture Land | Crop land | | 0.00 | 0.00 |
| | Fallow Land | | 43.56 | 2.21 |
| | Total Agriculture Land | | 43.56 | 2.21 |
| Waste Land | Waste Land | | 501.57 | 25.50 |
| | Land Body | | 0.00 | 0.00 |
| | Total Waste Land | | 501.57 | 25.50 |
| Mining Area | Advance Quarry area | | 0.00 | 0.00 |
| | Coal Quarry | | 101.05 | 5.74 |
| | Barren OB Dump | | 169.03 | 8.44 |
| | Back Fill | | 77.75 | 3.94 |
| | Coal Dump | | 4.89 | 0.25 |
| | Water Filled Qry | | 21.79 | 1.10 |
| | Total Mining Area | | 605.69 | 23.47 |
| Settlements | Urban Settlements | | 212.31 | 11.01 |
| | Rural Settlements | | 47.79 | 2.43 |
| | Industrial Settlements | | 8.13 | 0.41 |
| | Total Settlement Area | | 269.23 | 14.70 |
| Water Body | River/ Ponds | | 23.53 | 1.19 |
| | Total Area | | 1967.22 | 100.00 |

| | | | | | |
|---|---|---|---|---|---|
| Customer | Bharat Coking Coal Limited | | | | |
| Title | Land Reclamation Monitoring of BCCL Clusters | | | | Sub Title |
| Subject | Author | Name | Designation | Signature | |
| Land Reclamation Monitoring Status of Cluster-IX Group of Mines based on Satellite Data (RS-2 LISS-IV) of the year 2020 | Prepared | A. Panda | Dy. Mgr(Geology) | | |
| | Checked | S.K. Choudhary | Ch. Mgr(RS) | | |
| | Approved | R. Kumar | G.M.(Geomatics) | | |
| cmpdi | Scale | 0 0.25 0.5 1 Km | | | Sheet 1 |
| | Drg No. | BQ/RS/2020/BCCL/IX | | | Revised |


CLUSTER XVII
To Bhirabanpur
To Dhanbad
To Sitarampur
To Chirkunda
Victoria Block UG
Bagdiha UG
Legend
Roads
Railway Line
Cluster XVII Boundary
Area Statistics - Cluster XVII (2020)
Level I
Level II
Colour
Core Zone
Area (Ha)
% of Total
Forest
Plantation Area
Agriculture Land
Waste Land
Mining Area
Settlements
Water Bodies
Total Area
Bharat Coking Coal Limited
Land Reclamation Monitoring of BCCL Clusters
Prepared
Checked
Approved
Plate-5

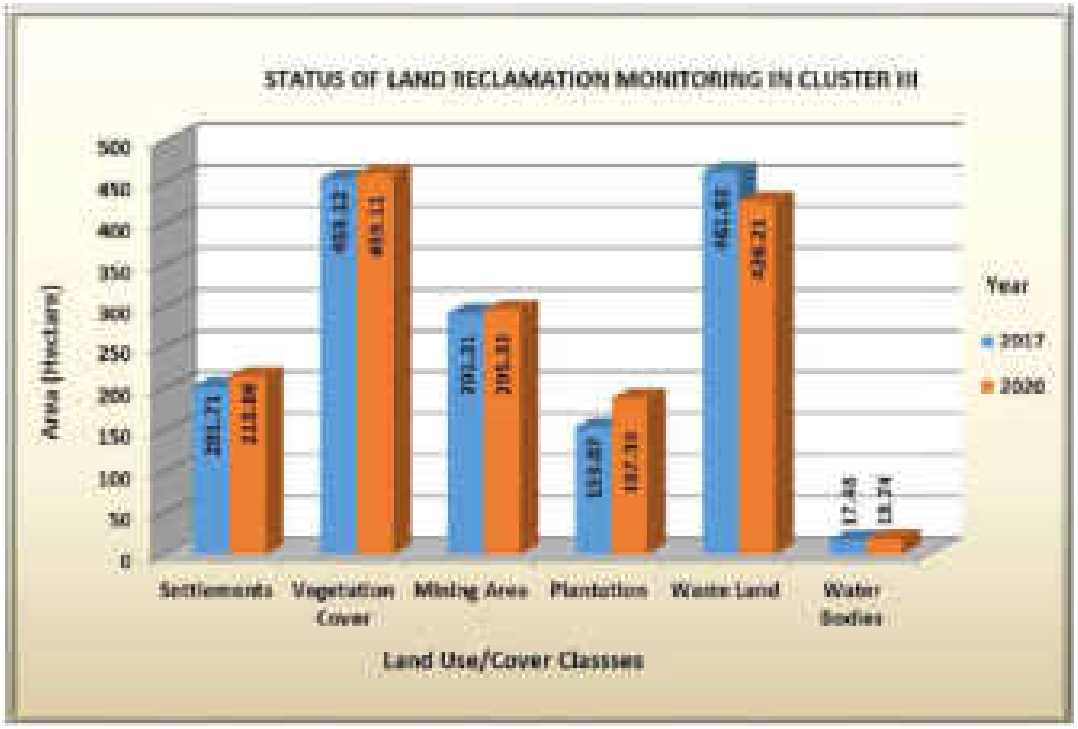



**Fig. 3: Land Reclamation Status of Cluster III**

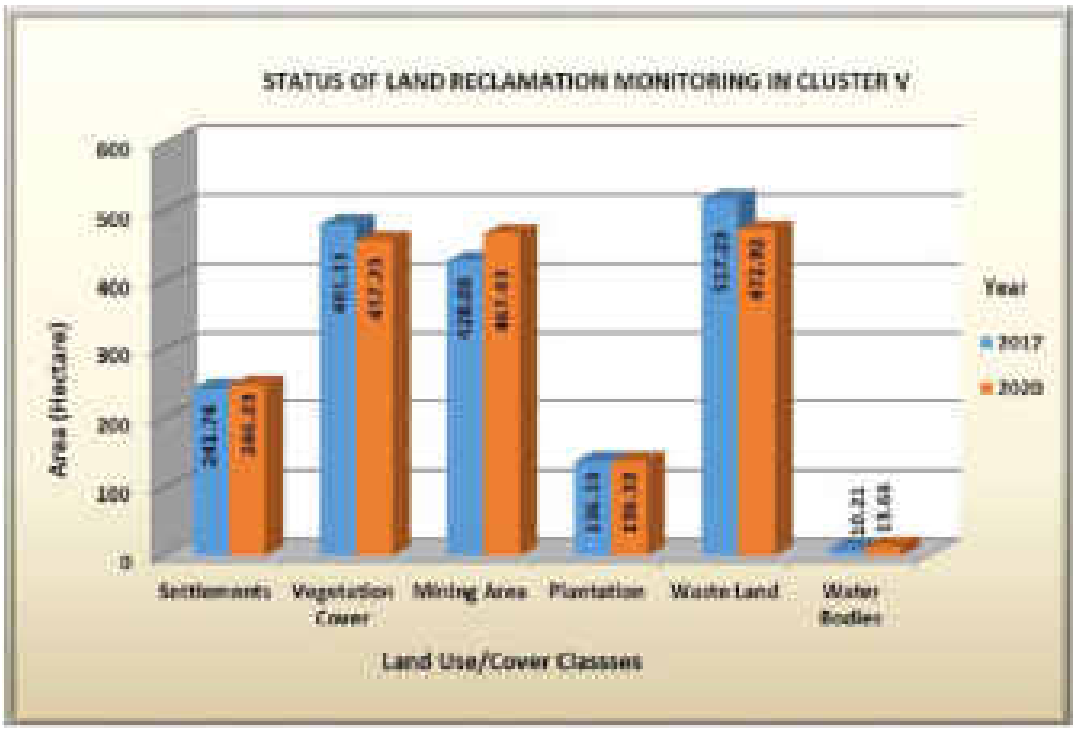



**Fig. 4: Land Reclamation Status of Cluster V**

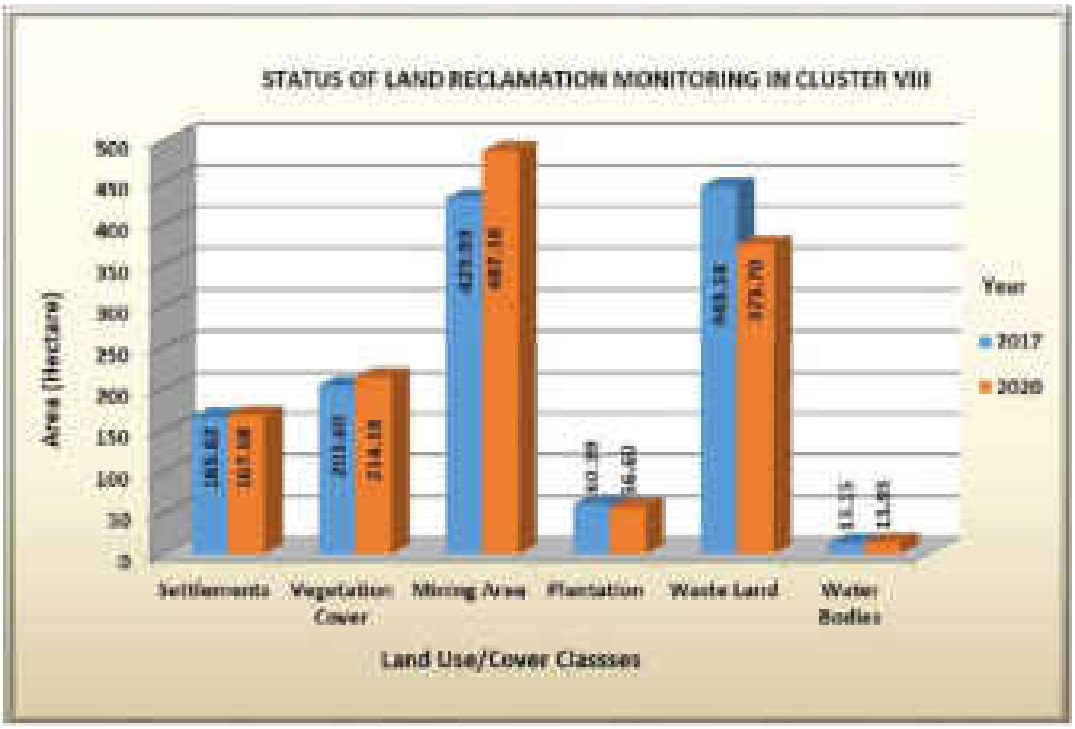



**Fig. 5: Land Reclamation Status of Cluster VIII**

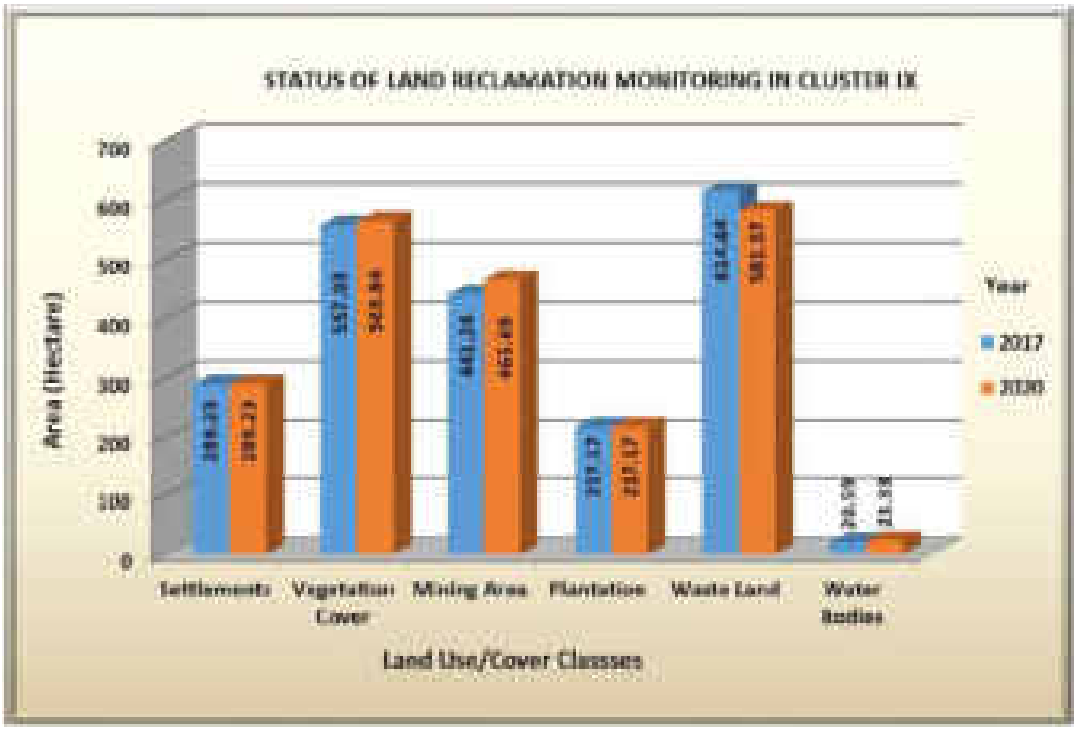



**Fig. 6: Land Reclamation Status of Cluster IX**

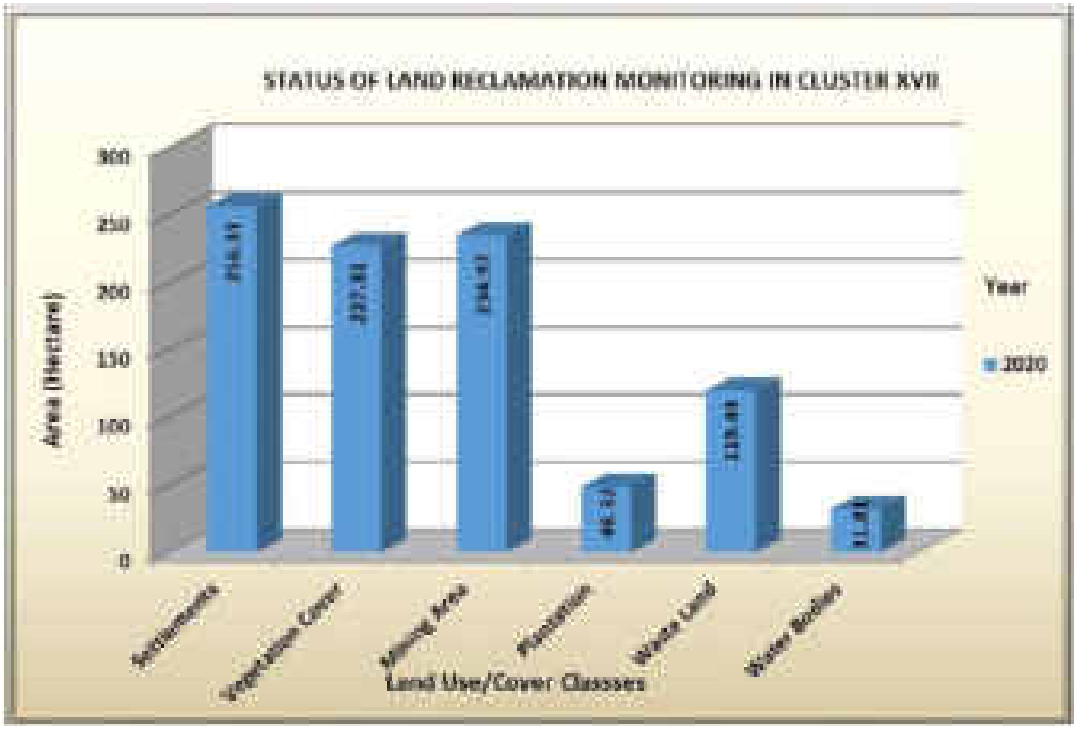



**Fig. 7: Land Reclamation Status of Cluster XVII**

**Photo 1: Plantation on OB dump, Cluster III**

**Photo 2: Eco Restoration Site, Cluster V**

**Photo 3: Plantation on OB Dump, Cluster V**

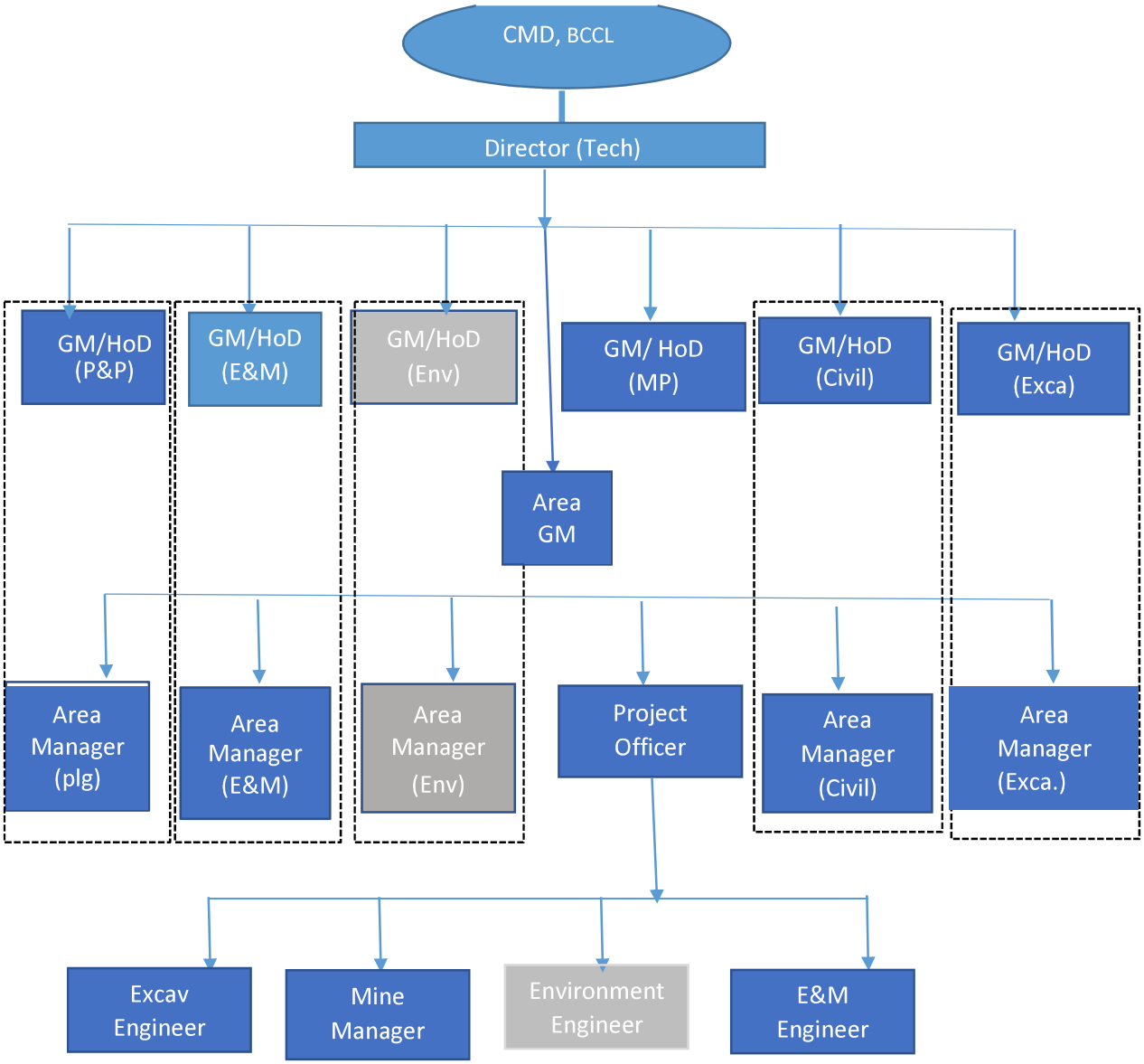
**Photo 4: Plantation on OB Dump, Cluster VIII**

**Photo 5: Gokul Eco Cultural Park, Cluster IX**

**Photo 6: Plantation in Cluster XVII**

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
Wesite : www.cmpdi.co.in, Email : cmpdihq@cmpdi.co.in

**Annexure XXIV**



**Annexure XXV**

ANNEXURE-A

**Letter by Under Secretary Coal regarding quarterly basis monitoring of safety, Environment and Quality of coal in Board Meetings**

No. 23/3/ 2015 ASD/BA
Government of India
Ministry of Coal
******

New Delhi, 26th April, 2017

To

**CMDs of Coal India Limited/ NLC India Limited & all Subsidiaries.**

Subject: Quarterly review in the Board Meetings – Safety, Environment & Quality.

Sir,

Ministry of Coal has identified four thrust areas – Safety, Environment, Quality & New Technologies. It is necessary that these areas are incorporated in the functioning of the coal companies and monitored at the Board level.

2. It has therefore been decided that agenda items on the performance of the concerned company on each of the three aspects, viz Safety, Environment and Quality of Coal shall be placed in the Board meeting, thoroughly discussed and monitored by the Board on quarterly basis along with quarterly accounts.

3. The agenda item on safety shall include the implementation and effectiveness of all safety related aspects / mechanism required as per law and directions of Ministry/ CIL. Similarly, the agenda item on environment shall consist of the compliance with regard to the conditions of environment clearance, forest clearance, water and air pollution norms, requirements of mining plan, mining closure plan and reclamation of mined out areas as well as utilization of mined water. The quality aspect would include proper siting of coal & adherence to supply of declared grade of coal and elimination of grade slippage, etc.

4. Concerned Director (Technical) in the Company would be responsible to ensure the compliance to safety, environment and quality related aspects in the company. The Govt. nominee Director on the Board of the company is requested to see that the agenda items on these aspects are comprehensive and guide the discussion to ensure effective monitoring by the board.

You are requested to ensure compliance of these instructions.

Yours faithfully,

(Sanjib Bhattacharya)
Under Secretary to the Government of India

Copy to all Govt. nominee Directors of each company.

CS Scanned with CamScanner

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 – IX

**(FOR THE MONTH AUGUST 2025)**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

# CONTENTS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| 4. | CHAPTER-IV | STANDARDS AND PLANS | 20-21 |

# 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 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 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 analysed 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 Mines were 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-IX is in the Eastern part of the Jharia coalfield. It includes a group of 6 Mines (viz. Lodna UG, Bagdigi UG, Joyrampur UG, Bararee UG, Jealgora UG, NT/ST Expan. OCP. The Cluster – IX is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – IX are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage pattern of the area is governed by Kashi Jore.

1.2 The Cluster-IX is designed to produce 6.548 MTPA (normative) and 8.512 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forest and Climate Change (MoEF&CC) for a rated capacity 6.548 MTPA (normative) and 8.512 MTPA (peak) capacity of coal production vide letter no. J-11015/307/2010-IA.II (M) dated 1st March, 2018.

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) Jeenagora (A13) : Industrial Area**

The location of the sampling station is 23° 42' 31.00" N & 86° 25' 48.00" E. The sampler was placed at a height of 1.5 m from the ground level at the Safety Office.

#### II. BUFFER ZONE Monitoring Location

**i) Kusmatand Village (A12): Industrial Area**

The location of the sampling station is 23°45' 4.65" N & 86° 26' 42.10" E. The sampler was placed at a height of 1.5 m from the ground level of the village.

**ii) 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 1.5 m above the ground level of Project Office.

**Iii) Hurriladih UGP (A28) : Industrial Area**

The location of the sampling station is 23°44' 4.18" N & 86° 24' 6.21" E. The sampler was placed at a height of 1.5 m from the ground level of the mine office.

# AMBIENT AIR QUALITY DATA

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 08/2025 | **Cluster** | **Cluster IX** | **ULR No.** | TC143211500000200 4F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 05.09.2025 |
| **Project** | Jeenagora | **Sample Ref. No.** | REM/BCCL/2025/08 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 11.08.25 | 29.08.25 | **Period of Analysis** | 11.08.25 to 02.09.2025 | **Zone of Station:** Core Zone |

| **Sl. No.** | **Parameter** | **Method of Analysis** | **Observed Values ( in µg/m³)** A4373 | A4470 | **Range Of Testing** | **L.D.L** | **MoEF Standards Notification dated 25th September,2000 (GSR 742 E )** | **NAAQS, 2009** |
|---|---|---|---|---|---|---|---|---|
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 72 | 74 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 34 | 31 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 28 | 31 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

** LDL Indicates Lower Detection Limit,*

***All units are in µg/m3, 24 hourly Average.*

*ANALYSED BY*

(Gaurav Kant)
*REVIEWED BY*

(Kumar Vaibhav)
***Authorised Signatory***

***Note:*** *The results above relate to the samples tested as received. This report cannot be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*-- End of Report --*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdrl2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 08/2025 | **Cluster** | | **ULR No.** | TC143212500000 2004F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 05.09.2025 |
| **Project** | Kusmatand Village | **Sample Ref. No.** | REM/BCCL/2025/08 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 07.08.25 | 29.08.25 | **Period of Analysis** | 07.08.2025 to 02.09.2025 | **Zone of Station:** Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) A4356 | Observed Values ( in µg/m³) A4471 | Range Of .Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 68 | 70 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 30 | 35 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 25 | 26 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

** LDL indicates Lower Detection Limit,*

***All units are in µg/m3, 24 hourly Average,*

***ANALYSED BY*** (Gaurav Kant) ***REVIEWED BY*** (Kumar Vaibhav) ***Authorised Signatory***

***Note:*** *The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

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Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 08/2025 | **Cluster** | **Cluster X** | **ULR No.** | TC143212500000020004F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 05.09.2025 |
| **Project** | Bhowrah North | **Sample Ref. No.** | REM/BCCL/2025/08 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 11.08.25 | 20.08.25 | **Period of Analysis** | 11.08.2025 to 02.09.2025 | **Zone of Station:** Bufer Zone |

| SL No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) A4372 | Observed Values ( in µg/m³) A4410 | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 67 | 74 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS-5182(Part 24):2019 | 29 | 34 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 34 | 32 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

*ANALYSED BY*

(Gaurav Kant)
*REVIEWED BY*

[ Kumar Vaibhav ]
*Authorised Signatory*

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdrl2cmpdi@coalindia.in

## Test Report for Ambient Air Samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 08/2025 | Cluster | Cluster IX | | | ULR No. | TC143212500000200 4F |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 05.09.2025 |
| Project | Hurriladih UGP | | Sample Ref. No. | REM/BCCL/2025/08 | Sampling Method | CMPDI/RI-II/LPM 11 , ( IS 5182) | |
| Date of Sampling | 08.08.25 | | 21.08.25 | Period of Analysis | 08.08.2025 to 02.09.2025 | Zone of Station: | Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) | | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| | | | A4364 | A4417 | | | | |
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 83 | 83 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 36 | 36 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 34 | 31 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

*ANALYSED BY*

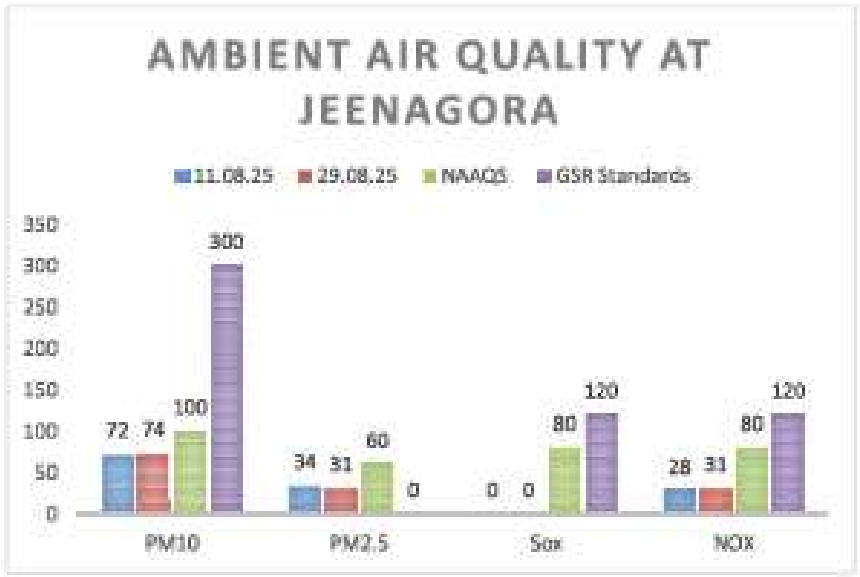
(Gaurav Kant)
*REVIEWED BY*

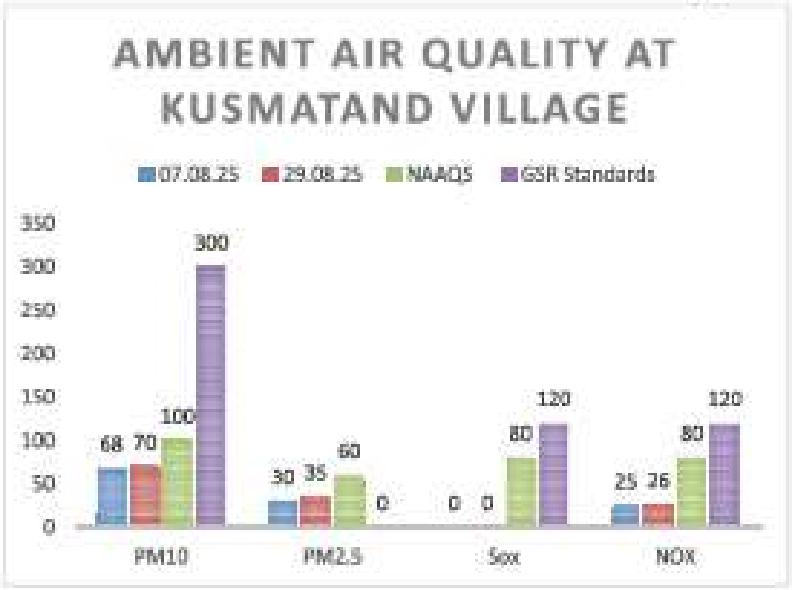
(Kumar Vaibhav)
*Authorised Signatory*

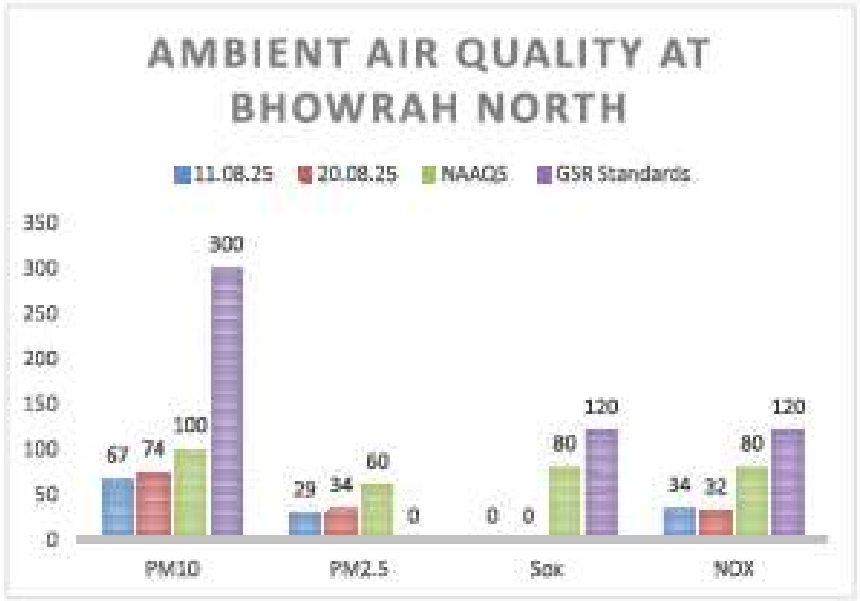
***Note:*** *The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

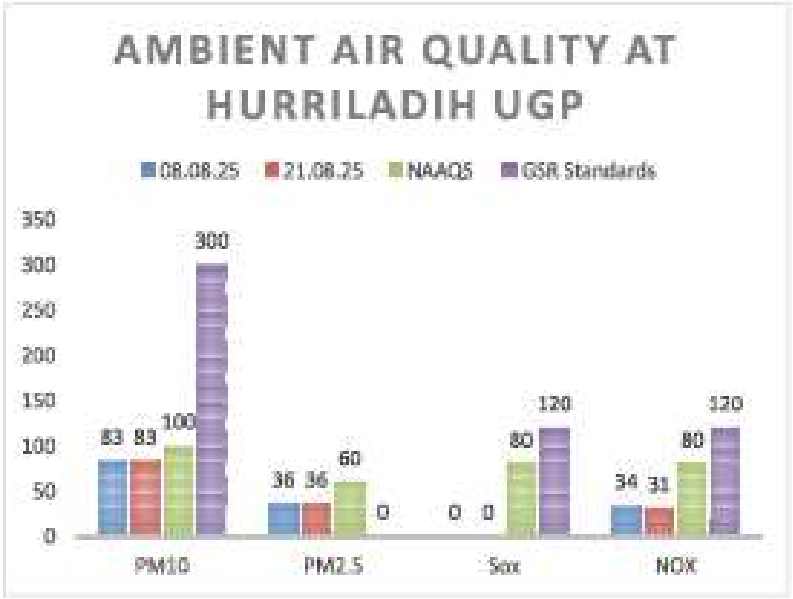
*---- End of Report ----*

*Page -1 of 1*


AMBIENT AIR QUALITY AT JEENAGORA
11.08.25
29.08.25
NAAQS
GSR Standards
350
300
250
200
150
100
50
0
72 74 100 300
34 31 60 0
0 0 80 120
28 31 80 120
PM10
PM2.5
Sox
NOX


AMBIENT AIR QUALITY AT KUSMATAND VILLAGE
07.08.25
29.08.25
NAAQS
GSR Standards
350
300
250
200
150
100
50
0
68 70 100 300
30 35 60 0
0 0 80 120
25 26 80 120
PM10
PM2.5
Sox
NOX


AMBIENT AIR QUALITY AT BHOWRAH NORTH
11.08.25
20.08.25
NAAQS
GSR Standards
350
300
250
200
150
100
50
0
67 74 100 300
29 34 60 0
0 0 80 120
34 32 80 120
PM10
PM2.5
Sox
NOX


AMBIENT AIR QUALITY AT HURRILADIH UGP
08.08.25
21.08.25
NAAQS
GSR Standards
350
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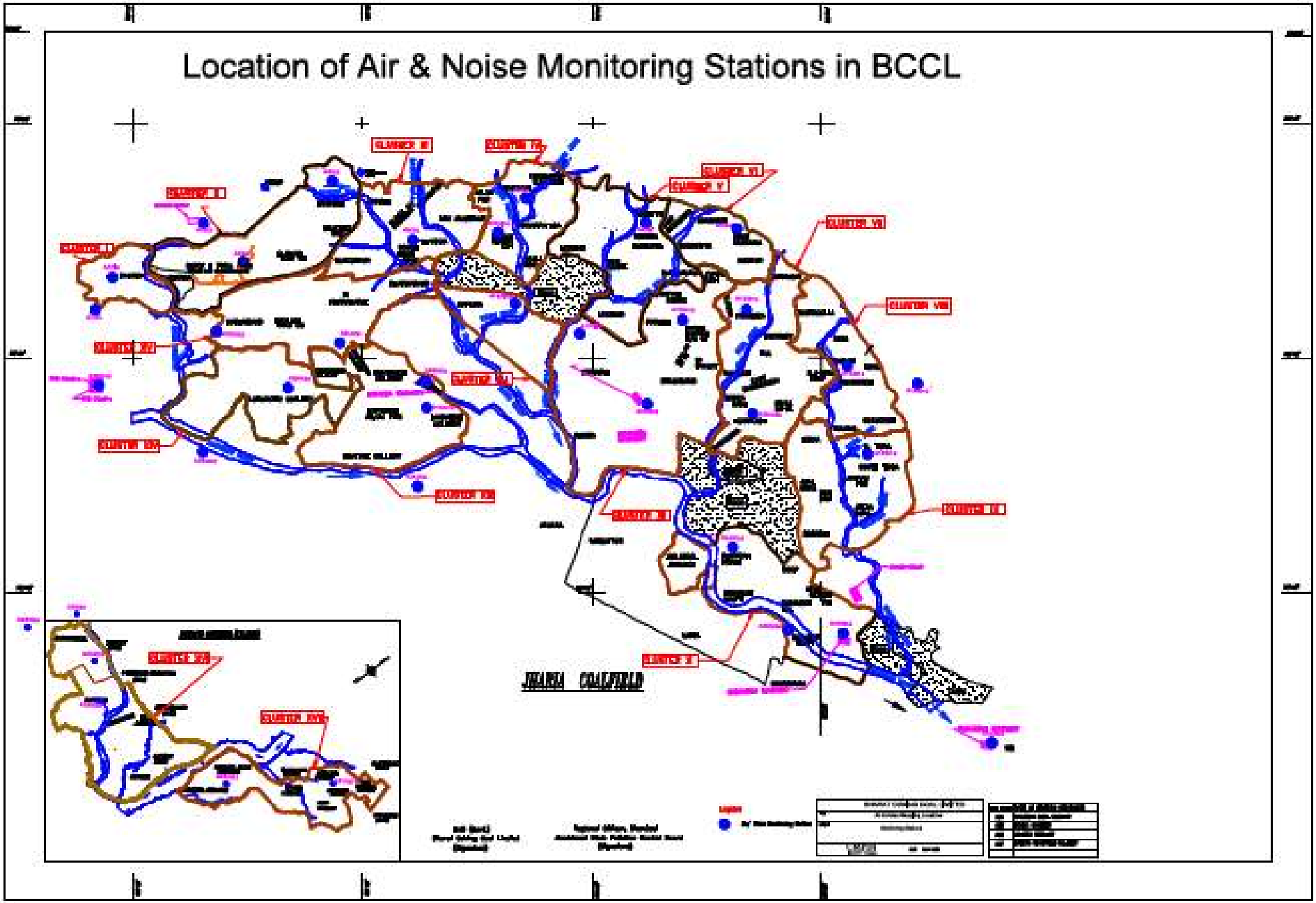
Location of Air & Noise Monitoring Stations in BCCL
JHARIA COALFIELD

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# ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER – IX

**(FOR THE MONTH JULY 2025)**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

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| 4. | CHAPTER-IV | STANDARDS AND PLANS | 20-21 |

# 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 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 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 analysed 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 Mines were 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-IX is in the Eastern part of the Jharia coalfield. It includes a group of 6 Mines (viz. Lodna UG, Bagdigi UG, Joyrampur UG, Bararee UG, Jealgora UG, NT/ST Expan. OCP. The Cluster – IX is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – IX are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage pattern of the area is governed by Kashi Jore.

1.2 The Cluster-IX is designed to produce 6.548 MTPA (normative) and 8.512 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forest and Climate Change (MoEF&CC) for a rated capacity 6.548 MTPA (normative) and 8.512 MTPA (peak) capacity of coal production vide letter no. J-11015/307/2010-IA.II (M) dated 1st March, 2018.

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) Jeenagora (A13) : Industrial Area**

The location of the sampling station is 23° 42' 31.00" N & 86° 25' 48.00" E. The sampler was placed at a height of 1.5 m from the ground level at the Safety Office.

#### II. BUFFER ZONE Monitoring Location

**i) Kusmatand Village (A12): Industrial Area**

The location of the sampling station is 23°45' 4.65" N & 86° 26' 42.10" E. The sampler was placed at a height of 1.5 m from the ground level of the village.

**ii) 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 1.5 m above the ground level of Project Office.

**Iii) Hurriladih UGP (A28) : Industrial Area**

The location of the sampling station is 23°44' 4.18" N & 86° 24' 6.21" E. The sampler was placed at a height of 1.5 m from the ground level of the mine office.

# AMBIENT AIR QUALITY DATA

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 07/2025 | **Cluster** | **Cluster IX** | **ULR No.** | TC143211250000001952F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 21.08.2025 |
| **Project** | Jeenagora | **Sample Ref. No.** | REM/BCCL/2025/07 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 14.07.25 | 22.07.25 | **Period of Analysis** | 14.07.2025 to 20.08.2025 | **Zone of Station:** Core Zone |

| SL No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) A4079 | Observed Values ( in µg/m³) A4157 | Range Of Testing | L.D.L. | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 75 | 71 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 35 | 32 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 29 | 31 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

** LDL Indicates Lower Detection Limit,*

***All units are in µg/m3, 24 hourly Average.*

*ANALYSED BY*

(Gaurav Kant)
*REVIEWED BY*

(Amit Raj Mishra)
*Authorised Signatory*

***Note:*** *The results above relate to the samples tested as received. This report cannot be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*--- End of Report ---*

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Annexure XXVI

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD, -826005
Phone:0326-223-850
email: rdrl2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 07/2025 | **Cluster** | | **ULR No.** | TC143212500001952F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 21.08.2025 |
| **Project** | Kusmatand Village | **Sample Ref. No.** | REM/BCCL/2025/07 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 14.07.25 | 22.07.25 | **Period of Analysis** | 14.07.25 to 20.08.2025 | **Zone of Station:** Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) | | Range Of .Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| | | | A4042 | A4120 | | | | |
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 65 | 72 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 35 | 37 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 25 | 26 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

** LDL indicates Lower Detection Limit,*

***All units are in µg/m3, 24 hourly Average,*

***ANALYSED BY***

(Gaurav Kant)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

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*---- End of Report ----*

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 07/2025 | **Cluster** | **Cluster X** | **ULR No.** | TC143212500001952F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 21.08.0=25 |
| **Project** | Bhowrah North | **Sample Ref. No.** | REM/BCCL/2025/07 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 08.07.2025 | 22.07.2025 | **Period of Analysis** | 08.07.2025 to 20.08.2025 | **Zone of Station:** Bufer Zone |

| SL No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) A4062 | Observed Values ( in µg/m³) A4140 | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| 1 | $PM_{10}$ | IS -5182[Part 23]:2006, R-2017 | 60 | 71 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS-5182(Part 24):2019 | 27 | 31 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | 10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 34 | 32 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

*ANALYSED BY*

(Gaurav Kant)
*REVIEWED BY*

(Amit Raj Mishra)
*Authorised Signatory*

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*---- End of Report ----*

*Page -1 of 1*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdrl2cmpdi@coalindia.in

## Test Report for Ambient Air Samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 07/2025 | Cluster | Cluster IX | | | ULR No. | TC143212500001952F |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 21.08.2025 |
| Project | Hurriladih UGP | Sample Ref. No. | REM/BCCL/2025/07 | Sampling Method | | CMPDI/RI-II/LPM 11 , ( IS 5182) | |
| Date of Sampling | 14.07.25 | 25.07.25 | Period of Analysis | 14.07.2025 to 20.08.25 | | Zone of Station: | Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) | | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| | | | A4063 | A4141 | | | | |
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 83 | 81 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 37 | 33 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 36 | 31 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

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REVIEWED BY

(Amit Raj Mishra)
Authorised Signatory

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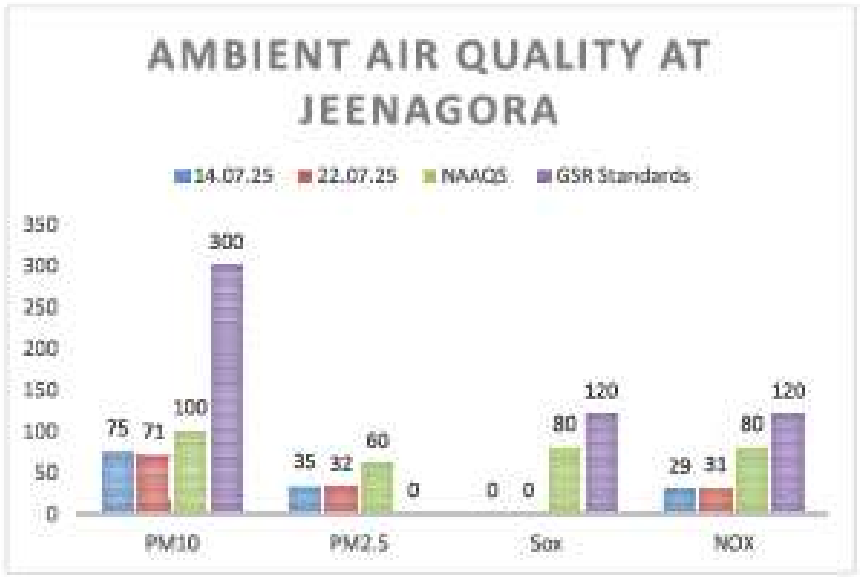
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14.07.25
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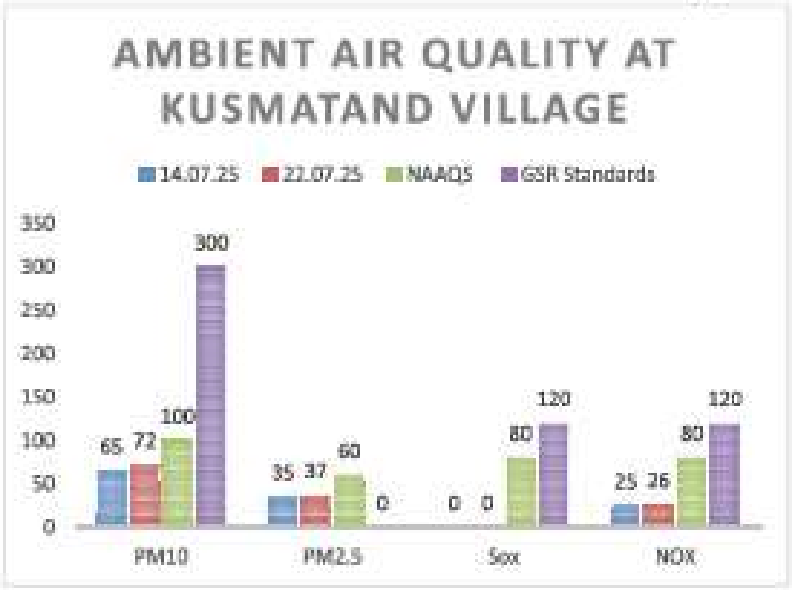
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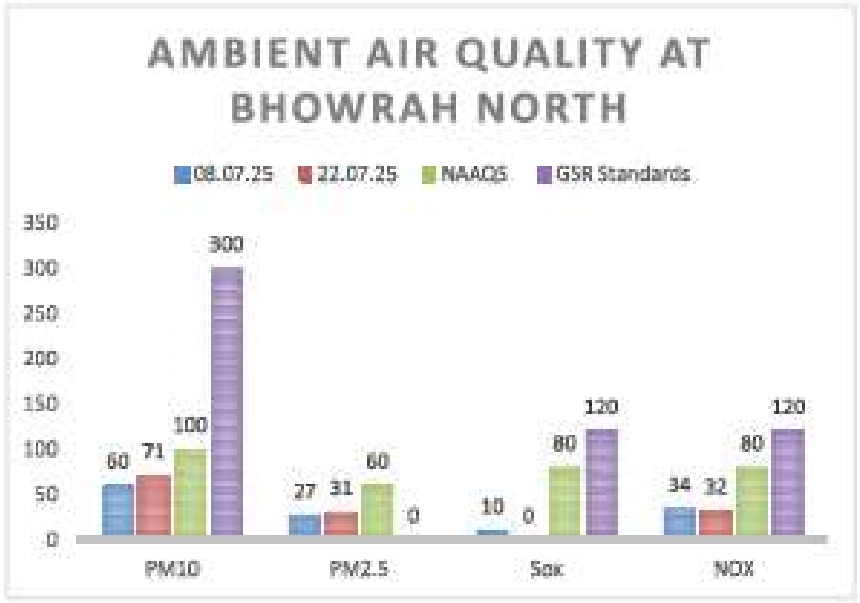
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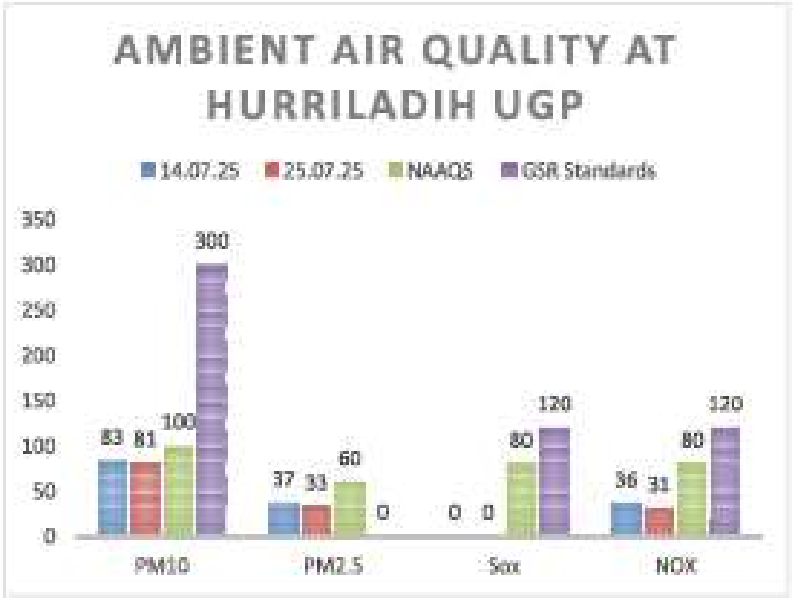
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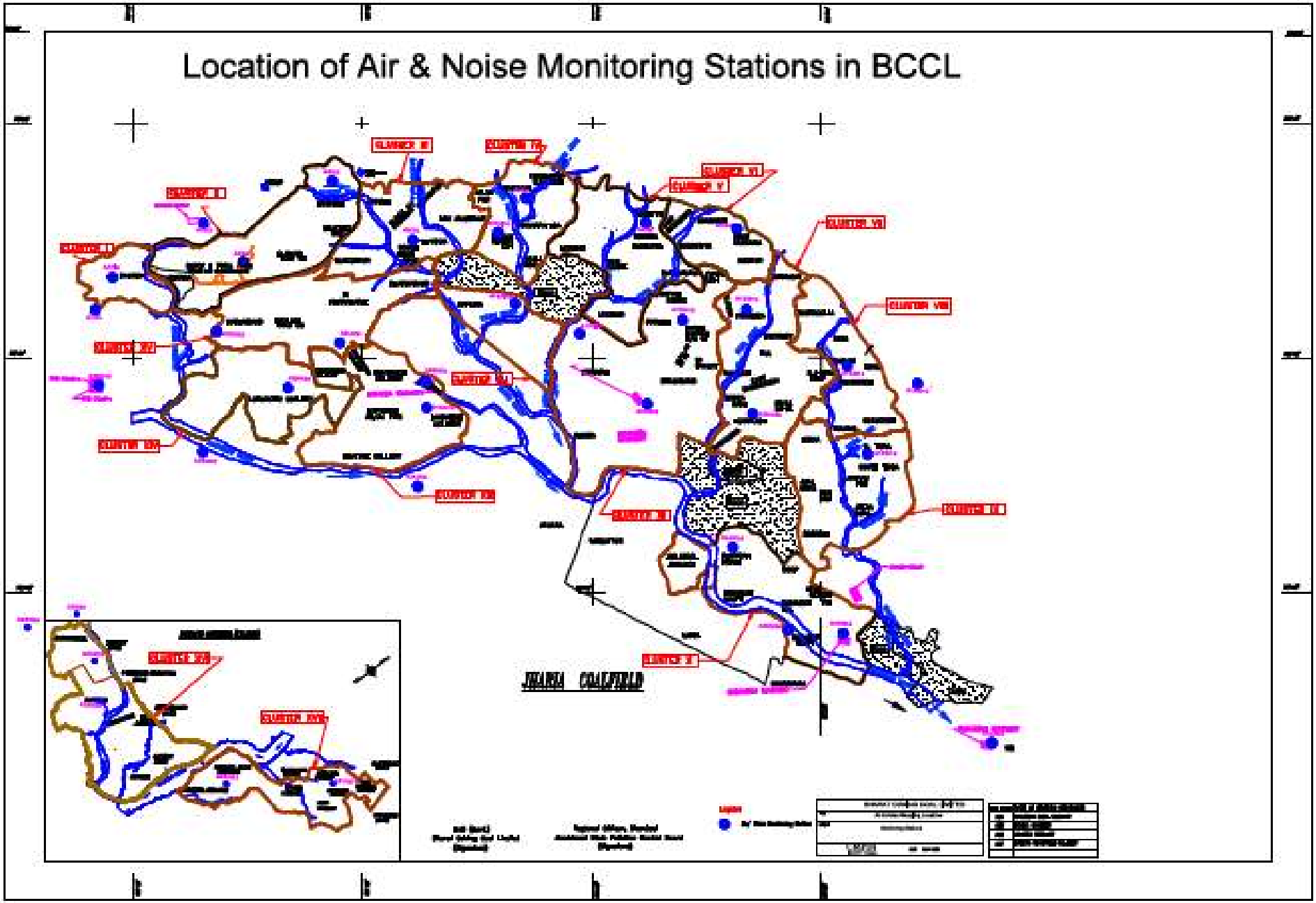
Location of Air & Noise Monitoring Stations in BCCL
JHARIA COALFIELD

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# ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER – IX

**(FOR THE MONTH JUNE, 2025)**

**E. C. no. J-11015/307/2010-IA.II (M) dated 01.03.2018**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

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# 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 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 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 analysed 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 Mines were 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-IX is in the Eastern part of the Jharia coalfield. It includes a group of 6 Mines (viz. Lodna UG, Bagdigi UG, Joyrampur UG, Bararee UG, Jealgora UG, NT/ST Expan. OCP. The Cluster – IX is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – IX are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage pattern of the area is governed by Kashi Jore.

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The Project has Environmental Clearance from Ministry of Environment, Forest and Climate Change (MoEF&CC) for a rated capacity 6.548 MTPA (normative) and 8.512 MTPA (peak) capacity of coal production vide letter no. J-11015/307/2010-IA.II (M) dated 1st March, 2018.

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) Jeenagora (A13) : Industrial Area**

The location of the sampling station is 23° 42' 31.00" N & 86° 25' 48.00" E. The sampler was placed at a height of 1.5 m from the ground level at the Safety Office.

#### II. BUFFER ZONE Monitoring Location

**i) Kusmatand Village (A12): Industrial Area**

The location of the sampling station is 23°45' 4.65" N & 86° 26' 42.10" E. The sampler was placed at a height of 1.5 m from the ground level of the village.

**ii) 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 1.5 m above the ground level of Project Office.

**Iii) Hurriladih UGP (A28) : Industrial Area**

The location of the sampling station is 23°44' 4.18" N & 86° 24' 6.21" E. The sampler was placed at a height of 1.5 m from the ground level of the mine office.

# AMBIENT AIR QUALITY DATA

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 06/2025 | **Cluster** | Cluster IX | **ULR No.** | TC143211250000001898F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 11.08.2025 |
| **Project** | Jeenagora | **Sample Ref. No.** | REM/BCCL/2025/06 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 13.06.25 | 27.06.25 | **Period of Analysis** | 13.06.2025 TO 25.07.2025 | **Zone of Station:** Core Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) A4079 | Observed Values ( in µg/m³) A4157 | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 131 | 96 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 63 | 52 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 23 | 26 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

** LDL indicates Lower Detection Limit,*

***All units are in µg/m3, 24 hourly Average,*

***ANALYSED BY***

(Gaurav Kant)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

***Note:*** *The results above relate to the samples tested as received. This report cannot be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD, -826005
Phone:0326-223-850
email: rdrl2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 06/2025 | **Cluster** | | **ULR No.** | TC143212500001898F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 11.08.2025 |
| **Project** | Kusmatand Village | **Sample Ref. No.** | REM/BCCL/2025/06 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 06.06.25 | 20.06.25 | **Period of Analysis** | 06.06.2025 TO 25.07.2025 | **Zone of Station:** Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) A4042 | Observed Values ( in µg/m³) A4120 | Range Of .Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 74 | 80 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 37 | 42 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 22 | 34 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

** LDL indicates Lower Detection Limit,*

***All units are in µg/m3, 24 hourly Average,*

***ANALYSED BY***

(Gaurav Kant)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

***Note:*** *The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*

*Page -1 of 1*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 06/2025 | **Cluster** | **Cluster X** | **ULR No.** | TC143212500001898F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 11.08.2025 |
| **Project** | Bhowrah North | **Sample Ref. No.** | REM/BCCL/2025/06 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 11.06.25 | 25.06.25 | **Period of Analysis** | 11.06.2025 TO 25.07.2025 | **Zone of Station:** Buffer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) A4082 | Observed Values ( in µg/m³) A4140 | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 87 | 91 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS-5182(Part 24):2019 | 48 | 50 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 25 | 34 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

*ANALYSED BY*

(Gaurav Kant)
*REVIEWED BY*

(Amit Raj Mishra)
*Authorised Signatory*

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*---- End of Report ----*

*Page -1 of 1*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdrl2cmpdi@coalindia.in

## Test Report for Ambient Air Samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 06/2025 | Cluster | Cluster IX | | | ULR No. | TC143212500000189 8F |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 11.08.2025 |
| Project | Hurriladih UGP | | Sample Ref. No. | REM/BCCL/2025/06 | Sampling Method | CMPDI/RI-II/LPM 11 , ( IS 5182) | |
| Date of Sampling | 11.06.25 | | 25.06.25 | Period of Analysis | 11.06.2025 TO 25.07.2025 | Zone of Station: | Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) | | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| | | | A4083 | A4141 | | | | |
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 91 | 89 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 48 | 45 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | 12 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 31 | 25 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

*ANALYSED BY*

(Gaurav Kant)
*REVIEWED BY*

(Amit Raj Mishra)
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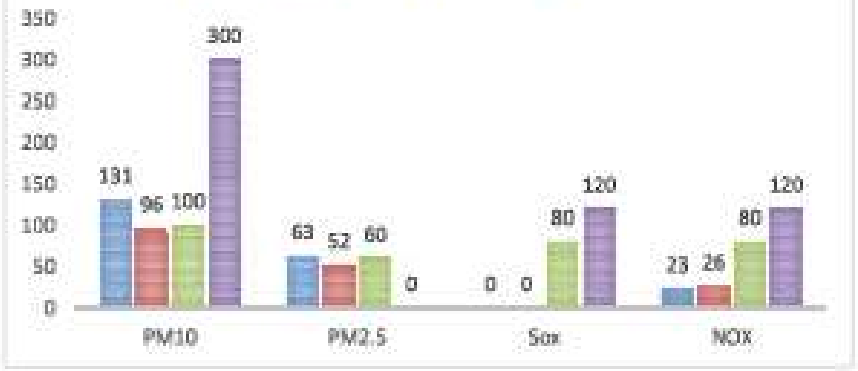
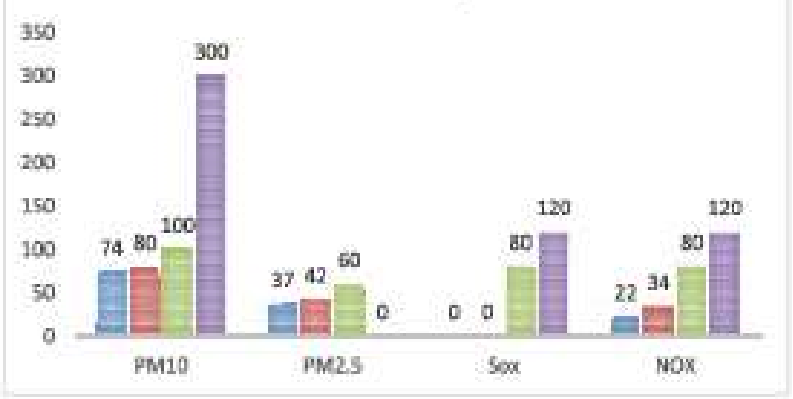
*---- End of Report ----*

*Page -1 of 1*

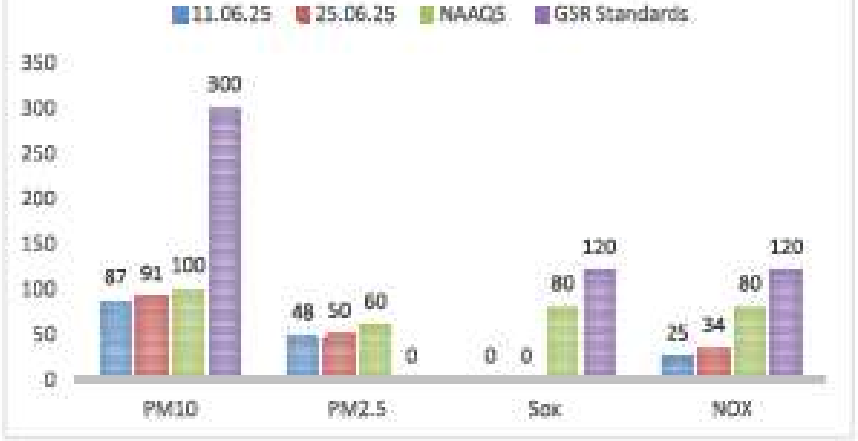
## AMBIENT AIR QUALITY AT JEENAGORA



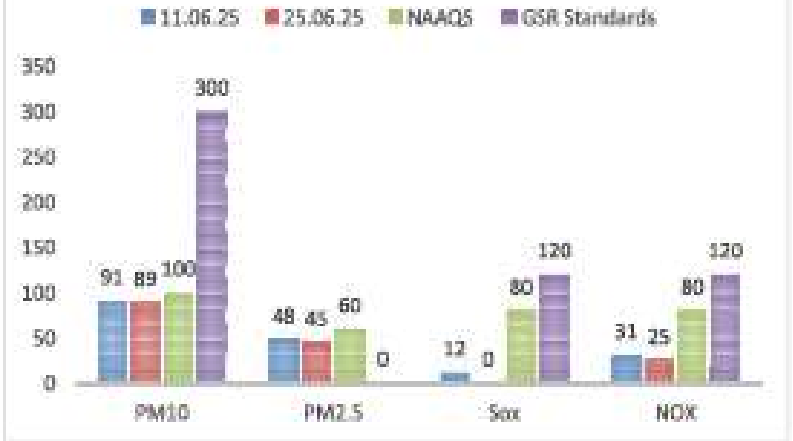

## AMBIENT AIR QUALITY AT KUSMATAND VILLAGE

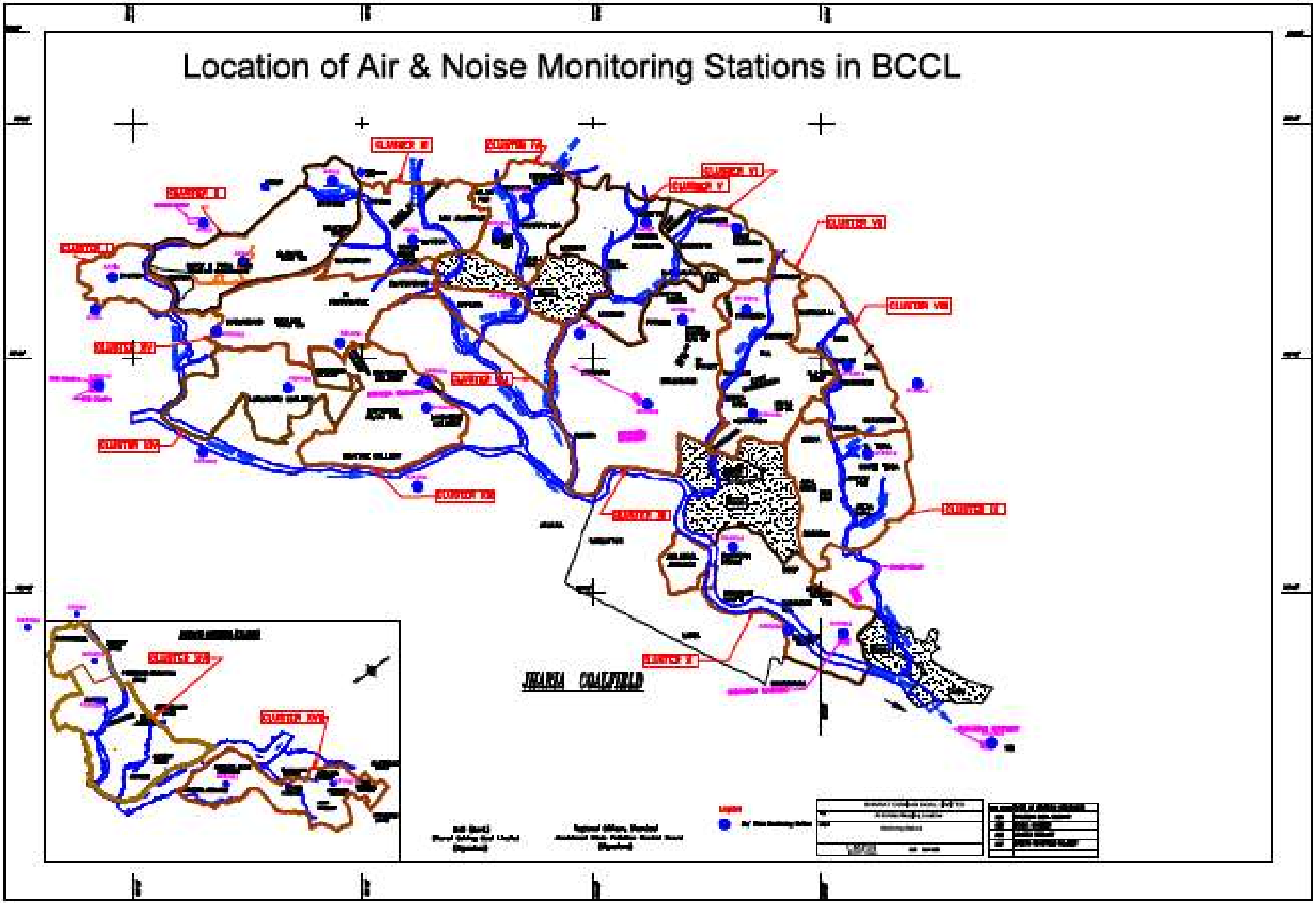



## AMBIENT AIR QUALITY AT BHOWRAH NORTH




## AMBIENT AIR QUALITY AT HURRILADIH UGP




Location of Air & Noise Monitoring Stations in BCCL
JHARIA COALFIELD

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 – IX

**(FOR THE MONTH MAY, 2025)**

**E. C. no. J-11015/307/2010-IA.II (M) dated 01.03.2018**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

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# 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 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 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 analysed 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.
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- 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 Mines were 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.

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The Project has Environmental Clearance from Ministry of Environment, Forest and Climate Change (MoEF&CC) for a rated capacity 6.548 MTPA (normative) and 8.512 MTPA (peak) capacity of coal production vide letter no. J-11015/307/2010-IA.II (M) dated 1st March, 2018.

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."

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The location of the sampling station is 23°45' 4.65" N & 86° 26' 42.10" E. The sampler was placed at a height of 1.5 m from the ground level of the village.

**ii) 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 1.5 m above the ground level of Project Office.

**Iii) Hurriladih UGP (A28) : Industrial Area**

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Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 05/2025 | **Cluster** | **Cluster IX** | **ULR No.** | TC143215000001844F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 24.06.2025 |
| **Project** | Jeenagora | **Sample Ref. No.** | REM/BCCL/2025/05 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 15.05.25 | 30.05.25 | **Period of Analysis** | 15.05.25 TO 20.06.2025 | **Zone of Station:** Core Zone |

| SL No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) | | Range Of Testing | L.D.L. | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| | | | A3926 | A4003 | | | | |
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 124 | 118 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 68 | 62 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | 11 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 26 | 28 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

** LDL indicates Lower Detection Limit.*

***All units are in µg/m3, 24 hourly Average.*

***ANALYSED BY*** (Gaurav Kant) ***REVIEWED BY*** [Amit Raj Mishra] ***Authorised Signatory***

***Note:*** *The results above relate to the samples tested as received. This report cannot be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*---- End of Report ----*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdrl2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 04/2025 | **Cluster** | | **ULR No.** | TC143212500001844F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 24.06.2025 |
| **Project** | Kusmatand Village | **Sample Ref. No.** | REM/BCCL/2025/04 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 15.05.25 | 30.05.25 | **Period of Analysis** | 15.05.25 TO | **Zone of Station:** Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) | | Range Of .Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| | | | A3925 | A4002 | | | | |
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 83 | 85 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 47 | 47 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | 10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 24 | 23 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

** LDL indicates Lower Detection Limit,*

***All units are in µg/m3, 24 hourly Average,*

***ANALYSED BY***

(Gaurav Kant)
***REVIEWED BY***

(Amit Raj Mishra)
***Authorised Signatory***

***Note:*** *The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 05/2025 | **Cluster** | **Cluster X** | **ULR No.** | TC143212500000184 4F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 24.06.2025 |
| **Project** | Bhowrah North | **Sample Ref. No.** | REM/BCCL/2025/05 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 06.05.25 | 22.05.25 | **Period of Analysis** | 06.06.25 TO 20.06.2025 | **Zone of Station:** Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) | | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| | | | A3870 | A3961 | | | | |
| 1 | $PM_{10}$ | IS -5182[Part 23]:2006, R-2017 | 125 | 116 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS-5182[Part 24]:2019 | 68 | 62 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | 11 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 32 | 30 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit.*

***ANALYSED BY*** (Gaurav Kant) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

*--- End of Report ---*

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdrl2cmpdi@coalindia.in

## Test Report for Ambient Air Samples

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 05/2025 | Cluster | Cluster IX | | | ULR No. | TC143212500001844F |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of Issue | 24.06.2025 |
| Project | Hurriladih UGP | Sample Ref. No. | REM/BCCL/2025/05 | Sampling Method | | CMPDI/RI-II/LPM 11 , ( IS 5182) | |
| Date of Sampling | 06.05.25 | 16.05.25 | Period of Analysis | 06.05.25 TO 20.06.2025 | | Zone of Station: | Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) | | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| | | | A3871 | A3933 | | | | |
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 94 | 89 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 50 | 47 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | 10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 31 | 33 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

*ANALYSED BY*

(Gaurav Kant)
*REVIEWED BY*

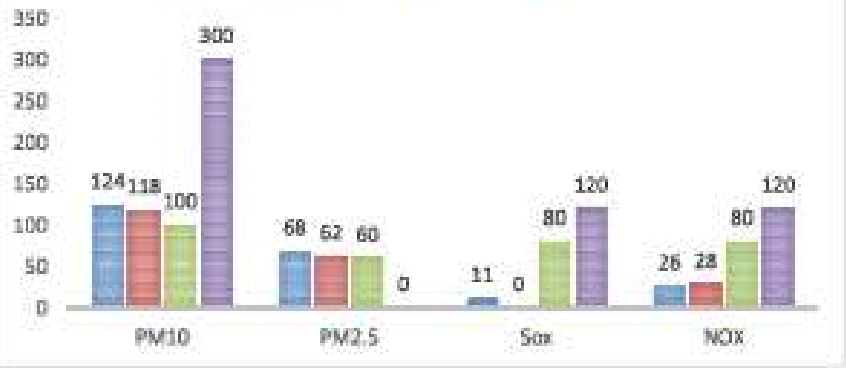
(Amit Raj Mishra)
*Authorised Signatory*

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.*

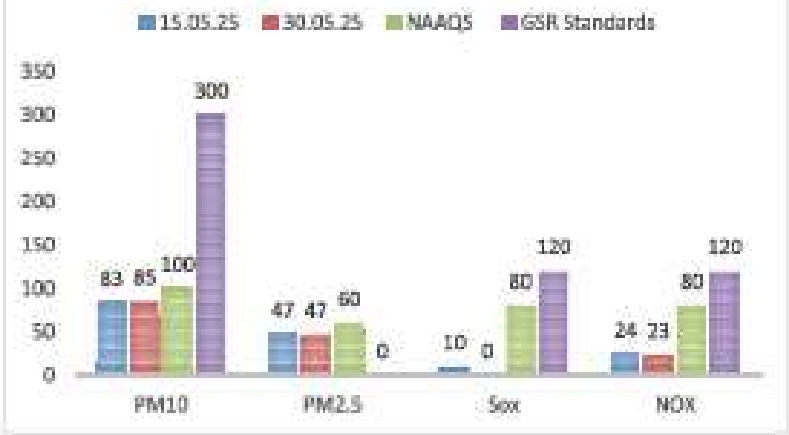
*---- End of Report ----*

*Page -1 of 1*

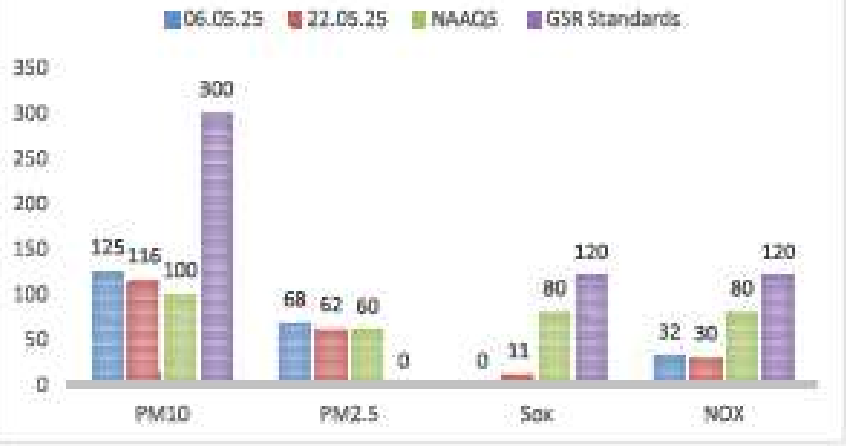
## AMBIENT AIR QUALITY AT JEENAGORA



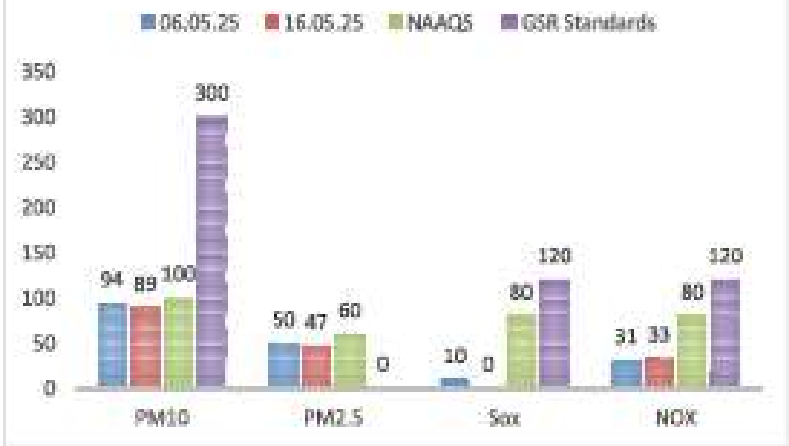

## AMBIENT AIR QUALITY AT KUSMATAND VILLAGE

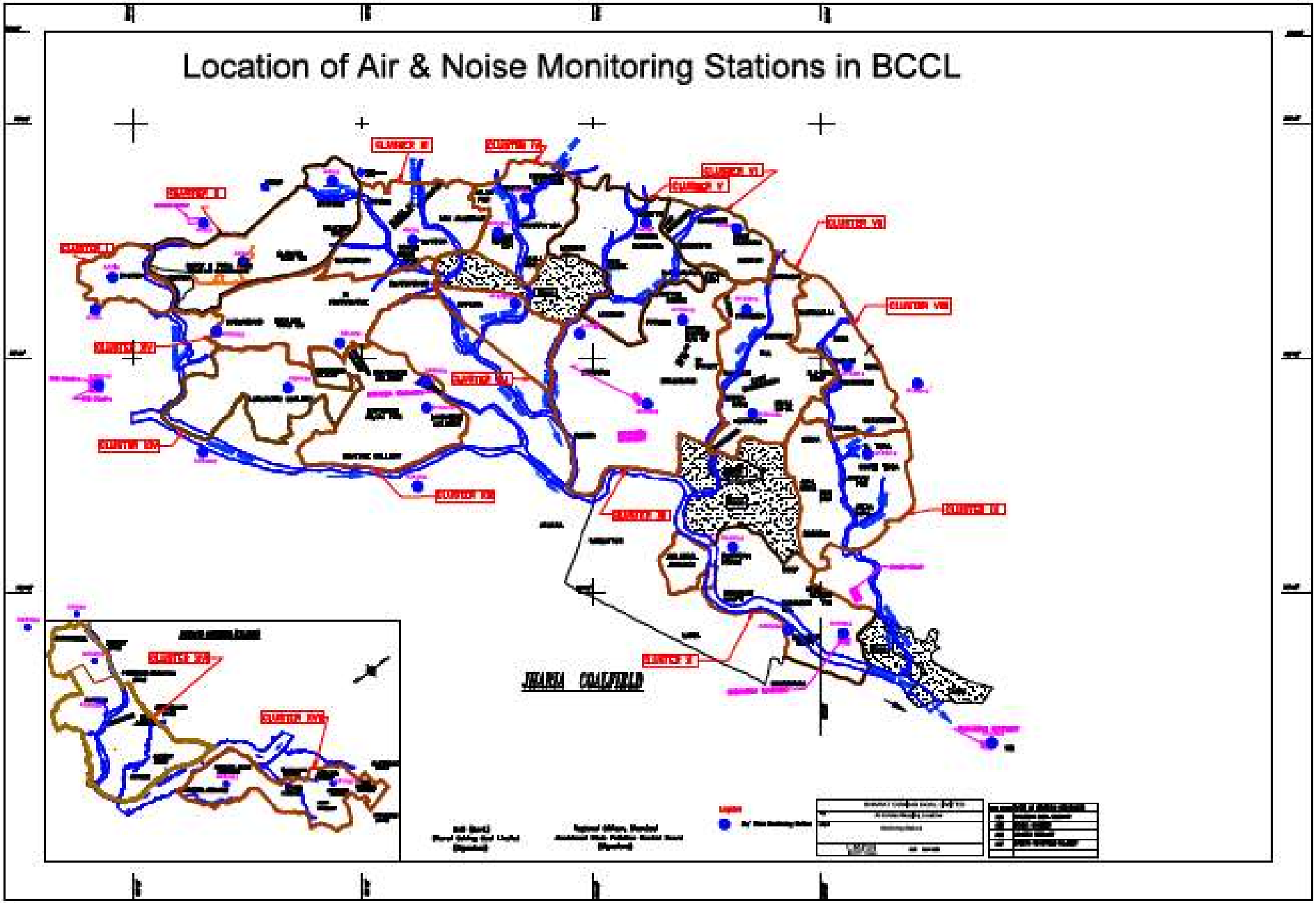



## AMBIENT AIR QUALITY AT BHOWRAH NORTH




## AMBIENT AIR QUALITY AT HURRILADIH UGP




Location of Air & Noise Monitoring Stations in BCCL
JHARIA COALFIELD

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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 – IX

**(FOR THE MONTH APRIL, 2025)**

**E. C. no. J-11015/307/2010-IA.II (M) dated 01.03.2018**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

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| 4. | CHAPTER-IV | STANDARDS AND PLANS | 20-21 |

# 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 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 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 analysed 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 Mines were 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-IX is in the Eastern part of the Jharia coalfield. It includes a group of 6 Mines (viz. Lodna UG, Bagdigi UG, Joyrampur UG, Bararee UG, Jealgora UG, NT/ST Expan. OCP. The Cluster – IX is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – IX are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage pattern of the area is governed by Kashi Jore.

1.2 The Cluster-IX is designed to produce 6.548 MTPA (normative) and 8.512 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forest and Climate Change (MoEF&CC) for a rated capacity 6.548 MTPA (normative) and 8.512 MTPA (peak) capacity of coal production vide letter no. J-11015/307/2010-IA.II (M) dated 1st March, 2018.

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) Jeenagora (A13) : Industrial Area**

The location of the sampling station is 23° 42' 31.00" N & 86° 25' 48.00" E. The sampler was placed at a height of 1.5 m from the ground level at the Safety Office.

#### II. BUFFER ZONE Monitoring Location

**i) Kusmatand Village (A12): Industrial Area**

The location of the sampling station is 23°45' 4.65" N & 86° 26' 42.10" E. The sampler was placed at a height of 1.5 m from the ground level of the village.

**ii) 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 1.5 m above the ground level of Project Office.

**Iii) Hurriladih UGP (A28) : Industrial Area**

The location of the sampling station is 23°44' 4.18" N & 86° 24' 6.21" E. The sampler was placed at a height of 1.5 m from the ground level of the mine office.

# AMBIENT AIR QUALITY DATA

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 04/2025 | **Cluster** | Cluster IX | **ULR No.** | TC143211250000001792F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 30.05.2025 |
| **Project** | Jeenagora | **Sample Ref. No.** | REM/BCCL/2025/04 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 15.04.25 | 25.04.25 | **Period of Analysis** | 15.04.25 to 26.05.2025 | **Zone of Station:** Core Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) 1st FN A3770 | Observed Values ( in µg/m³) 2nd FN A3828 | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 107 | 95 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 56 | 51 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 22 | 24 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

*ANALYSED BY*

(Gaurav Kant)
*REVIEWED BY*

(Amit Raj Mishra)
*Authorised Signatory*

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CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD, -826005
Phone:0326-223-850
email: rdrl2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 04/2025 | **Cluster** | | **ULR No.** | TC143212500001792F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 30.05.2025 |
| **Project** | Kusmatand Village | **Sample Ref. No.** | REM/BCCL/2025/04 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 15.04.25 | 26.04.25 | **Period of Analysis** | 15.04.25 to 25.05.2025 | **Zone of Station:** Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) 1st FN A3726 | Observed Values ( in µg/m³) 2nd FN A3803 | Range Of .Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 89 | 89 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 47 | 43 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | 10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 22 | 24 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

*ANALYSED BY*

(Gaurav Kant)
*REVIEWED BY*

(Amit Raj Mishra)
*Authorised Signatory*

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Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

**Test Report for Ambient Air Samples**

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 04/2025 | **Cluster** | **Cluster X** | **ULR No.** | TC143212500001792F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 30.05.2025 |
| **Project** | Bhowrah North | **Sample Ref. No.** | REM/BCCL/2025/04 | **Sampling Method** | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| **Date of Sampling** | 03.04.2025 | 18.04.2025 | **Period of Analysis** | 03.04.2025 to 25.05.2025 | **Zone of Station:** Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) | | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| | | | 1st FN A3708 | 2nd FN A3788 | | | | |
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 108 | 110 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS-5182(Part 24):2019 | 60 | 58 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | 11 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 33 | 29 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

ANALYSED BY

(Gaurav Kant)
REVIEWED BY

(Amit Raj Mishra)
Authorised Signatory

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## Test Report for Ambient Air Samples

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | 04/2025 | Cluster | Cluster IX | ULR No. | TC143212500001792F |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | Date of Issue | 30.05.2025 |
| Project | Hurriladih UGP | Sample Ref. No. | REM/BCCL/2025/04 | Sampling Method | CMPDI/RI-II/LPM 11 , ( IS 5182) |
| Date of Sampling | 03.04.2025 | 18.04.2025 | Period of Analysis | 03.04.2025 to 25.05.2025 | Zone of Station: Bufer Zone |

| Sl. No. | Parameter | Method of Analysis | Observed Values ( in µg/m³) | | Range Of Testing | LDL | MoEF Standards Notification dated 25th September,2000 (GSR 742 E ) | NAAQS, 2009 |
|---|---|---|---|---|---|---|---|---|
| | | | 1st FN A3709 | 2nd FN A3789 | | | | |
| 1 | $PM_{10}$ | IS -5182(Part 23):2006, R-2017 | 109 | 103 | 10 µg/m³ - 1000 µg/m³ | 10 µg/m³ | 300 | 100 |
| 2 | $PM_{2.5}$ | IS -5182(Part 24):2019 | 56 | 53 | 10 µg/m³ - 400 µg/m³ | 10 µg/m³ | Not Specified | 60 |
| 3 | $SO_2$ | IS-5182(Part-2): 2001 , R-2017 | <10 | <10 | 10 µg/m³ - 1050 µg/m³ | 10 µg/m³ | 120 | 80 |
| 4 | $NO_2$ | IS-5182 (Part-6): 2006 , R-2017 | 27 | 30 | 06 µg/m³ - 420 µg/m³ | 06 µg/m³ | 120 | 80 |

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

ANALYSED BY

(Gaurav Kant)
REVIEWED BY

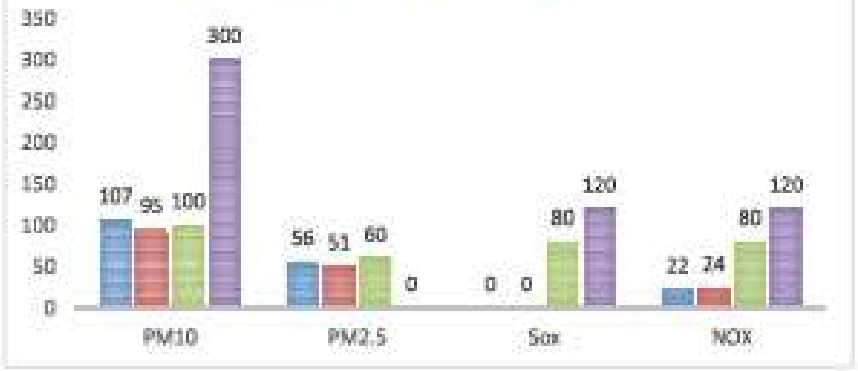
(Amit Raj Mishra)
Authorised Signatory

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.*

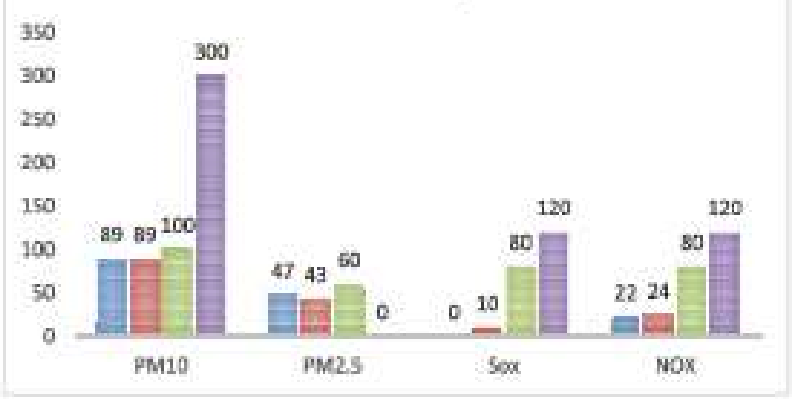
*---- End of Report ----*

*Page -1 of 1*

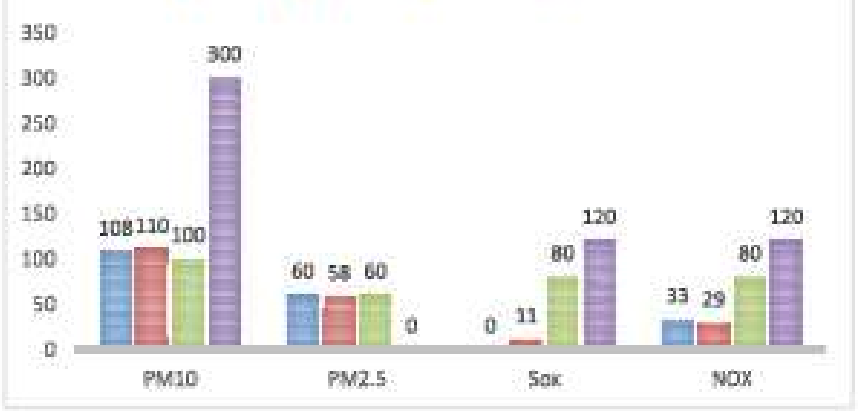
## AMBIENT AIR QUALITY AT JEENAGORA



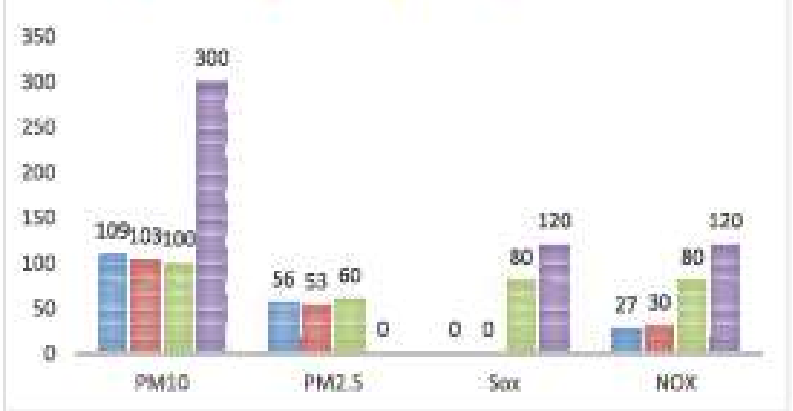

## AMBIENT AIR QUALITY AT KUSMATAND VILLAGE

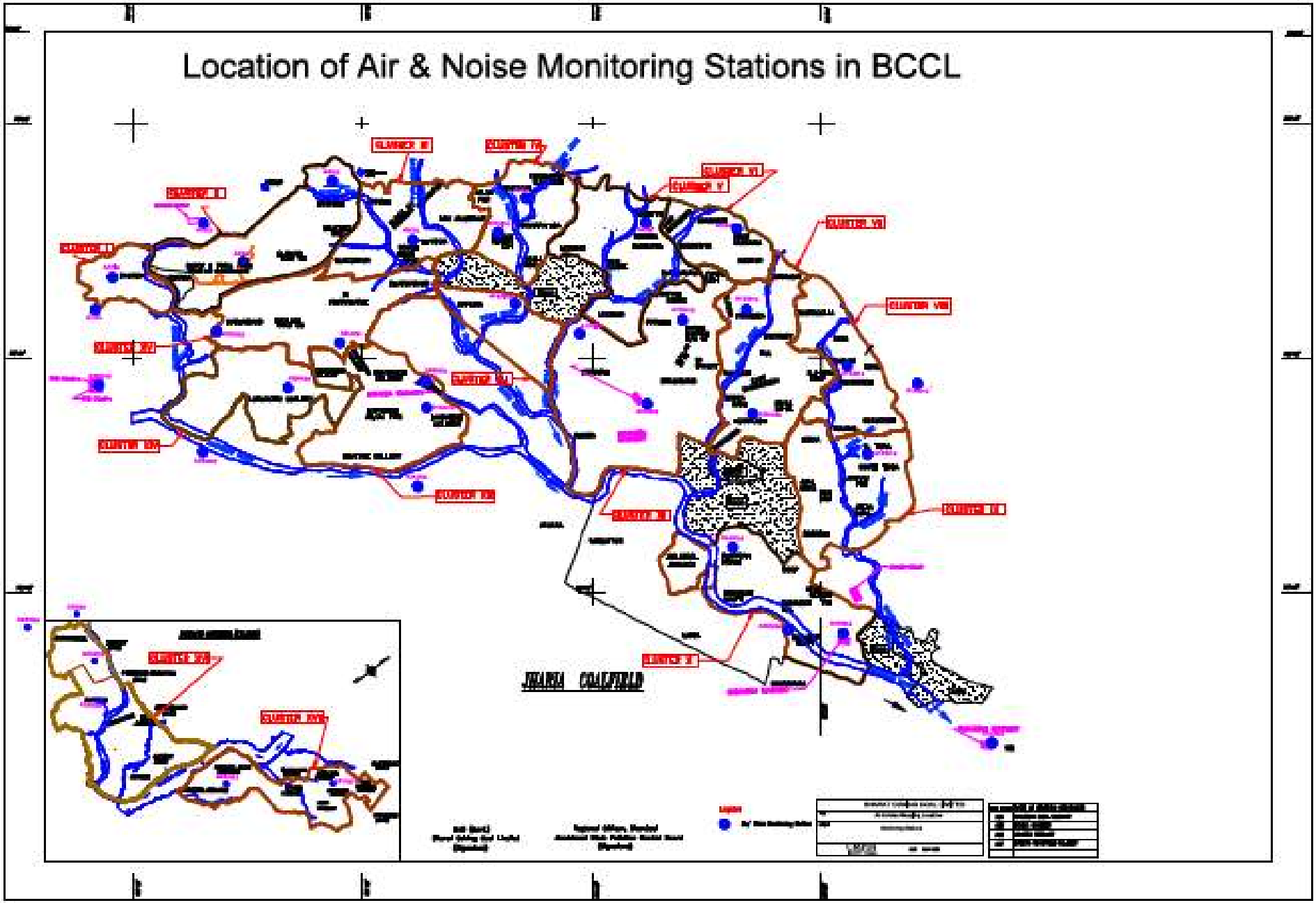



## AMBIENT AIR QUALITY AT BHOWRAH NORTH




## AMBIENT AIR QUALITY AT HURRILADIH UGP




Location of Air & Noise Monitoring Stations in BCCL
JHARIA COALFIELD

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 – IX

**(FOR THE MONTH AUGUST 2025)**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

# NOISE LEVEL QUALITY MONITORING

## 4.1 Location of sampling sites

1. **Jeenagora (N13)**
2. **Kusmatand Village (N12)**
3. **Bhowrah North (N14)**
4. **Hurriladih UGP (N28)**

## 4.2 Methodology of sampling and analysis

Noise level measurements in form of '$L_{EQ}$' were taken using Integrated Data Logging Sound Level Meter during day time & night time. Noise levels were measured for the complete day & night time, the Intergration time taken was one hour or 3600 seconds. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

## 4.3 Results & Interpretations

Ambient noise levels were recorded during day time & night time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day & night 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.

CMPDI, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-233-650
email: rdrl2cmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

## Environment Laboratory, Regional Institute-II

## Ambient Noise Level Test Report

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | 08/2025 | Cluster | Cluster IX | ULR No. | TC143212500000203BF |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | Date of Issue | 05.09.2025 |
| Project | | Sample Ref. No. | REM/BCCL/2025/08 | Sampling Method | CMPDI/RI-II/LPM 22 |
| Sampling Stations | 1 | Jeenagora | Date of Sampling | 11.08.25 / 29.08.25 | Zone Category of Station: Core Zone |

| Sl. No. | Parameter | Hour / Time of day | Observed Values (In Leq dB(A)) First Fortnight | Observed Values (In Leq dB(A)) Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards: Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A)Leq - Day | 06:00 - 07:00 | 50 | 47.1 | CPCB, Protocol for Ambient Level Noise Monitoring - 2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 75 |
| 2 | | 07:00 - 08:00 | 57.4 | 52.8 | | | | Commercial | 65 |
| 3 | | 08:00 - 09:00 | 58.6 | 55.9 | | | | Residential | 55 |
| 4 | | 09:00 - 10:00 | 58.9 | 53.8 | | | | Silence | 50 |
| 5 | | 10:00 - 11:00 | 58.1 | 56.6 | | | | | |
| 6 | | 11:00 - 12:00 | 56.8 | 55.5 | | | | | |
| 7 | | 12:00 - 13:00 | 62.2 | 61.5 | | | | | |
| 8 | | 13:00 - 14:00 | 55.8 | 54.5 | | | | | |
| 9 | | 14:00 - 15:00 | 50.1 | 51.6 | | | | | |
| 10 | | 15:00 - 16:00 | 42.6 | 42.1 | | | | | |
| 11 | | 16:00 - 17:00 | 56.8 | 55.3 | | | | | |
| 12 | | 17:00 - 18:00 | 48.4 | 48.4 | | | | | |
| 13 | | 18:00 - 19:00 | 45.6 | 44.9 | | | | | |
| 14 | | 19:00 - 20:00 | 42.8 | 43 | | | | | |
| 15 | | 20:00 - 21:00 | 38.7 | 38.6 | | | | | |
| 16 | | 21:00 - 22:00 | 39.2 | 39.7 | | | | | |
| | | Leq DAY | 55.9 | 53.9 | | | | | |
| 1 | Noise Level dB(A)Leq -Night | 22:00-23:01 | 39.7 | 40.7 | CPCB, Protocol for Ambient Level Noise Monitoring - 2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 70 |
| 2 | | 23:00-00:00 | 39.1 | 40.4 | | | | Commercial | 55 |
| 3 | | 00:00-01:00 | 38.5 | 40.2 | | | | Residential | 45 |
| 4 | | 01:00-02:00 | 38.4 | 39.3 | | | | Silence | 50 |
| 5 | | 02:00-03:00 | 38.4 | 39 | | | | | |
| 6 | | 03:00-04:00 | 40.1 | 38.4 | | | | | |
| 7 | | 04:00-05:00 | 40.9 | 41.2 | | | | | |
| 8 | | 05:00-06:01 | 42.1 | 41.5 | | | | | |
| | | Leq Night | 39.9 | 40.3 | | | | | |

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *L.D.L indicates Lower Detection Limit

| | | | |
|---|---|---|---|
| Sampling Assistants | [Gaurav Kant] | | (Kumar Vaibhav) |
| ANALYSED BY | REVIEWED BY | | Authorised Signatory |

Note: The results above relate to the samples tested or received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.

--- End of Report ---

Page 1 of 1

Annexure XXVII

CMPDI, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD, -826005
Phone:0326-229-850
email: rdii2cmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
## Environment Laboratory, Regional Institute-II
## Ambient Noise Level Test Report

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 08/2025 | **Cluster** | CLUSTER IX | **ULR No.** | TC143212500000203BF |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 05.09.2025 |
| **Project** | | **Sample Ref. No.** | REM/BCCL/2025/08 | **Sampling Method** | CMPDI/RI-II/LPM 22 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sampling Stations** | 1 | **Kusmatand Village** | **Date of Sampling** | 07.08.25 | 29.08.25 | **Zone Category of Station:** | | **Buffer Zone** |

| Sl. No. | Parameter | Hour / Time of day | Observed Values ( in Leq dB(A) ) First Fortnight | Observed Values ( in Leq dB(A) ) Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A)Leq - Day | 06:00 - 07:00 | 30.3 | 31.2 | CPCB, Protocol for Ambient Level Noise Monitoring- 2015 | 35 dB-135 dB | 35 dB(A) | Industrial<br>Commercial<br>Residential<br>Silence | 75<br>65<br>55<br>50 |
| 2 | | 07:00 - 08:00 | 33.2 | 33.6 | | | | | |
| 3 | | 08:00 - 09:00 | 33.2 | 33.7 | | | | | |
| 4 | | 09:00 - 10:00 | 38.3 | 38.2 | | | | | |
| 5 | | 10:00 - 11:00 | 39.1 | 39.5 | | | | | |
| 6 | | 11:00 - 12:00 | 38.6 | 38.8 | | | | | |
| 7 | | 12:00 - 13:00 | 40.9 | 39.1 | | | | | |
| 8 | | 13:00 - 14:00 | 41.2 | 39.7 | | | | | |
| 9 | | 14:00 - 15:00 | 43.4 | 43.3 | | | | | |
| 10 | | 15:00 - 16:00 | 44 | 44 | | | | | |
| 11 | | 16:00 - 17:00 | 39.1 | 38.7 | | | | | |
| 12 | | 17:00 - 18:00 | 39 | 38.7 | | | | | |
| 13 | | 18:00 - 19:00 | 39.2 | 39 | | | | | |
| 14 | | 19:00 - 20:00 | 32.8 | 30.9 | | | | | |
| 15 | | 20:00 - 21:00 | 30.7 | 30.9 | | | | | |
| 16 | | 21:00 - 22:00 | 29.9 | 29.8 | | | | | |
| | | **Leq DAY** | 58.7 | 58.4 | | | | | |
| 1 | Noise Level dB(A)Leq -Night | 22:00-23:00 | 29.2 | 29 | CPCB, Protocol for Ambient Level Noise Monitoring- 2015 | 35 dB-135 dB | 35 dB(A) | Industrial<br>Commercial<br>Residential<br>Silence | 70<br>55<br>45<br>50 |
| 2 | | 23:00- 00:00 | 27.6 | 27.5 | | | | | |
| 3 | | 00:00- 01:00 | 27.5 | 27.6 | | | | | |
| 4 | | 01:00-02:00 | 27.4 | 27.5 | | | | | |
| 5 | | 02:00-03:00 | 27.4 | 27.4 | | | | | |
| 6 | | 03:00-04:00 | 27.5 | 28 | | | | | |
| 7 | | 04:00-05:00 | 28.8 | 28.5 | | | | | |
| 8 | | 05:00-06:00 | 29.6 | 30.9 | | | | | |
| | | **Leq Night** | 38.2 | 38.3 | | | | | |

***All noise measurements are integrated for a 01 hour period. All units in dB(A) *LDL Indicates Lower Detection Limit*

| | | | |
|---|---|---|---|
| Sampling Assistants | [Gaurav Kant] | | [Kumar Vaibhav] |
| ***ANALYSED BY*** | ***REVIEWED BY*** | | ***Authorised Signatory*** |

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI RI-II.*

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*Page -1 of 1*

CMPDI, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD, -826005
Phone:0326-2201850
email: rdr2cmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

## Environment Laboratory, Regional Institute-II

## Ambient Noise Level Test Report

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Month & Year** | 08/2025 | **Cluster** | Cluster IX | | | | | **ULR No.** | TC143212500000203IF |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenvbccl@coalindia.in) | | | | | | | **Date of Issue** | 05.09.2025 |
| **Project** | | | **Sample Ref. No.** | RFM/BCCL/2025/08 | | **Sampling Method** | | CMPDI/RI-II/LPM 22 | |
| **Sampling Stations** | 1 | Bhowrah North | | **Date of Sampling** | 11.08.25 | 20.08.25 | **Zone Category of Station:** | | Buffer Zone |

| SL No. | Parameter | Hour / Time of day | Observed Values [ in Leq dB(A) ] First Fortnight | Observed Values [ in Leq dB(A) ] Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A)Leq - Day | 06:00-07:00 | 46.3 | 45.6 | CPCB, Protocol for Ambient Level Noise Monitoring -2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 75 |
| 2 | | 07:00-08:00 | 48.8 | 48.6 | | | | Commercial | 65 |
| 3 | | 08:00-09:00 | 51.1 | 51.1 | | | | Residential | 55 |
| 4 | | 09:00-10:00 | 55.9 | 55 | | | | Silence | 50 |
| 5 | | 10:00-11:00 | 56.8 | 54.2 | | | | | |
| 6 | | 11:00-12:00 | 55.4 | 55.3 | | | | | |
| 7 | | 12:00-13:00 | 57.7 | 57 | | | | | |
| 8 | | 13:00-14:00 | 52 | 50.2 | | | | | |
| 9 | | 14:00-15:00 | 49.2 | 48.3 | | | | | |
| 10 | | 15:00-16:00 | 41.3 | 53.8 | | | | | |
| 11 | | 16:00-17:00 | 41.4 | 53.3 | | | | | |
| 12 | | 17:00-18:00 | 40 | 52.8 | | | | | |
| 13 | | 18:00-19:00 | 38.8 | 45.9 | | | | | |
| 14 | | 19:00-20:00 | 39 | 38.2 | | | | | |
| 15 | | 20:00-21:00 | 39.1 | 39.6 | | | | | |
| 16 | | 21:00-22:00 | 38.6 | 38.5 | | | | | |
| | | **Leq DAY** | 51.1 | 52.0 | | | | | |
| 1 | Noise Level dB(A)Leq -Night | 22:00-23:00 | 40 | 40.3 | CPCB, Protocol for Ambient Level Noise Monitoring -2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 70 |
| 2 | | 23:00-00:00 | 39.9 | 39.7 | | | | Commercial | 55 |
| 3 | | 00:00-01:00 | 39.7 | 39.8 | | | | Residential | 45 |
| 4 | | 01:00-02:00 | 39.4 | 39.6 | | | | Silence | 50 |
| 5 | | 02:00-03:00 | 39.3 | 39.7 | | | | | |
| 6 | | 03:00-04:00 | 40.5 | 40.4 | | | | | |
| 7 | | 04:00-05:00 | 40.4 | 40.7 | | | | | |
| 8 | | 05:00-06:00 | 40.7 | 41 | | | | | |
| | | **Leq Night** | 40.9 | 40.1 | | | | | |

***All noise measurements are integrated for a 01 hour period. All units in dB(A) *LDL Indicates Lower Detection Limit*

| | | | |
|---|---|---|---|
| Sampling Assistants | (Gaurav Kant) | | (Kumar Vaibhav) |
| *ANALYSED BY* | *REVIEWED BY* | | *Authorised Signatory* |

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.*

*-- End of Report --*

*Page -1 of 1*

CMPDI, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD, -826005
Phone:0326-220-850
email: rdcfcmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
## Environment Laboratory, Regional Institute-II
## Ambient Noise Level Test Report

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Month & Year** | 08/2025 | **Cluster** | Cluster IX | | | | **ULR No.** | TC143212500000020388F |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (Email: gmenv.bccl@coalindia.in) | | | | | | **Date of Issue** | 05.09.2025 |
| **Project** | | **Sample Ref. No.** | SEM/BCCL/2025/08 | | **Sampling Method** | | CMPDI/RI-II/LPM 22 | |
| **Sampling Stations** | 1 | Hurriladih UGP | **Date of Sampling** | 08.08.25 | 21.08.25 | **Zone Category of Station:** | **Buffer Zone** | |

| Sl. No. | Parameter | Hour / Time of day | Observed Values [ in Leq dB(A) ] First Fortnight | Observed Values [ in Leq dB(A) ] Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A)Leq - Day | 06:00 - 07:00 | 42.3 | 40.3 | CPCB, Protocol for Ambient Level Noise Monitoring - 2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 75 |
| 2 | | 07:00 - 08:00 | 44.2 | 43.3 | | | | Commercial | 65 |
| 3 | | 08:00 - 09:00 | 46.2 | 46.2 | | | | Residential | 55 |
| 4 | | 09:00 - 10:00 | 51.1 | 51.5 | | | | Silence | 50 |
| 5 | | 10:00 - 11:00 | 53.2 | 53 | | | | | |
| 6 | | 11:00 - 12:00 | 51.2 | 51.5 | | | | | |
| 7 | | 12:00 - 13:00 | 53.5 | 52.8 | | | | | |
| 8 | | 13:00 - 14:00 | 45.4 | 46 | | | | | |
| 9 | | 14:00 - 15:00 | 38.1 | 38.4 | | | | | |
| 10 | | 15:00 - 16:00 | 38.1 | 38 | | | | | |
| 11 | | 16:00 - 17:00 | 38.5 | 38.6 | | | | | |
| 12 | | 17:00 - 18:00 | 37.4 | 38.8 | | | | | |
| 13 | | 18:00 - 19:00 | 38.8 | 38.2 | | | | | |
| 14 | | 19:00 - 20:00 | 38 | 37.4 | | | | | |
| 15 | | 20:00 - 21:00 | 39 | 40.3 | | | | | |
| 16 | | 21:00 - 22:00 | 40.2 | 39.9 | | | | | |
| | | **Leq DAY** | 47.1 | 47.2 | | | | | |
| 1 | Noise Level dB(A)Leq - Night | 22:00-23:00 | 40.6 | 39.9 | CPCB, Protocol for Ambient Level Noise Monitoring - 2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 70 |
| 2 | | 23:00- 00:00 | 40.4 | 40 | | | | Commercial | 55 |
| 3 | | 00:00- 01:00 | 38.7 | 39.8 | | | | Residential | 45 |
| 4 | | 01:00-02:00 | 39.6 | 40.2 | | | | Silence | 50 |
| 5 | | 02:00-03:00 | 39.9 | 40.5 | | | | | |
| 6 | | 03:00-04:00 | 38.9 | 39.6 | | | | | |
| 7 | | 04:00-05:00 | 37 | 38.3 | | | | | |
| 8 | | 05:00-06:00 | 38.7 | 35.9 | | | | | |
| | | **Leq Night** | 39.1 | 39.3 | | | | | |

**All noise measurements are computed for a 01 hour period. All units in dB(A) *LDL indicates Lower Detection Limit

| Sampling Assistants | | (Gaurav Kant) | | (Kumar Vaibhav) |
|---|---|---|---|---|
| ANALYSED BY | | REVIEWED BY | | Authorized Signatory |

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.*

--- End of Report ---

Page - 1 of 1

**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<br><br>Coal mines located in the coal fields of<br>• Jharia<br>• Raniganj<br>• Bokaro | Suspended Particulate Matter (SPM) | Annual Average *<br>24 hours **| 500 µg/m³<br><br>700 µg/m³ | - High Volume Sampling (Average flow rate not less than 1.1 |
| | Respirable Particulate Matter (size less than 10 µm) (RPM) | Annual Average *<br>24 hours **| 250 µg/m³<br><br>300 µg/m³ | Respirable Particulate Matter sampling and analysis |
| | Sulphur Dioxide ($SO_2$) | Annual Average *<br>24 hours **| 80 µg/m³<br><br>120 µg/m³ | 1.Improvedwest and Gaeke method<br>2.Ultraviolet fluorescene |
| | Oxide of Nitrogen as $NO_2$ | Annual Average *<br>24 hours **| 80 µg/m³<br><br>120 µg/m³ | 1. Jacob & Hochheiser Modified (Na-Arsenic) Method<br>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/8hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days.

# NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

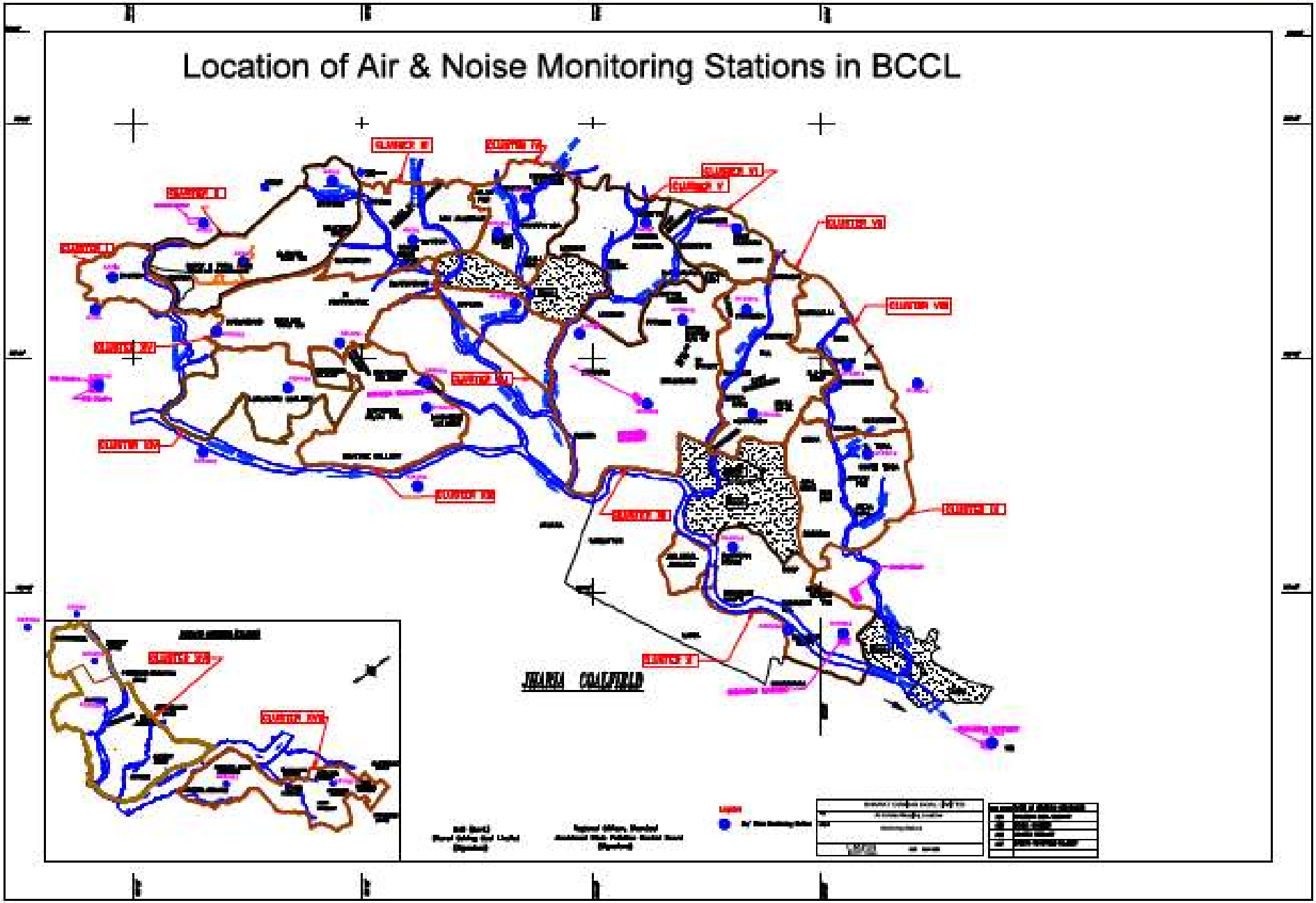
In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th November 1998, the Central Pollution Control 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 * <br> 24 Hours ** | 50 <br> 80 | 20 <br> 80 | -Improved West and Gaeke Method <br> -Ultraviolet Fluorescence |
| Nitrogendioxide ($NO_2$), µg/m³ | Annual * <br> 24 Hours ** | 40 <br> 80 | 30 <br> 80 | -Jacob &Hochheiser modified (NaOH-$NaAsO_2$) Method <br> -Gas Phase Chemiluminescence |
| Particulate Matter (Size less than 10µm) or $PM_{10}$, µg/m³ | Annual * <br> 24 Hours ** | 60 <br> 100 | 60 <br> 100 | -Gravimetric <br> -TEOM <br> -Beta attenuation |
| Particulate Matter (Size less than 2.5µm) or $PM_{2.5}$, µg/m³ | Annual * <br> 24 Hours ** | 40 <br> 60 | 40 <br> 60 | -Gravimetric <br> -TEOM <br> -Beta attenuation |
| Ozone ($O_3$) , µg/m³ | 8 Hours ** <br> 1 Hour ** | 100 <br> 180 | 100 <br> 180 | -UV Photometric <br> -Chemiluminescence <br> -Chemical Method |
| Lead (Pb) , µg/m³ | Annual * <br> 24 Hours ** | 0.50 <br> 1.0 | 0.50 <br> 1.0 | -AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper <br> -ED-XRF using Teflon filter |
| Carbon Monoxide (CO), mg/m³ | 8 Hours ** <br> 1 Hour ** | 02 <br> 04 | 02 <br> 04 | -Non dispersive Infrared (NDIR) Spectroscopy |
| Ammonia ($NH_3$), µg/m³ | Annual * <br> 24 Hours ** | 100 <br> 400 | 100 <br> 400 | -Chemiluminescence <br> -Indophenol blue method |
| Benzene ($C_6H_6$), µg/m³ | Annual * | 05 | 05 | -Gas Chromatography (GC) based continuous analyzer <br> -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
JHARIA COALFIELD

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# ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER – IX

**(FOR THE MONTH JULY 2025)**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

# NOISE LEVEL QUALITY MONITORING

## 4.1 Location of sampling sites

1. Jeenagora (N13)
2. Kusmatand Village (N12)
3. Bhowrah North (N14)
4. Hurriladih UGP (N28)

## 4.2 Methodology of sampling and analysis

## 4.3 Results & Interpretations

-

Annexure XXVII

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

Ambient Noise Level Test Report

| Month & Year | 07/2025 | Cluster | Gu | | |
|---|---|---|---|---|---|

| | | |

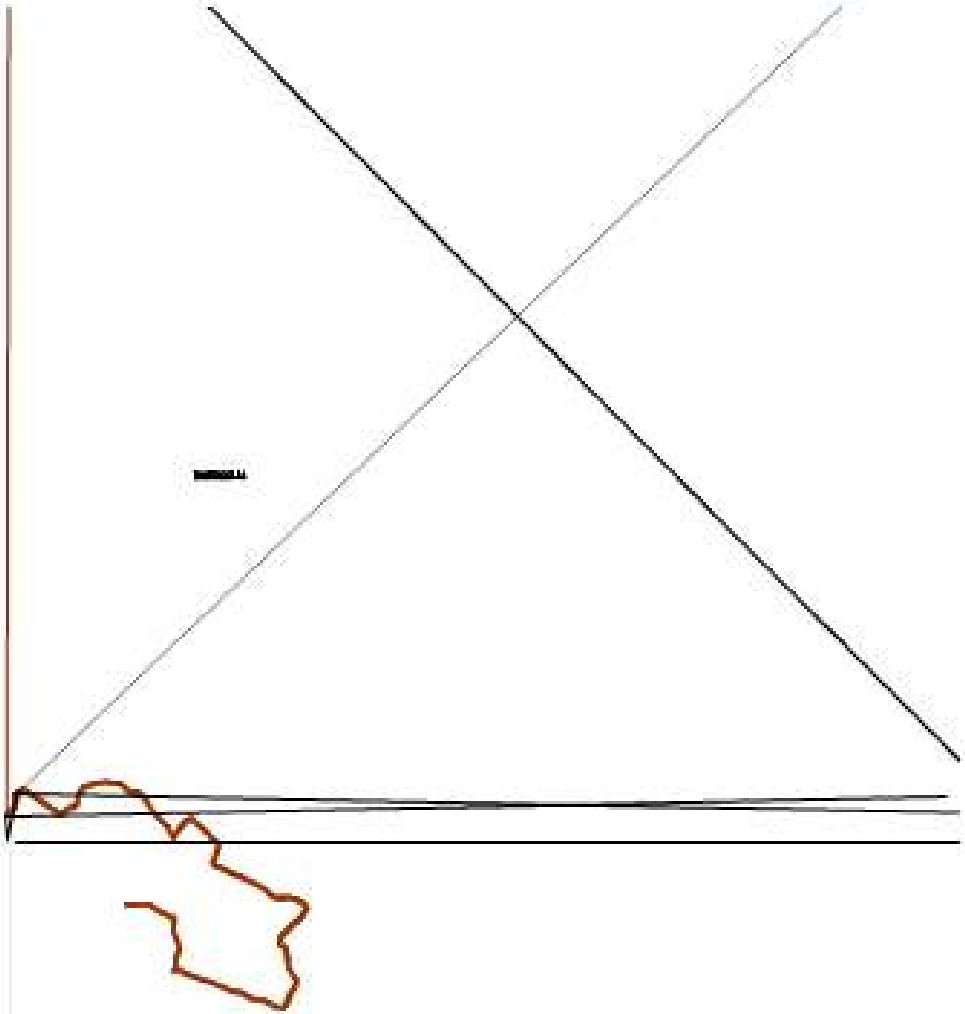
**Ambient Air Quality Standards for Jharia Coal Field**
**As per the Environment (Protection) Amendment Rules, 2000 notified vide notification G.S.R. 742(E), dated 25.9.2000.**

| Category | Pollutant | Time weighted average | Concentration in Ambient Air | Method of Measurement |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| III<br>Coal mines located in the coal fields of<br>• | | | | |

# NATIONAL AMBIENT AIR QUALITY STANDARDS

| 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 | | | | |
| Nitrogendioxide ($NO_2$), µg/m³ | | | | |
| Particulate Matter (Size less than 10µm) or $PM_{10}$, µg/m³ | | | | |
| Particulate Matter (Size less than 2.5µm) or $PM_{2.5}$, µg/m³ | | | | |
| Ozone ($O_3$) , µg/m³ | | | | |
| Lead (Pb) , µg/m³ | | | | |
| Carbon Monoxide (CO), mg/m³ | | | | |
| Ammonia ($NH_3$), µg/m³ | | | | |
| Benzene ($C_6H_6$), µg/m³ | | | | |
| Benzo(a)Pyrene (BaP) Particulate phase only, ng/m³ | | | | |
| Arsenic (As), ng/m³ | | | | |
| Nickel (Ni), ng/m³ | | | | |

NOTE:



E. C. no. J -11015/307/2010-IA.II (M) dated 01.03.2018

# NOISE LEVEL QUALITY MONITORING

## 4.1 Location of sampling sites

Jeenagora (N13)

2. Kusmatand Village (N12)
3. Bhowrah North (N14)

Hurriladih UGP (N28)

## 4.2 Methodology of sampling and analysis

Noise level measurements in form of '$L_{EQ}$' were taken using Integrated Data Logging Sound Level Meter during day time & night time. Noise levels were measured for the complete day & night time, the Intergration time taken was one hour or 3600 seconds. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

## 4.3 Results & Interpretations

Ambient noise levels were recorded during day time & night time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day & night 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.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

Ambient Noise Level Test Report

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | 06/2025 | Cluster | Cluster IX | ULR No. | TC143212500001932F |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | Date of Issue | 11.08.2025 |
| Project | | Sample Ref. No. | | | |

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

Ambient Noise Level Test Report

| Month & Year | 06/2025 | Cluster | CLUSTER IX | ULR No. | TC143212500001932F |
|---|---|---|---|---|---|
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | |

## CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
### Environment Laboratory, Regional Institute-II
### Ambient Noise Level Test Report

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | 06/2025 | Cluster | Cluster IX | ULR No. | TC143212500001932F |
| Customer | [redacted] | | | | |
| | | No. | REM/BCCL/2025/06 | Sampling Method | CHPDI/RI-II/LPM 22 |
| Sampling Stations | 1 | Bhowrah North | Date of Sampling | Zone Category of Station: | Buffer Zone |

| Sl. No. | Parameter | Hour / Time of day | Observed Values [ in Leq dB(A) ] First Fortnight | Observed Values [ in Leq dB(A) ] Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1. | | 06:00 – 07:00 | [redacted] | | | | | | |

Noise Level
dB(A)Leq - Day

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Noise Level Test Report

| Month & Year | 06/2025 | Cluster | Cluster IX | ULR No. | [redacted] |
|---|---|---|---|---|---|

As per the Environment (Protection) Amendment Rules, 2000 notified vide notification G.S.R. 742(E), dated 25.9.2000.

| | | | | |
|---|---|---|---|---|
| | | | | |
| • | | | 9<br>9 | |
| • | | | 9 | |
| • | 9 | | 9 | |
| | | | 9<br>9 | |
| | | | 9<br>9 | |

Note:

* Annual Arithmetic mean for the measurements taken in a year, following the guidelines for frequency of sampling laid down in clause2.

** 24hourly/8hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days.

# NATIONAL AMBIENT AIR QUALITY STANDARDS
New Delhi the 18th November 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 November 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 * <br> 24 Hours ** | 50 <br> 80 | 20 <br> 80 | -Improved West and Gaeke Method <br> -Ultraviolet Fluorescence |
| Nitrogendioxide ($NO_2$), µg/m³ | Annual * <br> 24 Hours ** | 40 <br> 80 | 30 <br> 80 | -Jacob &Hochheiser modified ($NaOH$-$NaAsO_2$) Method <br> -Gas Phase Chemiluminescence |
| Particulate Matter (Size less than 10µm) or $PM_{10}$, µg/m³ | Annual * <br> 24 Hours ** | 60 <br> 100 | 60 <br> 100 | -Gravimetric <br> -TEOM <br> -Beta attenuation |
| Particulate Matter (Size less than 2.5µm) or $PM_{2.5}$, µg/m³ | Annual * <br> 24 Hours ** | 40 <br> 60 | 40 <br> 60 | -Gravimetric <br> -TEOM <br> -Beta attenuation |
| Ozone ($O_3$), µg/m³ | 8 Hours * <br> 1 Hour ** | 100 <br> 180 | 100 <br> 180 | -UV Photometric <br> -Chemiluminescence <br> -Chemical Method |
| Lead (Pb), µg/m³ | Annual * <br> 24 Hours ** | 0.50 <br> 1.0 | 0.50 <br> 1.0 | -AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper <br> -ED-XRF using Teflon filter |
| Carbon Monoxide (CO), mg/m³ | 8 Hours ** <br> 1 Hour ** | 02 <br> 04 | 02 <br> 04 | -Non dispersive Infrared (NDIR) Spectroscopy |
| Ammonia ($NH_3$), µg/m³ | Annual * <br> 24 Hours ** | 100 <br> 400 | 100 <br> 400 | -Chemiluminescence <br> -Indophenol blue method |
| Benzene ($C_6H_6$), µg/m³ | Annual * | 05 | 05 | -Gas Chromatography (GC) based continuous analyzer <br> -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.

Annexure XXVII

n of Air & Noise Monitoring Stations in BCCL

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# ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER – IX

**(FOR THE MONTH MAY, 2025)**

**E. C. no. J-11015/307/2010-IA.II (M) dated 01.03.2018**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

# NOISE LEVEL QUALITY MONITORING

## 4.1 Location of sampling sites

1. **Jeenagora (N13)**
2. **Kusmatand Village (N12)**
3. **Bhowrah North (N14)**
4. **Hurriladih UGP (N28)**

## 4.2 Methodology of sampling and analysis

Noise level measurements in form of '$L_{EQ}$' were taken using Integrated Data Logging Sound Level Meter during day time & night time. Noise levels were measured for the complete day & night time, the Intergration time taken was one hour or 3600 seconds. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

## 4.3 Results & Interpretations

Ambient noise levels were recorded during day time & night time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day & night 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.

CMPDI, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-233-650
email: rdrl2cmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
## Environment Laboratory, Regional Institute-II
## Ambient Noise Level Test Report

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | 05/2025 | Cluster | Cluster IX | ULR No. | |
| Customer | Environment Department, Bharat Coking Coal Limited [BCCL], Koyla Bhawan, Dhanbad [Email: gmenv.bccl@coalindia.in] | | | Date of Issue | 26.06.2025 |
| Project | | Sample Ref. No. | RDM/BCCL/2025/05 | Sampling Method | CMPDI/RDM/LPM 22 |
| Sampling Stations | 1 | Jeenagora | Date of Sampling | 15.05.25 - 30.05.25 | Zone Category of Station: Core Zone |

| Sl. No. | Parameter | Hour / Time of day | Observed Values (in Leq dB(A)) First Fortnight | Observed Values (in Leq dB(A)) Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards: Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A)Leq - Day | 06.00 - 07.00 | 57.7 | 58.3 | CPCB, Protocol for Ambient Level Noise Monitoring - 2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 75 |
| 2 | | 07.00 - 08.00 | 66.3 | 60.9 | | | | Commercial | 65 |
| 3 | | 08.00 - 09.00 | 67.6 | 64.6 | | | | Residential | 55 |
| 4 | | 09.00 - 10.00 | 68.2 | 62.1 | | | | Silence | 50 |
| 5 | | 10.00 - 11.00 | 66.9 | 65.4 | | | | | |
| 6 | | 11.00 - 12.00 | 65.6 | 64 | | | | | |
| 7 | | 12.00 - 13.00 | 71.8 | 70.7 | | | | | |
| 8 | | 13.00 - 14.00 | 64.4 | 62.9 | | | | | |
| 9 | | 14.00 - 15.00 | 57.8 | 59.8 | | | | | |
| 10 | | 15.00 - 16.00 | 69.2 | 68.9 | | | | | |
| 11 | | 16.00 - 17.00 | 65.6 | 63.7 | | | | | |
| 12 | | 17.00 - 18.00 | 57 | 55.9 | | | | | |
| 13 | | 18.00 - 19.00 | 52.7 | 51.9 | | | | | |
| 14 | | 19.00 - 20.00 | 49.4 | 49.6 | | | | | |
| 15 | | 20.00 - 21.00 | 44.7 | 44.6 | | | | | |
| 16 | | 21.00 - 22.00 | 45.2 | 45.8 | | | | | |
| | | Leq DAY | 65.0 | 62.7 | | | | | |
| 1 | Noise Level dB(A)Leq -Night | 22.00-23.00 | 41.6 | 42.5 | CPCB, Protocol for Ambient Level Noise Monitoring - 2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 70 |
| 2 | | 23.00-00.00 | 43 | 42.3 | | | | Commercial | 55 |
| 3 | | 00.00-01.00 | 40.3 | 42.1 | | | | Residential | 45 |
| 4 | | 01.00-02.00 | 40.2 | 41.2 | | | | Silence | 50 |
| 5 | | 02.00-03.00 | 40.2 | 40.9 | | | | | |
| 6 | | 03.00-04.00 | 42 | 40.2 | | | | | |
| 7 | | 04.00-05.00 | 42.2 | 43.1 | | | | | |
| 8 | | 05.00-06.00 | 44.1 | 43.9 | | | | | |
| | | Leq Night | 41.6 | 42.2 | | | | | |

***All noise measurements are integrated for a 01 hour period. All units in dB(A) *LDL Indicates Lower Detection Limit*

| | | |
|---|---|---|
| Sampling Assistants | [Gaurav Kant] | [Amit Raj Mishra] |
| ANALYSED BY | REVIEWED BY | Authorised Signatory |

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.*

*--- End of Report ---*

CMPDI, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD, -826005
Phone:0326-225-850
email: rdii2cmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

## Environment Laboratory, Regional Institute-II

## Ambient Noise Level Test Report

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 05/2025 | **Cluster** | CLUSTER IX | **ULR No.** | |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 24.06.2025 |
| **Project** | | **Sample Ref. No.** | REM/BCCL/2025/05 | **Sampling Method** | CMPDI/RI-II/LPM 22 |
| **Sampling Stations** | 1 | **Kusmatand Village** | **Date of Sampling** | 15.05.25 – 30.05.25 | **Zone Category of Station:** Bufer Zone |

| Sl. No. | Parameter | Hour / Time of day | Observed Values ( in Leq dB(A) ) First Fortnight | Observed Values ( in Leq dB(A) ) Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A)Leq - Day | 06:00 – 07:00 | 45.5 | 44.4 | CPCB, Protocol for Ambient Level Noise Monitoring- 2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 75 |
| 2 | | 07:00 – 08:00 | 48 | 44.4 | | | | Commercial | 65 |
| 3 | | 08:00 – 09:00 | 50.3 | 50.2 | | | | Residential | 55 |
| 4 | | 09:00 – 10:00 | 55.8 | 53.7 | | | | Silence | 50 |
| 5 | | 10:00 – 11:00 | 56.4 | 54.7 | | | | | |
| 6 | | 11:00 – 12:00 | 53.1 | 53.4 | | | | | |
| 7 | | 12:00 – 13:00 | 54.1 | 56.1 | | | | | |
| 8 | | 13:00 – 14:00 | 56.1 | 57.3 | | | | | |
| 9 | | 14:00 – 15:00 | 55.8 | 53.7 | | | | | |
| 10 | | 15:00 – 16:00 | 50.8 | 50.8 | | | | | |
| 11 | | 16:00 – 17:00 | 48.3 | 48.8 | | | | | |
| 12 | | 17:00 – 18:00 | 48.5 | 47.9 | | | | | |
| 13 | | 18:00 – 19:00 | 47.1 | 47.8 | | | | | |
| 14 | | 19:00 – 20:00 | 46.8 | 46.8 | | | | | |
| 15 | | 20:00 – 21:00 | 46.6 | 47.1 | | | | | |
| 16 | | 21:00 – 22:00 | 46.7 | 45.7 | | | | | |
| | | **Leq DAY** | 51.8 | 51.8 | | | | | |
| 1 | Noise Level dB(A)Leq -Night | 22:00-23:00 | 41.3 | 43.7 | CPCB, Protocol for Ambient Level Noise Monitoring- 2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 70 |
| 2 | | 23:00- 00:00 | 41.2 | 43.5 | | | | Commercial | 55 |
| 3 | | 00:00- 01:00 | 40.9 | 41 | | | | Residential | 45 |
| 4 | | 01,00-02,00 | 40.6 | 40.3 | | | | Silence | 50 |
| 5 | | 02,00-03,00 | 40.2 | 40.2 | | | | | |
| 6 | | 03,00-04,00 | 39.1 | 40.1 | | | | | |
| 7 | | 04,00-05,00 | 38.7 | 40.1 | | | | | |
| 8 | | 05:00-06:00 | 39.4 | 40.2 | | | | | |
| | | **Leq Night** | 40.3 | 40.7 | | | | | |

***All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL Indicates Lower Detection Limit*

| | | |
|---|---|---|
| Sampling Assistants | [Gaurav Kant] | [Amit Raj Mishra] |
| ***ANALYSED BY*** | ***REVIEWED BY*** | ***Authorised Signatory*** |

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.*

*--- End of Report ---*

*Page -1 of 1*

Annexure XXVII

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

## Environment Laboratory, Regional Institute-II

## Ambient Noise Level Test Report

CMPDI, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD, -826005
Phone:0326-223-850
email: ridi2cmpdi@coalindia.in

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Month & Year | 05/2025 | Cluster | Cluster IX | | | | ULR No. | |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenvbcck@coalindia.in) | | | | | | Date of Issue | 24.06.2025 |
| Project | | Sample Ref. No. | RRM/BCCL/2025/05 | | Sampling Method | | CMPDI/RI-II/LPM 22 | |
| Sampling Stations | 1 | Bhowrah North | Date of Sampling | 06.05.25 | 22.05.25 | Zone Category of Station: | | Buffer Zone |

| Sl. No. | Parameter | Hour / Time of day | Observed Values ( in Leq dB(A) ) First Fortnight | Observed Values ( in Leq dB(A) ) Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A)Leq - Day | 06:00-07:00 | 53.4 | 52.7 | CPCB, Protocol for Ambient Level Noise Monitoring -2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 75 |
| 2 | | 07:00-08:00 | 56.3 | 56.1 | | | | Commercial | 65 |
| 3 | | 08:00-09:00 | 59 | 59 | | | | Residential | 55 |
| 4 | | 09:00-10:00 | 62.2 | 63.5 | | | | Silence | 50 |
| 5 | | 10:00-11:00 | 63.2 | 63.6 | | | | | |
| 6 | | 11:00-12:00 | 63.9 | 63.7 | | | | | |
| 7 | | 12:00-13:00 | 66.6 | 65.8 | | | | | |
| 8 | | 13:00-14:00 | 60 | 57.9 | | | | | |
| 9 | | 14:00-15:00 | 56.8 | 55.8 | | | | | |
| 10 | | 15:00-16:00 | 57.7 | 62.1 | | | | | |
| 11 | | 16:00-17:00 | 57.8 | 61.4 | | | | | |
| 12 | | 17:00-18:00 | 46.2 | 60.9 | | | | | |
| 13 | | 18:00-19:00 | 44.8 | 55 | | | | | |
| 14 | | 19:00-20:00 | 45 | 44.1 | | | | | |
| 15 | | 20:00-21:00 | 45.1 | 45.7 | | | | | |
| 16 | | 21:00-22:00 | 44.6 | 45.6 | | | | | |
| | | Leq DAY | 59.4 | 60.3 | | | | | |
| 1 | Noise Level dB(A)Leq -Night | 22:00-23:00 | 41.9 | 42.2 | CPCB, Protocol for Ambient Level Noise Monitoring -2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 70 |
| 2 | | 23:00-00:00 | 41.8 | 43.6 | | | | Commercial | 55 |
| 3 | | 00:00-01:00 | 41.6 | 43.3 | | | | Residential | 45 |
| 4 | | 01:00-02:00 | 41.3 | 43.5 | | | | Silence | 50 |
| 5 | | 02:00-03:00 | 41.2 | 43.6 | | | | | |
| 6 | | 03:00-04:00 | 42.2 | 43.5 | | | | | |
| 7 | | 04:00-05:00 | 42.8 | 43.6 | | | | | |
| 8 | | 05:00-06:00 | 42.6 | 43.9 | | | | | |
| | | Leq Night | 41.9 | 43.0 | | | | | |

***All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL Indicates Lower Detection Limit*

| | | | | | |
|---|---|---|---|---|---|
| Sampling Assistants | | (Gaurav Kant) | | | (Amit Raj Mishra) |
| ANALYSED BY | | REVIEWED BY | | | Authorised Signatory |

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.*

*— End of Report —*

*Page 1 of 1*

CMPDI, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-233-850
email: rdi2cmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
## Environment Laboratory, Regional Institute-II
## Ambient Noise Level Test Report

| | | | | | |
|---|---|---|---|---|---|
| **Month & Year** | 05/2025 | **Cluster** | Cluster IX | **ULR No.** | |
| **Customer** | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | **Date of Issue** | 24.06.2025 |
| **Project** | | **Sample ReC No.** | RSM/BCCL/2025/05 | **Sampling Method** | CMPDI/RI-II/LPM 22 |
| **Sampling Stations** | 1 | **Hurriladih OCP** | **Date of Sampling** | 08.05.25 to 16.05.25 | **Zone Category of Station** | **Buffer Zone** |

| Sl. No. | Parameter | Hour / Time of day | Observed Values [ In Leq dB(A) ] First Fortnight | Observed Values [ In Leq dB(A) ] Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards: Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A)Leq -Day | 06:00-07:00 | 47.7 | 46.5 | CPCB, Protocol for Ambient Level Noise Monitoring-2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 75 |
| 2 | | 07:00-08:00 | 51.1 | 50 | | | | Commercial | 65 |
| 3 | | 08:00-09:00 | 53.3 | 53.3 | | | | Residential | 55 |
| 4 | | 09:00-10:00 | 59 | 59.4 | | | | Silence | 50 |
| 5 | | 10:00-11:00 | 60.2 | 61.1 | | | | | |
| 6 | | 11:00-12:00 | 59.1 | 59.4 | | | | | |
| 7 | | 12:00-13:00 | 61.8 | 60.9 | | | | | |
| 8 | | 13:00-14:00 | 52.4 | 53.1 | | | | | |
| 9 | | 14:00-15:00 | 44 | 44.4 | | | | | |
| 10 | | 15:00-16:00 | 44 | 43.8 | | | | | |
| 11 | | 16:00-17:00 | 44.5 | 44.6 | | | | | |
| 12 | | 17:00-18:00 | 37.4 | 38.9 | | | | | |
| 13 | | 18:00-19:00 | 46 | 45.2 | | | | | |
| 14 | | 19:00-20:00 | 43.8 | 43.2 | | | | | |
| 15 | | 20:00-21:00 | 45 | 45.5 | | | | | |
| 16 | | 21:00-22:00 | 46.4 | 46.1 | | | | | |
| | | **Leq DAY** | 54.9 | 55.0 | | | | | |
| 1 | Noise Level dB(A)Leq -Night | 22:00-23:00 | 42.4 | 41.8 | CPCB, Protocol for Ambient Level Noise Monitoring-2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 70 |
| 2 | | 23:00-00:00 | 42.3 | 41.9 | | | | Commercial | 55 |
| 3 | | 00:00-01:00 | 41.6 | 41.7 | | | | Residential | 45 |
| 4 | | 01:00-02:00 | 41.5 | 42.1 | | | | Silence | 50 |
| 5 | | 02:00-03:00 | 41.8 | 42.4 | | | | | |
| 6 | | 03:00-04:00 | 38.7 | 41.5 | | | | | |
| 7 | | 04:00-05:00 | 38.8 | 38 | | | | | |
| 8 | | 05:00-06:00 | 38.4 | 37.6 | | | | | |
| | | **Leq Night** | 45.0 | 45.2 | | | | | |

***All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit*

| | | | |
|---|---|---|---|
| Sampling Assistants | (Gaurav Kant) | | (Amit Rai Mishra) |
| ***ANALYSED BY*** | ***REVIEWED BY*** | | ***Authorized Signatory*** |

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*--- End of Report ---*

*Page - 1 of 1*

**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<br><br>Coal mines located in the coal fields of<br>• Jharia<br>• Raniganj<br>• Bokaro | Suspended Particulate Matter (SPM) | Annual Average *<br>24 hours **| 500 µg/m³<br><br>700 µg/m³ | - High Volume Sampling (Average flow rate not less than 1.1 |
| | Respirable Particulate Matter (size less than 10 µm) (RPM) | Annual Average *<br>24 hours **| 250 µg/m³<br><br>300 µg/m³ | Respirable Particulate Matter sampling and analysis |
| | Sulphur Dioxide ($SO_2$) | Annual Average *<br>24 hours **| 80 µg/m³<br><br>120 µg/m³ | 1.Improvedwest and Gaeke method<br>2.Ultraviolet fluorescene |
| | Oxide of Nitrogen as $NO_2$ | Annual Average *<br>24 hours **| 80 µg/m³<br><br>120 µg/m³ | 1. Jacob & Hochheiser Modified (Na-Arsenic) Method<br>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/8hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days.

# NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

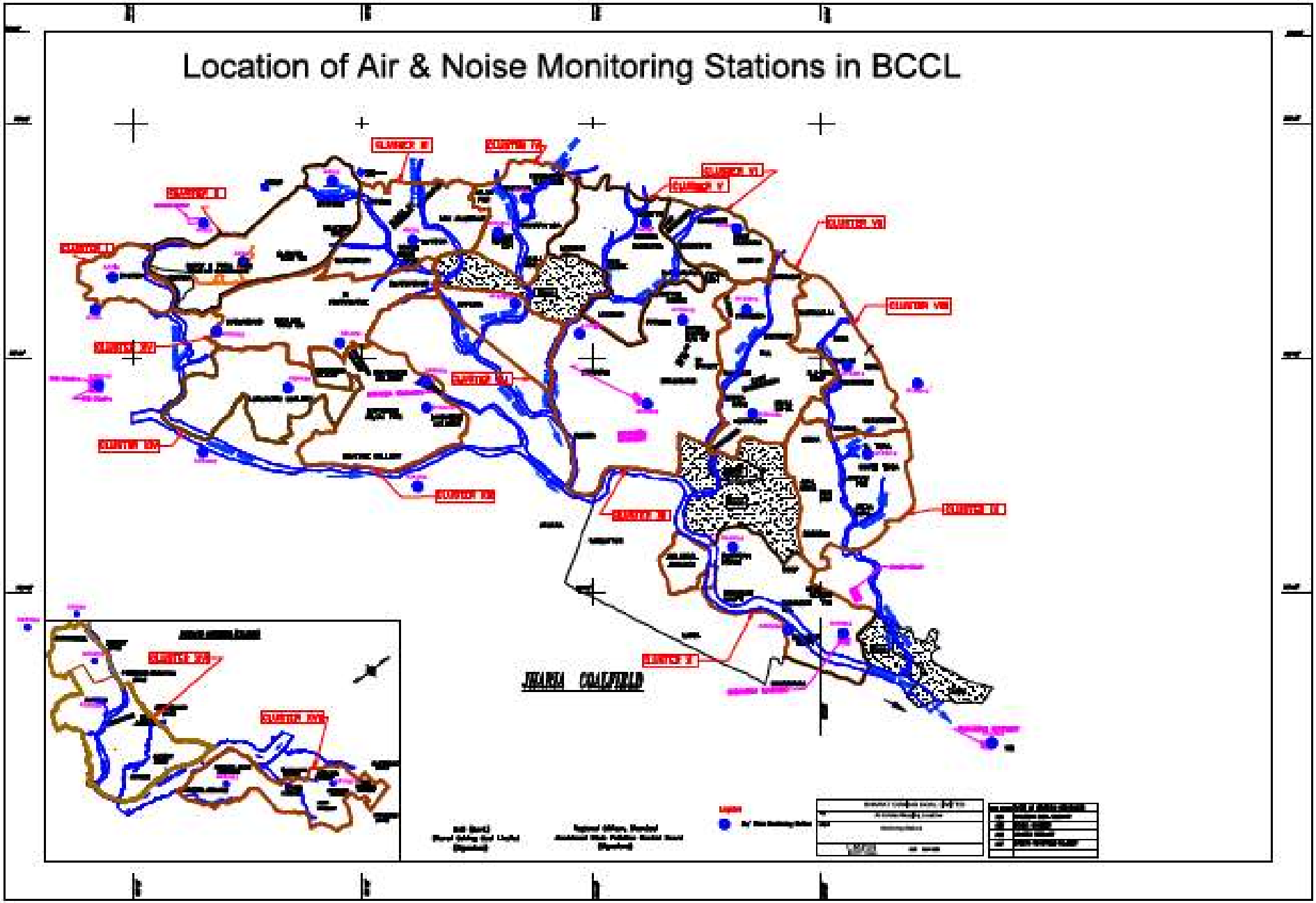
In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th November 1998, the Central Pollution Control 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 * <br> 24 Hours ** | 50 <br> 80 | 20 <br> 80 | -Improved West and Gaeke Method <br> -Ultraviolet Fluorescence |
| Nitrogendioxide ($NO_2$), µg/m³ | Annual * <br> 24 Hours ** | 40 <br> 80 | 30 <br> 80 | -Jacob &Hochheiser modified (NaOH-$NaAsO_2$) Method <br> -Gas Phase Chemiluminescence |
| Particulate Matter (Size less than 10µm) or $PM_{10}$, µg/m³ | Annual * <br> 24 Hours ** | 60 <br> 100 | 60 <br> 100 | -Gravimetric <br> -TEOM <br> -Beta attenuation |
| Particulate Matter (Size less than 2.5µm) or $PM_{2.5}$, µg/m³ | Annual * <br> 24 Hours ** | 40 <br> 60 | 40 <br> 60 | -Gravimetric <br> -TEOM <br> -Beta attenuation |
| Ozone ($O_3$) , µg/m³ | 8 Hours ** <br> 1 Hour ** | 100 <br> 180 | 100 <br> 180 | -UV Photometric <br> -Chemiluminescence <br> -Chemical Method |
| Lead (Pb) , µg/m³ | Annual * <br> 24 Hours ** | 0.50 <br> 1.0 | 0.50 <br> 1.0 | -AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper <br> -ED-XRF using Teflon filter |
| Carbon Monoxide (CO), mg/m³ | 8 Hours ** <br> 1 Hour ** | 02 <br> 04 | 02 <br> 04 | -Non dispersive Infrared (NDIR) Spectroscopy |
| Ammonia ($NH_3$), µg/m³ | Annual * <br> 24 Hours ** | 100 <br> 400 | 100 <br> 400 | -Chemiluminescence <br> -Indophenol blue method |
| Benzene ($C_6H_6$), µg/m³ | Annual * | 05 | 05 | -Gas Chromatography (GC) based continuous analyzer <br> -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
JHARIA COALFIELD

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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 – IX

**(FOR THE MONTH APRIL, 2025)**

**E. C. no. J-11015/307/2010-IA.II (M) dated 01.03.2018**

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

# NOISE LEVEL QUALITY MONITORING

## 4.1 Location of sampling sites

1. **Jeenagora (N13)**
2. **Kusmatand Village (N12)**
3. **Bhowrah North (N14)**
4. **Hurriladih UGP (N28)**

## 4.2 Methodology of sampling and analysis

Noise level measurements in form of '$L_{EQ}$' were taken using Integrated Data Logging Sound Level Meter during day time & night time. Noise levels were measured for the complete day & night time, the Intergration time taken was one hour or 3600 seconds. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

## 4.3 Results & Interpretations

Ambient noise levels were recorded during day time & night time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day & night 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.

Annexure-XXVII

KOYLA BHAWAN COMPLEX
DHANBAD -826005
Phone:0326 6229 859
email: rdr2.cmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
## Environment Laboratory, Regional Institute-II
## Ambient Noise Level Test Report

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | 04/2025 | Cluster | Cluster IX | ULR No. | TC143212500000182IF |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (Email: gmenvbccl@coalindia.in) | | | Date of Issue | 30.05.2025 |
| Project | | Sample Ref. No. | RRM/BCCL/2025/04 | Sampling Method | CMPDI/RI-II/LPM 22 |
| Sampling Station | 1 | Jeenagora | Date of Sampling | 15.04.25 – 25.04.25 | Zone Category of Station: Core Zone |

| Sl. No. | Parameter | Hour / Time of day | Observed Values (in Leq dB(A)) First Formula | Observed Values (in Leq dB(A)) Second Formula | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards: Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A)Leq -Day | 06:00 - 07:00 | 55.6 | 52.4 | CPCB, Protocol for Ambient Level Noise Monitoring-2015 | 35dB-135 dB | 35 dB(A) | Industrial<br>Commercial<br>Residential<br>Silence | 75<br>65<br>55<br>50 |
| 2 | | 07:00 - 08:00 | 63.8 | 58.7 | | | | | |
| 3 | | 08:00 - 09:00 | 65.1 | 62.2 | | | | | |
| 4 | | 09:00 - 10:00 | 66.6 | 59.9 | | | | | |
| 5 | | 10:00 - 11:00 | 64.5 | 63 | | | | | |
| 6 | | 11:00 - 12:00 | 63.2 | 61.7 | | | | | |
| 7 | | 12:00 - 13:00 | 69.2 | 68.2 | | | | | |
| 8 | | 13:00 - 14:00 | 62 | 60.6 | | | | | |
| 9 | | 14:00 - 15:00 | 55.7 | 57.6 | | | | | |
| 10 | | 15:00 - 16:00 | 47.4 | 46 | | | | | |
| 11 | | 16:00 - 17:00 | 63.2 | 61.4 | | | | | |
| 12 | | 17:00 - 18:00 | 54.9 | 53.8 | | | | | |
| 13 | | 18:00 - 19:00 | 50.7 | 50 | | | | | |
| 14 | | 19:00 - 20:00 | 47.6 | 47.8 | | | | | |
| 15 | | 20:00 - 21:00 | 43.1 | 42.9 | | | | | |
| 16 | | 21:00 - 22:00 | 43.6 | 44.2 | | | | | |
| | | Leq DAY | 62.5 | 60.3 | | | | | |
| 1 | Noise Level dB(A)Leq -Night | 22:00-23:00 | 45.1 | 46.1 | CPCB, Protocol for Ambient Level Noise Monitoring-2015 | 35dB-135 dB | 35 dB(A) | Industrial<br>Commercial<br>Residential<br>Silence | 70<br>55<br>45<br>50 |
| 2 | | 23:00-00:00 | 44.5 | 45.8 | | | | | |
| 3 | | 00:00-01:00 | 43.6 | 45.6 | | | | | |
| 4 | | 01:00-02:00 | 43.5 | 44.7 | | | | | |
| 5 | | 02:00-03:00 | 43.5 | 44.4 | | | | | |
| 6 | | 03:00-04:00 | 45.5 | 43.5 | | | | | |
| 7 | | 04:00-05:00 | 45.7 | 46.8 | | | | | |
| 8 | | 05:00-06:00 | 47.8 | 47.6 | | | | | |
| | | Leq Night | 45.1 | 45.7 | | | | | |

***All noise measurements are integrated for 1 hour period. All units in dB(A). L.D.L. indicates Lower Detection Limit*

Sampling Assistants

(Gaurav Kant)

(Amit Raj Mishra)

ANALYSED BY

REVIEWED BY

Authorised Signatory

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the MOS(Env), CMPDI, RI-II.*

*—End of Report—*

Annexure - XXVII

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
KOYLA BHAWAN COMPLEX
DHANBAD, -826005
Phone: 0326-225-850
email: rdri2cmpdi@coalindia.in

## Ambient Noise Level Test Report

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Month & Year | 04/2025 | Cluster | CLUSTER IX | | | ULR No. | TC143212500000182 6F |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | | | Date of issue | 30.05.2025 |
| Project | | Sample Ref. No. | REM/BCCL/2025/04 | | Sampling Method | CMPDI/RI-II/LPM 22 | |
| Sampling Stations | 1 | Kusmatand Village | Date of Sampling | 15.04.25 | 26.04.25 | Zone Category of Station: | Buffer Zone |

| Sl No. | Parameter | Hour / Time of day | Observed Values (in Leq dB(A)) First Fortnight | Observed Values (in Leq dB(A)) Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A) Leq - Day | 06:00 - 07:00 | 33.7 | 34.6 | CPCB, Protocol for Ambient Level Noise Monitoring - 2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 75 |
| 2 | | 07:00 - 08:00 | 36.9 | 36.2 | | | | Commercial | 65 |
| 3 | | 08:00 - 09:00 | 36.9 | 37.5 | | | | Residential | 55 |
| 4 | | 09:00 – 10:00 | 43.7 | 42.4 | | | | Silence | 50 |
| 5 | | 10:00 - 11:00 | 43.5 | 43.9 | | | | | |
| 6 | | 11:00 - 12:00 | 44.1 | 43.2 | | | | | |
| 7 | | 12:00 - 13:00 | 44.8 | 43.5 | | | | | |
| 8 | | 13:00 - 14:00 | 45.7 | 44.2 | | | | | |
| 9 | | 14:00 - 15:00 | 48.2 | 48.1 | | | | | |
| 10 | | 15:00 - 16:00 | 48.9 | 48.9 | | | | | |
| 11 | | 16:00 - 17:00 | 43.5 | 44.2 | | | | | |
| 12 | | 17:00 - 18:00 | 36.7 | 37.5 | | | | | |
| 13 | | 18:00 - 19:00 | 36.9 | 36.7 | | | | | |
| 14 | | 19:00 - 20:00 | 36.5 | 34.3 | | | | | |
| 15 | | 20:00 - 21:00 | 34.1 | 34.3 | | | | | |
| 16 | | 21:00 - 22:00 | 33.3 | 33.1 | | | | | |
| | | Leq DAY | 43.2 | 42.9 | | | | | |
| 1 | Noise Level dB(A) Leq -Night | 22:00-23:00 | 33.2 | 33 | CPCB, Protocol for Ambient Level Noise Monitoring - 2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 70 |
| 2 | | 23:00-00:00 | 31.3 | 31.2 | | | | Commercial | 55 |
| 3 | | 00:00-01:00 | 31.2 | 31.3 | | | | Residential | 45 |
| 4 | | 01:00-02:00 | 31.1 | 31.2 | | | | Silence | 50 |
| 5 | | 02:00-03:00 | 31.1 | 31.1 | | | | | |
| 6 | | 03:00-04:00 | 31.2 | 31.7 | | | | | |
| 7 | | 04:00-05:00 | 32.8 | 32.3 | | | | | |
| 8 | | 05:00-06:00 | 33.6 | 34.3 | | | | | |
| | | Leq Night | 32.1 | 32.2 | | | | | |

***All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL Indicates Lower Detection Limit*

| | | | |
|---|---|---|---|
| Sampling Assistants | (Gaurav Kant) | | (Amit Raj Mishra) |
| ANALYSED BY | REVIEWED BY | | Authorised Signatory |

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*--- End of Report ---*

*Page -1 of 1*

Annexure XXVII

CMPDI, RHI
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone: 0326-223-8550
email: rd@cmpdi@coalindia.in

# CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

## Environment Laboratory, Regional Institute-II

## Ambient Noise Level Test Report

| | | | | | |
|---|---|---|---|---|---|
| Month & Year | 04/2025 | Cluster | Cluster IX | ULR No. | TC143212500000182GF |
| Customer | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) | | | Date of Issue | 30.05.2025 |
| Project | | Sample Ref. No. | RRIM/BCCL/2025/04 | Sampling Method | CMPDI/RI-II/LPM 22 |
| Sampling Station | 1 | Bhowrah North | Date of Sampling | 03.04.25 to 18.04.25 | Zone Category of Station: Buffer Zone |

| Sl. No. | Parameter | Hour / Time of day | Observed Values (in Leq dB(A)) First Fortnight | Observed Values (in Leq dB(A)) Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A)Leq - Day | 06.00 - 07.00 | 51.5 | 50.7 | CPCB Protocol for Ambient Level Noise Monitoring -2015 | 35 dB-135 dB | 35 dB(A) | Industrial<br>Commercial<br>Residential<br>Silence | 75<br>65<br>55<br>50 |
| 2 | | 07.00 - 08.00 | 54.3 | 54 | | | | | |
| 3 | | 08.00 - 09.00 | 56.9 | 56.9 | | | | | |
| 4 | | 09.00 – 10.00 | 60 | 61.1 | | | | | |
| 5 | | 10.00 - 11.00 | 60.9 | 60.3 | | | | | |
| 6 | | 11.00 - 12.00 | 61.6 | 61.4 | | | | | |
| 7 | | 12.00 - 13.00 | 64.1 | 63.4 | | | | | |
| 8 | | 13.00 - 14.00 | 57.8 | 55.8 | | | | | |
| 9 | | 14.00 - 15.00 | 54.7 | 53.7 | | | | | |
| 10 | | 15.00 - 16.00 | 46 | 59.9 | | | | | |
| 11 | | 16.00 - 17.00 | 46.1 | 59.3 | | | | | |
| 12 | | 17.00 - 18.00 | 44.5 | 57 | | | | | |
| 13 | | 18.00 - 19.00 | 43.2 | 51 | | | | | |
| 14 | | 19.00 - 20.00 | 43.4 | 42.4 | | | | | |
| 15 | | 20.00 - 21.00 | 43.5 | 44.1 | | | | | |
| 16 | | 21.00 - 22.00 | 42.9 | 44 | | | | | |
| | | Leq DAY | 57.1 | 57.9 | | | | | |
| 1 | Noise Level dB(A)Leq -Night | 22.00-23.00 | 45.4 | 45.7 | CPCB Protocol for Ambient Level Noise Monitoring -2015 | 35 dB-135 dB | 35 dB(A) | Industrial<br>Commercial<br>Residential<br>Silence | 70<br>55<br>45<br>50 |
| 2 | | 23.00- 00.00 | 45.3 | 45.1 | | | | | |
| 3 | | 00.00- 01.00 | 45.1 | 44.8 | | | | | |
| 4 | | 01.00-02.00 | 44.8 | 45 | | | | | |
| 5 | | 02.00-03.00 | 44.7 | 45.1 | | | | | |
| 6 | | 03.00-04.00 | 45.7 | 45.8 | | | | | |
| 7 | | 04.00-05.00 | 45.8 | 46.2 | | | | | |
| 8 | | 05.00-06.00 | 46.2 | 46.5 | | | | | |
| | | Leq Night | 45.4 | 45.6 | | | | | |

***All noise measurements are integrated for a 01 hour period. All units in dB(A). *LDL is denotes Lower Detection Limit*

Sampling Assistants — (Gaurav Kant) — (Amit Raj Mishra)

ANALYSED BY — REVIEWED BY — Authorised Signatory

*Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.*

*—End of Report—*

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Annexure-IPRVII

CMPDI, R-II
KOYLA BHAWAN COMPLEX
DHANBAD- 826005
Phone 0326-229-850
e-mail: rdi2cmpdi@coalindia.in

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Noise Level Test Report

| Month & Year: | 04/2025 | Cluster: | Cluster IX | | | | ULR No. | TC143212500001826F |
|---|---|---|---|---|---|---|---|---|
| Customer: | Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad [E-mail: gmenvbcd@coalindia.in] | | | | | | Date of Issue | 30.05.2025 |
| Project: | | Sample Ref. No. | REM/BCCL/2025/04 | | Sampling Method | | CMPDI/RI-II/LPM 22 | |
| Sampling Station: | 1 | Hurriladih UGP | Date of Sampling | 03.04.25 | 18.04.25 | Zone Category of Station: | | Buffer Zone |

| Sl No. | Parameter | Hour / Time of day | Observed Values (in leq dB(A)) First Fortnight | Observed Values (in leq dB(A)) Second Fortnight | Method of Analysis | Range Of Testing | LDL | NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards: Zones | Limits in dB |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Noise Level dB(A Leq) -Day | 06.00 - 07.00 | 46 | 44.8 | CPCB, Protocol for Ambient Level Noise Monitoring-2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 75 |
| 2 | | 07.00 - 08.00 | 49.2 | 48.1 | | | | Commercial | 65 |
| 3 | | 08.00 - 09.00 | 51.4 | 51.4 | | | | Residential | 55 |
| 4 | | 09.00 – 10.00 | 56.9 | 57.3 | | | | Silence | 50 |
| 5 | | 10.00 - 11.00 | 58 | 58.9 | | | | | |
| 6 | | 11.00 - 12.00 | 57 | 57.3 | | | | | |
| 7 | | 12.00 - 13.00 | 59.5 | 58.7 | | | | | |
| 8 | | 13.00 - 14.00 | 50.5 | 51.1 | | | | | |
| 9 | | 14.00 - 15.00 | 42.3 | 42.7 | | | | | |
| 10 | | 15.00 - 16.00 | 42.3 | 42.2 | | | | | |
| 11 | | 16.00 - 17.00 | 42.8 | 42.9 | | | | | |
| 12 | | 17.00 - 18.00 | 36 | 37.6 | | | | | |
| 13 | | 18.00 - 19.00 | 44.3 | 43.6 | | | | | |
| 14 | | 19.00 - 20.00 | 42.2 | 41.6 | | | | | |
| 15 | | 20.00 - 21.00 | 43.4 | 44.8 | | | | | |
| 16 | | 21.00 - 22.00 | 44.7 | 44.4 | | | | | |
| | | Leq DAY | 52.8 | 52.9 | | | | | |
| 1 | Noise Level dB(A Leq) Night | 22.00-23.00 | 46 | 45.3 | CPCB, Protocol for Ambient Level Noise Monitoring-2015 | 35 dB-135 dB | 35 dB(A) | Industrial | 70 |
| 2 | | 23.00-00.00 | 45.8 | 45.4 | | | | Commercial | 55 |
| 3 | | 00.00-01.00 | 45.1 | 45.2 | | | | Residential | 45 |
| 4 | | 01.00-02.00 | 45 | 45.6 | | | | Silence | 50 |
| 5 | | 02.00-03.00 | 45.3 | 45.9 | | | | | |
| 6 | | 03.00-04.00 | 42 | 45 | | | | | |
| 7 | | 04.00-05.00 | 42.1 | 41.2 | | | | | |
| 8 | | 05.00-06.00 | 41.7 | 40.7 | | | | | |
| | | Leq Night | 44.8 | 44.7 | | | | | |

*All noise measurements are integrated for a 01 hour period, All units in dB(A) *L.D. indicates Lower Detection Limit

| Sampling Assistants | | (Gaurav Kant) | | | (Amit Raj Mishra) |
|---|---|---|---|---|---|
| ANALYSED BY | | REVIEWED BY | | | Authorised Signatory |

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.

—End of Report—

Page - 1 of 1

**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<br><br>Coal mines located in the coal fields of<br>• Jharia<br>• Raniganj<br>• Bokaro | Suspended Particulate Matter (SPM) | Annual Average *<br>24 hours **| 500 µg/m³<br><br>700 µg/m³ | - High Volume Sampling (Average flow rate not less than 1.1 |
| | Respirable Particulate Matter (size less than 10 µm) (RPM) | Annual Average *<br>24 hours **| 250 µg/m³<br><br>300 µg/m³ | Respirable Particulate Matter sampling and analysis |
| | Sulphur Dioxide ($SO_2$) | Annual Average *<br>24 hours **| 80 µg/m³<br><br>120 µg/m³ | 1.Improvedwest and Gaeke method<br>2.Ultraviolet fluorescene |
| | Oxide of Nitrogen as $NO_2$ | Annual Average *<br>24 hours **| 80 µg/m³<br><br>120 µg/m³ | 1. Jacob & Hochheiser Modified (Na-Arsenic) Method<br>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/8hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days.

# NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

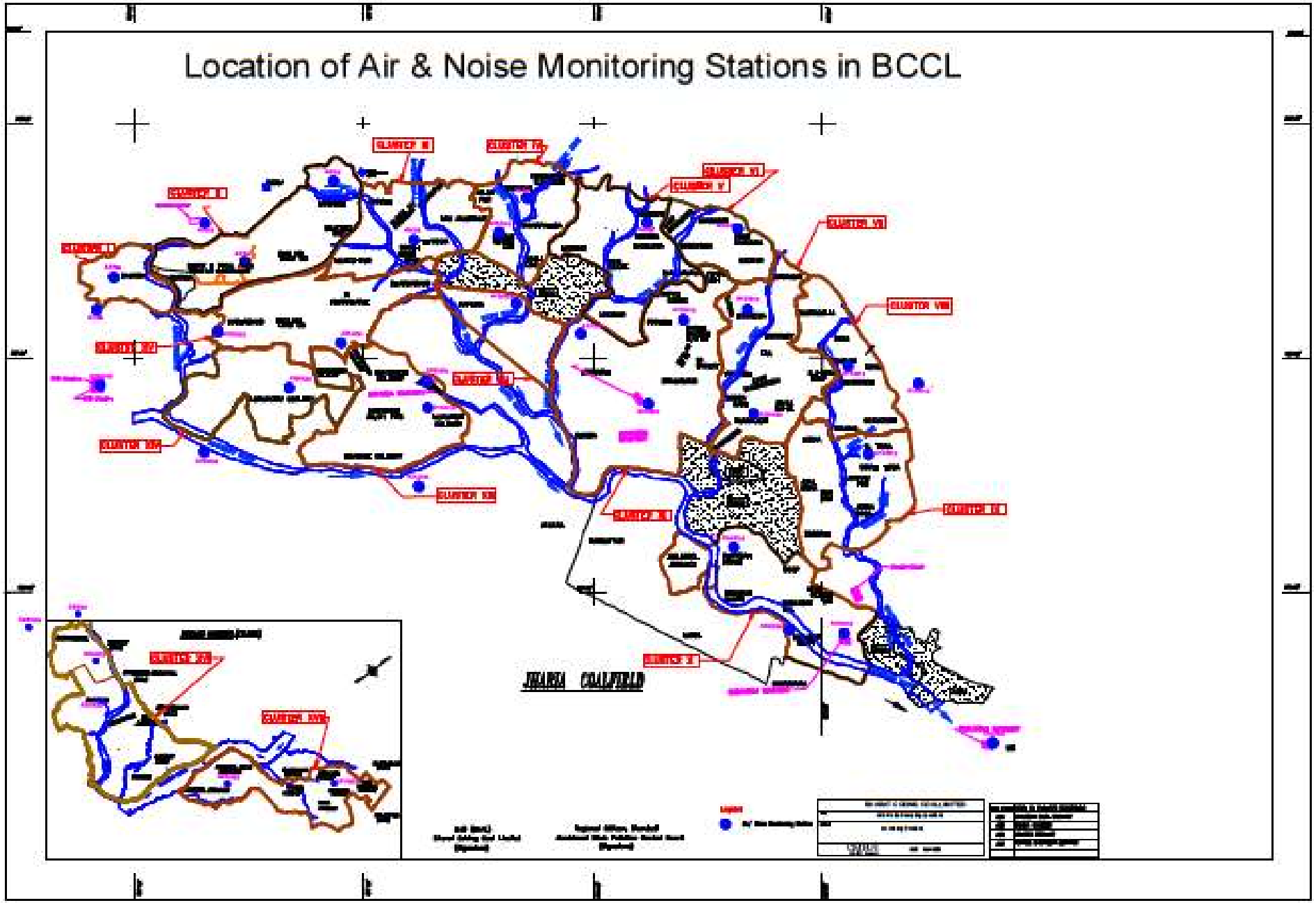
In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th November 1998, the Central Pollution Control 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 * | 50 | 20 | -Improved West and Gaeke Method |
| | 24 Hours ** | 80 | 80 | -Ultraviolet Fluorescence |
| Nitrogendioxide ($NO_2$), µg/m³ | Annual * | 40 | 30 | -Jacob &Hochheiser modified ($NaOH$-$NaAsO_2$) Method |
| | 24 Hours ** | 80 | 80 | -Gas Phase Chemiluminescence |
| Particulate Matter (Size less than 10µm) or $PM_{10}$, µg/m³ | Annual * | 60 | 60 | -Gravimetric |
| | 24 Hours ** | 100 | 100 | -TEOM |
| | | | | -Beta attenuation |
| Particulate Matter (Size less than 2.5µm) or $PM_{2.5}$, µg/m³ | Annual * | 40 | 40 | -Gravimetric |
| | 24 Hours ** | 60 | 60 | -TEOM |
| | | | | -Beta attenuation |
| Ozone ($O_3$) , µg/m³ | 8 Hours ** | 100 | 100 | -UV Photometric |
| | 1 Hour ** | 180 | 180 | -Chemiluminescence |
| | | | | -Chemical Method |
| Lead (Pb) , µg/m³ | Annual * | 0.50 | 0.50 | -AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper |
| | 24 Hours ** | 1.0 | 1.0 | -ED-XRF using Teflon filter |
| Carbon Monoxide (CO), mg/m³ | 8 Hours ** | 02 | 02 | -Non dispersive Infrared (NDIR) Spectroscopy |
| | 1 Hour ** | 04 | 04 | |
| Ammonia ($NH_3$), µg/m³ | Annual * | 100 | 100 | -Chemiluminescence |
| | 24 Hours ** | 400 | 400 | -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
JHARIA COALFIELD

**Annexure XXVIII**

Form 59

[See rules 115 (2)]

**Pollution Under Control Certificate**

Authorised By :
Government of Jharkhand

| | | |
|---|---|---|
| **Date** | : | **07/09/2022** |
| **Time** | : | **08:57:22 AM** |
| **Validity upto** | : | **06/03/2023** |

| | | |
|---|---|---|
| Certificate Sl. No. | : | JH01002200003318 |
| Registration No. | : | JH13B5629 |
| Date of Registration | : | 23/Oct/2014 |
| Month & Year of Manufacturing | : | September-2014 |
| Valid Mobile Number | : | ******7121 |
| Emission Norms | : | BHARAT STAGE III |
| Fuel | : | DIESEL |
| PUC Code | : | JH0100220 |
| GSTIN | : | |
| Fees | : | Rs.300.00 (GST to be paid extra as applicable) |
| MIL observation | : | No |

Vehicle Photo with Registration plate
60 mm x 30 mm

| Sr. No. | Pollutant (as applicable) | Units (as applicable) | Emission limits | Measured Value (upto 2 decimal places) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Idling Emissions | Carbon Monoxide (CO) | percentage (%) | | |
| | Hydrocarbon, (THC/HC) | ppm | | |
| High idling emissions | CO | percentage (%) | | |
| | RPM | RPM | 2500 ± 200 | |
| | Lambda | - | 1 ± 0.03 | |
| Smoke Density | Light absorption coefficient | 1/metre | 2.45 | 0.02 |

This PUC certificate is system generated through the national register of motor vehicles and does not require any signature.

Note : 1. Vehicle owners to link their mobile numbers to registered vehicle by logging to https://vahan.parivahan.gov.in

Authorised Signature with stamp of PUC operator
60mm x 20 mm

Scanned with CamScanner

Scanned with CamScanner

Form 59

[See rules 115 (2)]

**...ion Under Control Certificate**

...orised By :

Government of Jharkhand

| | | |
|---|---|---|
| **Date** | : | **14/07/2022** |
| **Time** | : | **08:50:51 AM** |
| **Validity upto** | : | **13/01/2023** |

| | | |
|---|---|---|
| Certificate SL No | : | JH01003440000032 |
| Registration No. | : | JH10CC4908 |
| Date of Registration | : | 05/Feb/2010 |
| Month & Year of Manufacturing | : | February-2010 |
| Valid Mobile Number | : | ******4222 |
| Emission Norms | : | BHARAT STAGE III |
| Fuel | : | DIESEL |
| PUC Code | : | JH0100344 |
| GSTIN | : | |
| Fees | : | Rs.300.00 (GST to be paid extra as applicable) |
| MIL observation | : | No |

Vehicle Photo with Registration plate
60 mm x 30 mm

| Sr. No. | Pollutant (as applicable) | Units (as applicable) | Emission limits | Measured Value (upto 2 decimal places) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Idling Emissions | Carbon Monoxide (CO) | percentage (%) | | |
| | Hydrocarbon, (THC/HC) | ppm | | |
| High idling emissions | CO | percentage (%) | | |
| | RPM | RPM | 2500 ± 200 | |
| | Lambda | - | 1 ± 0.03 | |
| Smoke Density | Light absorption coefficient | 1/metre | 2.45 | 0.42 |

This PUC certificate is system generated through the national register of motor vehicles and does not require any signature.

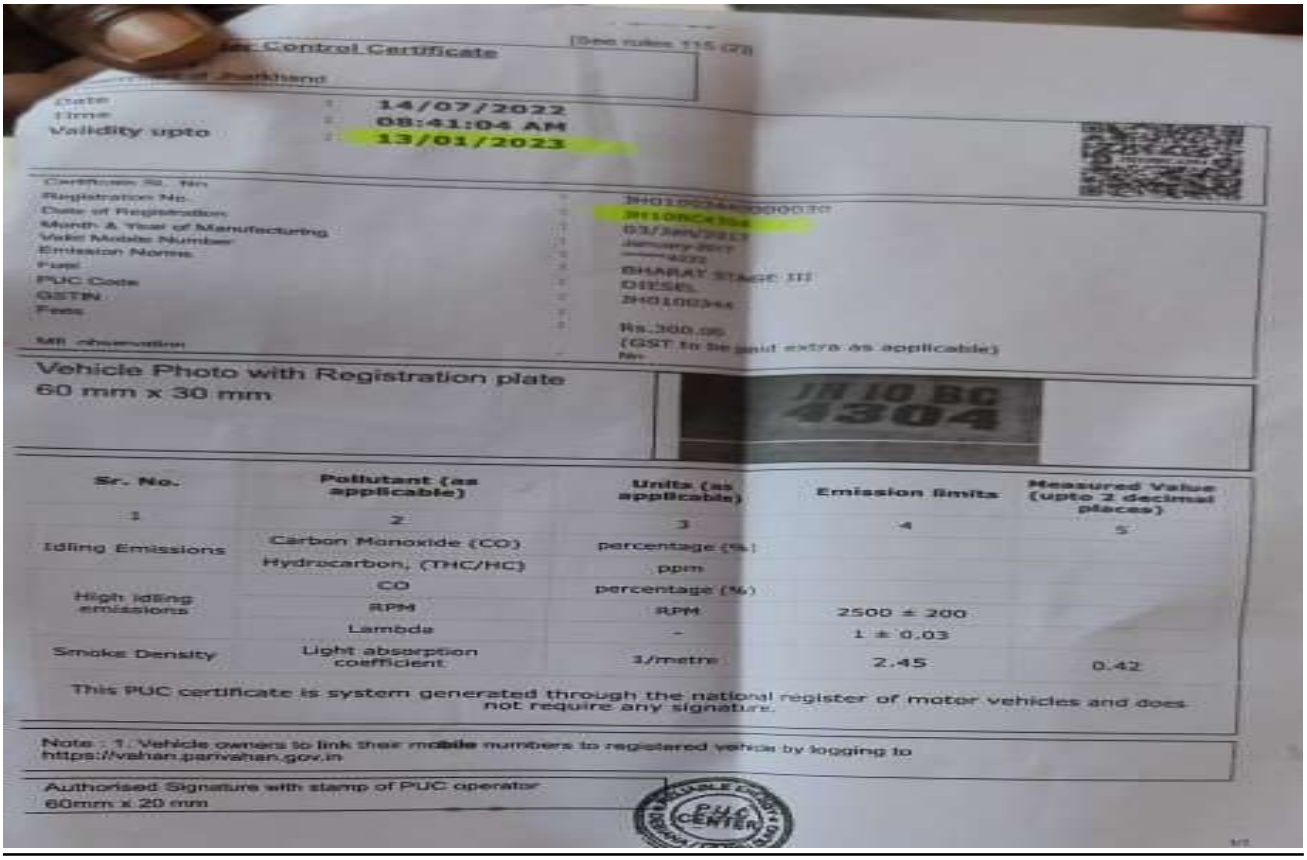
Note : 1. Vehicle owners to link their mobile numbers to registered vehicle by logging to https://vahan.parivahan.gov.in

Authorised Signature with stamp of PUC operator
60mm x 20 mm

RELIABLE ENERGY * P.U.C CENTER * DEBIANA / GOPALGANG

1/1

Scanned with CamScanner



[See rules 115 (2)]

Control Certificate

Validity upto : 14/07/2022 08:41:04 AM 13/01/2023

Registration No. : JH10BC4304
Date of Registration : 03/Jan/2017
Month & Year of Manufacturing : January-2017
Emission Norms : BHARAT STAGE III
Fuel : DIESEL
PUC Code : JH0100344
Fees : Rs.300.00
(GST to be paid extra as applicable)

Vehicle Photo with Registration plate
60 mm x 30 mm

JH 10 BC 4304

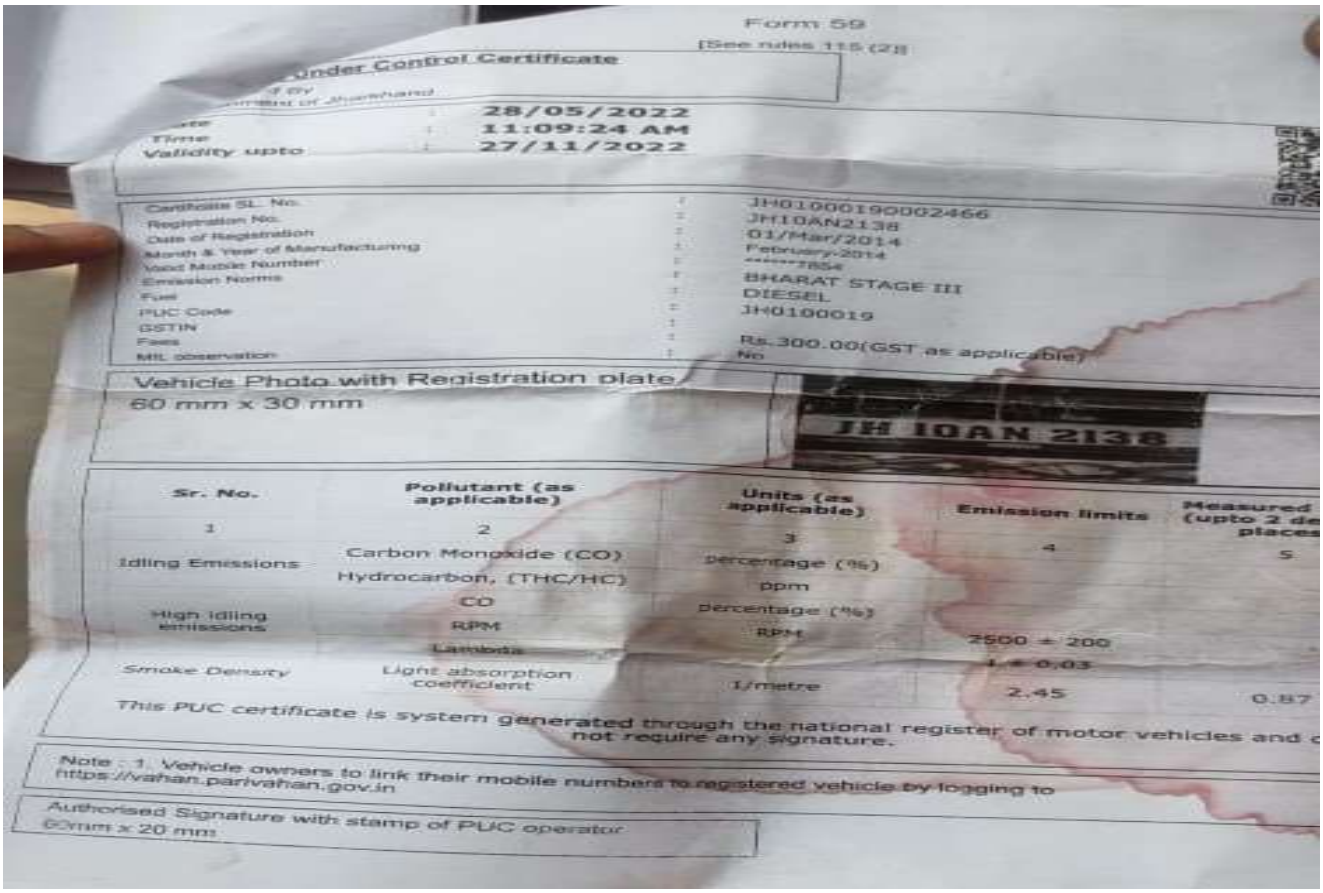
| Sr. No. | Pollutant (as applicable) | Units (as applicable) | Emission limits | Measured Value (upto 2 decimal places) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Idling Emissions | Carbon Monoxide (CO) | percentage (%) | | |
| | Hydrocarbon, (THC/HC) | ppm | | |
| High idling emissions | CO | percentage (%) | | |
| | RPM | RPM | 2500 ± 200 | |
| | Lambda | - | 1 ± 0.03 | |
| Smoke Density | Light absorption coefficient | 1/metre | 2.45 | 0.42 |

This PUC certificate is system generated through the national register of motor vehicles and does not require any signature.

Note : 1. Vehicle owners to link their mobile numbers to registered vehicle by logging to https://vahan.parivahan.gov.in

Authorised Signature with stamp of PUC operator
60mm x 20 mm

PUC CENTER



Form 59

[See rules 115 (2)]

Under Control Certificate

Validity upto : 28/05/2022 11:09:24 AM 27/11/2022

Certificate SL. No. : JH0100019000246
Registration No. : JH10AN2138
Date of Registration : 01/Mar/2014
Month & Year of Manufacturing : February-2014
Emission Norms : BHARAT STAGE III
Fuel : DIESEL
PUC Code : JH0100019
Fees : Rs.300.00(GST as applicable)
MIL observation : No

Vehicle Photo with Registration plate
60 mm x 30 mm

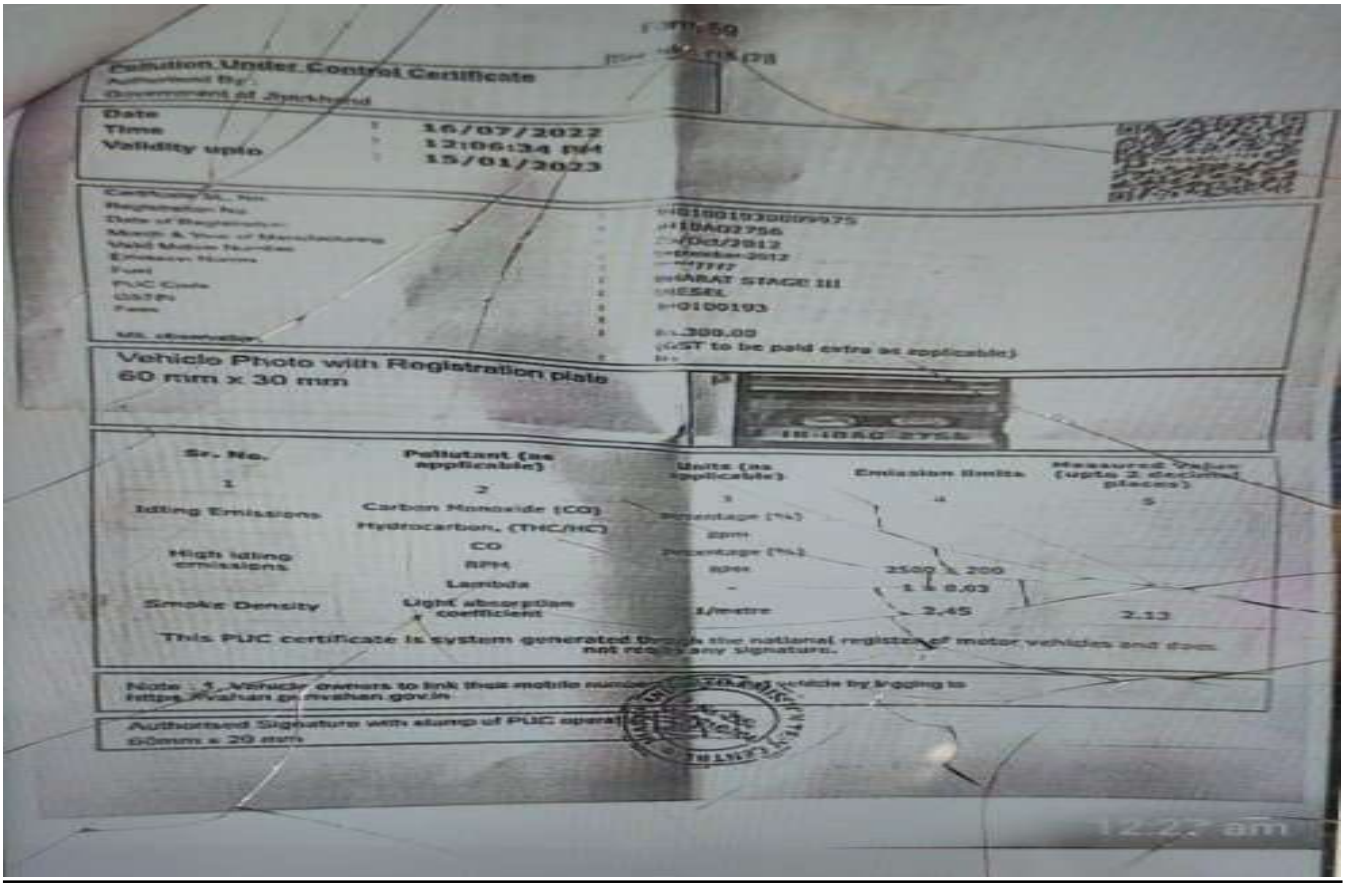
JH 10AN 2138

| Sr. No. | Pollutant (as applicable) | Units (as applicable) | Emission limits | Measured (upto 2 de places |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Idling Emissions | Carbon Monoxide (CO) | percentage (%) | | |
| | Hydrocarbon, (THC/HC) | ppm | | |
| High idling emissions | CO | percentage (%) | | |
| | RPM | RPM | 2500 ± 200 | |
| | Lambda | | 1 ± 0.03 | |
| Smoke Density | Light absorption coefficient | 1/metre | 2.45 | 0.87 |

This PUC certificate is system generated through the national register of motor vehicles and d not require any signature.

Note : 1. Vehicle owners to link their mobile numbers to registered vehicle by logging to https://vahan.parivahan.gov.in

Authorised Signature with stamp of PUC operator
60mm x 20 mm



Pollution Under Control Certificate
Authorised By :
Government of Jharkhand

| | | |
|---|---|---|
| Date | : | 16/07/2022 |
| Time | : | 12:06:34 PM |
| Validity upto | : | 15/01/2023 |

| | | |
|---|---|---|
| Certificate SL. No. | : | JH01019300009975 |
| Registration No. | : | JH10BA2756 |
| Date of Registration | : | [illegible]/Dec/2012 |
| Month & Year of Manufacturing | : | [illegible]-2012 |
| Valid Mobile Number | : | [illegible] |
| Emission Norms | : | BHARAT STAGE III |
| Fuel | : | DIESEL |
| PUC Code | : | JH0100193 |
| GSTIN | : | |
| Fees | : | Rs.300.00 |
| MB. observation | : | (GST to be paid extra as applicable) |

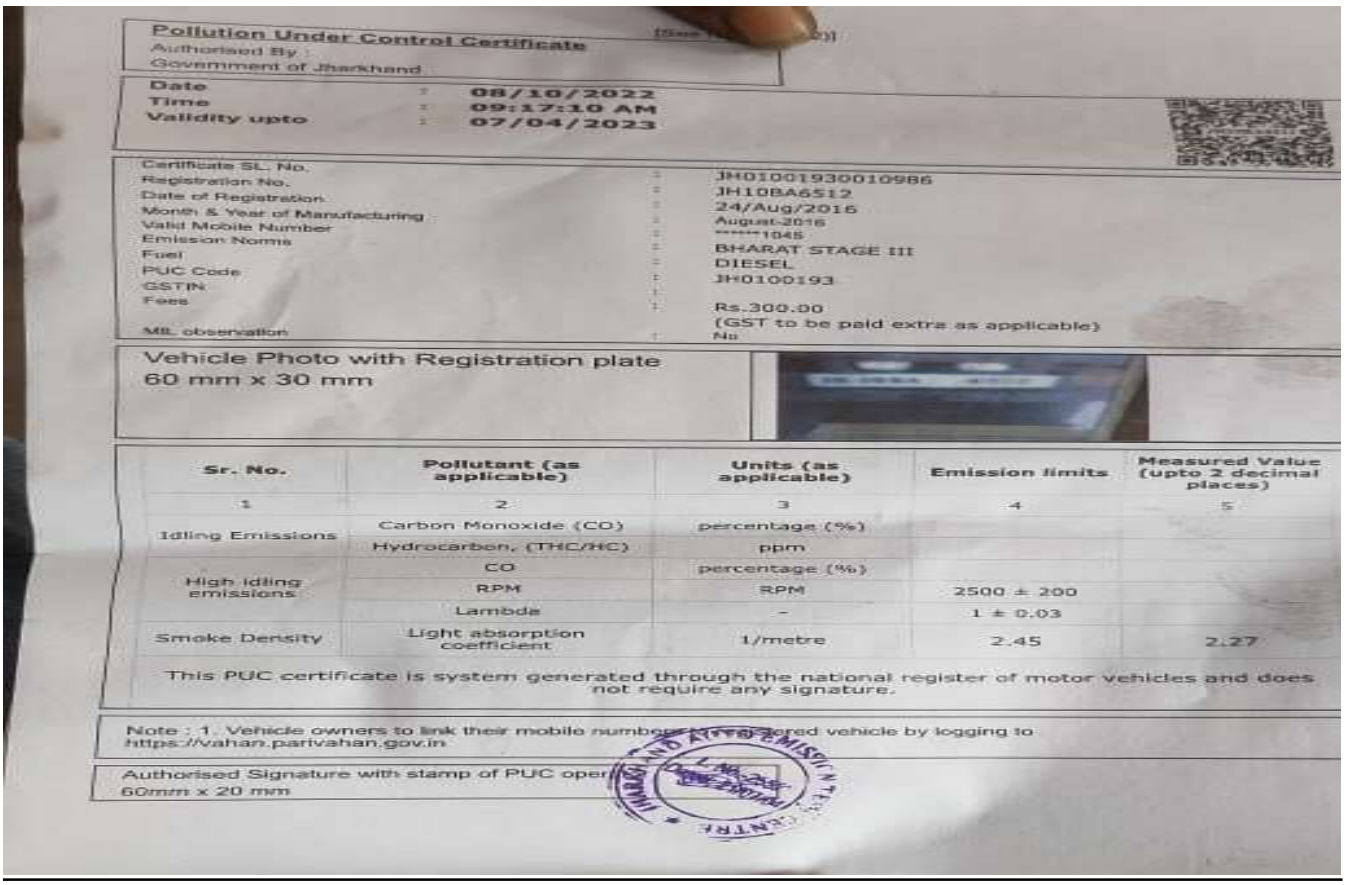
Vehicle Photo with Registration plate
60 mm x 30 mm

| Sr. No. | Pollutant (as applicable) | Units (as applicable) | Emission limits | Measured Value (upto 2 decimal places) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Idling Emissions | Carbon Monoxide (CO) | Percentage (%) | | |
| | Hydrocarbon, (THC/HC) | ppm | | |
| High idling emissions | CO | Percentage (%) | | |
| | RPM | RPM | 2500 ± 200 | |
| | Lambda | - | 1 ± 0.03 | |
| Smoke Density | Light absorption coefficient | 1/metre | 2.45 | 2.13 |

This PUC certificate is system generated through the national register of motor vehicles and does not require any signature.

Note : 1. Vehicle owners to link their mobile number to registered vehicle by logging to https://vahan.parivahan.gov.in

Authorised Signature with stamp of PUC operator
60mm x 20 mm



Pollution Under Control Certificate
Authorised By :
Government of Jharkhand

| | | |
|---|---|---|
| Date | : | 08/10/2022 |
| Time | : | 09:17:10 AM |
| Validity upto | : | 07/04/2023 |

| | | |
|---|---|---|
| Certificate SL. No. | : | JH01001930010986 |
| Registration No. | : | JH10BA6512 |
| Date of Registration | : | 24/Aug/2016 |
| Month & Year of Manufacturing | : | August-2016 |
| Valid Mobile Number | : | ******1045 |
| Emission Norms | : | BHARAT STAGE III |
| Fuel | : | DIESEL |
| PUC Code | : | JH0100193 |
| GSTIN | : | |
| Fees | : | Rs.300.00 |
| MB. observation | : | (GST to be paid extra as applicable)<br>No |

Vehicle Photo with Registration plate
60 mm x 30 mm

| Sr. No. | Pollutant (as applicable) | Units (as applicable) | Emission limits | Measured Value (upto 2 decimal places) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Idling Emissions | Carbon Monoxide (CO) | percentage (%) | | |
| | Hydrocarbon, (THC/HC) | ppm | | |
| High idling emissions | CO | percentage (%) | | |
| | RPM | RPM | 2500 ± 200 | |
| | Lambda | - | 1 ± 0.03 | |
| Smoke Density | Light absorption coefficient | 1/metre | 2.45 | 2.27 |

This PUC certificate is system generated through the national register of motor vehicles and does not require any signature.

Note : 1. Vehicle owners to link their mobile number to registered vehicle by logging to https://vahan.parivahan.gov.in

Authorised Signature with stamp of PUC operator
60mm x 20 mm

Form 59

[See rules 115 (2)]

**Pollution Under Control Certificate**

Authorised By :
Government of Jharkhand

| | | |
|---|---|---|
| Date | : | 19/11/2022 |
| Time | : | 12:35:49 PM |
| Validity upto | : | 18/05/2023 |

| | | |
|---|---|---|
| Certificate SL. No. | : | JH01000090008454 |
| Registration No. | : | JH02AF1032 |
| Date of Registration | : | 16/Apr/2015 |
| Month & Year of Manufacturing | : | February-2015 |
| Valid Mobile Number | : | ******1111 |
| Emission Norms | : | BHARAT STAGE III |
| Fuel | : | DIESEL |
| PUC Code | : | JH0100009 |
| GSTIN | : | |
| Fees | : | Rs.300.00 (GST to be paid extra as applicable) |
| MIL observation | : | No |

Vehicle Photo with Registration plate
60 mm x 30 mm

| Sr. No. | Pollutant (as applicable) | Units (as applicable) | Emission limits | Measured Value (upto 2 decimal places) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Idling Emissions | Carbon Monoxide (CO) | percentage (%) | | |
| | Hydrocarbon, (THC/HC) | ppm | | |
| High idling emissions | CO | percentage (%) | | |
| | RPM | RPM | 2500 ± 200 | |
| | Lambda | - | 1 ± 0.03 | |
| Smoke Density | Light absorption coefficient | 1/metre | 2.45 | 2.35 |

This PUC certificate is system generated through the national register of motor vehicles and does not require any signature.

Note : 1. Vehicle owners to link their mobile numbers to registered vehicle by logging to https://vahan.parivahan.gov.in

Authorised Signature with stamp of PUC operator
60mm x 20 mm

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Form 59

[See rules 115 (2)]

**Pollution Under Control Certificate**

Authorised By
Government of Jharkhand

| | | |
|---|---|---|
| Date | : | 17/09/2022 |
| Time | : | 11:04:50 AM |
| Validity upto | : | 16/03/2023 |

| | | |
|---|---|---|
| Certificate SL. No. | : | JH01002200003374 |
| Registration No. | : | JH10AQ9302 |
| Date of Registration | : | 04/Jul/2014 |
| Month & Year of Manufacturing | : | July-2014 |
| Valid Mobile Number | : | ******8686 |
| Emission Norms | : | BHARAT STAGE III |
| Fuel | : | DIESEL |
| PUC Code | : | JH0100220 |
| GSTIN | : | |
| Fees | : | Rs.300.00 (GST to be paid extra as applicable) |
| MIL observation | : | No |

Vehicle Photo with Registration plate
60 mm x 30 mm

| Sr. No. | Pollutant (as applicable) | Units (as applicable) | Emission limits | Measured Value (upto 2 decimal places) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Idling Emissions | Carbon Monoxide (CO) | percentage (%) | | |
| | Hydrocarbon, (THC/HC) | ppm | | |
| High idling emissions | CO | percentage (%) | | |
| | RPM | RPM | 2500 ± 200 | |
| | Lambda | - | 1 ± 0.03 | |
| Smoke Density | Light absorption coefficient | 1/metre | 2.45 | 0.02 |

This PUC certificate is system generated through the national register of motor vehicles and does not require any signature.

Note : 1. Vehicle owners to link their mobile numbers to registered vehicle by logging to https://vahan.parivahan.gov.in

Authorised Signature with stamp of PUC operator
60mm x 20 mm

## Annexure XXIX

# Expenditure made as per EMP for Cluster-IX

### Capital Cost of Environment Management

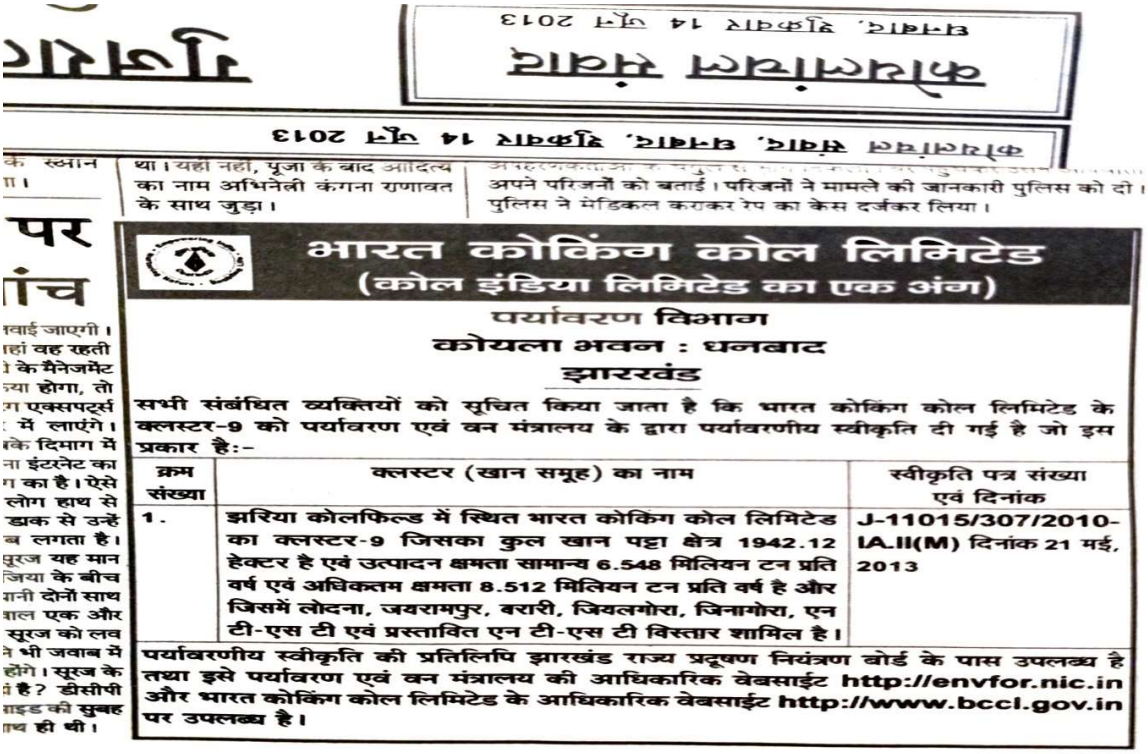
| Sl. No. | Item | Year | Cost (Lakhs) | Remarks |
|---|---|---|---|---|
| **1.** | 2.70-3.5 m3 Diesel Hyd. Shovel (For reclamation and other Misc. jobs) | **2013-14** | **217.00** | **-** |
| **2.** | 8 m3/te tipper | **2013-14** | **264.00** | **-** |
| **3.** | Dozer 355 dp | **2016-17** | **613.00** | **-** |
| **4.** | Water Sprinkler (10 KL & 28 KL) | **2013-14** | **340.28** | **-** |
| **5.** | **POLLUTION MONITORING** | | | **-** |
| | a) Respirable dust sampler | **CMPDIL has been hired for monitoring works and charges of monitoring paid to CMPDI is indicated in monitoring cost.** | | |
| | b) Micro-meteorological station | | | |
| | c) Laboratory for testing | | | |
| | d) Acoustics for noise pollution control | | | |
| **6.** | Lab Equipment's for monitoring and analyzing air , dust , water , soil , noise , vibration & lighting standards | | | |
| **7.** | Domestic Effluent Treatment Plant (Septic tanks) | **2017-18** | **5.00** | **-** |
| **8.** | Industrial Effluent Treatment Plant | **2012-13** | **2.00** | **-** |
| **9.** | Procurement of 15 nos. of Rain Gun type fixed sprinkler for Railway Siding | **2019-20** | **2.12** | **-** |
| **10.** | Procurement of Truck Mounted Fog Cannon | **2021-22** | **24.80** | |
| **11.** | Procurement of 02 nos. of PM10 Analyzer | **2021-22** | **42.69** | |
| **12.** | Procurement of DWLR | **2022-23** | **0.75** | |

## Revenue Cost of Environment Management

| Sl. No. | Item | Actual cost incurred (lakhs) | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | FY 2016-17 | FY 2017-18 | FY 2018-19 | FY 2019-20 | FY 2020-21 | FY 2021-22 | FY 2022-23 | |
| 1. | Air quality Monitoring Cost | Approx. 5.8428 | Approx. 25.26503 | Approx. 30.07068 | Approx. 20.97 | Approx. 8.53 | Approx. 11.03 | Apprx. 20.88 | As per information provided by Env department, HQ: Being done by CMPDIL RI-II Dhanbad |
| 2. | Water quality Monitoring Cost | | | | | | | | |
| 3. | Noise Monitoring Cost | | | | | | | | |
| 4. | Green Belt Development | 331.78572 (9292 nos. of Manpower with EMS @3570.66) | 364.25468 (9944 nos. of Manpower with EMS @ 3663.06) | 342.64941 (7434 nos. of Manpower with EMS @ 4609.22) | 208.85581 (4079 nos. of Manpower with EMS @ 5120.27) | 225.84768 (4832 nos. of Manpower with EMS @ 4674.00) | 329.20915 (4723 nos. of Manpower with EMS @ 6970.34.00) | 298.92 (4123 nos. of Manpower with EMS @ 7250.43) | Manpower Cost incurred on Green Belt Development |
| 5. | Ecological Restoration | 33.31425 | 5.49459 | 43.00402 | 47.77211 | **7.28** | **27.38** | | - |
| 6. | CSR | 1145 | 274 | 143 | 601 | **239 (provisional exp.)** | | | **Being Done at M/S BCCL HQ** |
| 7. | Miscellaneous | 189.32444 | 229.15276 | 318.48138 | | | | | Protective measures taken for the prevention of dust generation from the waste material. Water Sprinkling on haul roads |

1. EMP Preparation Cost: **Rs.107.21 Lakhs** (As per information provided by Env. Deptt. HQ, BCCL)
2. Toe wall Construction (**2020-21**)- **Rs.2,30,000.00**
3. Separate Reservoir of Oil and water in O&G Trap**- Rs.70,000.00**
4. Plantation Cost (16 Ha. of OB dump reclaimed by- **Rs.99,287.00** DFO, Dhanbad) - for the FY 2020-21
5. Maintenance of Gokul park- **Rs.**1.2 lakh/year
6. CTE of NT-ST-JG GROUP OF MINES- **Rs.**8,33,280.00
7. CTO (upto March'23) of NT-ST-JG GROUP OF MINES- **Rs.**10,99,882.00
8. CTE of Amal. Joyrampur OC- **Rs.**75,000.00
9. CTO (upto June'22) of Amal. Joyrampur OC- **Rs.**3,37,500.00
10. Plantation Cost (Approx.) (16 Ha. of OB dump reclaimed by DFO, Dhanbad) - for the FY 2020-21 **Rs.** 15,88,599.00
11. Plantation Cost (Approx.) (16 Ha. of OB dump reclaimed by DFO, Dhanbad) - for the FY 2021-22 **Rs.** 06,76,834.00
12. Avenue Plantation Cost FY 2020-21 (to be done by DFO, Dhanbad) **Rs.** 12,29,190.00
13. Avenue Plantation Cost FY 2021-22 (to be done by DFO, Dhanbad) **Rs.** 06,70,776.00

**Annexure XXX**



था। यहां नहीं, पूजा के बाद आदित्य का नाम अभिनेत्री कंगना रणावत के साथ जुड़ा।

अपने परिजनों को बताई। परिजनों ने मामले की जानकारी पुलिस को दी। पुलिस ने मेडिकल कराकर रेप का केस दर्जकर लिया।

## भारत कोकिंग कोल लिमिटेड
### (कोल इंडिया लिमिटेड का एक अंग)

**पर्यावरण विभाग**

**कोयला भवन : धनबाद**

**झारखंड**

**सभी संबंधित व्यक्तियों को सूचित किया जाता है कि भारत कोकिंग कोल लिमिटेड के क्लस्टर-9 को पर्यावरण एवं वन मंत्रालय के द्वारा पर्यावरणीय स्वीकृति दी गई है जो इस प्रकार है:-**

| क्रम संख्या | क्लस्टर (खान समूह) का नाम | स्वीकृति पत्र संख्या एवं दिनांक |
|---|---|---|
| 1. | झरिया कोलफिल्ड में स्थित भारत कोकिंग कोल लिमिटेड का क्लस्टर-9 जिसका कुल खान पट्टा क्षेत्र 1942.12 हेक्टर है एवं उत्पादन क्षमता सामान्य 6.548 मिलियन टन प्रति वर्ष एवं अधिकतम क्षमता 8.512 मिलियन टन प्रति वर्ष है और जिसमें लोदना, जयरामपुर, बरारी, जियलगोरा, जिनागोरा, एन टी-एस टी एवं प्रस्तावित एन टी-एस टी विस्तार शामिल है। | J-11015/307/2010-IA.II(M) दिनांक 21 मई, 2013 |

**पर्यावरणीय स्वीकृति की प्रतिलिपि झारखंड राज्य प्रदूषण नियंत्रण बोर्ड के पास उपलब्ध है तथा इसे पर्यावरण एवं वन मंत्रालय की आधिकारिक वेबसाईट http://envfor.nic.in और भारत कोकिंग कोल लिमिटेड के आधिकारिक वेबसाईट http://www.bccl.gov.in पर उपलब्ध है।**

## भारत कोकिंग कोल लिमिटेड
### (कोल इंडिया लिमिटेड का एक अंग)
### पर्यावरण विभाग
### कोयला भवन : धनबाद, झारखण्ड

**सभी सम्बंधित व्यक्तियों को सूचित किया जाता है कि भारत कोकिंग कोल लिमिटेड के क्लस्टर-9 को पर्यावरण एवं वन मंत्रालय के द्वारा पर्यावरणीय स्वीकृति दी गई है जो इस प्रकार है :-**

| क्रम संख्या | क्लस्टर (खान समूह) का नाम | स्वीकृति पत्र संख्या एवं दिनांक |
|---|---|---|
| 1. | झरिया कोलफिल्ड में स्थित भारत कोकिंग कोल लिमिटेड का क्लस्टर-9 जिसका कुल खान पट्टा क्षेत्र 1942.12 हेक्टर है एवं उत्पादन क्षमता सामान्य 6.548 मिलियन टन प्रति वर्ष एवं अधिकतम क्षमता 8.512 मिलियन टन प्रति वर्ष है और जिसमें लोदना, जयराम-पुर, बरारी, जियलगोरा, जिनागोरा, एन टी-एस टी एवं प्रस्तावित एन टी-एस टी विस्तार शामिल है. | J-11015/ 307/2010- IA.II (M) दिनांक 21 मई, 2013 |

**पर्यावरणीय स्वीकृति की प्रतिलिपि झारखंड राज्य प्रदूषण नियंत्रण बोर्ड के पास उपलब्ध है तथा इसे पर्यावरण एवं वन मंत्रालय की आधिकारिक वेबसाईड http://envfor.nic.in और भारत कोकिंग कोल लिमिटेड के आधिकारिक वेबसाईड http://www.bccl.gov.in पर उपलब्ध है.**

**Annexure XXXI**

No. J-11015/307/2010-IA.II (M)
Government of India
Ministry of Environment & Forests

Paryavaran Bhawan,
CGO Complex,
New Delhi-110510.

To

Dated: 21st May, 2013

General Manager (Environment)
M/s Bharat Coking Coal Ltd.
Koyala Bhawan,
Dhanbad-826005
Jharkhand

**Sub. : - Cluster IX group of six mines (combined preproduction capacity of 6.548 MTPA with a peak capacity of 8.512 MTPA in a total combine ML area of 1942.12 ha) of M/S Bharat Coking Coal Limited located in Jharia Coal Field (EC based on TOR granted on 23. 12.2010) -Environment Clearance –reg.**

Sir,

This has reference to the letter no. 430II/40/2010-CPAM dated 05th October, 2010 of Ministry of Coal along with your application for Terms of Reference (TOR) and this Ministry's grant of TOR on 23.12.2010. Reference is also invited to the letters no. BCCL/GM (Env.)/ /F-EMP-Cluster-IX/2012/490 dated 16.06.2012, 28/29.12.2012 and 31.01.2013 on the above-mentioned subject.

2. The Ministry of Environment & Forests has considered the application. It is noted that the proposal is for **Cluster IX group of six mines (combined preproduction capacity of 6.548 MTPA with a peak capacity of 8.512 MTPA in a total combine ML area of 1942.12 ha) of M/S Bharat Coking Coal Limited located in Jharia Coal Field**, dist. Dhanbad, Jharkhand. The proponent has informed that:

21/12/2021
श्रीमति बबिता गोराई
पार्षद
वार्ड संख्या-49
धनबाद नगर निगम

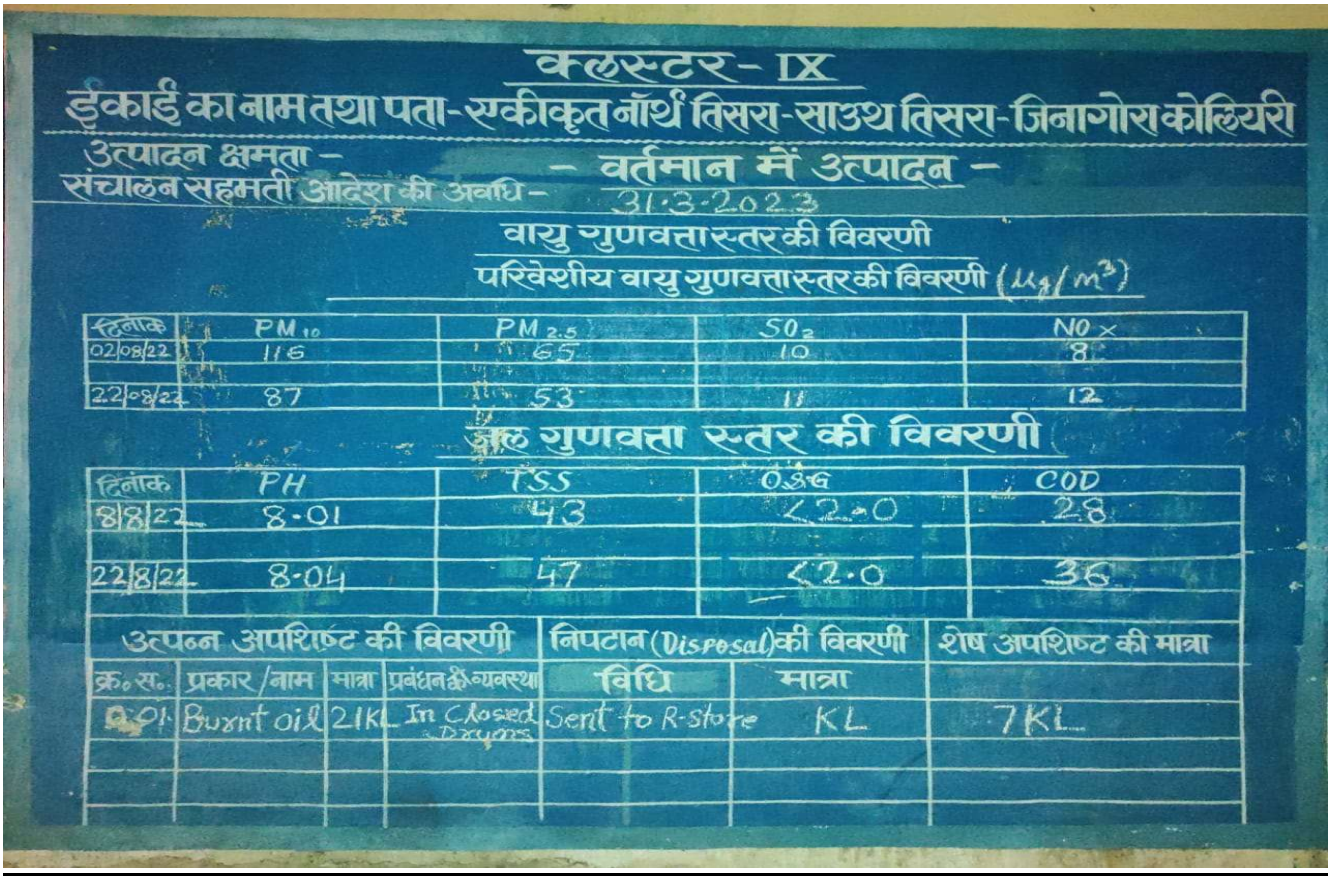
i. There are 6 underground mines (5 operating and 1 UG mine closed for operation only) and 2 OCP mines. The operating underground mines are Lodna UG, North Tisra(UG), Joyrampur (UG), Barari UG, Jealgora (UG), one Jeenagora Underground mine(closed for operation, mine not closed) and two opencast mines are Jeenagora OCP & proposed north Tisra/South Tisra expansion of OCP (NT/ST OCP). The cluster IX is in East-Central part of Jharia Coalfield Nearest Railway station is Bhaga Railway station which is located at 4 Km from Lodna area. Cluster IX mines of BCCL is located in the eastern part of Jharia Coal Field. The Cluster is bounded in the east by metamorphics, in the west by cluster cluster VII mines of BCCL and TISCO mines, in the north by Cluster VIII mines of BCCL and in the south by Cluster X mines of BCCL and metamorphics.

ii. As per the cluster approach, the production capacity of cluster IX is 6.548 MTPA (Normative) and 8.512 MTPA (Peak) in total lease area of 1942.12 ha.

iii. This proposal does not involve change in technology or change in product mix in the mines.

iv. This cluster is severely affected by mine fires and unstable areas. 2.245 sq km of habitated surface area is affected by mine fires and instability consisting of 98 unstable sites as per the approved Jharia Action Plan. In order to deal with the severe problem of fires and unstable sites, it is proposed to amalgamate/ merge some of the

**Annexure XXXII**



क्लस्टर - IX

इकाई का नाम तथा पता - एकीकृत नॉर्थ तिसरा - साउथ तिसरा - जिनागोरा कोलियरी

उत्पादन क्षमता -

संचालन सहमती आदेश की अवधि - 31.3.2023

- वर्तमान में उत्पादन -

वायु गुणवत्ता स्तर की विवरणी

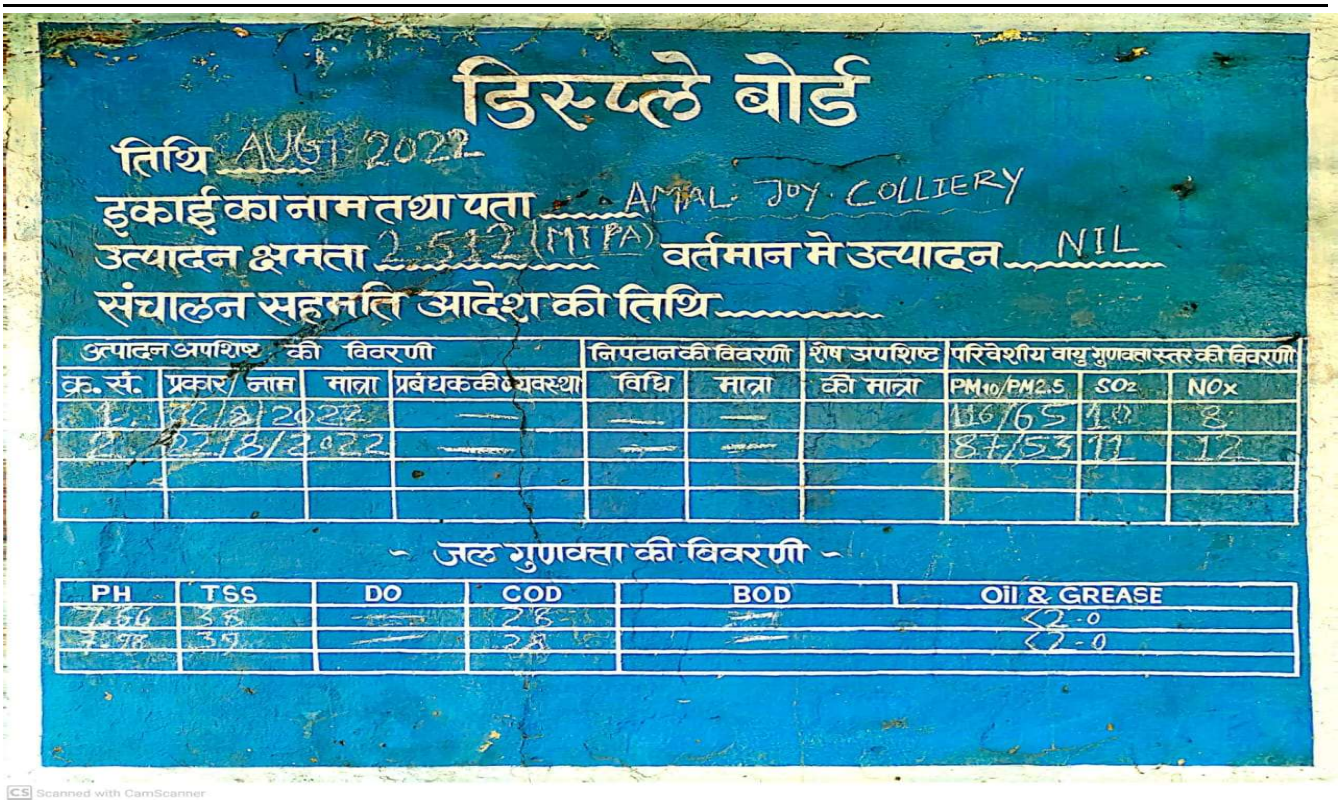
परिवेशीय वायु गुणवत्ता स्तर की विवरणी ($\mu g/m^3$)

| दिनांक | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_x$ |
|---|---|---|---|---|
| 02/08/22 | 116 | 65 | 10 | 8 |
| 22/08/22 | 87 | 53 | 11 | 12 |

जल गुणवत्ता स्तर की विवरणी

| दिनांक | PH | TSS | O&G | COD |
|---|---|---|---|---|
| 8/8/22 | 8.01 | 43 | <2.0 | 28 |
| 22/8/22 | 8.04 | 47 | <2.0 | 36 |

| उत्पन्न अपशिष्ट की विवरणी | | | | निपटान (Disposal) की विवरणी | | शेष अपशिष्ट की मात्रा |
|---|---|---|---|---|---|---|
| क्र.स. | प्रकार/नाम | मात्रा | प्रबंधन की व्यवस्था | विधि | मात्रा | |
| 1. | Burnt oil | 21KL | In Closed Dryers | Sent to R-Store | KL | 7KL |



डिस्प्ले बोर्ड

तिथि AUG 2022

इकाई का नाम तथा पता ..... AMAL JOY COLLIERY

उत्पादन क्षमता 2.512 (MTPA) वर्तमान मे उत्पादन NIL

संचालन सहमति आदेश की तिथि .....

| उत्पादन अपशिष्ट की विवरणी | | | | निपटान की विवरणी | | शेष अपशिष्ट की मात्रा | परिवेशीय वायु गुणवत्ता स्तर की विवरणी | | |
|---|---|---|---|---|---|---|---|---|---|
| क्र. सं. | प्रकार/नाम | मात्रा | प्रबंधक की व्यवस्था | विधि | मात्रा | | $PM_{10}/PM_{2.5}$ | $SO_2$ | $NO_x$ |
| 1. | 22/8/2022 | — | — | — | — | — | 116/65 | 10 | 8 |
| 2. | 22/8/2022 | — | — | — | — | — | 87/53 | 11 | 12 |

- जल गुणवत्ता की विवरणी -

| PH | TSS | DO | COD | BOD | Oil & GREASE |
|---|---|---|---|---|---|
| 7.66 | 38 | — | 28 | — | <2.0 |
| 7.98 | 39 | — | 28 | — | <2.0 |

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भारत कोकिंग कोल लिमिटेड
एक मिनी रत्न कंपनी
(कोल इंडिया का एक अंग)
महाप्रबंधक का कार्यालय
लोदना क्षेत्र ,पो.-भागा
धनबाद -828301,(झारखंड)
वेबसाइट :www.bcclweb.in
ई-मेल gmlodna.bccl@coalindia.in
सी.आई.एन.:U10101JH1972GOI000918

बीसीसीएल
BCCL

Bharat Coking Coal Limited
A Mini Ratna Company
(A Subsidiary of Coal India Limited)
Office of the General Manager
Lodna Area , PO-Bhaga
Dhanbad-828301 (Jharkhand)
Website: www.bcclweb.in
Email: gmlodna.bccl@coalindia.in
CIN:U10101JH1972GOI000918

Ref. No: - BCCL/LA/GM/ENVT/2025-26/ 708 Dated:- 27/9/25

To,
The Member Secretary
Jharkhand State Pollution Control Board
T.A. Building, Ground Floor, HEC, Dhuruva, Ranchi-834004.

Sub:-Submission of Environmental Statement for the financial year 2024-25 ending on the 31st March 2025 in respect of Cluster IX, Lodna Area BCCL.

Dear Sir,

Please find enclosed herewith the environmental statement for financial year 2024-25 ending on the 31st March 2025 in respect of Cluster IX, Lodna Area BCCL. in duly filled form V.

We request you to kindly accept it.

Encl:- As Above

Yours faithfully

General Manager
Cluster IX, Lodna Area ECCL

महाप्रबंधक
लोदना क्षेत्र-10, पो.को.भागा
General Manager
Lodna Area No.-7, B.C.C.L.

Copy to :-

1. The regional Officer, JSPCB, Dhanbad.
2. Office Copy.

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# FORM –V

(See rule 14)

## Environmental Statement For The Financial Year Ending The 31st March 2025

### PART-A

| | | |
|---|---|---|
| (1) | Name and address of the Owner/Occupier of the industry/ Operation or Process: | Sri Nikhil Trivedi, General Manager, Cluster IX group of Mines, Lodna More, Bhaga, Lodna Area, Bharat Coking Coal Ltd |
| (2) | Industry Category primary-(STC Code)<br>Secondary –(STC Code): | Primary |
| (3) | Production Capacity: | 8.512 MTPA |
| (4) | Year of Establishment: | Pre Nationalisation (Pre 1973) |
| (5) | Date of last environmental statement submitted | 30th September, 2024 |

### PART –B

1. Water and Raw Material Consumption

| Water Consumption | Daily In KL |
|---|---|
| 1. Process | 650 |
| 2. Cooling | NIL |
| 3. Domestic | 8200 |

| Name of Products: | Process water consumption per unit of product point | |
|---|---|---|
| | During the previous financial year (2023-24) | During the current financial year (2024-25) |
| COAL | 0.0206 KL/Tonne | 0.3856 KL/Tonnes |

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 (2023-24) | During the current financial year (2024-25) |
| POL (Lit/Tonne) | COAL | 6.17 | 12.45 |
| Explosive (Kg/Tonne) | COAL | 4.85 | 10.09 |

*Industry may use codes if disclosing details of raw material would violate contractual obligations otherwise all industries have to name the material used.

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## PART-C

Pollution discharged to Environment/unit of output (Parameter as specified in the consent issued)

| Pollution | Quality of pollutants Discharged (Mass/Day) | Concentration of pollution discharged (Mass/Volume) | Percentage of variation from prescribed stack with reason. |
|---|---|---|---|
| a) Water | Within permissible limit.<br>Analysis report is enclosed as Annexure -1. | Within the limit. | The quality of water discharge meets the standards. |
| b) Air | Within permissible limit.<br>Analysis report is enclosed as Annexure -1. | Within the limit. | The quality of air meets the standard. |

## PART-D

Hazardous Wastes (As specified under hazardous Wastes / Management and Handling rules, 1989)

| Hazardous Wastes | Total Quantity (in Kg.) | |
|---|---|---|
| | During the previous financial year<br>(2023-24) | During the current financial year<br>(2024-25) |
| a) From Process | 3 KL | 5 KL |
| b) From pollution Control Facilities | NIL | NIL |

## PART –E

Solid Wastes

| Solid Wastes | Total Quantity (in Kg.) | |
|---|---|---|
| | During the previous financial year<br>(2023-24) | During the current financial year<br>(2024-25) |
| a) From Process | OB-267.15 Mm$^3$ | OB- 55.32 Mm$^3$ |

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| | | |
|---|---|---|
| b) From pollution Control Facilities | NIL | NIL |
| 1. Quantity recycled or reutilized with the unit.<br>2. Solid<br>3. Disposal | The overburden excavated during mining operations will be utilized for backfilling the mine voids subsequent to the cessation of mining activities | The overburden excavated during mining operations will be utilized for backfilling the mine voids subsequent to the cessation of mining activities |

## PART –F

Please specify the characterizations (in terms of composite and quantum) of hazardous as well as solid wastes and indicated disposal practice adopted for both these categories of waste.

Hazardous wastes generated mainly from workshops, such as burnt and spent oil, are being stored, transported, and managed in accordance with the Hazardous Waste (Management and Handling) Rules, and are finally disposed of through auctioning via the central store. Overburden (OB) generated as solid waste during mining operations will be systematically utilized for void filling at the end of the mining operations.

## PART –G

Impact of the pollution abatement measures taken on conservation of natural resources and on the cost of production.

1. Water sprinkler tankers are being deployed for dust suppression in operational areas.
2. Mechanical sweepers are being operated to control road dust within the cluster leasehold.
3. An Effluent Treatment Plant (ETP) is being operated at Jealgora Regional Hospital for wastewater management.
4. A pressure filter is being run to ensure potable water supply.
5. Coal is being transported in covered carriers to minimize fugitive emissions.
6. Mobile water sprinklers and fog cannons are being used along major haul and transport roads for dust suppression.
7. Plantation is being maintained along the roads for dust control and ecological improvement.
8. Around 1 km of toe wall is being constructed along the overburden (OB) dump to control run-off and stabilize slopes.
9. Pucca roads has been constructed from South Tisra Workshop (non-operational) to North Tisra Checkpost to reduce dust generation.
10. Grass seeding is being undertaken on dormant OB dumps to prevent erosion and suppress dust.
11. Coal is being wetted before loading at railway sidings to reduce particulate emissions.
12. A PM10 analyser is being operated for continuous monitoring of ambient air quality.
13. Trolley-mounted fog cannons are being operated at GOL Siding No. 9 for localized dust mitigation.
14. Piezometers and flow meters have been installed to monitor and regulate groundwater levels.

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## PART –II

Additional measures/Investment proposal for environment protection including abatement of pollution, prevention of pollution.

Monitoring of various environmental parameters is being conducted continuously in accordance with the guidelines prescribed by the Ministry of Environment, Forest and Climate Change (MoEFCC) and the Jharkhand State Pollution Control Board (JSPCB).

Applications for consent to emit or continue emission under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981, as well as applications for consent to discharge or continue discharge under Sections 25/26 of the Water (Prevention and Control of Pollution) Act, 1974, will be submitted regularly. All conditions stipulated in the Consent to Operate granted by JSPCB will be rigorously adhered to.

## PART –I

Any other particulars for improving the quality of the environment.

All directives issued by MoEF&CC and JSPCB are being complied with for continuous improvement of environmental quality.

General Manager
Cluster IX, Lodna Area
BCCL
महाप्रबंधक
लोदना क्षेत्र–10, भा.को.को.लि.
General Manager
Lodna Area No.-X, B.C.C.L.

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**FOR COMPANY USE ONLY RESTRICTED**
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# TRACE METAL CONCENTRATION OF AMBIENT AIR QUALITY REPORT OF BHARAT COKING COAL LIMITED,

## (FOR THE HALF YEAR ENDING, DECEMBER, 2024)

**CMPDI**
ISO 9001 Company
**Regional Institute-II**
**Dhanbad, Jharkhand**

(FOR THE Q.E. DECEMBER, 2024)

# CONTENTS


| SL. NO. | CHAPTER | PARTICULARS |
|---|---|---|
| 1. | CHAPTER - I | EXECUTIVE SUMMARY<br>INTRODUCTION |
| 2. | CHAPTER-II | AIR SAMPLING & ANALYSIS |
| 3. | PLATES:<br>PLATE NO. - I | SURFACE PLAN SHOWING AIR & NOISE MONITORING LOCATIONS |

# 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 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 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) were used for sampling these heavy metals on EPM filter paper. These heavy metals are analyzed regularly on half yearly basis. The samples were analyzed in Environment Laboratory of CMPDI, RI-II, Dhanbad.

## 4.0 Results and interpretations

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

# CHAPTER – II

## AMBIENT AIR QUALITY MONITORING

## 2.1 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.

## TRACE METAL CONCENTRATION IN AMBIENT AIR QUALITY

Name of the Company: **Bharat Coking Coal Limited** Year : **2024-25.**

PERIOD: **HALF YEAR ENDING DEC. 24**

**HEAVY METAL ANALYSIS REPORT OF AMBIENT AIR QUALITY**

| SAMPLE CODE | DATE | Station Name | Cd CONC. IN µg/m3 | Hg CONC. IN µg/m3 | As CONC. IN ng/m3 | Cr CONC. IN µg/m3 | Ni CONC. IN ng/m3 | Pb CONC. IN µg/m3 |
|---|---|---|---|---|---|---|---|---|
| A1 | 16.11.2024 | Karmatand Village | <0.001 | <0.001 | <1.0 | <0.01 | 3.06 | 0.007 |
| A2 | 17.11.2024 | Damoda | <0.001 | <0.001 | <1.0 | <0.01 | 2.34 | <0.005 |
| A3 | 26.11.2024 | Madhuband Washery | <0.001 | 0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A4 | 17.11.2024 | Block-II | <0.001 | <0.001 | <1.0 | <0.01 | 2.01 | 0.011 |
| A5 | 30.11.2024 | Muraidih | <0.001 | <0.001 | <1.0 | <0.01 | 4.16 | <0.005 |
| A6 | 23.11.2024 | Block-IV | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A7 | 23.11.2024 | Govindpur/Ramkanali | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.035 |
| A8 | 25.11.2024 | Nichitpur | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A9 | 25.11.2024 | East Basseriya | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A10 | 23.11.2024 | Dhansar/Kusunda | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.005 |
| A11 | 23.11.2024 | Dobari | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.010 |
| A12 | 29.11.2024 | Kusmatand Village | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A13 | 28.11.2024 | Jeenagora | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A14 | 16.11.2024 | Bhowrah North | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A15 | 16.11.2024 | Sudamdih Washery | <0.001 | 0.002 | <1.0 | <0.01 | <2.0 | 0.045 |
| A16 | 16.11.2024 | Pootki | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.013 |
| A17 | 29.11.2024 | Moonidih UGP | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A18 | 25.11.2024 | Rudih Basti | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.010 |
| A19 | 26.11.2024 | Murlidih 20/21 | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A20 | 22.11.2024 | Lohapatti | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A21 | 22.11.2024 | Kharkharee | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |

| SAMPLE CODE | DATE | Station Name | Cd CONC. IN µg/m3 | Hg CONC. IN µg/m3 | As CONC. IN ng/m3 | Cr CONC. IN µg/m3 | Ni CONC. IN ng/m3 | V CONC. IN µg/m3 |
|---|---|---|---|---|---|---|---|---|
| A22 | 27.11.2024 | Dahibari | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.016 |
| A23 | 27.11.2024 | Basantimata | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A24 | 28.11.2024 | Gopinathpur | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A25 | 28.11.2024 | Gullardih | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.009 |
| A26 | 25.11.2024 | Begunia | <0.001 | <0.001 | <1.0 | <0.01 | 3.26 | 0.010 |
| A27 | 25.11.2024 | Damagoria | <0.001 | <0.001 | <1.0 | <0.01 | 2.22 | 0.036 |
| A28 | 16.11.2024 | Hurriadih | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.006 |
| A29 | 30.11.2024 | Moonidih Washery | <0.001 | 0.003 | <1.0 | <0.01 | <2.0 | <0.005 |
| A30 | 17.11.2024 | Sitanala | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.048 |
| A31 | 27.11.2024 | Dumarda | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.005 |
| A32 | 29.11.2024 | Telmacho Bridge | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A33 | 30.11.2024 | Madhuband UGP | <0.001 | 0.005 | <1.0 | <0.01 | <2.0 | <0.005 |
| A34 | 30.11.2024 | Bhojudih Washery | <0.001 | 0.02 | <1.0 | <0.01 | <2.0 | 0.049 |
| A35 | 16.11.2024 | Dugda Washery | <0.001 | 0.003 | <1.0 | <0.01 | <2.0 | 0.016 |
| A36 | 30.11.2024 | Mahuda | <0.001 | 0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A37 | 23.11.2024 | Katras Choitudih | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A38 | 23.11.2024 | Sinidih Workshop | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.009 |
| A39 | 17.11.2024 | Patherdih | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A40 | 22.11.2024 | Koyla Nagar | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A41 | 17.11.2024 | Sudamdih Shaft | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.024 |
| A42 | 29.11.2024 | RHB | <0.001 | <0.001 | <1.0 | <0.01 | 2.56 | 0.017 |
| A43 | 16.11.2024 | Pandwabhita | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |
| A44 | 17.11.2024 | Sadarladih | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | 0.007 |
| A45 | 30.11.2024 | Bhojudih Buffer | <0.001 | <0.001 | <1.0 | <0.01 | 2.15 | <0.005 |
| A46 | 16.11.2024 | C.H.D | <0.001 | <0.001 | <1.0 | <0.01 | <2.0 | <0.005 |

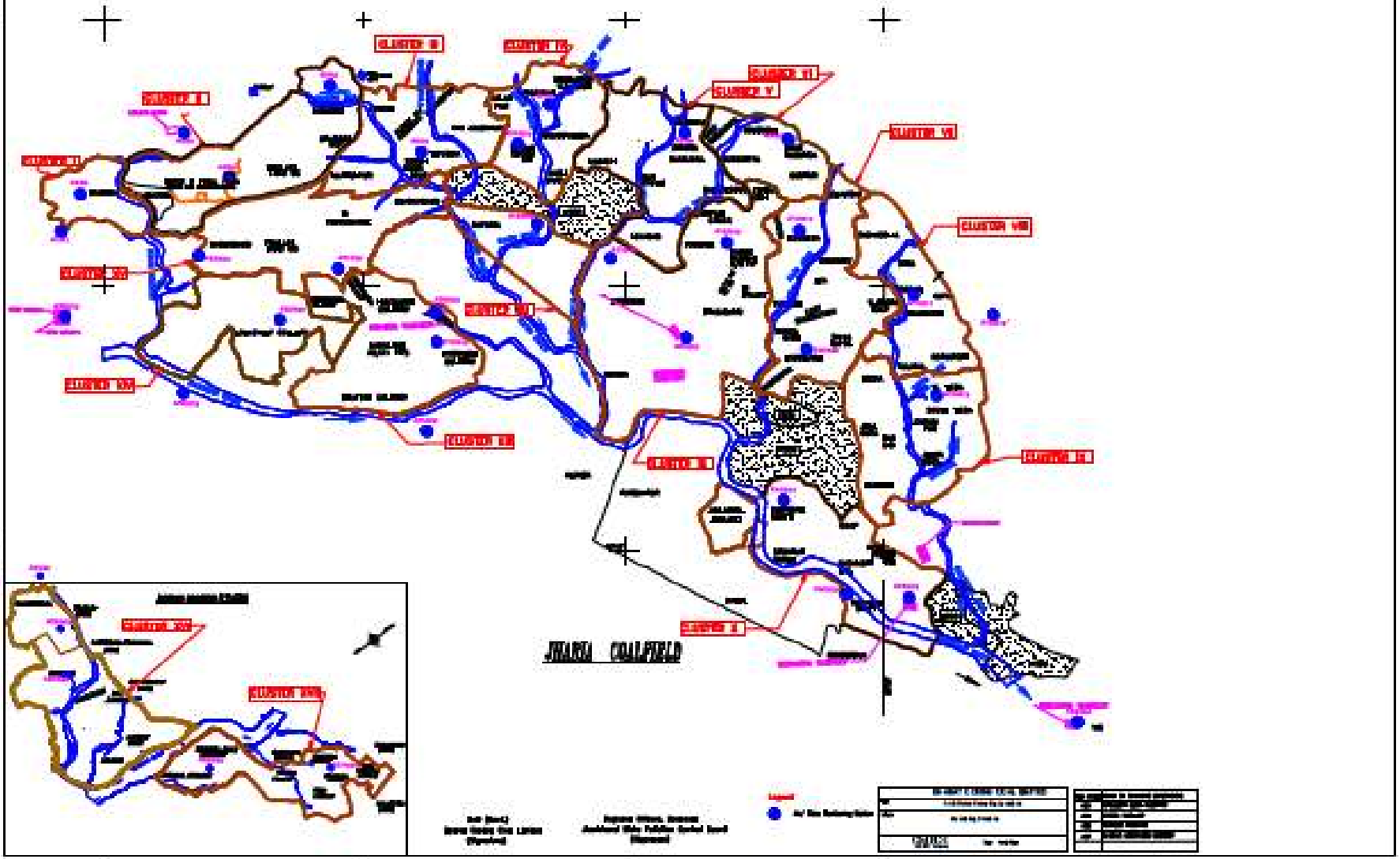
| *Metal (Unit)* | *LDL* | *Standard as per NAAQS* |
|---|---|---|
| Hg (µg/m$^3$) | 0.001 | *Standard Not defined |
| Cr(µg/m$^3$) | 0.01 | *Standard Not defined |
| As (ng/m$^3$) | 1 | 6 |
| Pb (µg/m$^3$) | 0.005 | 0.5 |
| Ni (ng/m$^3$) | 2 | 20 |
| Cd (µg/m$^3$) | 0.001 | *Standard Not defined |

Analysed By
JSA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

# Location of Air & Noise Monitoring Stations in BCCL



| Safety Equipment Distributed between FY 2019-20 to FY 2025-26 (Till Oct 2025) | | | | | | | |
|---|---|---|---|---|---|---|---|
| YEAR | 2019-20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 | 2024-25 | 2025-26 (Till Oct) |
| Wire Nettings | -- | 15000 | -- | 35 Rolls | -- | -- | -- |
| Mining Shoes | 450 | 1326 | 1880 | 1080 | 1910 | 679 | 184 |
| Gumboots | -- | 240 | -- | -- | 00 | 120 | 129 |
| Helmet | 35 | 200 | 400 | -- | 1200 | 352 | 47 |
| Dust Mask | -- | 300 | -- | 260 | 112 | 123 | 736 |
| Folding Stretcher | -- | -- | 10 | 10 | -- | -- | -- |
| Goggles | -- | -- | -- | 400 | 116 | 160 | 100 |
| Ear Muffs | -- | -- | -- | -- | 110 | 30 | -- |
| Fluorescent Jackets | -- | 1508 | -- | 200 | 240 | 325 | 654 |
| Hand Gloves (HT) | -- | 36 | -- | -- | 42 | 10 | 01 |
| Hand Gloves (LT) | 5 | 35 | -- | -- | 15 | 4 | -- |
| First Aid Kits | -- | 400 | -- | 200 | 05 | 1 | 160 |
| Electric Arc Safety Suit | -- | -- | -- | -- | 03 | 1 | -- |
| Life Jacket | -- | -- | -- | -- | 03 | 5 | 10 |
| Safety Belt | -- | -- | -- | -- | 15 | 16 | 07 |

08.11.25

Area Safety Officer
Lodna Area

| IME/PME done between 2018 till Oct 2025 | | |
|---|---|---|
| **YEAR** | **IME** | **PME** |
| 2018 | Nil | 1400 |
| 2019 | 380 | 1058 |
| 2020 | 133 | 495 |
| 2021 | Nil | 1100 |
| 2022 | Nil | 1027 |
| 2023 | Nil | 558 |
| 2024 | 34 | 882 |
| 2025 (Till October) | Nil | 338 |

08.11.25

Area Safety Officer
Lodna Area

# BHARAT COKING COAL LIMITED

# COPRPORATE ENVIRONMENT POLICY 2025

**Back Ground:**

Bharat Coking Coal Limited (BCCL) subscribes to the view of Sustainable Development. Unless the environment can sustain all the developmental activities, any pursuit of development in isolation can cause irreparable damage to the ecosystem and associated environmental attributes.

The present policy is the revision of the Corporate Environment Policy 2019 and is complimentary to the National Environmental Policy, 2006.This modification in the present policy is the outcome of the experience gained since 2019 keeping in view the modifications / amendments made time to time in environmental policies and additional stipulations notified by MoEF&CC (Ministry of Environment, Forest& Climate Change) and other organizations concerning mine closure, reclamation of degraded land, environmental clearance etc. and also with the objective of revisiting the corporate policy. Government of India is signatory to few international conventions/agreements relevant to BCCL amongst others and activities associated with such conventions/agreements are embodied in the present policy

This Policy has a vision of Green Mining and mission of 100% compliance of environmental statutes applicable to coal mining industry.

**Policy Statement:** Bharat Coking Coal Limited(BCCL) is committed to promote low carbon, sustainable and socially inclusive coal mining by protecting the environment through integrated project planning & design, prevention/mitigation of pollution, conservation of natural resources, restoration of ecology & biodiversity, recycling/ proper disposal of wastes, addressing climate change and inclusive growth. It also aims to bringing awareness amongst its stakeholders for continual improvement in environmental performances following good environmental practices.

**Objectives:**

*BCCL shall endeavour to-*

*1. Plan & design projects with due consideration to environmental and social concerns for Sustainable Development and reduction in emission intensity of its operations.*

*2. Conduct mining and associated operation in an environmentally responsible manner to comply with applicable laws and other requirements related to environmental aspects.*

*3. Prevent pollution in surrounding habitation by continuous monitoring and adopting suitable measures for environment protection.*

*4. Ensure effective implementation of Environment Management Plans (EMPs) in all our mines / projects to mitigate pollution, conservation of natural resources and restoration of ecology & biodiversity.*

5. *Ensure compliance of all statutory conditions prescribed by regulatory agencies.*
6. *Ensure waste management in each unit on the principle of REDUCE, REUSE, RECYCLE and SAFE DISPOSAL.*
7. *Put special thrusts on efficient energy utilization / renewable energy and other measures to reduce carbon foot-print.*
8. *Strive for continual improvement in our environmental performances by setting targets, measuring progress and taking corrective action.*
9. *Take measures to gainful repurposing of land and render productive post mining land use for ensuring environmentally sustainable closure of mine, keeping in view the social needs and requirement of the locals.*
10. *Take steps for dealing, prevention and control of coal mine fire and related subsidence.*
11. *Ensure implementation of activities applicable to BCCL arising out of International Conventions.*
12. *Create environmental awareness and ensure environmental education among the employees, local communities and other stakeholders through pro-active communication and training.*
13. *Promote R&D projects/innovations addressing various environmental concerns like minimization of carbon footprints of BCCL and environmental issues in mining & surrounding areas.*
14. *Establish eco-parks in the reclaimed mined areas and promote eco-mining tourism in the coalfield areas.*
15. *Ensure transparency in Environmental reporting / disclosure to stakeholders.*

**Review of Environmental Policy:**

In view of the present fast changing social, economic and environmental scenario, this policy shall be reviewed every 5 years to incorporate the changes in the legal, technical, environmental, economic and social inputs prevailing at that time. Whenever, there is change in National Environmental Policy or other National / State relevant policies, Acts etc, this Corporate Environmental Policy would be reviewed and suitably revised.

**Chairman-cum-Managing Director,**

**BCCL**

**Place:** Dhanbad