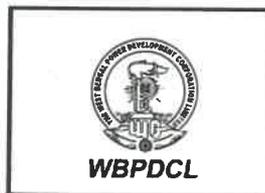


APPLICANT
West Bengal Power Development Corporation Limited
3/C, LA-BLOCK, FLOOR-II, SECTOR-III, SALT LAKE CITY
KOLKATA-700 098



Mining Plan including Mine Closure Plan
(Revision-2)
For
Barjora North Coal Mine
Project area 683.04 ha
Barjora Coalfield, Bankura District, West Bengal

Prepared by

Abhai Pratap Singh

RQP. (No. 34011/(50)/2009-CPAM; Dt. 07.10.2009)
D 2/F2, Govinda Gourkhede Complex,
Seminary Hills, Nagpur 440006, Maharashtra.

TEXT & ANNEXURE
VOLUME 1A
SEPTEMBER, 2019

CONSULTANT
United Exploration India Private Limited



Compliance to the Observations made by the Standing Committee on 20.8.219, vide letter No. 34011/21/2019-CPAM; dt. 21.08.2019.

Ref para	Observations and Compliance status
Cover page	<p>Observation: Name of the mining plan should be mining plan (including Mining Closure plan) (Revision-02) for Barjora North Mine instead of Revised Mining plan (2nd Revision) Barjora North Coal Mine.</p> <p>Compliance: Complied with.</p>
Plate	<p>Observation: KML file of the block area, proposed ML area and project area should be shown/attached.</p> <p>Compliance: KML file superimposed in google earth image has been depicted in Plate No. IA. Separate KML file is also submitted along with the soft copy of the Mining Plan including Mine Closure Plan (Revision-2).</p>
CL 1 (F) & Annexure 17	<p>Observation: The guide line dated 15th July 2015 requires boundary certificate duly certified by CMPDIL. Conceptual plan (showing geo- reference co -ordinates of Lease area, project area and geological block area) duly certified by CMPDIL in compliance with the guideline dated 15th July 2015 should be attached.</p> <p>Compliance: During preparation of the Mining Plan including Mine Closure Plan Revision-01, CMPDI has duly certified the Geological Block Boundary of Barjora North Coal Mine vide their letter no. CMPDI/BD/C (886-A)/167 dt. 29.03.2017. Initially application for Boundary certification has been submitted to CMPDIL for obtaining certification. However, CMPDIL has mentioned as the Block Boundary certification has already been provided during preparation of the 1st Revision of Mining Plan, they required MOC's further instruction for fresh certification. On receipt of this observation point, 5 copies of conceptual plan showing the Geological Block Boundary and Project Boundary has been submitted to CMPDIL vide Letter No. WBPDC/Director (Mining)/717/ dt. 27.8.2019. the copy of the submission letter is submitted in Annexure – II B.</p>
	<p>Observation: The plate showing the CMPDI certified plan relating to the bounding co - ordinates of the Coal Block as per the vesting order of the nominated authority should be a part of the report. Instead a plan signed by the RQP has been enclosed.</p> <p>Compliance: Complied with. Please refer to Plate-II A.</p>
CL 2(a),CL 8(i)	<p>Observation: Base date of mining plan has been shown to be July 2019, while balance life and reserves has been considered with respect to March 2020, this needs to corrected. For assessment of balance life, reserve and other geo-mining parameters base date of March 2019 should be taken into consideration.</p> <p>Compliance: Base date of this Mining Plan has been reconsidered to 1st April, 2019. Necessary changes has been made accordingly in the relevant parts of the Text and Plates.</p>

Ref para	Observations and Compliance status																																																																																																																																																								
CL7 (K),CL 8(G),CL 8 (E), Sum 1 (h), Sum 2 (1)	<p>Observation: The depleted reserve of 6.88 Mt includes 0.77 Mt of Coal yet to be produced in 2019-20 and first year of production has been taken as 2020-21. Provision of MMDR 1957 states that once this mining plan is approved, the earlier approved mining plan will be void. As such base date of mining plan should be taken as 1st April 2019 and reserve and calendar plan should be corrected accordingly.</p> <p>Compliance: Complied with. Necessary changes have been incorporated in the calendar plan and other parts of the documents. The revised Calendar Plan is furnished in below table:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="6">Coal Production Plan " MT"</th> </tr> <tr> <th rowspan="2">S.L. Year</th> <th rowspan="2">Financial Year</th> <th colspan="2">Coal Production</th> <th rowspan="2">OB "MM³"</th> <th rowspan="2">SR</th> </tr> <tr> <th>UG</th> <th>OC</th> </tr> </thead> <tbody> <tr><td>Y-1</td><td>2019-20</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-2</td><td>2020-21</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-3</td><td>2021-22</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-4</td><td>2022-23</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-5</td><td>2023-24</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-6</td><td>2024-25</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-7</td><td>2025-26</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-8</td><td>2026-27</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-9</td><td>2027-28</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-10</td><td>2028-29</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-11</td><td>2029-30</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-12</td><td>2030-31</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-13</td><td>2031-32</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-14</td><td>2032-33</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-15</td><td>2033-34</td><td></td><td>3.00</td><td>11.50</td><td>3.83</td></tr> <tr><td>Y-16</td><td>2034-35</td><td></td><td>3.00</td><td>11.00</td><td>3.67</td></tr> <tr><td>Y-17</td><td>2035-36</td><td></td><td>3.00</td><td>10.00</td><td>3.33</td></tr> <tr><td>Y-18</td><td>2036-37</td><td></td><td>3.00</td><td>10.00</td><td>3.33</td></tr> <tr><td>Y-19</td><td>2037-38</td><td></td><td>3.00</td><td>10.00</td><td>3.33</td></tr> <tr><td>Y-20</td><td>2038-39</td><td></td><td>3.00</td><td>10.00</td><td>3.33</td></tr> <tr><td>Y-21</td><td>2039-40</td><td></td><td>3.00</td><td>10.00</td><td>3.33</td></tr> <tr><td>Y-22</td><td>2040-41</td><td></td><td>2.59</td><td>10.00</td><td>3.86</td></tr> <tr> <td>Total</td> <td></td> <td></td> <td>65.59</td> <td>243.50</td> <td>3.71</td> </tr> </tbody> </table>	Coal Production Plan " MT"						S.L. Year	Financial Year	Coal Production		OB "MM ³ "	SR	UG	OC	Y-1	2019-20		3.00	11.50	3.83	Y-2	2020-21		3.00	11.50	3.83	Y-3	2021-22		3.00	11.50	3.83	Y-4	2022-23		3.00	11.50	3.83	Y-5	2023-24		3.00	11.50	3.83	Y-6	2024-25		3.00	11.50	3.83	Y-7	2025-26		3.00	11.50	3.83	Y-8	2026-27		3.00	11.50	3.83	Y-9	2027-28		3.00	11.50	3.83	Y-10	2028-29		3.00	11.50	3.83	Y-11	2029-30		3.00	11.50	3.83	Y-12	2030-31		3.00	11.50	3.83	Y-13	2031-32		3.00	11.50	3.83	Y-14	2032-33		3.00	11.50	3.83	Y-15	2033-34		3.00	11.50	3.83	Y-16	2034-35		3.00	11.00	3.67	Y-17	2035-36		3.00	10.00	3.33	Y-18	2036-37		3.00	10.00	3.33	Y-19	2037-38		3.00	10.00	3.33	Y-20	2038-39		3.00	10.00	3.33	Y-21	2039-40		3.00	10.00	3.33	Y-22	2040-41		2.59	10.00	3.86	Total			65.59	243.50	3.71
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CL 11 (a) Table 14.11	<p>Observation: Land use plan indicated at Para under reference needs to be rechecked and details should be furnished in the following table:</p> <p>Compliance: Complied with. Corrected Landuse Table furnished below:</p>																																																																																																																																																								

Ref para	Observations and Compliance status
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	Pre Mining Land Use "ha"	Type	Land Use during Mining	land use (End of Life)	Land Use (Post Closure)						Total	
					Agricultural Land	Plantation	Water Body	Public/ Company Use	Forest Land (Returned)	Undisturbed		
Tenancy	Agricultural	233.44	Excavation Area	609.66	-							
	Township	-	Backfilled Area	-	431.32	95.07	100.02	-		216.23		431.32
	Grazing	-	Excavated Void Without Plantation	-	178.34			75.82		102.52		178.34
	Barren	0.065		-	-							0
	Water Body	55.88	Top Soil Dump	1.81	1.81		1.81	-	-			1.81
	Road	3.15	External Dump	-								0
	Community	-	Safety Zone/ Rationalisation Area.	8.59	8.59		8.59					8.59
	Inhabitated	1.034	Road Diversion.	0	0							0
	Village	-	Diversion/ Below River / Nala / Canal.	11.27	11.27				11.27			11.27
Govt. Non Forest	Agricultural	45.14	Road & Infrastructure area.	11.18	11.18		9.18		2.00			11.18
	Township	-	Garland Drains.	2.25	2.25				2.25			2.25
	Grazing/ Others	-	Embankment.	0	0							0
	Road	-	Green Belt.									0
	Water Body	55.85	Water Reservoir Near Pit/ Water Body.	-	-							0
	Others.	-	UG Entry.									0
Forest	Reserve		Pit Head Power Plant									0
	Protected	338.75	Resettlement.									0
	CJBJ		Undisturbed / Mining Rights for UG.	37.63	37.63						37.63	37.63
Free Hold		Others (Magazine, ETP, Access Trench etc.)	0.65	0.65				0.65			0.65	
Total =	683.044		683.04	683.04	95.07	119.60	75.82	16.17	338.75	37.63	683.04	

Distribution of the Forest Land Returned: Agriculture Land – 10 ha; Plantation area – 226.2 ha, Water Body – 102.52 ha.

CL 12.2	<p>Observation: Statutory obligations vis-a-vis compliance status should be indicated in a tabular form:</p> <p>Compliance: Complied with. Please refer to Chapter-15, Statutory Obligations. The mine has following Statutory Clearances to be complied with:</p>
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हिटलर सिंह / HITLAR SINGH
 अवर सचिव / Under Secretary
 कोयला मंत्रालय / Ministry of Coal
 भारत सरकार / Gov't. of India
 शास्त्री भवन / Shastri Bhawan
 नई दिल्ली / New Delhi

ROP/Key Report Singh
 Reg No. 34011/1501/2009-CPAM,
 Dt. 07/10/2009

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Compliance Status Report: Barjora North Coal Mine,
WWBPDCL.

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भारत सरकार / Gov't. of India
शास्त्री भवन / Shastri Bhawan
नई दिल्ली / New Delhi

ROP/Anil Kumar Singh
Reg No. 34011/150/2009-CPAM.
Dt. 07.11.2009

Ref para	Observations and Compliance status
CL 12.4 & Table 14.13	<p>Observation: Technical and Biological Reclamation should be furnished in the following table:</p> <p>Compliance: Technical Reclamation is furnished in below table: Biological Reclamation is furnished in Table No. OBS-5.</p>

Stage/ Year		Land Degraded (ha) - Cumulative				Technically Reclaimed Area (ha) - Cumulative			
		Excavation	Dump (External +Top Soil)	Infra/ Others	Total	Backfill	Dump (External +Top Soil)	Infra/ Others	Total
Stage-1	2019-20	133.31	2.40	33.94	169.65	35.03			35.03
Stage-3	2021-22	129.61	5.13	33.94	168.68	57.43			57.43
Stage-5	2023-24	147.31	5.13	33.94	186.38	82.69			82.69
Stage-10	2028-29	220.29	5.13	33.94	259.36	104.52			104.52
Stage-15	2033-34	365.01	5.13	33.94	404.08	145.41			145.41
Stage-20	2038-39	539.21	1.81	33.94	574.96	373.46			373.46
Final Stage	2040-41	609.66	1.81	33.94	645.41	431.32			431.32
Post Closure									
Closure (+ 3 Years)	2043-44	609.66	1.81	33.94	645.41	431.32	1.81	212.28	645.41

Stage/ Year		Biologically Reclaimed Area (ha) - Cumulative					Forest Land (Returned)	Undisturbed/ To be left for Public/ Community Use	Total
		Agriculture	Plantation	Water Body	Public/ Company Use	Total			
Stage-1	2019-20	-	-	-	-	0	-	-	0
Stage-3	2021-22	-	-	-	-	0	-	-	0
Stage-5	2023-24	-	-	-	-	0	-	-	0
Stage-10	2028-29	-	-	-	-	0	-	-	0
Stage-15	2033-34	-	35.70	2.50	-	38.2	-	-	38.2
Stage-20	2038-39	-	45.72	2.50	-	48.22	-	-	48.22
Final Stage	2040-41	95.07	56.50	2.50	-	154.07	-	-	154.07
Post Closure									
Closure (+ 3 Years)	2043-44	95.07	119.6	75.82	16.17	306.66	338.75	37.63	683.04

Compliance Status Report: Barjora North Coal Mine, WWBPDCL.

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हिटलर सिंह / HITLAR SINGH
 अवर सचिव / Under Secretary
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RQP Anil Kumar Singh
 Reg No. 34011/150/2009-CPAM,
 Dt 07/11/2009

Ref para	Observations and Compliance status
Table 15.78 & Table 15.8	<p>Observation: Reference WPI as on Feb. 18 & Aug 09 needs to be furnished and amount to be deposited in the escrow account needs to be checked. Year-wise deposition in Escrow Account, may be furnished in the following table:</p> <p>Compliance: Complied with. Tables are furnished below:</p>

WPI as on			Aug-09		129.6
WPI as on base date	Base year 11-12	156.13	01-04-2019*	121.7	190.01
Escalation rate of Closure cost					1.47
				UG	OC
Base Rate of Closure Cost "Rs. Crs./Ha"					0.06
Closure Cost "Rs. Crs./Ha"					0.09
Project Area					683.04
Amount to be deposited into Escrow Account "Rs. in Crs"					61.47
Rate of compounding of Annual Closure Cost					5.00%
Balance Life of the project "in Yrs"					22
Annual Closure Cost					2.79
Amount to be deposited into Escrow Account after compounding @ of 5% "Rs. in Crs"					107.43
Amount already deposited into Escrow Account "Rs. in Crs"					7.03
Net Amount to be deposited into Escrow Account "Rs. in Crs"					100.40

Rs. In Crores

Year	OC	UG	Total	Already deposited	Balance to be deposited
2019-20	2.79		2.79	7.03	0.00
2020-21	2.93		2.93		0.00
2021-22	3.08		3.08		1.77
2022-23	3.23		3.23		3.23
2023-24	3.39		3.39		3.39
2024-25	3.56		3.56		3.56
2025-26	3.74		3.74		3.74
2026-27	3.93		3.93		3.93
2027-28	4.12		4.12		4.12
2028-29	4.33		4.33		4.33
2029-30	4.54		4.54		4.54
2030-31	4.77		4.77		4.77
2031-32	5.01		5.01		5.01

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RQP/Anil Kumar Singh
 Reg No. 34011/150/2009-CPAM.
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Ref para	Observations and Compliance status				
2032-33	5.26		5.26		5.26
2033-34	5.52		5.52		5.52
2034-35	5.80		5.80		5.80
2035-36	6.09		6.09		6.09
2036-37	6.39		6.39		6.39
2037-38	6.71		6.71		6.71
2038-39	7.05		7.05		7.05
2039-40	7.40		7.40		7.40
2040-41	7.77		7.77		7.77
Total=	107.43		107.43		100.40

Annexure **Observation:** A certificate by the RQP that he has been duly authorized by the mining company to prepare Mining plan & MCP on their behalf and that he has a valid recognition from MOC under MCR ,1960 to prepare the Mining plan and that provisions of all relevant rules and regulation made there under have been observed in the preparation of mining plan.
Compliance: Complied with. Annexure-VIII.

Annexure **Observation:** A certificate by the RQP that the Mining plan / Mine Closure plan has been prepared considering the guidelines pertaining to mining plan / mine closure plan issued by MoC, GOI & wherever specific permission will be required the applicant will approach the concerned authorities.
Compliance: Complied with. Annexure-IX.

Annexure **Observation:** Plan / chart showing schedule of Implementation with duration of important activities for a period of life of the mine plus 3 years.
Compliance: Activity Chart Shown below:

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Ref para	Observations and Compliance status										
Head	Parameters	Stage-1	Stage-3	Stage-5	Stage-10	Stage-15	Stage-20	Stage-Final	Closure-1	Closure-2	Closure-3
Progressive Closure	Water Quality Management										
	Air Quality Management										
	Waste Management										
	Ditch and Plant Fencing around dump										
	Biological fencing around the Lease Area										
	Filling of voids										
	Top Soil management										
	Technical and Biological Reclamation of mined out of land and OB dump										
	Plantation over virgin area including green belt.										
	Manpower cost and supervision										
	Toe wall around the dump.										
	Garland Drain										
	Garland Drain around the dump.										
	Any Other Activities.										
Dismantling of Infrastructure & Disposal or rehabilitation of Mining Machinery	Dismantling of Workshop.										
	Rehabilitation of the dismantled facility.										
	Dismantling of pumps and pipes / Other Facilities										
	Dismantling of Stowing bunkers/ provisioning of pumps for borewell pumping arrangement.										
	Dismantling of UG equipment										
Safety & Security	Rearranging water pipeline to dump top park / Agricultural land										
	Dismantling of power lines.										
	Biological fencing around dumps										
	Biological fencing around the pit.										
	Net fencing with masonry pillars										
	Concrete wall with masonry pillar around the pit.										
	Securing air shaft and installation of borewell pump										
	Securing of Incline										
	Concrete wall fencing around the water body										
	Boundary wall around the water body										
Technical & Biological Reclamation of Mined out of land and OB Dump	Stabilisation (Viz. Benching, Pitching) of side walls of the water body.										
	Toe wall around the dump.										
	Garland drain										
	Garland drain around the dump.										
	Drainage channel from main OB dump.										
	Filling of void.										
	Top Soil management										
	OB rehandling for backfilling.										
	Terracing, Blanketing with soil, and vegetation of External OB dump										
	Peripheral road, gates, view point, cemented steps on bank.										
Post Closure Management and Supervision	Expenditure on development of agricultural land.										
	Landscaping and plantation.										
	Power Cost										
	Post mining water quality management										
	Post mining air quality management										
Others	Subsidence monitoring for five years.										
	Waste Management										
	Manpower cost and supervision.										
	Entrepreneurship development (Vocational/Skill development/training for sustainable income of affected people).										
	Golden Handshake / Retrenchment benefits to OC employees.										
	Golden Handshake / Retrenchment benefits to UG employees.										
	Institutions / Organisations which is dependent upon the project.										
Provide Jobs in other mine of the company.											
Continuation of other services like running of schools etc.											
Annexure	<p>Observation: Project proponent to confirm whether the coal production envisaged is in line with CMDPA. If not the coal production schedule should be modified matching with the CMDPA.</p> <p>Compliance: Complied with.</p>										
	<p>Observation: Arrangement for Biological fencing to prevent unauthorized entry should be made.</p>										

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RQP
RQP
Reg No. 340TI/150/2009-CPAM.
Dt 07/10/2009

Ref para	Observations and Compliance status
	Compliance: Complied with. Please refer to 15.3.5 and 15.3.6 of Mining Plan including Mine Closure Plan (Revision 02).
	Observation: Documentation of Annexure and Plate should be done in the sequence suggested in the standard Checklist format. Compliance: Complied with.
	Observation: In the stage plans the coal benches, over burden benches and haul roads has not been designed as per the DGMS guidelines. Compliance: Complied with. The Stage Plans are checked and verified and rectified wherever required. The Stage Plans are furnished in Plate Nos. XIII A to G of Mining Plan including Mine Closure Plan (Revision 02).
	Observation: The coal seams dip at 2° to 7° and stripping ratio for the first eight years of operation is 4.0 and above, and also the overall stripping ratio is 3.71. So it may be checked whether dumping all of 240.50 Mcum of OB internally in mine void without any provision of re-handling is feasible or not. Compliance: To accommodate the OB for the initial three years, Stages are proposed over the existing internal dump (Bacfilled). At present the dump height is restricted to 20 meter height, which is proposed to be maintained at 60 meter height during this planned period. Progressive concurrent backfilling is proposed from 3 rd year onward and enough voids will be created by that time.
	Observation: The 1 st year stage plan shows an internal dump of 39.47 Mcum. It should be correctly shown as Existing Dump of 39.47 Mcum and should show the incremental quantity dumped internally in the first year. Compliance: Complied with. The 1 st year Stage Plan (Plate No. XIII A) marked with bifurcation of existing quantity and incremental quantity. Existing Quantity of OB has been shown in the present Surface Plan.
	Observation: The surface plan showing the Barjora Nala should show the HFL of the nala and also the direction of flow should be clearly marked on it. Compliance: As such Tartora Nala crossing within the Block Boundary is a Seasonal Nala and Occasional flow is observed during the rainy season only. The Nala flows within its course and maximum height observed is 94 m from MSL while exit point shows 76 m AMSL. The HFL within the block is considered is 3 meter from the bank of the Nala. Average HFL considered as 85 AMSL.
	Observation: a) The provision of rear dumpers for over burden is on the lower side. It should be checked and corrected. Compliance: At present, Mining Operation is being carried out by MDO. As practiced, MDO is operating the mines with the same configuration which has been suggested in this mining plan. The MDO is supposed to deliver coal o WBPDCCL on fixed cost basis with maintaining all safety and Environmental norms. The maximum capacity of Rear dumper considered is 50 T in conjunction with 6 Cum Shovel.
	Observation: b) The provision of dozers for over burden is on the lower side. It should be checked and corrected.

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RQP/Ankur Prasad Singh
 Reg No. 34071/150/2009-CPAM.
 Dt. 07/10/2009

Ref para	Observations and Compliance status																				
	<p>Compliance: At present, Mining Operation is being carried out by MDO. As practiced, MDO is operating the mines with the same configuration which has been suggested in this mining plan. The MDO is supposed to deliver coal o WBPDCCL on fixed cost basis with maintaining all safety and Environmental norms. The Dozer Capacity considered for OB is 320 HP and is found to be operated well at present.</p>																				
	<p>Observation: A scientific slope stability study of this area should from a part of this report.</p> <p>Compliance: A slope Stability Study report already have been prepared by Dr. Indrajit Roy, BIT- Mesra. The same report is furnished in Annexure- XVIII I.</p>																				
	<p>Observation: The existing Land Use Plan looks more like Revenue Plan & should be modified.</p> <p>Compliance: The land use plan prepared from the Record Of Rights has been submitted earlier.</p> <p>An additional Land Use Plan based on satellite imagery study has been provided in Plate No. VIII A. The same plan is also depicted Chapter 14.</p>																				
	<p>Observation: Action plan for occurrence of coal on the Eastern side of the block needs to be confirmed.</p> <p>Compliance: Three number of Boreholes are planned to drill in the eastern side of the block beyond the project boundary but within the Geological Block boundary. The proposed coordinates and depths are furnished in below table. The proving will be done within 3 years from the date of receipt of this approval.</p> <table border="1"> <thead> <tr> <th>Proposed Borehole No.</th> <th>X</th> <th>Y</th> <th>Tentative depth of drill in m</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td>P-1</td> <td>52940.32</td> <td>2592318.80</td> <td>70 m</td> <td>For proving of Seam-I occurrence.</td> </tr> <tr> <td>P-2</td> <td>525758.44</td> <td>2592036.22</td> <td>65 m</td> <td>For proving of Seam-I occurrence.</td> </tr> <tr> <td>P-3</td> <td>525786.66</td> <td>2591634.87</td> <td>70 m</td> <td>For proving of Seam-I occurrence.</td> </tr> </tbody> </table>	Proposed Borehole No.	X	Y	Tentative depth of drill in m	Remarks	P-1	52940.32	2592318.80	70 m	For proving of Seam-I occurrence.	P-2	525758.44	2592036.22	65 m	For proving of Seam-I occurrence.	P-3	525786.66	2591634.87	70 m	For proving of Seam-I occurrence.
Proposed Borehole No.	X	Y	Tentative depth of drill in m	Remarks																	
P-1	52940.32	2592318.80	70 m	For proving of Seam-I occurrence.																	
P-2	525758.44	2592036.22	65 m	For proving of Seam-I occurrence.																	
P-3	525786.66	2591634.87	70 m	For proving of Seam-I occurrence.																	

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RQP/Anil K. Bhardwaj Singh
 Reg No. 34011/150/2009-CPAM,
 Dt 07/06/2009



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I

RQP: Abhai Pratap Singh

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LIST OF ABBREVIATIONS

AAQ	Ambient Air Quality
amsl	Above Mean Sea Level
bgl	Below Ground Level
BHS	Boreholes
BkTPP	Bakreswar Thermal Power Plant
BTPS	Bandel Thermal Power Station
C	Carbon
CaCo ₃	Calcium Carbonate
CCO	Chief Coal Officer
CHP	Coal Handling Plant
CIL	Coal India Limited
CMPDI	Central Mine Planning and Design Institute
Co	Cobalt
CO.	Company
CPCB	Central Pollution Control Board
CSR	Corporate Social Responsibility
Cum	Cubic metre
Cum/t	Cubic metre per tonne
Deg.	Degrees
DGMS	Directorate General of Mines Safety
DGPS	Differential Geographic Positioning System
dia	Diameter
DMMF	Dry Mineral Matter free
DVC	Damodar Valley corporation
E	East
EC	Environmental Clearance
e.g.	for example
E.O.M	End of Mine
EAC	Environmental Appraisal Committee
EIA	Environmental Impact Assessment
EMP	Environment Management Program
EMTA	Eastern Minerals and Trading Agency

II

RQP: Abhai Pratap Singh

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EOT	Electric Overhead Travelling Crane
Etc.	Et cetera
Ex. Band	Excluding Band
FBC	Fluidised Bed combustion
FT	Fusion Temperature
GCV	Gross Calorific Value
GOI	Government of India
Govt.	Government
GSI	Geological Survey of India
H	Hydrogen
ha	Hectare
HEMM	Heavy Earth Moving Machineries
HGI	Hardgrove Grindability Index
HP	Horse Power
I ₁₀₀	Excluding 100 mm thickness
IBM	Indian Bureau of Mines
IDT	Initial Deformation Temperature
J.V	Joint Venture
Kg	Kilogram
Kl	Kilolitre
Km	Kilometre
KTPS	Kolaghat Thermal Power Station
KV	Kilovolts
LAN	Local Area Network
LMV	Light Motor Vehicle
Lps	Litre per second
M	Million
m	Meter
M/s	Messer's
Max.	Maximum
Mcum	Million cubic metre
MCR	Mineral Concession Rules
MDO	Mine Developer & Operator
Min.	Minimum

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ML	Mining Lease hold
mm	Millimeter
MoC	Ministry of Coal
MoEF & CC	Ministry of Environment and Forest & Climate Change
Mtes	Million Tonnes
MTPA	Million Tonnes per Annum
MW	Mega Watt
N	North
NA	Not Applicable
NA	Nominated Authority
NH	National Highway
NO ₂	Nitrogen Dioxide
NO _x	Oxides of Nitrogen
OB	Over burden
OBR	Overburden removal.
OCP	Open Cast Project
OMS	Output Per Manshift
Pb	Lead
PM ₁₀	Particulate Matter 10
PM _{2.5}	Particulate Matter 2.5
PRC	Peak rated Capacity
PPV	Peak Particle velocity
P.S.	Police Station
RF	Representative Fraction
RH	Relative Humidity
RMP	Revised Mining Plan
ROM	Run of Mine
RPM	Respirable particulate Matter
RQP	Recognised Qualified Person
S	South
SgTPP	Sagardighi Thermal Power Plant
SMS	Site Mixed Slurry
SO ₂	Sulphur Dioxide
Sp. Gr.	Specific Gravity

IV

RQP: Abhai Pratap Singh

RQP. (No. 34011/(50)/2009-CPAM; Dt. 07.10.2009).

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SPCB	State Pollution Control Board.
SPM	Suspended Particulate matter
STPS	Santhaldih Thermal Power Station
tes	Tonnes
ToR	Terms of Reference
tph	Tonnes per hour
Ug	Ungraded
U/g	Under Ground
UHV	Useful Heat Value
Unger	Ungraded
VM	Volatile Matter
W	West
WBIDC	West Bengal Industrial Development Corporation Limited.
WBPDCCL	The West Bengal Power Development Corporation
WG	Washery Grade
WM	Weathered Mantle
WPI	Wholesale Price Index
Yrs	Years
°c	Degree celsius
°F	Degree Fahrenheit

V

RQP: Abhai Pratap Singh

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5	Mining	Ch5_1-22
6	Blasting	Ch6_1-3
7	Mine Ventilation	Ch7_1-1
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LIST OF ANNEXURE

Sl. No.	ANNEXURE NO	SUBJECT
1	Annexure-I	The Vesting order (103/07/2015 /NA dt 31 st March 2015) and Corrigendum (103/07/2015 /NA; dt. 7 th March, 2017)
2	Annexure-IIA	Certificate of Geological Coordinates used in preparation of Mining Plan Barjora (North) Coal Mine, of M/S WBPDCCL, Kolkata in accordance with the vesting order
	Annexure-IIB	Submission letter of Barjora North for project boundary certification to CMPDIL
3	Annexure-III	Approvals of Mining plan including mine closure plan from Board of the company
4	Annexure-IVA	Copy of the Mining Plan approval letter (letter no. 47011/4/2003-CA-I; dt. 24-08-2006)
5	Annexure-IVB	Copy of the Revised Mining Plan approval letter (letter no. 34011/19/2017-CPAM; dt 4 th September, 2017)
6	Annexure-V	Copy of certificate by RQP for valid recognition from MoC, GoI under MCR, 1960.
7	Annexure-VI	Letter of authorization by the block allottee for formulation of Mining Plan and Mine Closure Plan by the RQP
8	Annexure-VII	Certificate of acceptance of the RQP to formulate the Mining Plan and Mine Closure Plan on behalf of the project proponent
9	Annexure-VIII	A certificate by the RQP that he has been duly authorized by the mining company to prepare Mining Plan and Mine Closure Plan on their behalf and that he has a valid recognition from MOC under MCR, 1960 to prepare the Mining plan and that provisions of all relevant rules and regulations made there under have been observed in the preparation of Mine Closure Plan
10	Annexure-IX	The Mining Plan and Mine Closure Plan has been prepared considering the guidelines pertaining to mining plan/ mine closure plan issued by MoC, GOI & wherever specific permission will be required the applicant will approach the concerned authorities
11	Annexure-X	Confirmation from RQP that he has verified the block area with the relevant plans supplied by CMPDI/ SCCL / NLC and area

VII

RQP: Abhai Pratap Singh

RQP. (No. 34011/(50)/2009-CPAM; Dt. 07.10.2009).

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		covered by the Mining Plan and Mine Closure Plan does not encroach on any other coal lignite block
12	Annexure-XI	Certificate from empowered representative of / or Block allottee/ applicant that the mine will be developed as per the approval of the Mining Plan and Mine Closure Plan from Ministry of coal and all other approvals, as required will be obtained from relevant authorities
13	Annexure-XII	GR purchase Record
14	Annexure-XIII	Certificate of RQP that the project boundary considered for the Mining Plan and Mine Closure Plan has been verified by RQP. It is in coherence with the block boundary of vesting order and approved mining plan and no discrepancy has been found
15	Annexure-XIV	Certificate that the Mining Plan and Mine Closure Plan have been prepared in line with the approved Mining plan and the mine parameters considered for formulation of mine closure plan is the same, which has been approved in the Mining plan
16	Annexure-XV	Certificate from empowered representative of / or Block allottee/ applicant that the mine that the reclamation & rehabilitation work shall be carried out in accordance with the approved Mining Plan and Mine Closure Plan and any modification /amendments which may be made in the Mining Plan and Mine Closure Plan by Ministry of Coal, from time to time
17	Annexure-XVI	Mining lease document
18	Annexure-XVII	Mine pit dewatering permission from the state water investigation department
19	Annexure-XVIIIA	Notice of Opening from office of the CCO
20	Annexure- XVIIIB	Consent To Establish
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22	Annexure- XVIIID	Blasting Permission from DGMS
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CHECK LIST

**Checklist for Mining Plan
& Mine Closure Plan.**



CHECKLIST FOR MINING PLAN AND MINE CLOSURE PLAN

	Parameters	Details		Observation
1.	DETAILS OF THE BLOCK			
a.	Name of Coal / Lignite Block.	Barjora North Coal Mine.		
b.	Name of the Coalfield/ Coal belt	Barjora Coalfield.		
c.	Particulars of adjacent blocks: North, South, East, West	North: No block South: Barjora South Coal Block.	East: No block West: No block	
d.	Topo sheet No with latitude and longitude	Vesting Order with corrigendum no 01 dt 07-03-2017	Mining Plan & Mine Closure Plan	
	Topo sheet No	F45D3 & F45D7 (73M/3 & 73M/7)	F45D3 & F45D7 (73M/3 & 73M/7)	
	Latitudes (N):	23° 25'59.238"N - 23° 27' 42.094"N	23° 25'59.238"N - 23° 27' 42.094"N	
	Longitude (E):	87° 13'17.106"E - 87° 15' 26.268" E	87° 13'17.106"E - 87° 15' 26.268" E	
e.	Location of the Block District /State.	At Village – Ghutgoria, Baguli, Manohar, Sitarampur, Sarjora, Tikargram&Barapukuria. P.S. – Barjora. District – Bankura. West Bengal.		
f.	CMPDIL Certificate of the project boundary of the Mining Plan.	Letter no. WBPDCCL/DIRECTOR (MINING)/717; dt. 27.08.2019. Received copy of submission letter for Certification of the Conceptual Plan (showing geo-reference coordinates of Lease area, Project area and Geological Block area) with respect to Barjora North Coal Mine, District Bankura, West Bengal is furnished in annexure.		
g.	Type of the Project (Operating / under Implementation)	Mining operation is in progress.		
2.	DETAILS OF THE PRESENT PROPOSAL			
a.	BASE DATE OF MINING PLAN/MINE CLOSURE PLAN	1 st of April, 2019.		
b.	Scope of the mining plan	To mine coal deposits within the proposed lease area of 683.04 ha and suggest final closure activities.		
3.	ALLOTTEE COMPANY DETAILS			
a.	Name the Mine Allottee	The West Bengal Power Development Corporation Ltd.		
b.	Status of the Applicant Company	The West Bengal Power Development Corporation Limited (WBPDCCL) is an enterprise of Government of West Bengal.		

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**Checklist for Mining Plan
& Mine Closure Plan.**



Parameters		Details			Observation
c.	Details of allotment/vesting order	31 st March,2015 vide allotment number No. 103/07/2015 /NA (Annexure-1) and subsequent corrigendum 01, vide No. 103/07/2015 /NA; dt. 7 th March, 2017 (Annexure-I).			
d.	Name and address of the applicant	Regd. Office: Name The West Bengal Power Development Corporation Ltd. Address BidyutUnnayanBhaban. Plot No. 3/C, LA-Block, Sector-III, Floor- II, Salt Lake City, Kolkata – 700098.	Principal Place of Business: Name The West Bengal Power Development Corporation Ltd. Address BidyutUnnayanBhaban. Plot No. 3/C, Floor- II,LA-Block, Sector-III, Salt Lake City, Kolkata – 700098.		
e.	Relationship between the applicant and allottee company	Applicant and Block allottee are same company.			
f.	Name and address of RQP with registration No	Shri Abhai Pratap Singh D 2/F2, GovindaGourkhede Complex, Seminary Hills, Nagpur 440006, Maharashtra. Mobile No.: +91-9423684516. Email id: apsingh49wcl@gmail.com Registration No. :34011/ (50)/2009-CPAM, Dt. 7 th October, 2009. Valid Till: 6 th October, 2019.			
g.	Name of the Previous allottee of the Block	The West Bengal Power Development Corporation Ltd.			
4.	Details of the Previous approval of Mining plan:				
a.	Date of Approval	Mining Plan approved by MOC,GOI on 24 th August, 2006, vide their letter no. 47011/4/2003-CA-I; for total allotted block area of 800 ha. (Annexure 2). ARevisedMining Plan (Revision -01) was prepared and approved by MOC, GOI on 4 th September, 2017, vide their letter 34011/19/2017-CPAM; for an area of 260.14 ha. (Annexure 3).			
b.	Conditions, if any	S.L. No.	Conditions Imposed	Compliance Status	

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**Checklist for Mining Plan
& Mine Closure Plan.**



Parameters		Details		Observation
		1	Mining Company shall come up with revised mining plan including mine closure plan for the entire mine area within a reasonable time frame on receipt of Forestry Clearance.	Being Complied.
		2	The mining company shall include part of the 7 Mt of coal reserve falling within the non forest area unless CMPDIL advices it otherwise.	The Geological Model has been developed in line with the ISP 2017 and the data has been migrated to GCV based grading system. Consideration of High and Low Carbonaceous Shale has been induced based on the BB analysis data available in the Geological Report. The resources re-estimated and furnished in this mining plan and has been included the reserves.
		3	Mining Company shall develop an action plan by 31 st March 2019 for net zero energy consumption through solar energy as a part of mine closure	Complied and cover in this mining Plan under Chapter-15.

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**Checklist for Mining Plan
& Mine Closure Plan.**



Parameters		Details		Observation
			activities.	
		4	Mining company shall not dump OB on the coal bearing area which in any way sterilizes the extractable coal reserve.	Being complied.
		5	The mining company shall take all necessary precautions regarding safety of mine workings and persons deployed therein.	Being complied.
		6	Mining lease of this block shall not encroach into any other adjacent block.	Being complied.
		7	The cost of abandonment for carrying out the closure activities envisaged in the Mine closure plan is indicative; the actual cost for carrying out the activities at the time of final closure may be higher. The actual cost of abandonment will have to be borne by the project proponent for carrying out the closure activities.	Shall be complied.
		8	The approval of the mine closure plan is without prejudice to the requirement of approvals from	Noted.

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**Checklist for Mining Plan
& Mine Closure Plan.**



Parameters		Details				Observation																																																					
				competent/prescribed authority under the relevant rules /regulations etc.																																																							
c.	Scheduled year of start of production	2017-18																																																									
d.	Proposed year of achieving the targeted production	4 th year(i.e. 2021-2022)																																																									
e.	Date of actual commencement of mining operations, if operations already started.	<p>Prior Allottee has started mining activity from January 2011 till 31stMarch, 2015.</p> <p>After reallocation, WBPDCCL has obtained necessary approval and started mining activity from June, 2018. Till 31st March 2019, there was no Coal production, only developmental works were undergone.</p>																																																									
f.	Likely date of mining operations, if operations not yet started & reasons for non-commencement of operations.	Production started in the year 2019-20.																																																									
g.	Planned production and actual levels achieved in last 3years (Coal in Mte,OB in MM ₃ , SR in M ₃ /te).	<p>Production status as on 31.3.2019:</p> <table border="1"> <thead> <tr> <th colspan="9">Planned Production and Actual Level Achieved in last 3 years</th> </tr> <tr> <th rowspan="2">Calendar Year</th> <th colspan="3">Planned</th> <th colspan="5">Actual Coal Production "Mte"</th> </tr> <tr> <th>Coal</th> <th>OB</th> <th></th> <th>UG</th> <th>OC</th> <th>Total Mte</th> <th>Total MM₃</th> <th>SR</th> </tr> </thead> <tbody> <tr> <td>Y-1 2016-17</td> <td>3.00</td> <td>15.51</td> <td></td> <td>-</td> <td>-</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Y-2 2017-18</td> <td>0.77</td> <td>4.93</td> <td></td> <td>-</td> <td>-</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Y-3 2018-19</td> <td>1.5</td> <td>7.42</td> <td></td> <td>-</td> <td>-</td> <td></td> <td>1.56</td> <td></td> </tr> </tbody> </table>				Planned Production and Actual Level Achieved in last 3 years									Calendar Year	Planned			Actual Coal Production "Mte"					Coal	OB		UG	OC	Total Mte	Total MM ₃	SR	Y-1 2016-17	3.00	15.51		-	-				Y-2 2017-18	0.77	4.93		-	-				Y-3 2018-19	1.5	7.42		-	-		1.56		
Planned Production and Actual Level Achieved in last 3 years																																																											
Calendar Year	Planned			Actual Coal Production "Mte"																																																							
	Coal	OB		UG	OC	Total Mte	Total MM ₃	SR																																																			
Y-1 2016-17	3.00	15.51		-	-																																																						
Y-2 2017-18	0.77	4.93		-	-																																																						
Y-3 2018-19	1.5	7.42		-	-		1.56																																																				
h.	Reasons for difference between the planned and actual production levels	Commencement of mine production is linked to obtaining of Environmental Clearance, Notice of Opening and other requisite permissions. The developmental works and OB removal work started only after obtaining the stated permissions from the concerned Government Authorities in the month of June, 2018. So far(as on 31 st March,																																																									

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**Checklist for Mining Plan
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Parameters		Details			Observation
		2019), no coal production has been made.			
5.	Details of changes in the new mining plan compared to earlier approval:				
		Approved Mining Plan (663.00 ha)	Approved Mining Plan including Mine Closure Plan, Revision-1 (260.14 ha)	Mining Plan including Mine Closure Plan, Revision-02(683.04 ha)	
a.	Lease area "Ha"	663.00 ha	260.14 ha	683.04 ha	
b.	Project Area "Ha"	927.50 ha	260.14 ha	683.04 ha	
c.	Life of the Project "Yrs"	22 years	7 years	22 years	
d.	Minimum and Maximum Depth of working "m"	20 meter (min) 155 meter (max)	20 meter (min) 145 meter (max)	20 meter (min) 145 meter (max)	
e.	Geological Block "Ha"	800 ha	800 ha	800 ha	
f.	Production Target "MTPA"	3.0 MTPA	3.0 MTPA	3.0 MTPA	
g.	Seams Available "As per GR"	9	9	9	
h.	Seams not considered for Mining with Reasons.	Seam -IV- Inconsistent and thin in nature.	Seam -IV- Inconsistent and thin in nature.	-	
i.	Geological Reserve "Mt"	85.49 Mt - Net In-situ. (For the whole block of 800 ha).	25.85 Million Tons of Net In situ Reserve in 260.14 ha.	91.67 Million Tons of Net In-situ Reserve in the whole Block of 800 ha.	
j.	Blocked Reserve "Mt"	12.62 Mt. in safety barriers and 8.55 Million Tons of reserves reduced on account of dirt band.	In safety barrier, batter & unapproachable area 7.25 Mt.	16.20 Million Tons reserve is blocked in safety barrier, nala diversion, barrier from existing road and quarry batters.	

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	Parameters	Details			Observation
k.	Mineable Reserve "Mt"	64.32 Mt.	18.60 Mt.	75.47 Mt.	
l.	Extractable Reserves "Mt"	61.11 Mt.	17.67 Mt.	71.70 Mt.	
m.	% of Extraction/recovery.	71.40%	68.35 %	78.21 %	
n.	Reserve Depleted (till the base date) Reserves "Mt"	-	6.11 Mt.	6.11 Mt	
o.	Balance Extractable reserve "Mt"	61.11 Mt.	11.56 Mt.	65.59 Mt.	
p.	Average Grade	"F" Grade.	G10-G13	G10-G13	
q.	OB in MM3	305.08 MM3	93.41 MM3	243.50 Mcum	
r.	SR MM3/te	4.99 cum/te	5.29 cum/te	3.71 cum/te	
s.	Mining Technology	Mechanized opencast; Conventional drilling & blasting for OB removal and Surface Miner for Coal Winning.	Mechanized opencast; Conventional drilling & blasting for OB removal and Surface Miner for Coal Winning.	Mechanized opencast; Conventional drilling & blasting for OB removal and Surface Miner for Coal Winning.	
t.	Coal Beneficiation envisaged	No.	No.	No.	
u.	Handling of Rejects	Not applicable.	Not applicable.	Not applicable.	
v.	Land use pattern "Ha"				
1.	Excavation Area	663.00 ha	191.00 ha	609.66 ha	
2.	Top Soil Dump	Nil	5.86 ha	1.81 ha	
3.	External Dump	100.00 ha (Proposed but not implemented)	Nil	Nil	
4.	Safety Zone	12.50 ha	17.89 ha.	8.59 ha	
5.	Other Use	95.50 ha	12.87 ha.	14.17 ha	

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Parameters		Details			Observation												
6.	Infrastructure area	56.50 ha – including colony area.	26.90 ha.	11.18 ha													
7.	Green Belt	-	-	-													
8.	Undisturbed Area	-	5.62 ha	37.63 ha													
9.	Total	927.50 ha	260.14 ha	683.04 ha													
w.	Reasons for Revision	<p>The Barjora North Coal Mine comprises both forest and non-forestland types. In order to obtain an Environment Clearance for the leasehold non forest land of 260.14 ha, WBPDCCL has obtained approval of Revised Mining Plan restricting their extent of operation only within the aforesaid area from Ministry of Coal, vide letter No. 34011/19/2017-CPAM; dt 4thSeptember, 2017. In accordance with the Revised Mining Plan for 260.14 ha, Environmental Clearance was also obtained by WBPDCCL from MoEF& CC vide their letter no. J-11015/90/2017-IA.II(M);dt 31st May (furnished as Annexure XIX).</p> <p>As per the conditions laid in the Mining Plan Approval letter and in order to prepare the application for Forest Clearance of Barjora North Coal Mine, a mining plan preparation work has been necessitated by WBPDCCL for the entire block including Forest and Non-Forest Land. Based on the Geology, Surface Constraints and other Geo-mining parameters, the project boundary has been conceptualized as 683.04 ha out of the allotted block area of 800 ha. This mining plan is thus restricted within 683.04 ha of area comprising both forest and non-forest land.</p>															
6.	END USE OF COAL/LIGNITE																
a.	End Use of Coal/Lignite as per approval by the Competent Authority	<p>A per the allotment order (vide no. 103/7/2015/NA; 31stMarch, 2015), coal will be utilized in the following end use plants of WBPDCCL:</p> <table border="1"> <thead> <tr> <th>S. L. No.</th> <th>Name of Specified End Use Plants</th> <th>Address</th> <th>Configuration</th> <th>Capacity</th> <th>Existing or Proposed</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Santaldih Thermal</td> <td>Santaldih, Purulia,</td> <td>2 x 250 MW</td> <td>500 MW.</td> <td>Existing.</td> </tr> </tbody> </table>			S. L. No.	Name of Specified End Use Plants	Address	Configuration	Capacity	Existing or Proposed	1.	Santaldih Thermal	Santaldih, Purulia,	2 x 250 MW	500 MW.	Existing.	
S. L. No.	Name of Specified End Use Plants	Address	Configuration	Capacity	Existing or Proposed												
1.	Santaldih Thermal	Santaldih, Purulia,	2 x 250 MW	500 MW.	Existing.												

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Parameters		Details					Observation																											
		Power Station.	West Bengal – 723146.																															
	2.	Kolaghat Thermal Power Station.	Mecheda, Medinipur, West Bengal – 721137.	6 x 210 MW	1260 MW.	Existing.																												
	3.	Bakreswar Thermal Power Plant.	Birbhum, West Bengal – 731104.	5 x 210 MW	1050 MW.	Existing.																												
	4.	Bandel Power Station.	Tribeni, Hoogly, West Bengal – 712503.	4 x 60 = 240 MW 1 x 210 = 210 MW	450 MW.	Existing.																												
	5.	Sagardighi Thermal Power Plant; Unit 1 & 2.	Manigram, Murshidabad, West Bengal – 742237.	2 x 300 MW	600 MW.	Existing.																												
		Sagardighi Thermal Power Plant – Unit 3 & 4.	Manigram, Murshidabad, West Bengal – 742237.	2 x 500 MW	1000 MW.	Existing.																												
b.	<p>Norms adopted for calculating ROM quantity requirement based in the allotment order: Annual Coal requirements for end use plants of WBPDCCL is given below along with the norms of calculation:</p> <table border="1"> <thead> <tr> <th></th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>4</th> <th>5</th> <th>5</th> <th></th> </tr> </thead> <tbody> <tr> <td>Name of EUP's</td> <td>Santal dihi TPS</td> <td>Kolaghat TPS</td> <td>Bakreswar TPS</td> <td>Bandel# 5</td> <td>Bandel #1,2,3,4</td> <td>Sagardighi TPP 1 & 2</td> <td>Sagardighi TPP 3 & 4</td> <td>Total</td> </tr> <tr> <td>Capacity of the end use Plants (MW)</td> <td>500</td> <td>1260</td> <td>1050</td> <td>210</td> <td>240</td> <td>600</td> <td>1000</td> <td>4860</td> </tr> </tbody> </table>							1	2	3	4	4	5	5		Name of EUP's	Santal dihi TPS	Kolaghat TPS	Bakreswar TPS	Bandel# 5	Bandel #1,2,3,4	Sagardighi TPP 1 & 2	Sagardighi TPP 3 & 4	Total	Capacity of the end use Plants (MW)	500	1260	1050	210	240	600	1000	4860	
	1	2	3	4	4	5	5																											
Name of EUP's	Santal dihi TPS	Kolaghat TPS	Bakreswar TPS	Bandel# 5	Bandel #1,2,3,4	Sagardighi TPP 1 & 2	Sagardighi TPP 3 & 4	Total																										
Capacity of the end use Plants (MW)	500	1260	1050	210	240	600	1000	4860																										

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Parameters		Details							Observation
Capacity of the Project in MTPA		3.00							
Raw Coal Availability from this project.		3.00							
Washed Coal Availability "MTPA".		0.00							
Reject " MTPA".		0.00							
Station Heat Rate " Kcal/ Kwhr"	2500	2500	2500	2500	2770	2375	2375		
Average Calorific value of Coal (Kcal/Kg)	4600	4600	4600	4600	4600	4600	4600		
Raw Coal	4047	4047	4047	4047	4484	3844	3844		
Washed Coal	-	-	-	-	-	-	-		
Rejects	-	-	-	-	-	-	-		
Specific Consumption									
Specific Consumption "Kg/Kwhr"	0.54	0.54	0.54	0.54	0.60	0.52	0.52		
Plant Load Factor/ Capacity Utilisation	0.85	0.85	0.85	0.85	0.85	0.85	0.85		
Coal Requirement "MTPA"	2.02	5.10	4.25	0.85	1.08	2.31	3.84	19.45	
Source of Coal Requirement									
Coal From This Project " MTPA"									3
Linkages/ E-Auction from CIL " MTPA"									0
Other Block of the Company " MTPA"									
Percentage of End Use requirements to be met from this mine.									15.43

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	Parameters	Details	Observation																					
c.	Percentage of end use requirement to be met from this mine.	15.43 %																						
d.	If washing / beneficiation of the coal/ lignite is planned to be conducted on site or adjacent to the extraction area, briefly describe the nature of the beneficiation and recovery rate, consumption of water etc.	Coal beneficiation and washing is not proposed.																						
e.	Proposed Use of Rejects/Middling's	Not Applicable.																						
f.	Distance of End use plant from the pit head of the project in "km"	Distances of different end use plants from the pit head of the mines through proposed Bankura and Durgapur Railway sidings are given below: <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Name of End Use Plants</th> <th>Distance from Bankura Railway Station.</th> <th>Distance from Durgapur Railway Station.</th> </tr> </thead> <tbody> <tr> <td>Santaldih TPS</td> <td>116</td> <td>120</td> </tr> <tr> <td>Kolaghat TPS</td> <td>212</td> <td>233</td> </tr> <tr> <td>Bakreswar</td> <td>201</td> <td>73</td> </tr> <tr> <td>Bandel</td> <td>214</td> <td>186</td> </tr> <tr> <td>Sagardighi TPP, Unit 1 & 2</td> <td>407</td> <td>279</td> </tr> <tr> <td>Sagardighi TPP, Unit 3 & 4</td> <td>407</td> <td>279</td> </tr> </tbody> </table>	Name of End Use Plants	Distance from Bankura Railway Station.	Distance from Durgapur Railway Station.	Santaldih TPS	116	120	Kolaghat TPS	212	233	Bakreswar	201	73	Bandel	214	186	Sagardighi TPP, Unit 1 & 2	407	279	Sagardighi TPP, Unit 3 & 4	407	279	
Name of End Use Plants	Distance from Bankura Railway Station.	Distance from Durgapur Railway Station.																						
Santaldih TPS	116	120																						
Kolaghat TPS	212	233																						
Bakreswar	201	73																						
Bandel	214	186																						
Sagardighi TPP, Unit 1 & 2	407	279																						
Sagardighi TPP, Unit 3 & 4	407	279																						
g.	Mode of Coal Transport	Road & Rail.																						
7.	EXPLORATION AND GEOLOGY																							

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	Parameters	Details	Observation									
a.	Geological Block Area "Ha"	800 ha.										
b.	Status of Exploration of the block	Explored.										
c.	Area covered by 'detailed' exploration within the block (sq. km)	800 ha.										
d.	Whether entire lease area has been covered by 'detailed' exploration.	Yes. The total lease area of 683.04 ha has been covered by detailed exploration.										
e.	No. of boreholes drilled within the block	Block area-64 boreholes										
f.	Whether any further exploration/study is required or suggested and time frame in which it is to be completed	No further exploration is envisaged/required. An area of around 40 ha needs further exploration to prove the extension of coal seams in the south eastern part of the block. This will be explored within 3 years' time period on obtaining the forest clearance.										
g.	Overall borehole density within the block (no./ sq. km) approx.	Block area-8.0 BH/Sq. km.										
h.	No of Seams available as per GR	9 no. of coal seams.										
i.	Seams not considered for Mining with Reasons.	Seam IV; because of its inconsistency and thin nature.										
j.	Dip of the Seam	2°- 7°. Strike of the beds roughly trend in N- S direction with local variation and swings from NE- SW to NW-SE at places. However, dip directions are broadly to the east and west in the western and eastern limbs of the block respectively.										
k.	Seam wise Thickness and Depth with Reserve assessment:											
	Blocked Reserve Below (in Million Tons)											
	Seam name	Thickn ess Range (m)	Depth Rang e (m)	Net Insitu	High wall/ batter	Nala / River Road	Barri er	Une conomic	Total Block ed	U G	O C	Mi nin g Los ses
	SEAM											
	IX	0.26-	15.14-	1.152	0.066	0.040	0.098	-	0.204			0.0

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Parameters			Details								Observation
	2.78	41.21								47	
Parting	4.70-11.56										
VIII	0.30-2.94	6.13-46.67	2.173	0.124	0.075	0.184	-	0.384		0.089	
Parting	3.24-29.71										
VII	0.38-4.72	7.00-77.60	11.830	0.676	0.410	1.004	-	2.091		0.487	
Parting	4.69-24.53										
VI	0.25-4.42	17.20-76.30	8.702	0.497	0.302	0.738	-	1.538		0.358	
Parting	1.80-29.45										
VTOP	0.65-4.26	12.00-102.06	6.327	0.362	0.219	0.537	-	1.118		0.260	
Parting	4.45-23.43										
VBOT-OM	0.56-4.75	10.88-108.61	7.494	0.428	0.260	0.636	-	1.324		0.308	
Parting	1.90-14.39										
V	0.50-6.29	12.96-115.55	20.075	1.148	0.696	1.704	-	3.548		0.826	
Parting	2.13-14.02										
IV	0.20-1.30	12.95-71.54	1.302	0.074	0.045	0.111	-	0.230		0.054	
Parting	12.60-19.45										
III											
III/II											
II	4.42-6.34	18.68-150.11	32.616	1.864	1.131	2.770	-	5.765		1.343	
III/II/I											
II/I											
I											
			91.67	5.24	3.18	7.78	-	16.20		3.77	

Seam	As on Base date "Mte"											Reason Not considered for mining
	EXT Res "Mte"			Depletion of reserve			Balance Reserve					
	UG	OC	High wall	UG	OC	Highwall	UG	OC	High wall	Total		
SEAM								0.00			0.00	
IX		0.90						0.90			0.90	
VIII		1.70						1.70			1.70	
VII		9.25						9.25			9.25	

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Parameters		Details										Observation
VI	6.81							6.81		6.81		
VTOP	4.95			1.2				3.73		3.73		
VBOT	5.86			0.								
OM				56				5.30		5.30		
V	15.70							15.70		15.70		
IV	1.018							1.02		1.02		
III												
III/II												
II	25.50			4.3				21.17		21.17		
III/II/I	8			30				8		78		
II/I												
I												
Total	71.7			6.				65.5		65.		
=	0			11				9		59		

i.	Average GCV	Seam Wise recalculated GCV given below:													
		SEAM	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	Total	
		IX		0.010	0.097	0.095	0.105	0.164	0.058	0.543	0.080				1.152
		VIII					0.011	0.256	0.233	0.686	0.716	0.225	0.046	2.173	
		VII			0.204	1.259	2.630	3.096	2.511	1.379	0.464	0.270	0.017	11.830	
		VI		0.170	0.868	2.147	2.841	1.688	0.987					8.702	
		VTOP			0.033	0.569	1.468	2.039	1.743	0.475				6.327	
		VBOT		0.189	0.382	0.809	2.559	2.463	0.696	0.267	0.128			7.494	
		V			0.076	0.789	5.865	5.498	3.498	2.627	0.902	0.819		26.075	
		IV	0.017	0.084	0.233	0.330	0.252	0.169	0.161	0.026	0.022	0.009		1.302	
		III	0.116	0.758	0.861	1.787	2.630	0.934	0.329	0.162				7.577	
		III/II												0.000	
		II	0.001	0.188	1.658	1.043	1.358	0.370						4.599	
		III/II/I				0.813	1.356	2.163						4.332	
		II/I	0.035	0.773	0.443	1.469	0.489	0.186						3.394	
I	0.382	0.776	1.352	2.316	4.481	2.553	0.451	0.225	0.179			12.715			
Gross Insitu		0.551	2.948	6.207	13.43	26.03	21.58	10.67	6.389	2.492	1.323	0.063	91.67		

m.	Gross Geological Reserve of the block "Mte"	100.83 MT
n.	Net Geological Reserve of the block "Mte"	91.67 MT
o.	Mineable Reserve of the block "Mte"	75.47 MT
p.	Blocked Reserve	16.2 MT

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**Checklist for Mining Plan
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	Parameters	Details	Observation																										
	"Mte																												
q.	Corresponding extractable reserve of the block "Mte"	71.70 MT																											
r.	Percentage of Extraction	78.22 MT																											
s.	Reserve already depleted (Base date of Mining Plan)	6.11 MT (Extracted by Prior Allottee)																											
t.	Balance Reserve (As on Base Date)	65.59 MT																											
8.																													
a.	Existing method of mining if the mine is under operation	Opencast mining methodology with Drilling and Blasting for OB excavation and Surface Miner for Coal Winning. Shovel-Dumper combination for OB removal and FEL/Shovel- Tipper/Dumper for coal removal.																											
b.	Proposed method of mining with justification on suitability of method of mining	Opencast mining methodology with Drilling and Blasting for OB excavation and Surface Miner for Coal Winning. Shovel-Dumper combination for OB removal and FEL/Shovel- Tipper/Dumper for coal removal.																											
c.	Coal production capacity proposed "Mtpa"	3.0 MTPA (Peak Rated Capacity).																											
d.	Justification for optimisation Coal production capacity	As required by the end use plant.																											
e.	Calendar year from which the production will start	2019-2020																											
f.	Year of Achieving rated production	1 st year (2019-20).																											
g.	Coal production Plan "MT" – all opencast																												
	<table border="1" style="width: 100%;"> <thead> <tr> <th colspan="6">Coal Production Plan " MT"</th> </tr> <tr> <th rowspan="2">S.L. Year</th> <th rowspan="2">Financial Year</th> <th colspan="2">Coal Production</th> <th rowspan="2">OB "MM3"</th> <th rowspan="2">SR</th> </tr> <tr> <th>UG</th> <th>OC</th> </tr> </thead> <tbody> <tr> <td>Y-1</td> <td>2019-20</td> <td></td> <td>3.00</td> <td>11.50</td> <td>3.83</td> </tr> <tr> <td>Y-2</td> <td>2020-21</td> <td></td> <td>3.00</td> <td>11.50</td> <td>3.83</td> </tr> </tbody> </table>			Coal Production Plan " MT"						S.L. Year	Financial Year	Coal Production		OB "MM3"	SR	UG	OC	Y-1	2019-20		3.00	11.50	3.83	Y-2	2020-21		3.00	11.50	3.83
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Parameters		Details					Observation
	Y-3	2021-22		3.00	11.50	3.83	
	Y-4	2022-23		3.00	11.50	3.83	
	Y-5	2023-24		3.00	11.50	3.83	
	Y-6	2024-25		3.00	11.50	3.83	
	Y-7	2025-26		3.00	11.50	3.83	
	Y-8	2026-27		3.00	11.50	3.83	
	Y-9	2027-28		3.00	11.50	3.83	
	Y-10	2028-29		3.00	11.50	3.83	
	Y-11	2029-30		3.00	11.50	3.83	
	Y-12	2030-31		3.00	11.50	3.83	
	Y-13	2031-32		3.00	11.50	3.83	
	Y-14	2032-33		3.00	11.50	3.83	
	Y-15	2033-34		3.00	11.50	3.83	
	Y-16	2034-35		3.00	11.00	3.67	
	Y-17	2035-36		3.00	10.00	3.33	
	Y-18	2036-37		3.00	10.00	3.33	
	Y-19	2037-38		3.00	10.00	3.33	
	Y-20	2038-39		3.00	10.00	3.33	
	Y-21	2039-40		3.00	10.00	3.33	
	Y-22	2040-41		2.59	10.00	3.86	
	Total			65.59	243.50	3.71	
h.	Peak/Rated Capacity	3.0 MTPA					
	- By OC	3.0 MTPA					
	- By UG	NIL					
	- Overall	3.0 MTPA					
i.	Life of the mine :						
	- By OC	This mining plan is prepared for covering total workable coal reserve in 683.04 ha of lease area. It covers 22 years of productive life.					
	- By UG	Not applicable.					
	- Overall	22 years.					
j.	Whether the proposed external OB dump site is coal/	Not applicable. External OB dumping not envisaged in this mining plan.					

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	lignite bearing: If so, whether coal/lignite below waste disposal area is extractable.																																																																										
k.	Whether negative proving for coal / lignite in the proposed site for OB dump/ infrastructure has been done.	Not applicable.																																																																									
l.	Whether the mining operations to be carried out through departmental equipment/ MDO/ outsourcing.	Mining operation will be carried out through MDO or outsourcing.																																																																									
m.	Operations that are proposed to be outsourced.	Coal and OB removal. Transportation of coal from mine site to coal despatch site.																																																																									
n.	Proposed configuration of HEMM for OC (Coal & OB) & Major Equipment for UG.	<p>HEMM for Opencast is provided below:</p> <table border="1"> <thead> <tr> <th>S. L. No.</th> <th>Equipment</th> <th>Capacity</th> <th>Maximum Population</th> </tr> </thead> <tbody> <tr> <td colspan="4" style="text-align: center;">Overburden</td> </tr> <tr> <td>1</td> <td>Diesel Hyd. Shovel</td> <td>4.5- 6.0 Cum</td> <td>3 Nos.</td> </tr> <tr> <td>2</td> <td>Diesel Hyd. Shovel</td> <td>3.1 - 3.5 Cum</td> <td>9 Nos.</td> </tr> <tr> <td>3</td> <td>Rear Dumper</td> <td>50- 60 T</td> <td>12 Nos.</td> </tr> <tr> <td>4</td> <td>Rear Dumper</td> <td>31- 39 T</td> <td>36 Nos.</td> </tr> <tr> <td>5</td> <td>Diesel Drill</td> <td>250mm</td> <td>1</td> </tr> <tr> <td>6</td> <td>Diesel Drill</td> <td>160mm</td> <td>4</td> </tr> <tr> <td>7</td> <td>Dozer</td> <td>165 & 320 hp</td> <td>4</td> </tr> <tr> <td colspan="4" style="text-align: center;">Coal</td> </tr> <tr> <td>1</td> <td>Surface Miner</td> <td>3800 series</td> <td>1</td> </tr> <tr> <td></td> <td>Surface Miner</td> <td>2200 series</td> <td>1</td> </tr> <tr> <td>2</td> <td>Diesel Hyd Backhoe/Shovel</td> <td>3.1-3.5 cum</td> <td>2</td> </tr> <tr> <td>3</td> <td>Rear Dumper</td> <td>31- 39 T</td> <td>12</td> </tr> <tr> <td>4</td> <td>FE loader</td> <td>2.5 -3.5 Cum</td> <td>2</td> </tr> <tr> <td>5</td> <td>Drill</td> <td>160mm</td> <td>1</td> </tr> <tr> <td>6</td> <td>Dozer</td> <td>165 & 320 hp</td> <td>4</td> </tr> <tr> <td colspan="4" style="text-align: center;">Common</td> </tr> </tbody> </table>	S. L. No.	Equipment	Capacity	Maximum Population	Overburden				1	Diesel Hyd. Shovel	4.5- 6.0 Cum	3 Nos.	2	Diesel Hyd. Shovel	3.1 - 3.5 Cum	9 Nos.	3	Rear Dumper	50- 60 T	12 Nos.	4	Rear Dumper	31- 39 T	36 Nos.	5	Diesel Drill	250mm	1	6	Diesel Drill	160mm	4	7	Dozer	165 & 320 hp	4	Coal				1	Surface Miner	3800 series	1		Surface Miner	2200 series	1	2	Diesel Hyd Backhoe/Shovel	3.1-3.5 cum	2	3	Rear Dumper	31- 39 T	12	4	FE loader	2.5 -3.5 Cum	2	5	Drill	160mm	1	6	Dozer	165 & 320 hp	4	Common				
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**Checklist for Mining Plan
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	Parameters	Details				Observation
		1	Grader	120 - 150 hp	3	
		3	Crane	20T- 40T	2	
		4	Crane	8-10T	1	
		5	Diesel Backhoe	1 cum	1	
		6	FE loader	4-6 cum	2	
		7	Dozer	165 hp	1	
			Ripper Dozer	300 - 450 HP	1	
		8	Diesel Browser		2	
		9	Fire tender		1	
		10	Boom truck		2	
		11	Heavy duty toe truck		1	
		12	Fork lift truck	5T	1	
		13	Tipping truck		5	
		14	Vibratory Compactor		1	
		15	Tyre Handler		1	
		16	Water Sprinkler	12 KL	5	
		17	Maintenance Van		1	
		18	Farm Tractor		1	
		Reclamation				
			Grader	120 - 150 hp	1	
			Dozer	165 HP	1	
			Water Sprinkler	12 KL	1	
o.	Mode of entry for underground mines (shaft, incline, adit.):	Not applicable.				
p.	Results of any investigation carried out for scientific mining, conservation of minerals and protection of environment; future proposals.	Besides Geological Report, Slope stability study has been carried out for the project.				
9.	IMPORTANT SAFETY ASPECTS – Major Risks and uncertainties to the project viz. Proximity to river, adjacent	Details of the safety aspects against flood, fire, slope failure, dump failure, other accidental aspects are covered in detail in chapter-11 of the document. No such situation exists.				

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**Checklist for Mining Plan
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	Parameters	Details	Observation
	working, geo-mining disturbances, slope stability and remedial measures suggested. It should also include proposed overall slope of the quarry and OB dump, dump height, strata control, fire and spontaneous heating, gas monitoring, disaster management, danger from inrush of water etc.		
10.	STATUS OF LEASE		
a.	Status of Lease	Lease granted for 260.14 ha of non-forest land out of applied 663 Ha (by Prior Allottee). The proposed lease area of 683.04 ha comprising already executed 260.14 ha, 338.75 ha of Forest Land (Forest clearance to be obtained) and remaining 84.15 ha of non forest land needs to be included in the lease.	
b.	Existing Lease Area "Ha"	260.14 ha. (Already transferred to WBPDCCL).	
c.	Period for which Mining Lease has been granted/is to be renewed/ is to be applied for.	30 years. Renewal due in the year 2045.	
d.	Date of expiry of earlier Mining Lease, if any	Not applicable.	
e.	Whether the lease boundary/ required boundary is same as demarcated by CMPDI/ SCCL/ NLC for delineating block/sub-block	Present proposed lease boundary comprising 683.04 ha falls well within the demarcated block boundary (comprising of 800 ha) by CMPDI. Plans are submitted to CMPDI for their certification.	
f.	Lease Area (applied/ required) as per the Mining Plan under consideration (Ha)	This mining plan is for 683.04 ha. Further land involving both 338.75 ha of forest land and 84.15 ha of non forest land is required for the planned period.	

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	Parameters	Details	Observation
g.	Whether the applied lease area falls within the allotted block	Yes. The applied lease area falls well within the certified block boundary.	
i.	Area (Ha) of lease which falls outside the block/sub-block delineated by CMPDI/SCCL/NLC.	Nil.	
j.	Details of outside area:	NOT APPLICABLE.	
	-Whether forms part of any other coal block	-	
	-Whether it contains any coal/lignite reserves	-	
	-Purpose for which it is required, e.g. roads/ OB dumps/ service buildings/ colony/ safety zone/ others (specify)	-	
k.	Whether some part(s) of the allotted block has not been applied for mining lease.	As per the previous mining plan mining lease area is 260.14 ha. This mining plan is being prepared including forest and non forest land comprising an area of 683.04 ha. out of 800 ha of block area. Thus there are left out areas for which lease has not been applied for.	
	-Total area in Ha of such part(s).	116.96 ha.	
	-Total reserves in such part(s). (Mt)	4.56MT	
	-Brief reasoning for leaving such part(s)	Reserves blocked within 45m surface barrier left from the existing road (between connecting Barjora and Mejia).	

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**Checklist for Mining Plan
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Parameters		Details								Observation		
11.		ENVIRONMENTAL MANANGEMENT										
a.		Land use pattern in Ha Pre Mining , During Mining and Post Closure Land Use and Post Closure Management of the Land should be provided in the following table										
Tenancy	Pre Mining Land Use "ha"	Type	Land Use during Mining	land use (End of Life)	Land Use (Post Closure)					Total		
					Agricultural Land	Plantation	Water Body	Public / Company Use	Forest Land (Returned)		Undisturbed	
Tenancy	Agricultural	233.44	Excavation Area	609.66	-							
	Township	-	Backfilled Area	-	431.42	95.07	100.02	-	236.23		431.42	
	Grazing	-	Excavated Void	-	178.34			75.82	102.52		178.34	
	Barren	0.065	Without Plantation	-	-						0	
	Water Body	55.88	Top Soil Dump.	1.81	1.81		1.81	-	-		1.81	
	Road	3.15	External Dump.	-							0	
	Community	-	Safety Zone/ Rationalisation Area.	8.59	8.59		8.59				8.59	
	Inhabited	1.034	Road Diversion.	0	0						0	
Govt. Non Forest	Village	-	Diversion/ Below River / Nala / Canal.	11.27	11.27				11.27		11.27	
	Agricultural	45.14	Road & Infrastructure area.	11.18	11.18		9.18		2.00		11.18	
	Township	-	Garland Drains.	2.25	2.25				2.25		2.25	
	Grazing/ Others	-	Embankment.	0	0						0	
	Road	-	Green Belt.								0	
	Water Body	5.585	Water Reservoir Near Pit/ Water Body.	-	-						0	
	Others.	-	UG Entry.								0	
Forest	Reserve		Pit Head Power Plant								0	
	Protected	338.75	Resettlement.								0	
	CJBJ		Undisturbed / Mining Rights for UG.	37.63	37.63					37.63	37.63	
Free Hold		Others (Magazine, ETP, Access Trench etc.)	0.65	0.65				0.65		0.65		
Total =	683.04			683.04	683.04	95.07	119.60	75.82	16.17	338.75	37.63	683.04

Distribution of the Forest Land Returned : Agriculture Land – 10 ha; Plantation area – 226.2 ha, Water Body – 102.52 ha.

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**Checklist for Mining Plan
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Parameters		Details			Observation
b.	Surface features over the block area.	Present surface plan is being furnished in Plate No. 4 of this document. Major surface features includes, Quarry Area, Forest Land, Backfilled Dump areas, infrastructure and office areas, nala, WBIDC Industrial complex, Barjora- Mejia Road etc.			
c.	No. of villages/Houses to be shifted.	Nil. Prior allottee has already implemented R & R.			
d.	Population to be affected by the project.	Already shifted by prior allottee.			
e.	Monitoring schedules for different environmental components after the commencement of mining and other related activities.	Air Quality	Once in on fortnight.		
		Water & effluent quality	Once a month.		
		Ground water level monitoring	Once in season (4 season).		
		Noise level	Once in a fortnight.		
		Study of Flora and Fauna	On receipt of the 2 nd revision of the mining plan approval, initiation of wild life conservation plan and EIA & EMP study shall be done. Flora and Fauna will be detailed during those study.		
	Soil Quality	Once in a year.			
12.	PROGRESSIVE & FINAL MINE CLOSURE PLAN				
12.1	Parameters of Mining Plan vis-a-vis Mine Closure plan (When only Mine Closure Plan is being placed for approval details of approved mining plan must be provided).				
		Approved Mining Plan	Approved Mining Pan including Mine Closure Plan – Revision-01.	Mining Plan & Mine Closure Plan (Revision-02)	
a.	Lease area “Ha”	663 ha	260.14 ha	683.04 ha	
b.	Project Area “Ha”	927.50 ha	260.14 ha	683.04 ha	
c.	Life of the Project in Years	22 years	5 years	22 years	
d.	Minimum and Maximum	20 meter (min) 155 meter (max)	20 meter (min) 145 meter (max)	20 meter (min) 145 meter (max)	

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	Parameters	Details			Observation
	Depth of working "m"				
e.	Geological Block "Ha"	800 ha.	800 ha.	800 ha	
f.	Production Target "MTPA"	3.0 MTPA	3.0 MTPA	3.0 MTPA	
g.	Seams Available "as per GR"	9 nos. of coal seams.	9 nos. of coal seams.	9 nos. of coal seams.	
h.	Seams not considered for mining with reasons	Seam IV not considered for mining because of its inconsistency and thin nature.	Seam IV not considered for mining because of its inconsistency and thin nature.	-	
i.	Geological Reserve "Mte"	85.49 Mt – Net In-situ. (For the whole block of 800 ha).	25.85 Million Tons of Net In situ Reserve in 260.14 ha.	91.67 Million Tonsof In-situ Reserve in 683.04 ha.	
j.	Blocked Reserve "Mte"	12.62 Mt. in safety barriers and 8.55 Million Tons of reserves reduced on account of dirt band.	In safety barrier, batter & unapproachable area 7.25 Mt.	16.20 Million Tons reserve is blocked in safety barrier, nala diversion, barrier from existing road and quarry batters.	
k.	Minable Reserve "Mte"	64.32 Mt.	18.60 Mt.	75.47 MT	
l.	Extractable Reserves " Mte"	61.11 Mt.	17.67 Mt.	71.70 MT	
m.	% of recovery	71.48 %	68.35 %	78.22 %	
	Reserve Depleted(till base date) inMte	-	6.11 Mt.	6.11 Mt.	
	Balance Extractable Reserve in Mt	61.11 Mt.	11.56 Mt.	65.59 Mt.	
	Avg. Grade	"F" Grade.	G10-G13	G10-G13	
n.	OB MM3	305.08 MM3	93.41 MM3	243.50 Mcum	

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Parameters		Details			Observation
o.	SR MM3/te	4.99 cum/te	5.29 cum/te	3.71 cum/te	
p.	Mining Technology	Opencast Mining through conventional drilling and blasting methodology for OB excavation; Coal winning through Surface Miner.	Opencast Mining through conventional drilling and blasting methodology for OB excavation; Coal winning through Surface Miner.	Opencast Mining through conventional drilling and blasting methodology for OB excavation; Coal winning through Surface Miner.	
q.	Coal Beneficiation envisaged	Coal beneficiation not envisaged in this project.	Coal beneficiation not envisaged in this project.	Coal beneficiation not envisaged in this project.	
r.	Handling of Rejects	Not applicable.	Not applicable.	Not applicable.	
s.	Land use pattern "Ha"				
	1. Excavation Area	663.00 ha	191.00 ha	609.66 ha	
	2. Top Soil Dump	Nil	5.86 ha	1.81 ha	
	3. External Dump	100.00 ha (Proposed but not implemented)	Nil	Nil	
	4. Safety Zone (including green belt)	12.50 ha	17.89 ha	8.59 ha	
	5. Other Use	95.50 ha	12.87 ha	14.17 ha	
	6. Infrastructure area	56.50 ha – including colony area.	26.90 ha	11.18 ha	
	7. Green Belt	-	-	-	
	8. Undisturbed Area	-	5.62 ha	60.69 ha	
	Total	927.50 ha	260.14 ha	683.04 ha	
12.2	Statutory obligations	At present this proposed mine with 683.04 ha of project area, is having all the requisites statutory clearances which includes the followings:			

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**Checklist for Mining Plan
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	The applicant, M/S WBDCL hereby undertakes to comply with all the statutory obligations which																																					

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Parameters	Details								Observation
	would arise after grant of various permissions/clearances to the applicant (WBPDCL) for running this mine.								
12.3	Waste Management (Figures in MM³):								
	Dumping schedule for the planned period is furnished below:								
	Waste Management (Figures in MM³)								
Year / Stage	Cumulative OB Removal			External Dump (Cumulative)		Internal Dump/Backfilling (Cumulative)		Embankment	
	Top Soil	OB	Total	OB	Top Soil	OB	Top Soil	OB	Top Soil
Y-1	0.311	11.190	11.500	-	-	11.190	-	-	-
Y-3	0.932	33.569	34.500	-	-	33.569	-	-	-
Y-5	1.553	55.948	57.500	-	-	55.948	0.250	-	-
Y-10	3.105	111.895	115.000	-	-	111.895	1.250	-	-
Y-15	4.658	167.843	172.500	-	-	167.843	1.750	-	-
Y-20	6.035	217.466	223.500	-	-	217.466	3.350	-	-
Y-22	6.575	236.926	243.500	-	-	236.926	4.080	-	-
Y-23	-	-	-	-	-	-	5.250	-	-
Y-24	-	-	-	-	-	-	5.900	-	-
Y-25	-	-	-	-	-	-	6.575	-	-
12.4	Biological and technical reclamation of mined out land:								
	Land Degraded (ha) - Cumulative				Technically Reclaimed Area (ha) - Cumulative				
Stage/ Year	Excavation	Dump (External + Top Soil)	Infra/ Others	Total	Backfill	Dump (External + Top Soil)	Infra / Others	Total	
Stage-1	2019-20	133.31	2.40	33.94	169.65	35.03		35.03	
Stage-3	2021-22	129.61	5.13	33.94	168.68	57.43		57.43	
Stage-5	2023-24	147.31	5.13	33.94	186.38	82.69		82.69	
Stage-10	2028-29	220.29	5.13	33.94	259.36	104.52		104.52	
Stage-15	2033-34	365.01	5.13	33.94	404.08	145.41		145.41	
Stage-20	2038-39	539.21	1.81	33.94	574.96	373.46		373.46	
Final Stage	2040-41	609.66	1.81	33.94	645.41	431.32		431.32	

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Parameters		Details							Observation	
Post Closure										
Closure (+ 3 Years)	2043-44	600.66	1.81	33.94	645.41	431.32	1.81	212.28	645.41	
Biologically Reclaimed Area (ha) - Cumulative										
Stage/ Year		Agricu lture	Plant ation	Water Body	Public / Compa ny Use	Total	Forest Land (Retur ned)	Undisturbed/ To be left for Public/ Community Use	Total	
Stage-1	2019-20	-	-	-	-	0	-	-	0	
Stage-3	2021-22	-	-	-	-	0	-	-	0	
Stage-5	2023-24	-	-	-	-	0	-	-	0	
Stage-10	2028-29	-	-	-	-	0	-	-	0	
Stage-15	2033-34	-	35.70	2.50	-	38.2	-	-	38.2	
Stage-20	2038-39	-	45.72	2.50	-	48.22	-	-	48.22	
Final Stage	2040-41	95.07	56.50	2.50	-	154.07	-	-	154.07	
Post Closure										
Closure (+ 3 Years)	2043-44	95.07	119.6	75.82	16.17	306.66	338.75	37.63	683.04	
12.5	Water Quality management : (Existing water bodies available in the lease hold area; Measures to be taken for protection of the same including control of erosion, sedimentation, siltation, water treatment, diversion of water course if any; Measures for protection of contamination of ground water from leaching etc; Quality of		During operational phase, all waste water coming from mine or workshop shall be treated in suitably designed effluent treatment plant. In post project phase the water accumulated in the lagoon shall be regularly sampled and analysed to monitor development of any acidity or toxicity in the accumulated water. During the planned period and closure period of 3 years, 93.19 ha broken area will be converted into and water bodies will be in active pumping and circulation stage. Hence no toxic water is anticipated. The pit waters will be sampled and analysed once every quarter.							

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	Parameters	Details	Observation																																																																																								
	surface water bodies and measures proposed to meet the water quality; Report of hydrological study of the area ; Water Balance Chart etc.)																																																																																										
12.6	<p>Top Soil Management – (Including Action plan for Top Soil management):</p> <table border="1"> <thead> <tr> <th colspan="7">Top Soil Management-(Including Action Plan for Top Soil Management)</th> </tr> <tr> <th rowspan="2">Year/St age</th> <th rowspan="2">Top Soil removal "MM3"</th> <th colspan="4">Top Soil Used "MM3"</th> <th rowspan="2">Total Utilisedt s</th> </tr> <tr> <th>Embank ment</th> <th>Spreading over the Backfilled Area</th> <th>Spreadi ng over the OB Dump Area</th> <th>Using for Green Belt Area</th> </tr> </thead> <tbody> <tr> <td>Y-1</td> <td>0.3105</td> <td>-</td> <td>-</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Y-3</td> <td>0.6210</td> <td>-</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Y-5</td> <td>0.6210</td> <td>-</td> <td>-</td> <td>0.25</td> <td></td> <td>0.250</td> </tr> <tr> <td>Y-10</td> <td>1.5525</td> <td>-</td> <td>1.000</td> <td>-</td> <td>-</td> <td>1.000</td> </tr> <tr> <td>Y-15</td> <td>1.5525</td> <td>-</td> <td>0.500</td> <td>-</td> <td>-</td> <td>0.500</td> </tr> <tr> <td>Y-20</td> <td>1.3770</td> <td>-</td> <td>1.600</td> <td>-</td> <td>-</td> <td>1.600</td> </tr> <tr> <td>Y-22</td> <td>0.5400</td> <td>-</td> <td>0.730</td> <td>-</td> <td>-</td> <td>0.730</td> </tr> <tr> <td>Y-23</td> <td>-</td> <td>-</td> <td>1.170</td> <td>-</td> <td>-</td> <td>1.170</td> </tr> <tr> <td>Y-24</td> <td>-</td> <td>-</td> <td>0.650</td> <td>-</td> <td>-</td> <td>0.650</td> </tr> <tr> <td>Y-25</td> <td>-</td> <td>-</td> <td>0.675</td> <td>-</td> <td>-</td> <td>0.675</td> </tr> </tbody> </table>	Top Soil Management-(Including Action Plan for Top Soil Management)							Year/St age	Top Soil removal "MM3"	Top Soil Used "MM3"				Total Utilisedt s	Embank ment	Spreading over the Backfilled Area	Spreadi ng over the OB Dump Area	Using for Green Belt Area	Y-1	0.3105	-	-				Y-3	0.6210	-					Y-5	0.6210	-	-	0.25		0.250	Y-10	1.5525	-	1.000	-	-	1.000	Y-15	1.5525	-	0.500	-	-	0.500	Y-20	1.3770	-	1.600	-	-	1.600	Y-22	0.5400	-	0.730	-	-	0.730	Y-23	-	-	1.170	-	-	1.170	Y-24	-	-	0.650	-	-	0.650	Y-25	-	-	0.675	-	-	0.675		
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Y-25	-	-	0.675	-	-	0.675																																																																																					
12.7	<p>Coal beneficiation and management of Coal Rejects, proposal regarding future maintenance and dismantling of structures, slurry pond and rejects</p>	Coal Beneficiation not conceptualize in this project.																																																																																									

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	Parameters	Details	Observation
12.8	Infrastructure to be retained and to be dismantled and measures to be taken for their physical stability and maintenance for the retained infrastructure facilities;	All infrastructures are to be demolished at the end of the plan period and only the office building and VT center, first aid room, pump houses and electrical rooms will remain till the closure of the mine. These infrastructures will be handed over to the community through local administrations.	
12.9	Decommissioning of mining equipment and their possible post mining use	Since mining operation will be carried out by MDO all mining machinery's deployed by them will be shifted to their other operations.	
12.10	Safety measures to be implemented to prevent access to surface opening for underground working, excavation etc (fencing to be carried out by barbed wires	<ul style="list-style-type: none"> • Thorough inspection of the mine and OB dump areas for assessing the left over closure jobs of already reclaimed internal dump areas. • Inspection of infrastructure and water body areas for their safe reclamation and abatement of any leftover dangers. • Action required making drainage and any fire areas safe for future period. • Making 2 meter high fencing wall against excavated void area to prevent inadvertent entry as per requirement. • Making safe approach road from surface to left out pit bottom for future uses, as void becomes a water body. • Completing the survey of total reclaimed areas like mined areas, internal dumps, mine faces, quarry fencing and other areas to complete and update the Mine Plans under Coal Mine Regulation. 	
12.11	Economic Repercussions of closure of mine - Manpower retrenchment, compensation to be given, socio-economic repercussions and remedial meas	Economic repercussion has been described under clause no. 15.3.4 of chapter-15 of this document.	

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Parameters		Details										Observation
ures consequent to closure												
12.1 2	Time scheduling for abandonment with bar chart for the life of the project plus 3 years.	A tentative time schedule including 3 years post closure has been furnished in chapter 15 and furnished below:										
Head	Parameters	Stage-1	Stage-3	Stage-5	Stage-10	Stage-15	Stage-20	Stage-Final	Closure-1	Closure-2	Closure-3	
Progressive Closure	Water Quality Management											
	Air Quality Management											
	Waste Management											
	Ditch and Plant Fencing around dump											
	Biological fencing around the Lease Area											
	Filling of voids											
	Top Soil management											
	Technical and Biological Reclamation of mined out of land and OB dump											
	Plantation over virgin area including green belt.											
	Manpower cost and supervision											
	Toe wall around the dump.											
	Garland Drain											
	Dismantling of Infrastructure & Disposal or rehabilitation of Mining Machinery	Garland Drain around the dump.										
Any Other Activities.												
Dismantling of Workshop.												
Rehabilitation of the dismantled facility.												
Dismantling of pumps and pipes / Other Facilities												
Dismantling of Stowing bunkers/ provisioning of pumps for borewell pumping arrangement.												
Safety & Security	Dismantling of UG equipment											
	Rearranging water pipeline to dump top park / Agricultural land											
	Dismantling of power lines.											
	Biological fencing around dumps											
	Biological fencing around the pit.											
	Net fencing with masonry pillars											
	Concrete wall with masonry pillar around the pit.											
	Securing air shaft and installation of borewell pump											
	Securing of Incline											
	Concrete wall fencing around the water body											
Technical & Biological Reclamation of Mined out of land and OB Dump	Boundary wall around the water body											
	Stabilisation (Viz. Benching, Pitching) of side walls of the water body.											
	Toe wall around the dump.											
	Garland drain											
	Garland drain around the dump.											
Post Closure Management and Supervision	Drainage channel from main OB dump.											
	Filling of void.											
	Top Soil management											
	OB rehandling for backfilling.											
Others	Terracing, Blanketing with soil, and vegetation of External OB dump											
	Periphera road, gates, view point, cemented steps on bank.											
Cost of Activities to be taken up for closure of the mine:	Expenditure on development of agricultural land.											
	Landscaping and plantation.											
Cost of Activities to be taken up for closure of the mine:	Power Cost											
	Post mining water quality management											
	Post mining air quality management											
	Subsidence monitoring for five years.											
	Waste Management											
Cost of Activities to be taken up for closure of the mine:	Manpower cost and supervision.											
	Entrepreneurship development (Vocational/Skill development/training for sustainable income of affected people).											
	Golden Handshake / Retrenchment benefits to OC employees.											
	Golden Handshake / Retrenchment benefits to UG employees.											
	Institutions/ Organisations which is dependent upon the project.											
Cost of Activities to be taken up for closure of the mine:	Provide Jobs in other mine of the company.											
	Continuation of other services like running of schools etc.											

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Checklist for Mining Plan & Mine Closure Plan.



3	Parameters	Details	Observation
	Head	Activities	Unit
		Water Quality Management	LS
		Air Quality Management	LS
		Rate Rs. (Lakhs)	Assessment Rs. In Lakhs
		25	31.25
		20	25.00
	Progressive Closure	Waste Management	MNI
		Dirch and Plant Fencing around dump	M
		Biological fencing around the Lease Area	M
		Filling of voids	MNI
		Top Soil management	MNI
		Technical and Biological Reclamation of mined out of land and OB dump	Ha
		Plantation over virgin area including green belt	Ha
		Manpower cost and supervision	PM
		Toe wall around the dump	M
		Carland Drain	M
		Carland Drain around the dump	M
		Any Other Activities	
	A.	Sub-Total =	153.35
	Dismantling of Infrastructure & Disposal of Mining Machinery	Dismantling of Workshop	LS
		Rehabilitation of the dismantled facility	LS
		Dismantling of pumps and pipes / Other Facilities	LS
		Dismantling of Stowing bunkers/ provisioning of pumps for borewell pumping arrangement	LS
		Dismantling of L/C equipment	
		Rearranging water pipeline to dump top park / Agricultural land	LS
		Dismantling of power lines	LS
	B.	Sub-Total =	350.00
	Safety & Security	Net fencing around dumps	M
		Biological fencing around the pit	M
		Net fencing with masonry pillars	M
		Concrete wall with masonry pillar around the Water Harvesting area	M
		Securing air shaft and installation of borewell pump	
		Securing of Incline	
		Concrete wall fencing around the water body	
		Boundary wall around the water body	
		Stabilisation (Vib. Benching, Pitching) of side walls of the water body	LS
		Toe wall around the dump	M
		Nala Diversion	M
		Carland drain around the dump	M
		Drainage channel from main OB dump	M
	C.	Sub-Total =	111.00
	Technical & Biological Reclamation of Mined out of land and OB Dump	Filling of void	Ha
		Top Soil management	MNI
		OB handling for backfilling	MNI
		Terracing, Blanketing with soil, and vegetation of External OB dump	Ha
		Peripheral road, gates, view point, cemented steps on bank	
		Expenditure on development of agricultural land	LS
		Landscaping and plantation	LS
	D.	Sub-Total =	111.00
	Post Closure Management and Supervision	Power Cost	Year
		Post mining water quality management	Year
		Post mining air quality management	Year
		Subsidence monitoring for five years	Year
		Waste Management	LS
		Manpower cost and supervision	Year
	E.	Sub-Total =	357.00
	Others	Entrepreneurship development (Vocational/Skill development/training for sustainable income of affected people)	Year
		Golden Handshake / Retrenchment benefits to OC employees	Nos
		Golden Handshake / Retrenchment benefits to U/C employees	Nos
		One time financial grant to societies / Institutions/ Organisations which is dependent upon the project	LS
		Provide jobs in other mine of the company	
		Continuation of other services like running of schools etc.	Year
	F.	Sub-Total =	24.00
		Total Mine Closure Cost in Rs. Lakhs. (A + B + C + D + E + F)	1076.00

12.1 Amount to be deposited in Escrow account as a security against the mine activities to be carried out for the closure of the mine:

WPI as on			Aug-09		129.6
WPI as on base date	Base year 11-12	156.13	01-04-2019	121.7	190.01
Escalation rate of Closure cost					1.47
Base Rate of Closure Cost "Rs. Crs./Ha"				UG	OC
Closure Cost "Rs. Crs./Ha"					0.06
Project Area					683.04
Amount to be deposited into Escrow Account "Rs. in Crs"					61.47

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**Checklist for Mining Plan
& Mine Closure Plan.**



Parameters		Details			Observation
Rate of compounding of Annual Closure Cost				5.00%	
Balance Life of the project "in Yrs"				22	
Annual Closure Cost				2.79	
Amount to be deposited into Escrow Account after compounding @ of 5% "Rs. in Crs"				107.43	
Amount already deposited into Escrow Account "Rs. in Crs"				7.03	
Net Amount to be deposited into Escrow Account "Rs. in Crs"				100.40	
Rs. In Crores					
Year	OC	UG	Total	Already deposited	Balance to be deposited
2019-20	2.79		2.79	7.03	0.00
2020-21	2.93		2.93		0.00
2021-22	3.08		3.08		1.77
2022-23	3.23		3.23		3.23
2023-24	3.39		3.39		3.39
2024-25	3.56		3.56		3.56
2025-26	3.74		3.74		3.74
2026-27	3.93		3.93		3.93
2027-28	4.12		4.12		4.12
2028-29	4.33		4.33		4.33
2029-30	4.54		4.54		4.54
2030-31	4.77		4.77		4.77
2031-32	5.01		5.01		5.01
2032-33	5.26		5.26		5.26
2033-34	5.52		5.52		5.52
2034-35	5.80		5.80		5.80
2035-36	6.09		6.09		6.09
2036-37	6.39		6.39		6.39
2037-38	6.71		6.71		6.71
2038-39	7.05		7.05		7.05
2039-40	7.40		7.40		7.40

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**Checklist for Mining Plan
& Mine Closure Plan.**



Parameters		Details			Observation
2040-41	7.77		7.77	7.77	
Total=	107.4		107.4	100.40	
	3		3		
13.	Responsibility of Mine owner	<p>The mine owner, the WBPDCCL, undertakes the responsibility of the mine closure as per the prevailing rules and regulations with respect to Mine Closure activities. Reclamation and rehabilitation works will be carried out as per the provisions of the Mining plan and Mine closure plan. Necessary fund arrangements will be made by the Owner. Certificate to this extent has been provided by the authorized person of WBPDCCL and is furnished in Annexure- XV.</p> <p>Periodical reports to this extent will be submitted to the Coal Controllers Organisation stating the progress of the closure activities.</p> <p>The mine owner will obtain a mine closure certificate from the coal controller to the effect that the protective, reclamation and rehabilitation works have been carried out by the mine owner in accordance with the mine closure plan/final mine closure plan for surrendering the reclaimed land to the concerned State Government.</p>			
14.	Provision of Mine Closure	Provisions of mine closure activities are described in chapter 15 of this document.			
15.	ANNEXURES				
I	Copy of allotment order /Vesting order.	Mandatory	Furnished in Annexure-I.		
II	Certificate of CMPDIL that the project boundary considered for the Mining plan is in coherence with the block boundary vested with the allottee.	Mandatory	Boundary certification from CMPDIL is furnished in Annexure-II.		
III	Approvals of Mining plan from the Board of the company.	Mandatory	Furnished in Annexure-III.		
IV	Copy of earlier approval of mining plan.	Mandatory	Furnished in Annexure-IVA.		

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	Parameters	Details		Observation
V	Copy of MOC's Lettergranting recognition to RQP for preparation of Mining plan.	Mandatory	Furnished in Annexure-V.	
VI	Letter of authorisation by the Block allottee for formulation of Mining Plan & Mine Closure Plan by the RQP.	MP & MCP	Furnished in Annexure-VI	
VII	Certificate of acceptance of the RQPto formulate theMining Plan &MineClosure Plan on behalf of the projectproponent.	MP & MCP	Furnished in Annexure-VII.	
VIII	A certificate by the RQP that he has beendulyauthorized by the mining company toprepare Mining plan &MCP on their behalfand that he has a validrecognition from MOCunder MCR, 1960 toprepare the Miningplan and thatprovisions of all relevant rules and regulations made there under have been observed in thepreparation of miningplan.	MP & MCP	Furnished in Annexure-VIII.	
IX	The Mining plan/ Mine Closure plan has been prepared considering the guidelines pertaining to mining plan/ mine closure plan issued by	MP & MCP	Furnished in Annexure-IX.	

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**Checklist for Mining Plan
& Mine Closure Plan.**



	Parameters	Details		Observation
	MoC,GOI&whereverspecific permission willbe required theapplicant will approachtheconcern edauthorities.			
X	Confirmation from RQP that he has verified the block areawiththerelevant plans supplied by MPDI/ SCCL / NLC and arecovered by the miningplan does notencroach on any othercoal/lignite block.	MP	Furnished in Annexure-X.	
XI	Certificate from empowered representative of / orBlockallottee/ applicant that he minewill be developed as per the approval of themining plan fromMinistry of coal and allother approvals, asrequired will be obtained from relevantauthorities	MP	Furnished in Annexure-XI.	
XII	Copy of the document to establish that the geological report hasbeen duly purchasedfrom CMPDI, GSI/ MECL as the case maybe.	MP	Furnished in Annexure-XII.	
XIII	Certificate of RQP that the project boundaryconsidered for the Mining Closure Plan	MP & MCP	Annexure-XIII.	

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**Checklist for Mining Plan
& Mine Closure Plan.**



	Parameters	Details		Observation
	has been verified by RQP. It is in coherence with the block boundary of vesting order and approved mining plan and no discrepancy has been found.			
XIV	Certificate that the Mine Plan & Mine Closure plan have been prepared in line with the approved Mining plan and the mine parameters considered for formulation of mine closure plan is exactly the same, which has been approved in the Mining plan.	MP & MCP	Annexure-XIV.	
XV	Certificate from empowered representative of / or Block allottee / applicant that he / she / it / they / them / them that the reclamation & rehabilitation work shall be carried out in accordance with the approved mine closure plan and any modification / amendments which may be made in the mine Closure Plan by Ministry of Coal, from time to time.	MP & MCP	Furnished in Annexure-XV.	
XVI	Documents in support of Mining Lease, in case the lease has already	MP & MCP	Furnished in Annexure-XVI.	

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**Checklist for Mining Plan
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	Parameters	Details		Observation
	been granted.			
XVI I	Hydrological study carried out if any.	MP & MCP	Not done.	
XVI II	Other document	MP & MCP	<ol style="list-style-type: none"> 1. Notice of opening from CCO-Annexure XVIIIA 2. Consent to Establish-Annexure XVIII B 3. Consent to Operate - Annexure XVIII C 4. Blasting permission from DGMS- XVIII D 5. Explosive License- XVIII E 6. Permission by DGMS for Heavy Earth Moving Machineries-Annexure XVIII F 7. Confirmation of payment against work order contract no HQ/M&C/605000096 5 dt 26.02.2019 regarding diversion of 220 kv HT line-Annexure XVIII G 8. Declaration by allottee for Nallah diversion-Annexure XVIII H 9. Dump and Pit stability study report of Barjora North Coal Mine Annexure XVIII I. 	
XIX	Environment Clearance to previous allottee& Transfer to current allottee	MP & MCP	Furnished in Annexure-XIX.	
XX	Stage – I FC diversion approval from MoEF& CC to the previous allottee& Transfer to current allottee.	MP & MCP	Not applied.	
16.	LIST OF PLANS			

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	Parameters	Details		Observation
I	Location plan	MP & MCP	Furnished in Plate no. I	
II	Reference no. of plan of block boundary issued by CMPDI/ SCCL/ NLC (A copy of the Plan also to be annexed)	MP	Furnished in Plate-II.	
III	Plan in scale of not less than 1: 10000 showing approved block boundary vis-à-vis proposed/existing mining lease & Mine boundary superimposed over it in distinct colour.	MP & MCP	Furnished in Plate-III.	
IV	Geological plan showing all the boreholes drilled and proposed to be drilled showing allotted block boundary and required lease area	MP & MCP	Furnished in Plate-IV.	
V	Graphic Litholog	MP & MCP	Furnished in Plate-V1-V8.	
VI	Surface Plan showing drainage system, Contour, at minimum 3m interval, location of BH	MP & MCP	Furnished in Plate-VI.	
VII	Conceptual plan showing infrastructure facilities including colony, boundary of mining area, mine entries, roads including road diversions and alignment etc.	MP & MCP	Furnished in Plate-VII.	
VIII	Land use plan showing Govt, forest	MP & MCP	Furnished in Plate-VIII.	

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	Parameters	Details		Observation
	and Tenancy land			
IX	Floor contour plan and seam folio plan, isograde plan	MP & MCP	Furnished in Plate-IXA1-A4 & IXB1-B4 respectively.	
X	X-section showing coal/Lignite seams	MP & MCP	Furnished in Plate-X	
XI	Plan showing existing and proposed surface layout	MP & MCP	Furnished in Plate no. XIA & XIB respectively.	
XII	Post mining land use plan	MP & MCP	Furnished in Plate XII.	
XIII	Progressive mine closure plan/ stage plan indicating stages at 1st, 3rd, 5th, 10th, and 20th interval (showing area, volume, dump height etc for OC and seam-wise layout projects and ventilation system in UG)	MP & MCP	Furnished in Plate XIII A TO XIII G	
XIV	Reclamation plan	MP & MCP	Furnished in Plate XIV	
	OPENCAST MINES			
XV	Plan showing total coal thickness and overburden thickness and stripping ratio	OC	Furnished in Plate-XV.	
XVI	Final stage quarry plan showing haul road alignment	OC	Furnished in Plate XVI.	
	UNGRAOUND MINES			
XVI I	Plan showing mode and location of entries and surface layouts.	UG	Not applicable.	
XVI II	Layout of the panel for each system Longwall, Board & Pillar, roadheader	UG	Not applicable.	

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	Parameters	Details		Observation
	should be given)			
XIX	Layout of pillar extraction	UG	Not applicable.	
XX	Support system	UG	Not applicable.	
XXI	Haulage and transport system	UG	Not applicable.	

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Checklist for Mining Plan & Mine Closure Plan.



ENCLOSURE 1

Head	Parameters	Stage-1	Stage-3	Stage-5	Stage-10	Stage-15	Stage-20	Stage-Final	Closure-1	Closure-2	Closure-3
Progressive Closure	Water Quality Management										
	Air Quality Management										
	Waste Management										
	Ditch and Plant Fencing around dump										
	Biological fencing around the Lease Area										
	Filling of voids										
	Top Soil management										
	Technical and Biological Reclamation of mined out of land and OB dump										
	Plantation over virgin area including green belt.										
	Manpower cost and supervision										
	Toe wall around the dump.										
	Garland Drain										
	Garland Drain around the dump.										
Any Other Activities.											
Dismantling of Infrastructure & Disposal or rehabilitation of Mining Machinery	Dismantling of Workshop.										
	Rehabilitation of the dismantled facility.										
	Dismantling of pumps and pipes / Other Facilities										
	Dismantling of Stowing bunkers/ provisioning of pumps for borewell pumping arrangement.										
	Dismantling of UG equipment										
	Rearranging water pipeline to dump top park / Agricultural land										
	Dismantling of power lines.										
Safety & Security	Barbed wire fencing around dumps										
	Barbed wire fencing around the pit.										
	Barbed wire fencing with masonry pillars										
	Concrete wall with masonry pillar around the pit.										
	Securing air shaft and installation of borewell (ump)										
	Securing of Incline										
	Concrete wall fencing around the water body										
	Boundary wall around the water body										
	Stabilisation (Viz. Benching, Pitching) of side walls of the water body.										
	Toe wall around the dump.										
Garland drain											
Garland drain around the dump.											
Drainage channel from main OB dump.											
Technical & Biological Reclamation of Mined out of land and OB Dump	Filling of void.										
	Top Soil management										
	OB rehandling for backfilling.										
	Terracing, Blanketing with soil, and vegetation of External OB dump										
	Peripheral road, gates, view point, cemented steps on bank.										
	Expenditure on development of agricultural land.										
Landscaping and plantation.											
Post Closure Management and Supervision	Power Cost										
	Post mining water quality management										
	Post mining air quality management										
	Subsidence monitoring for five years.										
	Waste Management										
Manpower cost and supervision.											
Others	Entrepreneurship development (Vocational/Skill development/training for sustainable income of affected people).										
	Golden Handshake / Retrenchment benefits to OC employees.										
	Golden Handshake / Retrenchment benefits to UG employees.										
	One time financial grant to societies / Institutions/ Organisations which is dependent upon the project.										
	Provide Jobs in other mine of the company.										
Continuation of other services like running of schools etc.											

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SUMMARISED DATA

Summarised Data (SD)

1.0 General:

a.	Name and Address of the applicant Company	The West Bengal Power Development Corporation Ltd. Bidyut Unnayan Bhaban. Plot No. 3/C, IIInd Floor, LA Block, Sector-III, Salt Lake City. Kolkata – 700098. CIN: U40104WB1985SGC039154.
b.	Name and address of the Block Allottee.	Same as above.
c.	Relationship between the applicant and allottee company.	Applicant and Block Allottee are same company.
d.	Status of the Applicant Company : Central /Public Sector Undertaking/State Government Undertaking/JV Company/ Pvt. Company/Public Co/Others (Specify)	The West Bengal Power Development Corporation Limited (WBPDCCL) is a Government of West Bengal undertaking.
e.	Name of the Coal Block together with name of Coalfield & State where located	Barjora North Coal Mine. Barjora Coalfield. Bankura District. West Bengal.
f.	Date of allotment	31 st March, 2015 vide allotment number No. 103/07/2015 /NA and subsequent corrigendum 01, vide No. 103/07/2015 /NA; dt. 7 th March, 2017 (Annexure-I).
g.	End Use of Coal/Lignite as per Approval by the Competent	Power Generation. End use power plants are situated at: 1. STPS, Santaldih, Purulia district. 2. KTPS, Mecheda, Purba Medinipur district.

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Summarised Data (SD)

	Authority	<p>3. BKTPP, Bakreswar, Birbhum district. 4. BTPS, Tribeni, Hoogly district. 5. SgTPP, Manigram, Murshidabad district unit 1 & 2. SgTPP, Manigram, Murshidabad district unit 3 & 4.</p> <p>Details are provided in Table no. SD.1. Status of EUP's: All the end use plants as listed in Table no. SD.1 is operational.</p>																																																																																																																																																											
h.	ROM Quantity proposed to be produced as per Mining Plan.	<p>Quantity proposed under this revised mining plan is furnished below:</p> <table border="1" style="width: 100%; margin: 10px auto; border-collapse: collapse;"> <thead> <tr> <th colspan="6" style="text-align: center;">Coal Production Plan " MT "</th> </tr> <tr> <th rowspan="2" style="text-align: center;">S.L. 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i.	Norms adopted for calculating ROM quantity requirement in case it differs from the quantity indicated in the Allotment Order.	Annual coal requirement of end use plants with Norms/Calculations is given in Table no. SD.2. Total coal requirement as depicted in Table SD.2 is 19.45 MTes to be catered from existing bucket of coal mines of WBPDCCL including this mine.
j.	Beneficiation required – Yes/No	No.
k.	Requirement of Beneficiated Coal & expected availability thereof.	No.
l.	Period for which Mining Lease has been granted/is to be renewed/ is to be applied for.	Long Term Mining Lease has been granted to the prior Allottee by the Department of Commerce and Industries, Government of West Bengal for 30 (thirty) years vide lease grant order no. 230-CI/o/Coal/38/07/MI for an area of 260.14 ha. Later on the as per the vesting order under the Coal Mines (Special provisions) Act, the same has been transferred to WBPDCCL on 4 th August, 2015.
m.	Date of Expiry of earlier Mining Lease, if any,	Mining lease is valid for 30 years from the date of issue of the long term mining lease- i.e. from 4 th of August, 2015.
n.	RQP who has prepared the Mining Plan Name Address Phone No/Fax/Email ID Registration No & date till valid Date of grant/Renewal of RQP Status Validity	Shri Abhai Pratap Singh D 2/F2, GovindaGourkhede Complex, Seminary Hills, Nagpur 440006, Maharashtra. Mobile No.: +91-9423684516. Email id: apsingh49wcl@gmail.com Registration No. :34011/ (50)/2009-CPAM, Dt. 7 th October, 2009. Valid Till: 6 th October, 2019.Attached as Annexure-V .

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Summarised Data (SD)

Table No. SD-1: Details of the End Use Power Plants of WBPDCCL.

S. L. No.	Name of Specified End Use Plants	Address	Configuration	Capacity
1.	Santaldih Thermal Power Station.	Santaldih, Purulia, West Bengal – 723146.	2 x 250 MW	500 MW.
2.	Kolaghat Thermal Power Station.	Mecheda, Medinipur, West Bengal – 721137.	6 x 210 MW	1260 MW.
3.	Bakreswar Thermal Power Plant.	Birbhum, West Bengal – 731104.	5 x 210 MW	1050 MW.
4.	Bandel Power Station.	Tribeni, Hoogly, West Bengal – 712503.	4 x 60 = 240 MW 1 x 210 = 210 MW	450 MW.
5.	Sagardighi Thermal Power Plant; Unit 1 & 2.	Manigram, Murshidabad, West Bengal – 742237.	2 x 300 MW	600 MW.
	Sagardighi Thermal Power Plan – Unit 3 & 4.	Manigram, Murshidabad, West Bengal – 742237.	2 x 500 MW	1000 MW.

Table No. SD-2: Annual Coal Requirement of End Use Plants with Norms/Calculations.

	1	2	3	4	4	5	5	
Name of EUP's	Santaldih TPS	Kolaghat TPS	Bakreswar TPS	Bandel #5	Bandel #1,2,3,4	Sagardighi TPP 1 & 2	Sagardighi TPP 3 & 4	Total
Capacity of the end use Plants (MW)	500	1260	1050	210	240	600	1000	4860
Capacity of the Project in MTPA	3.00							
Raw Coal Availability from this project.	3.00							
Washed Coal Availability" MTPA".	0.00							

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Reject " MTPA".	0.00							
Station Heat Rate " Kcal / Kwhr"	2500	2500	2500	2500	2770	2375	2375	
Average Calorific value of Coal (Kcal/Kg)	4600	4600	4600	4600	4600	4600	4600	
Raw Coal	4047	4047	4047	4047	4484	3844	3844	
Washed Coal	-	-	-	-	-	-	-	
Rejects	-	-	-	-	-	-	-	
Specific Consumption								
Specific Consumption "Kg/Kwhr"	0.54	0.54	0.54	0.54	0.60	0.52	0.52	
Plant Load Factor/ Capacity Utilisation	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
Coal Requirement "MTPA"	2.02	5.10	4.25	0.85	1.08	2.31	3.84	19.45

2.0 Information Regarding Earlier Mining Plans If Any:

a.	Approval Letter no. and Date	Letter No. 47011/4/2003-CA-I; dt. 24 th August, 2006. Copy furnished in Annexure-IVA (Previous mining plan). Letter no. 34011/19/2017-CPAM; dt 4th September, 2017. Copy furnished in Annexure-IVB (Previous revised mining plan).
b.	Lease Area	260.14 ha.
c.	Date of grant of Lease	07.04.2010
d.	Date of Expiry of Lease	06.04.2040
e.	Targeted Production	3.0 MTPA – peak rated.
f.	Proposed year of start of Production	2017-18
g.	Proposed year of achieving the targeted production level	4 th year(i.e. 2021-2022)
h.	Envisaged life of the mine (in years)	7 Years.
i.	Date of actual commencement of Mining Operations, if operations	Prior Allottee has started mining activity from January 2011 till 31 st March, 2015. After reallocation, WBPDCCL has obtained necessary

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Summarised Data (SD)

	already started	approval and started mining activity from June, 2018. Till 31 st March 2019, there was no Coal production, only developmental works were undergone.																																																				
j.	Likely date of Mining Operations, if operations not yet started & reasons for non-commencement of operations	Production started in the year 2019.																																																				
k.	Planned production and actual levels achieved in last 3 years.	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="9">Planned Production and Actual Level Achieved in last 3 years</th> </tr> <tr> <th rowspan="2"></th> <th rowspan="2">Calendar Year</th> <th colspan="2">Planned</th> <th colspan="5">Actual Coal Production "Mte"</th> </tr> <tr> <th>Coal</th> <th>OB</th> <th>UG</th> <th>OC</th> <th>Total Mte</th> <th>Total MM3</th> <th>SR</th> </tr> </thead> <tbody> <tr> <td>Y-1</td> <td>2016-17</td> <td>3.00</td> <td>15.51</td> <td>-</td> <td>-</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Y-2</td> <td>2017-18</td> <td>0.77</td> <td>4.93</td> <td>-</td> <td>-</td> <td>-</td> <td></td> <td>-</td> </tr> <tr> <td>Y-3</td> <td>2018-19</td> <td>1.5</td> <td>7.42</td> <td>-</td> <td>-</td> <td>-</td> <td>1.56</td> <td>-</td> </tr> </tbody> </table>	Planned Production and Actual Level Achieved in last 3 years										Calendar Year	Planned		Actual Coal Production "Mte"					Coal	OB	UG	OC	Total Mte	Total MM3	SR	Y-1	2016-17	3.00	15.51	-	-				Y-2	2017-18	0.77	4.93	-	-	-		-	Y-3	2018-19	1.5	7.42	-	-	-	1.56	-
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l.	Coal :- U/G O/Cast OB	Coal: Opencast- 6.11 Mtes. OB: 29.06 MCum.																																																				
m.	Reasons for difference between the planned and actual production levels.	Commencement of mine production is linked to obtaining of Environmental Clearance, Notice of Opening and other requisite permissions. The developmental works and OB removal work started only after obtaining the stated permissions from the concerned Government Authorities in the month of June, 2018. So far(as on 31 st March, 2019), no coal production has been made.																																																				
n.	Reason for revision of the Mining Plan.	The Barjora North Coal Mine comprises both forest and non-forestland types. In order to obtain an Environment Clearance for the leasehold non forest land of 260.14 ha, WBPDCCL has obtained approval of Revised Mining Plan restricting their extent of operation only within the aforesaid area from Ministry of Coal, vide letter No. 34011/19/2017-CPAM; dt 4 th September, 2017. In accordance with the Revised Mining Plan for 260.14 ha, Environmental Clearance was also obtained by WBPDCCL from MoEF& CC vide their letter no. J-11015/90/2017-IA.II(M);dt 31 st May (furnished as Annexure XIX). As per the conditions laid in the Mining Plan Approval letter and in order to prepare the application for Forest Clearance of Barjora North Coal Mine, a mining plan preparation work has been necessitated by WBPDCCL for the entire block including Forest and Non-Forest Land.																																																				

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		Based on the Geology, Surface Constraints and other Geo-mining parameters, the project boundary has been conceptualized as 683.04 ha out of the allotted block area of 800 ha. This mining plan is thus restricted within 683.04 ha of area comprising both forest and non-forest land.
0.	<p>Details of changes in the new mining plan compared to earlier approval</p> <p>(i) Lease Area (ii) Block Boundary (iii) Production level (iv) Reserves (v) Mining Technology(Additional sheets to be used, if required) (vi) Land use pattern</p>	<ol style="list-style-type: none"> 1. Lease area in previous revised mining plan is 260.14 ha and this mine plan is for 683.04 ha. 2. No change in allotted block area. However, block boundary has been surveyed as per WGS 84 system and certified by CMPDIL. 3. No change in peak rated capacity. 4. Mineable reserve is 18.60 MT in earlier mine plan. Mineable reserve within the Block boundary estimated to 75.47 Mt 5. No change in mining technology. Shovel dumper combination for OBR while Surface Miner for coal production will be adopted. 6. In principle there is no change in the dumping schedule. Total waste will be dumped internally within the proposed leasehold boundary. Non external dump is proposed.

3.0 Location:

a.	Location of the Block: Taluka/ Village/ Khasra/ Plot/ Block Range/ etc. / District/ State:	The Barjora North Coal Block is situated in Barjora Coalfield and administratively falls under Villages: Ghutgoria, Manohar, Baguli, Saharjora, Barapukhria, Tikargram&Sitarampurat Police station: Barjora of Bankura district, West Bengal.
b.	Name of the Coalfield/ Coal Belt:	Barjora Coalfield.
c.	Particulars of adjacent blocks:	In the south, existence of Barjora South Coal Block is there. The southern boundary of Barjora North Coal Block is a common boundary to Barjora South Coal Block. No other block in adjacent.
d.	d) Area of the Allotted Block (hectares): i Geological block area	<ol style="list-style-type: none"> 1. Area as per Geological report -8.00 Sq. Km or 800 ha. 2. Certified mine boundary - 800 ha.

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	ii Mining Block Area;	<p>3. 683.04 ha for this mining plan.</p> <p>4. Executed lease area – 260.14 ha. Remaining 338.75 ha of forest land and 84.15 ha of non forest land needs to be included in the lease.</p>
e.	Reference no. of plan of block boundary issued by CMPDI/ SCCL/ NLC (A copy of the Plan alongwith the coordinates of the boundaries to be annexed):	Certified map from CMPDI is furnished in Plate No. II.
f.	Whether the lease boundary/ required boundary is same as demarcated by CMPDI/ SCCL/ NLC for delineating block/sub-block.	Lease boundary falls well within the certified block boundary.
g.	Existing mining Lease Area in case of existing mines, (hectares):	Existing mining lease is for 260.14 ha of non forest land. Lease document furnished in Annexure-XVI.
h.	Applied/ required Lease Area as per the Mining Plan under consideration (hectares):	This mining plan has been proposed for 683.04ha. Lease is granted only for 260.14 ha.
i.	Whether the applied lease area falls within the allotted block:	Yes. The complete area falls within the allotted area of the coal block.
j.	Area (hectares) of lease which falls outside the block/sub-block delineated by CMPDI/SCCL/NLC.	Nil.
k.	Details of outside area: - Whether forms part of any other coal block	Not applicable.

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Summarised Data (SD)

	- Whether it contains any coal/lignitereserves - Purpose for which it is required, e.g. roads/ OB dumps/service buildings/ colony/ safety zone/ others (specify).																																												
l.	Whether some part(s) of the allotted block has not been applied for mining lease. - Total area in ha. Of such part(s). - Total reserves in such part(s). - Brief reasoning for leaving such part(s)	As per the previous mining plan mining lease area is 260.14 ha. This mine is being prepared including both forest and non forest land comprising an area of 683.04 ha. out of 800 ha of block area. <table border="1"> <tr> <td>-Total area in Ha of such part(s).</td> <td>116.96 ha.</td> </tr> <tr> <td>-Total reserves in such part(s). (Mt)</td> <td>4.56 MT</td> </tr> <tr> <td>-Brief reasoning for leaving such part(s)</td> <td>Reserves blocked within 45m surface barrier left from the existing road (between connecting Barjora and Mejia).</td> </tr> </table>	-Total area in Ha of such part(s).	116.96 ha.	-Total reserves in such part(s). (Mt)	4.56 MT	-Brief reasoning for leaving such part(s)	Reserves blocked within 45m surface barrier left from the existing road (between connecting Barjora and Mejia).																																					
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m.	Type of Land involved in Hectares; - Forest Land - Non Forest Land o Tenancy Land o Govt. Land	Total lease area: 683.04ha –Non forest. <table border="1"> <thead> <tr> <th colspan="2"></th> <th colspan="2">Pre Mining Land Use "ha"</th> </tr> </thead> <tbody> <tr> <td rowspan="8">Tenancy</td> <td>Agricultural</td> <td>233.44</td> <td></td> </tr> <tr> <td>Township</td> <td>-</td> <td></td> </tr> <tr> <td>Grazing</td> <td>-</td> <td></td> </tr> <tr> <td>Barren</td> <td>0.065</td> <td></td> </tr> <tr> <td>Water Body</td> <td>55.88</td> <td></td> </tr> <tr> <td>Road</td> <td>3.15</td> <td></td> </tr> <tr> <td>Community</td> <td>-</td> <td></td> </tr> <tr> <td>Inhabitated</td> <td>1.034</td> <td></td> </tr> <tr> <td rowspan="3">Govt. Non Forest</td> <td>Village</td> <td>-</td> <td></td> </tr> <tr> <td>Agricultural</td> <td>45.14</td> <td></td> </tr> <tr> <td>Township</td> <td>-</td> <td></td> </tr> <tr> <td></td> <td>Grazing/ Others</td> <td>-</td> <td></td> </tr> </tbody> </table>			Pre Mining Land Use "ha"		Tenancy	Agricultural	233.44		Township	-		Grazing	-		Barren	0.065		Water Body	55.88		Road	3.15		Community	-		Inhabitated	1.034		Govt. Non Forest	Village	-		Agricultural	45.14		Township	-			Grazing/ Others	-	
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Summarised Data (SD)

				Road	-
				Water Body	5.585
				Others.	-
		Forest		Reserve	
				Protected	338.75
				CJBJ	
		Free Hold			
		Total =			683.04
n.	Broad Land Use Pattern (Forest, Township, Industrial, Agricultural, Grazing, Barren etc.), in project area (683.04ha).	Present land use of the leasehold 683.04 ha is furnished below:			
				Type	Present Land Use
				Safety Zone area	8.59
				Quarry Area	40.27
				OB Dump with plantation	-
				OB Dump without plantation	43.66
				Top Soil Dump	5.75
				Forest Area	338.75
				Water Bodies	1.89
				Ponds	3.75
				Nallah (Tartora)	11.53
				Infrastructures	6.67
				Other Establishment	34.82
				Road	3.87
				Haul Road	0.31
				HT Row	4.33
				Other Untouched (Barring Forest Zone)	178.87
				Total area	683.04

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o.	Proximity of public road/ railway line/major water body if any and approximate distance:	Barjora – Mejia (Maliara) metalled road is passing through the north east corner of the block. Safety barrier has been considered along the road. Damodar river (Durgapur Barrage) is situated at a distance of around 5 km from the project site.
p.	Topo sheet No. with latitude and longitude as per WGS 84 system.	Survey of India Toposheet Nos. F 45 D3 & F45 D7(earlier toposheet nos. 73 M/3 and 73 M/7). The bounding coordinates as per vesting order (with corrigendum 01) is as given below: Latitude: 23°25'59.238" N – 23°27'42.094"N Longitude: 87°13'17.106"E – 87°15'26.268"E

6.0 Geology & Exploration:

a.	Name of the Geological Block and area in hectares	Barjora North Coal Block. 800 ha.
b.	Name of the Geological Report (GR) with year of preparation	Geological Report on Barjora North Coal Block, Barjora Coalfield, District Bankura, West Bengal. Year of preparation: 1999.
c.	Name of the agency which conducted exploration and prepared GR	Drilling has been conducted by Mining Associate Private Limited, while Geophysical Logging and Geological Report preparation job done by CMPDIL.
d.	Period of conducting exploration.	1982 – 1987.
e.	Details of drilling (by all agencies)	Drilling done by Mining Associates Private Limited, while Report prepared by RI-I, CMPDIL.
f.	No. of boreholes drilled within the block	64;
g.	Overall borehole density within the block (no./ sq. km)	8 BHs/Sq. Km.
h.	Area covered by 'detailed' exploration within the block (hectares)	800 ha.

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i.	Area covered by 'detailed' exploration outside the block (hectares) - No. of boreholes drilled outside the block - Bore hole density for outside area (no./sq. km).	Total 13.5 sq. km has been explored out of 8.0 Sq. km falls under Barjora North Coal block. Total 64 Boreholes falls within the Barjora North Coal Block.
j.	Whether entire lease area has been covered by 'detailed' exploration.	Yes.
k.	Whether any further exploration is required or suggested and time frame in which it is to be completed.	No. Further exploration not required.
l.	Number of coal/lignite seams/horizons. - thickness range of coal seams - mean Thickness of total coal horizon: - Standard Deviation of thickness: - Minimum & maximum depth of coal seams:	Details are provided in chapter-4.
m.	Gross Calorific Value (GCV in K Cal/kg) and useful Heat Value(UHV in K.Cal/Kg), of coal as per GR Range Mean	Details are provided in chapter-4.
n.	Quality (Grade) of coal as per GR: Range:	F-G; As per GCV based grading system, majority of the coal lies within G-9 to G-13.

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	Mean:	G-11. Details are provided in table nos. 4.10, 4.12 to 4.20.
o.	Total geological reserves in the block.	91.67 Mtes. In the block.
p.	Depletion of reserves (in case of running mine).	6.11 Mtes.
q.	Additional reserves established (if any for running mine)	No.
r.	Geological reserves considered forming: by opencast by Underground	available Geologicalreserve: 91.67 Mtes. All opencast reserve.
s.	Corresponding Extractable reserves:by opencast by Underground:	71.70 Mt.
t.	Percentage of recovery w.r.t. geological reserves: by opencast by Underground * Seam wise details of items (f) to (t) to be included in the relevant chapter.	78.22 %.

4.0 Mining:

a	Existing and proposed method of mining (Opencast for OB & coal separately with dragline/shovel/surface/miners/ manual/etc.) (underground by	For OB: Drilling & Blasting for excavation and Shovel-Dumper for removal. For Coal: Surface Miner for coal winning and Dozer-Shovel-Dumper combination for loading and transportation. Occasionally use of FEL is envisaged for coal loading directly from face.
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	longwall/ board & pillar/ continuous miners/LHD/ SDL/ manual/ etc.,)												
b	The Peak capacity as well in addition to targeted capacity in Mtespa when the mine is fully developed and the year in which proposed to be achieved By Underground : By opencast : Total :	Opencast mining method. Peak rated capacity shall be achieved in 1st year of production. Peak rated capacity should be achieved during 2019-2020.											
C	Life of the mine : Underground workings : Opencast workings : Overall :	22 years through opencast method.											
d	Indicate quantum of production and expected grade as in table below :-												
	Grade Wise - Seam Wise Mineable Coal Reserve of Barjora North Coal Mine (in Million Tons)												
	SEAM	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	Total
	IX	0.000	0.008	0.080	0.078	0.086	0.134	0.048	0.445	0.066	0.000	0.000	0.945
	VIII	0.000	0.000	0.000	0.000	0.000	0.210	0.101	0.562	0.587	0.184	0.018	1.782
	VII	0.000	0.000	0.167	1.033	2.157	2.538	2.059	1.131	0.381	0.222	0.014	9.701
	VI	0.000	0.140	0.712	1.761	2.330	1.384	0.809	0.000	0.000	0.000	0.000	7.135
	VTOP	0.000	0.000	0.027	0.466	1.204	1.672	1.429	0.390	0.000	0.000	0.000	5.188
	VBOTTOM	0.000	0.155	0.313	0.664	2.099	2.020	0.571	0.219	0.105	0.000	0.000	6.145
	V	0.000	0.000	0.043	0.647	4.800	4.508	2.868	2.154	0.740	0.672	0.000	16.461
	IV	0.014	0.069	0.191	0.271	0.206	0.139	0.132	0.021	0.018	0.007	0.000	1.068
	III	0.096	0.629	0.715	1.465	2.183	0.766	0.273	0.134	0.000	0.000	0.000	6.262
	III/II	-	-	-	-	-	-	-	-	-	-	-	-
	II	0.001	0.155	1.359	0.855	1.097	0.304	0.000	0.000	0.000	0.000	0.000	3.771
	III/II/I	0.000	0.000	0.000	0.666	1.112	1.774	0.000	0.000	0.000	0.000	0.000	3.552
	II/I	0.028	0.633	0.363	1.205	0.401	0.152	0.000	0.000	0.000	0.000	0.000	2.783
	I	0.321	0.652	1.136	1.945	3.764	2.145	0.379	0.189	0.150	0.000	0.000	10.681
	Mineable Reserve	0.46	2.44	5.13	11.06	21.46	17.75	8.76	5.25	2.05	1.08	0.05	75.47

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	Total coal is saleable. No beneficiation is envisaged. Extractable reserve will be graded as per the above percentage. A quality dilution with 2% ash is envisaged during mining.					
Furnish the detailed calendar programme of coal production yearwise and seam wise along with OB removal in the relevant chapter.	Calendar program furnished below:					
	Coal Production Plan " MT"					
	S.L. Year	Financial Year	Coal Production		OB "MM3"	SR
			UG	OC		
	Y-1	2019-20		3.00	11.50	3.83
	Y-2	2020-21		3.00	11.50	3.83
	Y-3	2021-22		3.00	11.50	3.83
	Y-4	2022-23		3.00	11.50	3.83
	Y-5	2023-24		3.00	11.50	3.83
	Y-6	2024-25		3.00	11.50	3.83
	Y-7	2025-26		3.00	11.50	3.83
	Y-8	2026-27		3.00	11.50	3.83
	Y-9	2027-28		3.00	11.50	3.83
	Y-10	2028-29		3.00	11.50	3.83
	Y-11	2029-30		3.00	11.50	3.83
	Y-12	2030-31		3.00	11.50	3.83
	Y-13	2031-32		3.00	11.50	3.83
	Y-14	2032-33		3.00	11.50	3.83
	Y-15	2033-34		3.00	11.50	3.83
	Y-16	2034-35		3.00	11.00	3.67
	Y-17	2035-36		3.00	10.00	3.33
	Y-18	2036-37		3.00	10.00	3.33
	Y-19	2037-38		3.00	10.00	3.33
	Y-20	2038-39		3.00	10.00	3.33
	Y-21	2039-40		3.00	10.00	3.33
	Y-22	2040-41		2.59	10.00	3.86
	Total			65.59	243.50	3.71

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e.	Whether the proposed external OB dump site is coal/lignite bearing: - If so, whether coal/lignite below waste disposal area is extractable.	No external OB dumping is proposed.																																																																								
f.	Whether negative proving for coal / lignite in the proposed site for OB dump/ infrastructure has been done.	As per the conditions imposed by MOC while conveying the approval of Mining Plan, proving of no coal zone in the external OB dumping ground was there. However, prior allottee has not utilized the external OB dumping during their operation period of 2011 – 2015. In this proposed mining plan, provision of external dumping has not been considered and 100% internal dumping has been planned.																																																																								
g.	Proposed configuration of HEMM for OC (Coal & OB) & Major Equipment for UG.	<table border="1"> <thead> <tr> <th>S. L. No.</th> <th>Equipment</th> <th>Capacity</th> <th>Maximum Population</th> </tr> </thead> <tbody> <tr> <td align="center" colspan="4">Overburden</td> </tr> <tr> <td>1</td> <td>Diesel Hyd. Shovel</td> <td>4.5- 6.0 Cum</td> <td>3 Nos.</td> </tr> <tr> <td>2</td> <td>Diesel Hyd. Shovel</td> <td>3.1 – 3.5 Cum</td> <td>9 Nos.</td> </tr> <tr> <td>3</td> <td>Rear Dumper</td> <td>50- 60 T</td> <td>12 Nos.</td> </tr> <tr> <td>4</td> <td>Rear Dumper</td> <td>31- 39 T</td> <td>36 Nos.</td> </tr> <tr> <td>5</td> <td>Diesel Drill</td> <td>250mm</td> <td>1</td> </tr> <tr> <td>6</td> <td>Diesel Drill</td> <td>160mm</td> <td>4</td> </tr> <tr> <td>7</td> <td>Dozer</td> <td>165 & 320 hp</td> <td>4</td> </tr> <tr> <td align="center" colspan="4">Coal</td> </tr> <tr> <td>1</td> <td>Surface Miner</td> <td>3800 series</td> <td>1</td> </tr> <tr> <td></td> <td>Surface Miner</td> <td>2200 series</td> <td>1</td> </tr> <tr> <td>2</td> <td>Diesel Hyd Backhoe/Shovel</td> <td>3.1 -3.5 cum</td> <td>2</td> </tr> <tr> <td>3</td> <td>Rear Dumper</td> <td>31- 39 T</td> <td>12</td> </tr> <tr> <td>4</td> <td>FE loader</td> <td>2.5 -3.5 Cum</td> <td>2</td> </tr> <tr> <td>5</td> <td>Drill</td> <td>160mm</td> <td>1</td> </tr> <tr> <td>6</td> <td>Dozer</td> <td>165 & 320 hp</td> <td>4</td> </tr> <tr> <td align="center" colspan="4">Common</td> </tr> </tbody> </table>	S. L. No.	Equipment	Capacity	Maximum Population	Overburden				1	Diesel Hyd. Shovel	4.5- 6.0 Cum	3 Nos.	2	Diesel Hyd. Shovel	3.1 – 3.5 Cum	9 Nos.	3	Rear Dumper	50- 60 T	12 Nos.	4	Rear Dumper	31- 39 T	36 Nos.	5	Diesel Drill	250mm	1	6	Diesel Drill	160mm	4	7	Dozer	165 & 320 hp	4	Coal				1	Surface Miner	3800 series	1		Surface Miner	2200 series	1	2	Diesel Hyd Backhoe/Shovel	3.1 -3.5 cum	2	3	Rear Dumper	31- 39 T	12	4	FE loader	2.5 -3.5 Cum	2	5	Drill	160mm	1	6	Dozer	165 & 320 hp	4	Common			
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Summarised Data (SD)

		1	Grader	120 - 150 hp	3		
		3	Crane	20T- 40T	2		
		4	Crane	8-10T	1		
		5	Diesel Backhoe	1 cum	1		
		6	FE loader	4-6 cum	2		
		7	Dozer	165 hp	1		
			Ripper Dozer	300 - 450 HP	1		
		8	Diesel Browser		2		
		9	Fire tender		1		
		10	Boom truck		2		
		11	Heavy duty toe truck		1		
		12	Fork lift truck	5T	1		
		13	Tipping truck		5		
		14	Vibratory Compactor		1		
		15	Tyre Handler		1		
		16	Water Sprinkler	12 KL	5		
		17	Maintenance Van		1		
		18	Farm Tractor		1		
		Reclamation					
			Grader	120 - 150 hp	1		
	Dozer	165 HP	1				
	Water Sprinkler	12 KL	1				
h	Mode of entry for underground mines (shaft, incline, adit,):	Not Applicable.					
i.	Proposed coal evacuation facilities: FacetoSurface: Surface to end use plants.	As this is an opencast mines, face to coal stack yard will be transferred through tipper. From stackyard to railway siding at Durgapur and Bankura will be transferred through trucks. End use plants will receive coal through rail. Details are discussed in chapter 9.					

6.0 End Use of Coal & Lignite:

a.	Capacity of the approved end use plants.	Details of the end use plants along their capacities are provided in table no. SD-1. Total capacity of the end use plants comes
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Summarised Data (SD)

		to 4860 MW.
b.	Coal/ lignite requirement for end use plant with grade/quality.	Total coal requirement for the end use plants estimated to 19.45 Mtes. Detail calculation of the coal requirement is given in table no. SD-2.
c.	%age of end use requirement to be met from this mine.	Peak rated production from Barjora North Coal Mine will fulfill about 15.4 % of the total requirement.
d.	If washing / beneficiation of the coal/ lignite is planned to be conducted on site or adjacent to the extraction area, briefly describe the nature of the beneficiation and recovery rate with consumption of water etc.	Coal will be won through surface miner and nobeneficiation/washing of coal is proposed in this revised mining plan.
e.	Proposed Use of Rejects/Middling's.	Not Applicable.

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Summarised Data (SD)

7.0 Environmental Management Plan:

a.	Existing land use pattern.	Present Land use pattern of the existing leasehold area(Project area) of 683.04ha land is given below:										
			Type				Present Land Use					
			Safety Zone area				8.59					
			Quarry Area				40.27					
			OB Dump with plantation				-					
			OB Dump without plantation				43.66					
			Top Soil Dump				5.75					
			Forest Area				338.75					
			Water Bodies				1.89					
			Ponds				3.75					
			Nallah (Tartora)				11.53					
			Infrastructures				6.67					
			Other Establishment				34.82					
			Road				3.87					
			Haul Road				0.31					
HT Row				4.33								
Other Untouched (Barring Forest Zone)				178.87								
Total area				683.04								
b.	Land area indicating the area likely to be degraded due to mining,dumping, roads, workshop, washery, township etc.	Post mine land use details are furnished below:										
			Land Use (Post Closure)									
	Pre Mining Land Use "ha"	Type	Land Use during Mining	land use (End of Life)	Agricultural Land	Plantation	Water Body	Public / Comp any Use	Forest Land (Returned)	Undisturbed	Total	

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Tenancy	Agricultural	233.44	Excavation Area	609.66	-								
	Towns hip	-	Backfilled Area	-	431.32	95.07	100.02	-		236.23		431.32	
	Grazing	-	Excavated Void	-	178.34			75.82		102.52		178.34	
	Barren	0.065	Without Plantation	-	-							0	
	Water Body	55.88	Top Soil Dump.	1.81	1.81		1.81	-	-			1.81	
	Road	3.15	External Dump.	-								0	
	Community	-	Safety Zone/ Rationalisation Area.	8.59	8.59			8.59				8.59	
	Inhabited	1.034	Road Diversion.	0	0							0	
	Village	-	Diversion/ Below River / Nala / Canal.	11.27	11.27					11.27		11.27	
	Govt. Non Forest	Agricultural	45.14	Road & Infrastructure area.	11.18	11.18		9.18		2.00		11.18	
Towns hip		-	Garland Drains.	2.25	2.25				2.25		2.25		
Grazing/ Others		-	Embankment.	0	0						0		
Road		-	Green Belt.								0		
Water Body		5.585	Water Reservoir Near Pit/ Water Body.	-	-						0		
Others.		-	UG Entry.								0		
Forest	Reserve		Pit Head Power Plant								0		
	Protected	338.75	Resettlement.								0		
	CJBJ		Undisturbed / Mining Rights for UG.	37.63	37.63					37.63	37.63		
Free Hold			Others (Magazine, ETP, Access Trench etc.)	0.65	0.65				0.65		0.65		
	Total =	683.044		683.04	683.04	95.07	119.60	75.82	16.17	338.75	37.63	683.04	
c.	Surface features over the block area.	Please refer to the present surface plan of the area attached as Plate no. VI .											
d.	No. of villages/Houses to be shifted.	Previous allottehas already completed R & R as per approved plan. Shifting of persons if any to be undertaken by WBPDC, shall be implemented as per approved R & R Policy.											
e.	Population to be affected by	R & R as per approved plan has been completed by previous allottee.											
f.	Year wise proposal for reclamation of land affected by	Total 645.41 ha of land will be reclaimed.											

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	mining activities.	
g.	Monitoring schedules for different environmental components after the commencement of mining and other related activities.	Environmental monitoring will be carried out as per the prevailing environmental norms and as will be amended time to time. CPCB guidelines and SPCB conditions will be complied for monitoring.

8.0 Progressive and Final Mine Closure Plan:

	A separate chapter is also to be incorporated.	Chapter 15.0 is incorporated as mine closure plan.
a.	Major closure activities with proposed Capital expenditure.	Discussed in chapter 15 of the document.
i.	Progressive closure.	Closure cost is furnished in chapter 15 of this document. Total closure cost is 100.40 Crores.
ii.	Total Closure cost.	

9.0 Others:

a.	Base date of Modified Mining Plan.	April, 2019
b.	Calendar year from which the production will start from the zero date i.e. date of approval of mining plan.	2019-2020
c.	Results of any investigation carried out for scientific mining, conservation of minerals and protection of environment; future proposals.	Dump and Pit stability study has been carried out.
d.	Signature of RQP: Date: 7.8.2017 Place:	

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Chapter 1
Introduction



1.1 The Company:

The Barjora North Coal Mine has been reallocated to “The West Bengal Power Development Corporation Limited” after enactment of the Coal Mines (Special Provision’s) Act, 2015.

Office of the nominated Authority constituted under section 6 of the Coal Mines (Special provisions) second Ordinance, 2014 issued Allotment Order under Clause no. (c) of sub rule 7 and sub-rule (1) of rule 13 with following details:

In re: Barjora (North) Coal Mine (“the mine”) particulars of which is specified in **Annexure-1**.

Order No. : 103/7/2015/NA.

Date: March 31, 2015.

In favour of: The West Bengal Power Development Corporation Limited incorporated in India under the Companies Act, 1956 with Corporate identity number U 40104WB1985SGC039154 whose registered office is at 3/C, LA-Block, Sector-III, Salt Lake, Kolkata, West Bengal – 700 098, India (“the allottee”). The company is State Government undertaking. The address for Correspondences for the west Bengal Power Development Corporation Limited (WBPDC) is given below:

**The West Bengal Power Development Corporation Ltd.
(WBPDC)**

BidyutUnnayan Bhaban.
Plot No. 3/C, LA-Block ,
Sector–III , Floor- IInd.
Salt Lake City.
Kolkata – 700098.

1.2 Location of the End Use Plants:

The coal of Barjora North Mine is for Utilisation in: End Use Plants situated at;

1. STPS, Santaldih, Purulia district.
2. KTPS, Mecheda, PurbaMedinipur district.
3. BKTPP, Bakreswar, Birbhum district.
4. BTPS, Tribeni, Hoogly district.
5. SGTPP, Manigram, Murshidabad district.

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Details of the end use plant capacities and configuration are given hereafter in Table no. 1.1.

Table No. 1.1

Detail configuration and Plant Capacities of the thermal power stations of West Bengal Power Development Corporation Limited.

S.L. No.	Name of Specified End Use Plants	Address	Configuration	Capacity	Existing or Proposed
1.	Santaldih Thermal Power Station.	Santaldih, Purulia, West Bengal – 723146.	2 x 250 MW	500 MW.	Existing.
2.	Kolaghat Thermal Power Station.	Mecheda, Medinipur, West Bengal – 721137.	6 x 210 MW	1260 MW.	Existing.
3.	Bakreswar Thermal Power Plant.	Birbhum, West Bengal – 731104.	5 x 210 MW	1050 MW.	Existing.
4.	Bandel Power Station.	Tribeni, Hoogly, West Bengal – 712503.	4 x 60 = 240 MW 1 x 210 = 210 MW	450 MW.	Existing.
5.	Sagardighi Thermal Power Plant; Unit 1 & 2.	Manigram, Murshidabad, West Bengal – 742237.	2 x 300 MW	600 MW.	Existing.
	Sagardighi Thermal Power Plant – Unit 3 & 4.	Manigram, Murshidabad, West Bengal – 742237.	2 x 500 MW	1000 MW.	Existing.

1.3 Coal Requirement for the End Use Plants:

The annual coal requirement for these units are given below in table no.

1.2.

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Table No. 1.2

Coal requirement for the existing power plants of WBPDCCL.

	Clinker	Power Plant							Blast Furnace
		1	2	3	4	4	5		
Name of EUP's		Santaldihi TPS	Kolaghat TPS	Bakreswar TPS	Bandel#5	Bandel #1,2,3,4	Sagardighi TPP 1 & 2	Sagardighi TPP 3 & 4	Total
Capacity of the end use Plants (MW)		500	1260	1050	210	240	600	1000	4860
Capacity of the Project in MTPA		3.00							
Raw Coal Availability from this project.		3.00							
Washed Coal Availability "MTPA".		0.00							
Reject " MTPA".		0.00							
Station Heat Rate " Kcal/ Kwhr"		2500	2500	2500	2500	2770	2375	2375	
Average Calorific value of Coal (Kcal/Kg)		4600	4600	4600	4600	4600	4600	4600	
Raw Coal		4047	4047	4047	4047	4484	3844	3844	
Washed Coal		-	-	-	-	-	-	-	
Rejects		-	-	-	-	-	-	-	
Specific Consumption									
Consumption Norm "Kg/Kwhr"		0.54	0.54	0.54	0.54	0.60	0.52	0.52	
Plant Load Factor/ Capacity Utilisation		0.85	0.85	0.85	0.85	0.85	0.85	0.85	
Coal Requirement "MTPA"		2.02	5.10	4.25	0.85	1.08	2.31	3.84	19.45
Total Requirement for the End use Plant "MTPA".		19.45							

Source of Coal Requirement	
Coal From This Project " MTPA"	3
Linkages/ E-Auction from CIL " MTPA"	0
Other Block of the Company " MTPA"	
Percentage of End Use requirements to be met from this mine.	15.43

The above table shows normative calculation of coal requirement based on the average GCV of coal on G-9 Grade. However, due to change in operational environments of the power plants, PLF's may vary and may result in changes in the coal requirement.

1.4 Coal Supply for the plants:

As can be seen from the table no. 1.2, the coal requirement for the end use plants of WBPDCCL comes to 19.45 MTPA considering G-9 grade of coal. At present coal is being sourced from the different subsidiaries of CIL through linkages as well as through e-auction.

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It is envisaged to supply coal of 3.0 MTPA from this mine to the different operational end use plants of WBPDCCL. Remaining requirement of coal will be fulfilled either from the other mines or through existing coal linkages with CIL. The existing linkages will remain operational for the power plants.

1.5 Coal Beneficiation:

No ROM coal beneficiation is envisaged.

1.6 Mineral Which Applicant intends to Mine:

Intended mineral to be mined is Coal.

1.7 Name and Address of RQP preparing Revised Mining Plan:

Abhai Pratap Singh

D 2/F2, GovindaGourkhede Complex,

Seminary Hills, Nagpur 440006, Maharashtra.

Mobile No.: +91-9423684516.

Email id: apsingh49wcl@gmail.com

Registration No. :34011/ (50)/2009-CPAM, Dt. 7thOctober, 2009.

Valid Till: 6thOctober, 2019.

Copy of RQP certificate granted by MoC, GOI under MCR 1960 is attached as **Annexure-23**.

1.8 Name of the Prospecting Agency:

Geological Report of Barjora Coal Block was prepared by Central Mining Planning& Designing Institutes Limited by its Regional Institute-I, Asansol.

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Chapter 2

Details of Earlier approval of Mining Plan



2.1 Approval of Earlier Mining Plan:

A mining plan was prepared by Shri. S. C. Chatterjee, (Registration No. 38011/4/2002 CA dt. 17.10.2002; valid for 10 years) and approved by Ministry of Coal vide their letter no. 47011/4/2003-CA-I; dt. 24-08-2006. Copy of the Mining Plan approval letter is furnished as **Annexure-IV A**.

A revised mining plan was prepared by Shri Vijay Kumar Singh for 260.14 ha of leasehold land (non forest area) and approved by Ministry of Coal vide their letter no. 34011/19/2017-CPAM; dt 4th September, 2017. Copy of the Mining Plan approval letter is furnished as **Annexure-IVB**.

2.2 Need for Revised/Modified Mining Plan:

The Barjora North Coal Mine comprises both forest and non-forestland types. In order to obtain an Environment Clearance for the leasehold non forest land of 260.14 ha, WBPDCCL has obtained approval of Revised Mining Plan restricting their extent of operation only within the aforesaid area from Ministry of Coal, vide letter No. 34011/19/2017-CPAM; dt 4th September, 2017. In accordance with the Revised Mining Plan for 260.14 ha, Environmental Clearance was also obtained by WBPDCCL from MoEF& CC vide their letter no. J-11015/90/2017-IA.II(M); dt 31st May (furnished as **Annexure XIX**).

As per the conditions laid in the Mining Plan Approval letter and in order to prepare the application for Forest Clearance of Barjora North Coal Mine, a mining plan preparation work has been necessitated by WBPDCCL for the entire block including Forest and Non-Forest Land. Based on the Geology, Surface Constraints and other Geo-mining parameters, the project boundary has been conceptualized as 683.04 ha out of the allotted block area of 800 ha. This mining plan is thus restricted within 683.04 ha of area comprising both forest and non-forest land.

2.3 Details of the Approved Mining Plan(as per item 4 of checklist):

Details of earlier approved mining plan are furnished below in Table no. 2.1.

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Table No. 2.1

Details of the earlier mining plan.

S.LNo	Particulars	Descriptions/ Comments																																																					
a.	Date of approval	Mining Plan approved by MOC, GOI on 4 th September, 2017, vide their letter no. 34011/19/2017-CPAM;																																																					
b.	Conditions, if any	Provided in Table no. 2.2.																																																					
c.	Scheduled year of start of production.	2017-2018.																																																					
d.	Proposed year of achieving the targeted production.	4 th year (2020-2021).																																																					
e.	Date of actual commencement of mining operations, if operations already started.	30 th June Year 2018. Overburden removal is in progress since 30 th June, 2018. So far Coal Production has not been commenced as on 31 st March, 2019.																																																					
f.	Likely date of mining operations, if operations not yet started & reasons for non-commencement of operations.	OB production started in the year of 2018. Coal production yet to started (as on 31 st March, 2019).																																																					
g.	Planned production and actual levels achieved in last 3 years (Coal in Mte, OB in MM ³ , SR in M ³ /te).	<p>The mining operation has commenced only in the month of June, 2018. So far the operation is restricted to OB removal only. Actual coal production yet to be started.</p> <table border="1"> <thead> <tr> <th colspan="9">Planned Production and Actual Level Achieved in last 3 years</th> </tr> <tr> <th rowspan="2">Calendar Year</th> <th colspan="2">Planned</th> <th colspan="6">Actual Coal Production "Mte"</th> </tr> <tr> <th>Coal</th> <th>OB</th> <th>UG</th> <th>OC</th> <th>Total Mte</th> <th>Total MM³</th> <th>SR</th> <th></th> </tr> </thead> <tbody> <tr> <td>Y-1 2016-17</td> <td>3.00</td> <td>15.51</td> <td>-</td> <td>-</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Y-2 2017-18</td> <td>0.77</td> <td>4.93</td> <td>-</td> <td>-</td> <td>-</td> <td></td> <td></td> <td>-</td> </tr> <tr> <td>Y-3 2018-19</td> <td>1.5</td> <td>7.42</td> <td>-</td> <td>-</td> <td>-</td> <td>1.56</td> <td></td> <td>-</td> </tr> </tbody> </table>	Planned Production and Actual Level Achieved in last 3 years									Calendar Year	Planned		Actual Coal Production "Mte"						Coal	OB	UG	OC	Total Mte	Total MM ³	SR		Y-1 2016-17	3.00	15.51	-	-					Y-2 2017-18	0.77	4.93	-	-	-			-	Y-3 2018-19	1.5	7.42	-	-	-	1.56		-
Planned Production and Actual Level Achieved in last 3 years																																																							
Calendar Year	Planned		Actual Coal Production "Mte"																																																				
	Coal	OB	UG	OC	Total Mte	Total MM ³	SR																																																
Y-1 2016-17	3.00	15.51	-	-																																																			
Y-2 2017-18	0.77	4.93	-	-	-			-																																															
Y-3 2018-19	1.5	7.42	-	-	-	1.56		-																																															
h.	Reasons for difference between the planned and actual production levels.	Mine production has commenced after obtaining the Environmental Clearance from MoEF& CC, and opening permission from CCO, Kolkata. The requisite permissions were obtained:																																																					

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S.LNo	Particulars	Descriptions/ Comments
		1. Environmental Clearance issued by MOEF & CC, vide letter No. J-11015/90/2017-IA.11 (M); dt. 31 st May, 2018. Please refer to Annexure-4 . 2. Notice of Opening from office of the CCO vide letter no. CC/Tech/Op-perm/Barjora North/2018-19; dt. 12 th June, 2018. Please refer to Annexure-6 . Mining Operation (developmental activities) commenced from 30 th June, 2018. Coal Production is yet to commence as on 31 st March, 2019.

2.4 Compliance Conditions imposed if any with Approval of Mining Plan:

The approval of mining plan of Barjora North Coal block involves the conditions imposed by Ministry of Coal vide their letter no. 34011/19/2017-CPAM; dt 4thSeptember, 2017 (**Annexure-IVB**) is given in table no. 2.2.

Table No. 2.2

Compliance Status of the Conditions imposed in the approval of the mining plan.

S.L. No.	Conditions Imposed	Compliance Status
1.	Mining company shall come up with revised mining plan including mine closure plan for the entire mine area within a reasonable time frame on receipt of Forestry clearance.	Being complied with.
2.	The mining company shall include part of the 7 Mt of coal reserve falling within the non-forest area unless CMPDIL advices it otherwise.	The Geological Model has been developed in line with the ISP 2017 and the data has been migrated to GCV based grading system. Consideration of High and Low Carbonaceous Shale has

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S.L. No.	Conditions Imposed	Compliance Status
		been induced based on the Band By Band analysis data available in the Geological Report. The resources re-estimated and furnished in this mining planned has been included the reserves.
3.	Mining company shall develop an action plan by 31 st March 2019 for net zeroenergy consumption through solar energy as a part of mine closure activities.	Shall be complied with.
4.	Mining company shall not dump OB on the coal bearing area which in any way sterilizes the extractable coal reserve.	Shall be complied with. The present plan doesn't envisage any OB dumping in the coal bearing areas.
5.	The Mining company shall take all necessary precautions regarding safety of mine workings and persons deployed therein.	Being complied with.
6.	Mining lease of this block shall not encroach into another adjacent block.	Complied with. The existing and proposed mining leases falls well within the Geological Block Boundary.
7.	The cost of abandonment for carrying out the closure activities envisaged in the Mine closure plan is indicative; the actual cost for carrying out the activities at the time of final closure may be higher. The actual cost of abandonment will have to be borne by the project proponent for carrying out the closure activities.	Shall be complied with.
8.	The approval of the mine closure plan is without prejudice to the requirement of approvals from competent / prescribed authority under the relevant rules/ regulations etc.	Noted.

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2.5 Mining Operations:

After the reallocation of Barjora North Coal Mine to M/S West Bengal Power Development Corporation Limited, a revised mining plan and EIA study reports were prepared to obtain the Mining Plan approval from Ministry of coal and MOEF & CC respectively. Subsequent to obtaining the Environmental Clearance from MOEF & CC in the month of May, 2018 (**Annexure-XIX**) and obtaining of notice of Opening from office of the CCO (**Annexure-XVIII A**), mining operation has commenced in the month of June, 2018. So far, the operation is restricted to OB removal only till 31st March, 2019. Copies of the Consent to Establish and Consent to Operate are furnished as **Annexure XVIII B & Annexure XVIII C**.

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Chapter 3

Location, Topography & Communication



3.1 Location of the Coalfield:

The Barjora Coalfield (Latitudes 23°23'N to 23°28' N and Longitudes 87°12'E to 87°18'18"E) identified by the Geological Survey of India during 1951-54 and is located on south west of the Damodar river outside the known limits of the Raniganj coalfield.

3.1.1 Location of the Block:

The Barjora North Coal Block of Barjora Coalfield lays South of Damodar River. The bounding coordinates as per vesting order (with corrigendum 01 as furnished in **Annexure I**) is as given below:

Latitude: 23°25'59.238" N – 23°27'42.094"N.

Longitude: 87°13'17.106"E – 87°15'26.268"E.

The area is covered under survey of India Toposheet nos. F45 D3 (earlier 73 M/3) and F45 D7 (earlier 73 M/7) in RF – 1:50,000. The block administratively falls under the jurisdiction of Barjora Police Station of Bankura district in the state of West Bengal. The certified geological block boundary as per the vesting order is also furnished in **Plate No. IIA**.

3.1.2 Block boundary:

Barjora North block boundary is demarcated along the following limits as per the Geological Report prepared by CMPDIL and subsequently certified with DGPS survey coordinates:

North: An arbitrary line passing 20m north of borehole no. BOR/MA/047 and 60m north of Borehole no. BOR/MA/60.

East: Fault F1-F1 and incrop of Seam-I in the eastern side.

South: 2000 (s) grid line which is also the northern boundary of Barjora South Block.

West: Incrop of Seam-V in the area north of fault F3-F3 and in-crop of Seam-I in the area south of fault F3-F3.



A general location map of the Barjora North Coal block with respect to India and West Bengal is depicted in Figure No. 3.1.

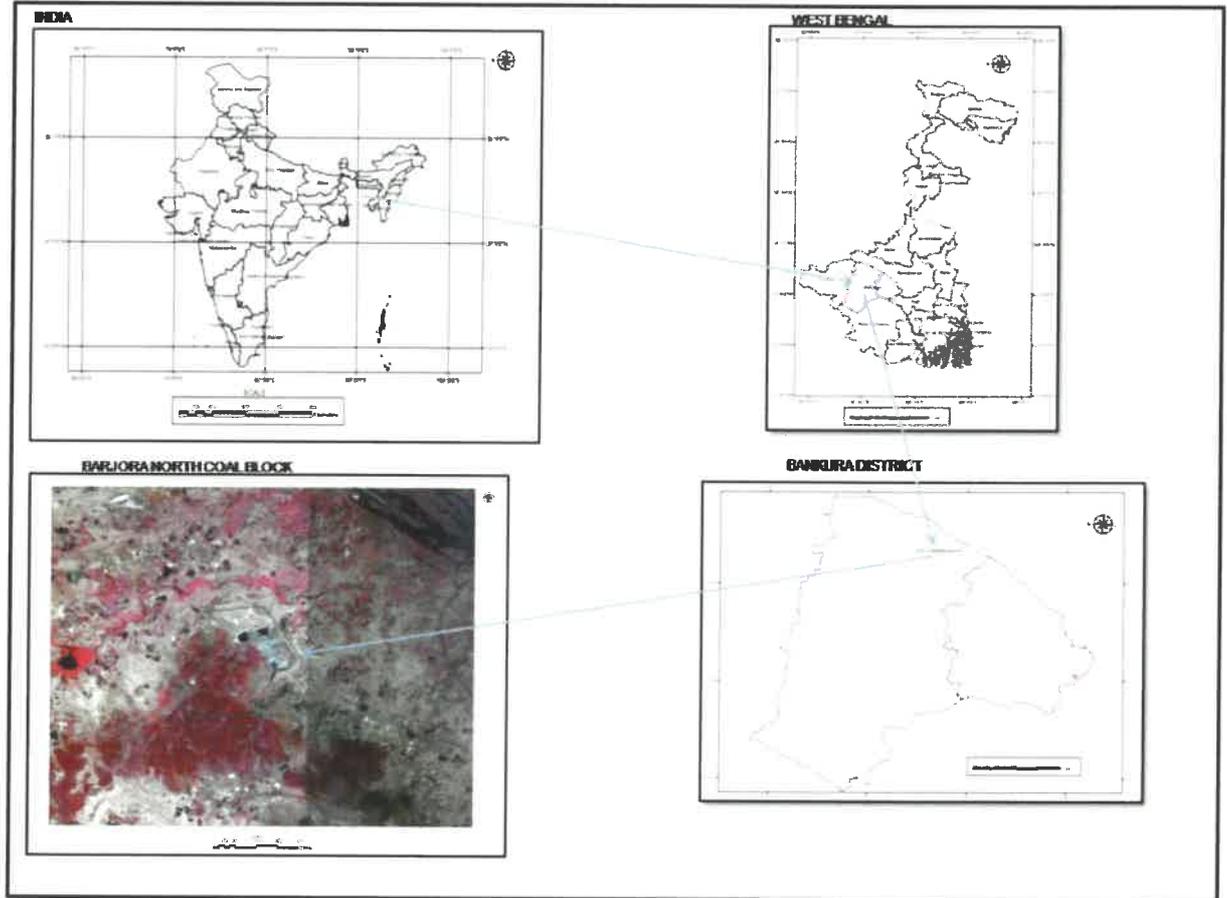


Figure No. 3.1: General Location Map of Barjora North Coal Block.

3.1.3 Lease Boundary:

As per the first approved mining plan for the block, the prior allottee has applied for mining lease over an area of 663 ha. An area of 260.14 ha was granted out of the 663 ha of applied area which was subsequently transferred to WBPDCCL post reallocation of the block. The first revision of the Mining Plan was only confined to 260.14 ha as per the directives of MOEF & CC. In accordance with the Revised Mining Plan, Environmental Clearance has been obtained and mining operation resumed from June, 2018.

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The Barjora North Coal Mine also consists of considerable quantum of Forest Land which needs to be diverted beforehand of Mining Operation. As per conditions laid down in the of 1st Revision Mining Plan approval, a combined mining plan must be submitted for mining in the Forest Land. Accordingly WBPDCCL has initiated the preparation of this of Mining Plan including Mine Closure Plan Revision-02 which involves the feasible mining areas within Barjora North Coal Block including both forest and non forest land types. The total project area has been conceptualized considering the existing mining areas, surface constraints, nala diversion, safety zone and safety barriers. The proposed project area comes to 683.04 ha.

The northern boundary of the lease area merges with the geological block boundary. Part of eastern boundary of the lease is guided by the safety barrier along the western edge of the metalled road, joining Barjora and Mejia, edge of Ghutgoria village and mine boundary. The southern and western boundary is guided by the geological block boundary. Corner points for the proposed mining lease boundary have been further worked out and furnished below in Table No. 3.1.

Table No. 3.1

Corner Points for the proposed Leasehold boundary for 683.04 ha.

ID	Latitude	Longitude
1	23°27'37.097"N	87°13'39.092"E
2	23°27'40.878"N	87°14'23.766"E
3	23°27'37.841"N	87°14'29.357"E
4	23°27'34.524"N	87°14'37.632"E
5	23°27'28.307"N	87°14'42.67"E
6	23°27'10.371"N	87°14'52.817"E
7	23°26'46.749"N	87°15'9.76"E
8	23°26'0.72"N	87°15'5.306"E
9	23°25'59.24"N	87°13'27.658"E
10	23°26'1.894"N	87°13'28.567"E
11	23°26'7.302"N	87°13'36.791"E
12	23°26'10.21"N	87°13'40.271"E
13	23°26'13.718"N	87°13'42.142"E
14	23°26'20.391"N	87°13'44.392"E

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ID	Latitude	Longitude
15	23°26'23.42"N	87°13'43.8"E
16	23°26'33.053"N	87°13'33.356"E
17	23°26'34.727"N	87°13'35.97"E
18	23°26'36.146"N	87°13'36.345"E
19	23°26'41.294"N	87°13'35.881"E
20	23°26'46.241"N	87°13'35.936"E
21	23°26'48.492"N	87°13'36.693"E
22	23°26'50.683"N	87°13'38.655"E
23	23°26'53.346"N	87°13'41.643"E
24	23°26'54.904"N	87°13'44.397"E
25	23°26'58.383"N	87°13'48.413"E
26	23°26'58.817"N	87°13'45.523"E
27	23°27'1.539"N	87°13'43.724"E
28	23°27'5.06"N	87°13'41.85"E
29	23°27'9.566"N	87°13'40.506"E
30	23°27'19.689"N	87°13'40.383"E
31	23°27'19.028"N	87°13'42.247"E
32	23°27'24.285"N	87°13'45.09"E
33	23°27'26.383"N	87°13'45.901"E
34	23°27'29.139"N	87°13'44.414"E
35	23°27'35.387"N	87°13'37.15"E

Figure 3.2 shows the geological block boundary and the mining lease boundary and the same has been furnished in **Plate No. 2A**.

References for Proposed Lease boundary:

- i. Extent of the Barjora North Coal Block as per Vesting Order No. 103/7/2015/NA; dt. 31.3.2015 and Corregendum-1 to the vesting order, dt. 07.3.2017.
- ii. Certified Block Boundary coordinates of Barjora North Coal Mine as issued by CMPDIL, vide their letter no. CMPDI/BD/C (886-A)/767; dt. 29.03.2017.
- iii. DGPS survey carried out by WBPDCCL with reference to the benchmark provided by Survey of India.

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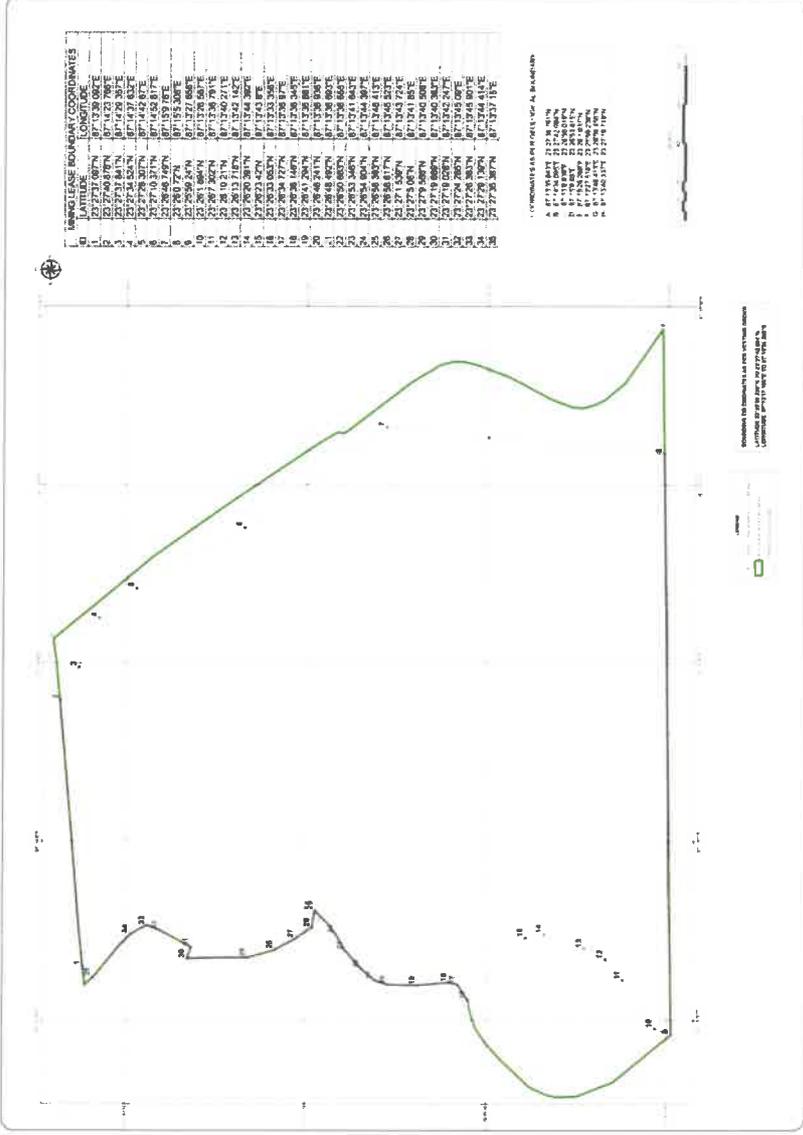


Figure No. 3.2: Figure showing the Geological Block Boundary and proposed Mining Lease boundary of Barjora North Coal Mine.

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3.2 Physiography and Drainage:

The area is characterized by gently undulating topography with the elevation ranging from 70m to 106 m above mean sea level. The general slope of the terrain is towards east and north-east direction.

The main drainage of the area is controlled by the Damodar River which flows about 5 km north east of the block. Tartora nallah with a north-easterly flow forms the main drainage within the block with seasonal surface flow.

Tartola nallah is going to be affected in the later phase of this proposed mining and suitable diversion plan has been suggested in the relevant chapter.

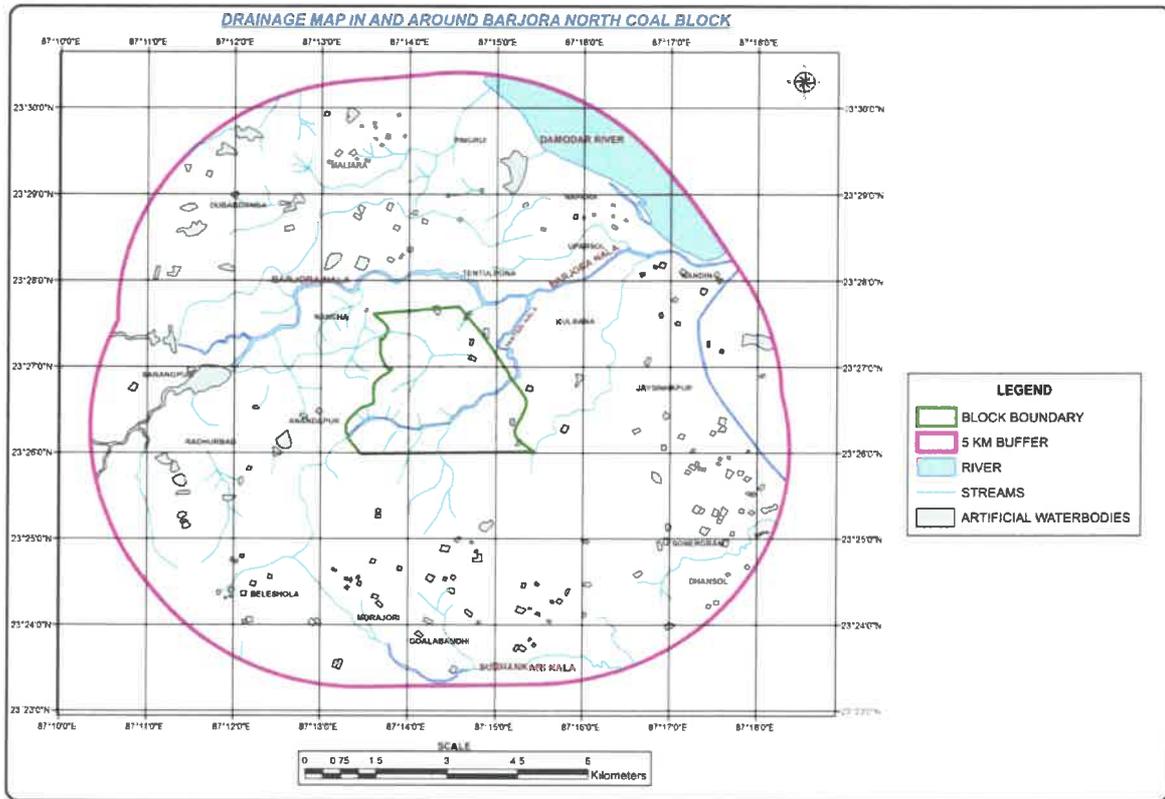


Figure No. 3.3: Figure showing the Drainage pattern of Barjora North Coal Mine.

3.3 Climate:

The temperature in winter broadly remains within 15°C to 22°C and in the summer the temperature varies from 25°C to 43°C. The annual rainfall is around 1380 mm as per IMD data obtained from the nearest Meteorological Station at Durgapur.

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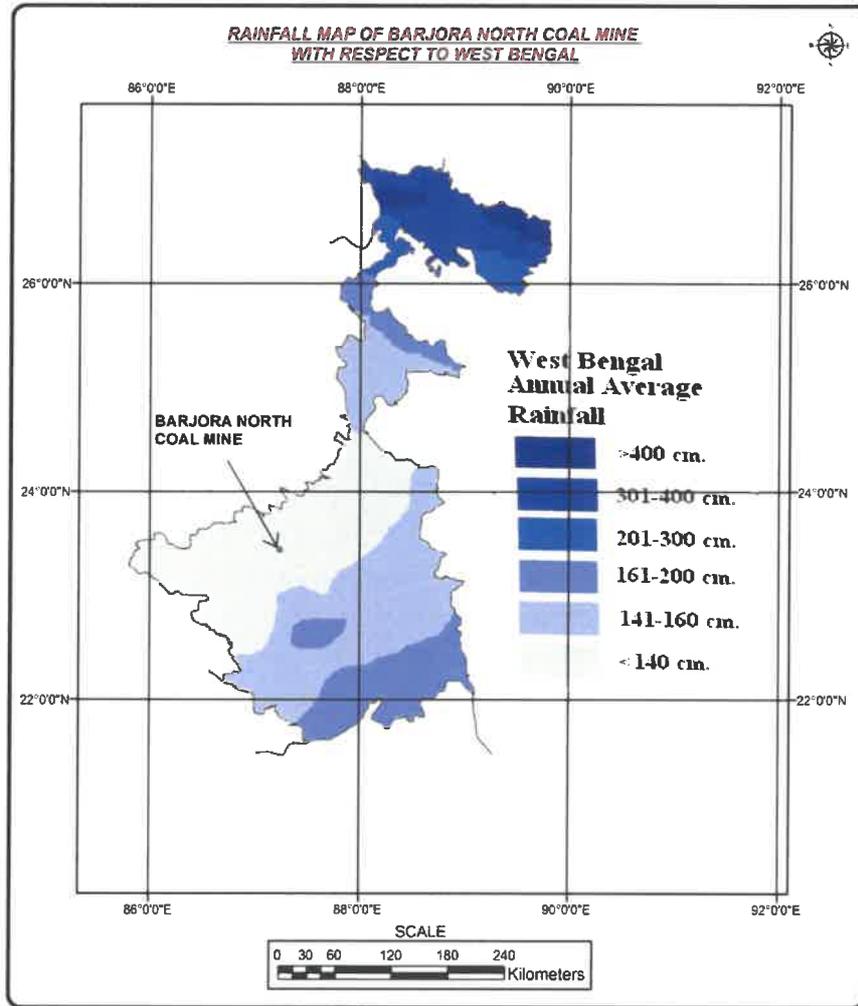


Figure No. 3.4: Figure showing the rainfall distribution map of Barjora North Coal Mine with respect to West Bengal.

3.4 Communication & Accessibility:

The nearest railway station is Durgapur at a distance of 10 km, located on the Howrah – Delhi main line of Eastern Railway.

Barjora Block is connected to Durgapur township by a metalled road via Durgapur Barrage. An all-weather metalled road connecting Barjora (lying on the Durgapur-Bankura State Highway - 9) and Saltora passes along the north-eastern boundary of the Barjora North Coal Block.

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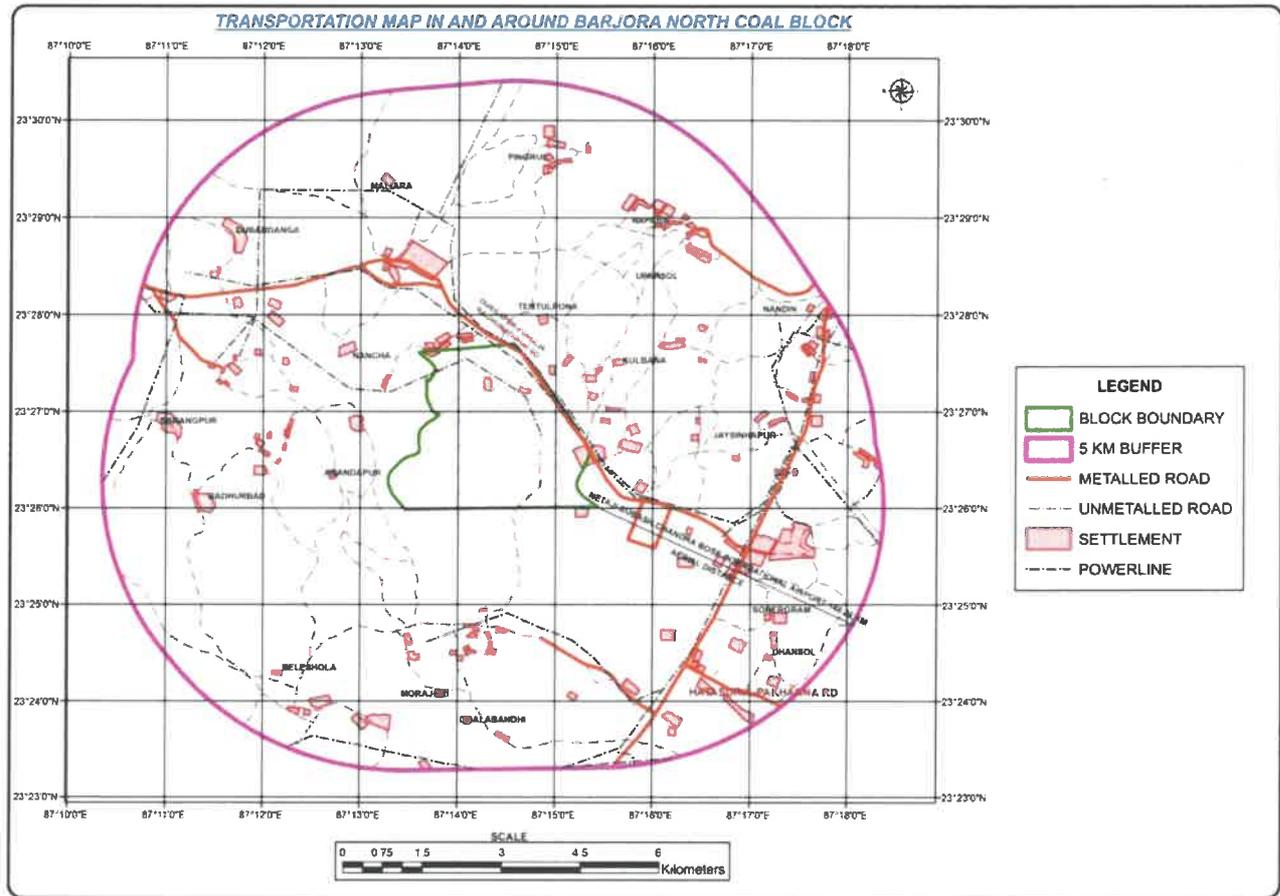


Figure No. 3.5: Figure showing the transportation map of Barjora North Coal Mine.

3.5 Availability of Power supply:

All HEMM proposed for this project, are diesel operated equipment. Hence, quarry power requirement is only for quarry lighting and haul road lighting, besides catering to the electrical load requirement for Workshop, pumping and office. Required power will be drawn from WBSUEDCL. The mine is already having available power facility.

3.6 Availability of water supply:

Accumulated water in the mine pit will be utilized for the plantation, water sprinkling and other workshop usage while water for domestic need will be

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catered through existing tube wells in the mine site. Domestic water will be catered through sinking of new well. Permission for sinking of new well has been obtained from State Water Investigation Department, Government of West Bengal vide their permit no. P0103010011690000001 TSE for 15 m³ per day withdrawal. As the mine is already in operation, mine pit water will be made available for regular sprinkling and plantation use.

3.7 Ownership/ Occupancy of land:

This revised mining plan involves an area of 683.04 ha of land involving both forest and non forest nature. Out of 683.04 ha, an area of 260.14 ha has already been transferred to WBPDCCL on 4th August, 2015; dt. 31st March, 2015. The remaining area involves 338.75 ha of forest land 84.15 ha of non forest land. Forest clearances need to obtain for the 338.75 ha of forest land before it is included in the mining lease. Remaining 84.15 ha of non forest land also to be included in the lease.

3.8 Involvement of Forest land:

The proposed project activity will be confined to 683.04 ha of land which involves about 338.75 ha of Forest land. WBPDCCL need to obtain the forest clearance in this area before extending its mining operation in the forest land.

3.9 Present land use details:

Mining operation was commenced in this block in the year 2011 when the block was operated by DVC-EMTA Coal Mining Limited. Post enactment of the Coal Mines Special Provision Act, 2015, the mine was re-allotted to WBPDCCL for supplying of coal to their existing and proposed thermal power stations. After obtaining the necessary approvals including approval of Mining Plan (for non forest land of 260.14 ha) and Environmental Clearance from MOEF & CC, the mining operation resumed from June 2018. Till 31st March' 2019, coal production has not been started, but restricted to OB removal only.

The area consists of a mined-out voids, Surface dumping grounds for both OB and top soil, haul roads, forest lands, few industrial establishments in the southern part of the block, Tartoranallah flowing from west to east across the block, mine infrastructural areas, water bodies and village roads. The pre-mining land use patterns derived from the land records collected from the revenue department of Government of West Bengal is furnished in table no. 3.2.



Table No. 3.2

Pre mining Land Use pattern of the 683.04 ha of leasehold area as per Record of Rights data.

Type of land	Classification	Area in ha
Tenancy	Agricultural	233.44
	Water Body	55.88
	Road	3.15
	Inhabited	1.03
	Others	0.07
Govt. Non Forest	Agricultural	45.14
	Road	-
	Water Body	5.59
	Others.	-
Forest	Reserve	338.75
	Protected	
	CJBJ	
Free Hold		-
Total =		683.04

As per the type of land specified in the Record of Rights, the land use pattern of the proposed project area is furnished in table no. 3.3.

Table No. 3.3

Present Land Use pattern of the 683.04 ha of leasehold area as per surface plan.

Type	Present Land Use
Safety Zone area	8.59
Quarry Area	40.27
OB Dump with plantation	-
OB Dump without plantation	43.66
Top Soil Dump	5.75
Forest Area	338.75
Water Bodies	1.89
Ponds	3.75
Nallah (Tartora)	11.53
Infrastructures	6.67
Other Establishment	34.82

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Type	Present Land Use
Road	3.87
Haul Road	0.31
HT Row	4.33
Other Untouched (Barring Forest Zone)	178.87
Total area	683.04

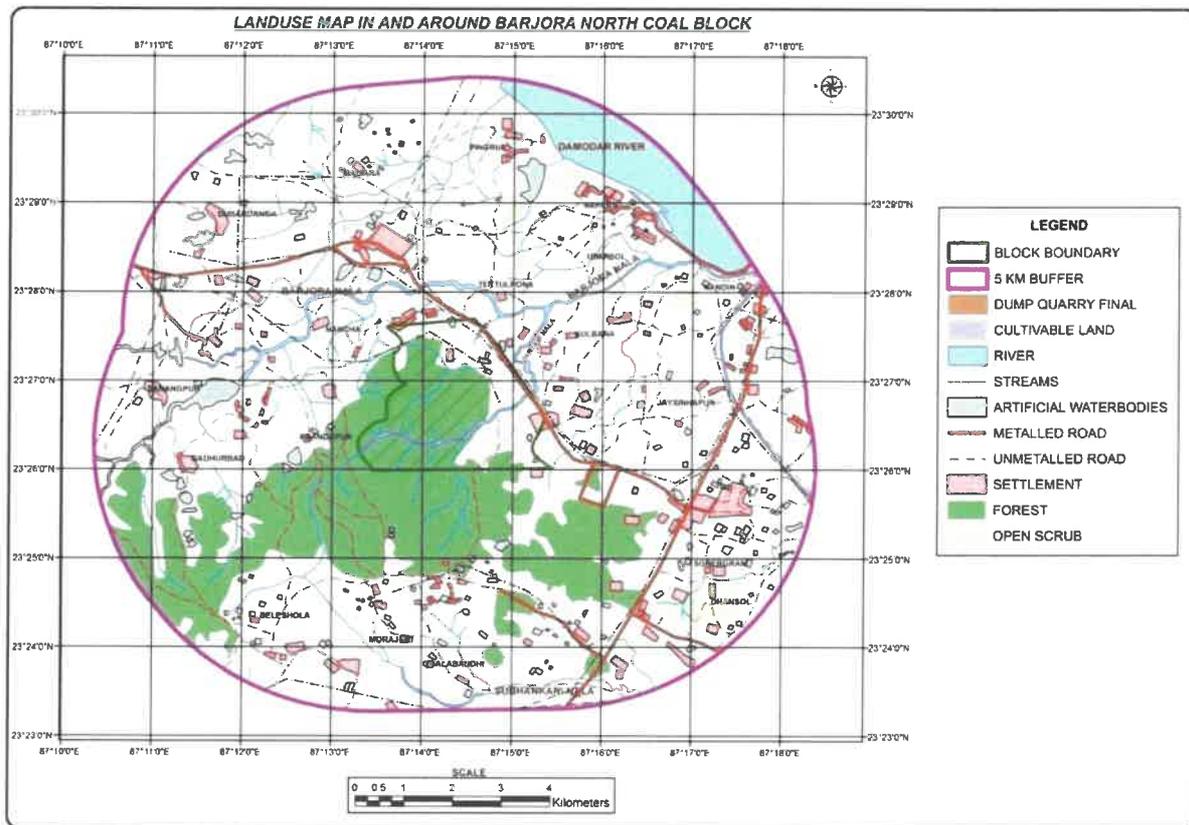


Figure No. 3.6: Figure showing the landuse pattern of Barjora North Coal Mine.

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3.11 Need for Shifting of 220 KV Mejia-Barjora Power Line and Tartola nallah:

An existing 220 KV power line belonging to Damodar Valley Corporation (DVC) passes through the eastern and northern part of the Barjora North Coal Block. The same needs to be diverted to have smooth and safe mining operation in this planned period. WBPDCCL has already initiated for this diversion and placed work contract to DVC vide no. HQ/M & C/ 6050000965; dt. 26.2.2019 and subsequently paid the requisite amount of Rs. 8.93 crores for diversion of this 220 KV HT line. The copy of the payment confirmation letter is furnished in **Annexure-XVIII G**. The approved layout plan for shifting of this HT line is furnished in **Plate No. XX**.

An existing Tartora nallah which flows from west to east, needs to be diverted along the southern edge of the proposed mine boundary. The elevation difference between the entry and exit points of this discharge scheme is about 8 meter. Total length of the diverted nala will be 6.30 km. Based on the present day flow parameters as observed at site, the base width and depth of the nala has been considered as 3 meter and 2.5 meter respectively. A more detail design needs to be done including cutting and filling requirement and vertical drop considerations before diversion of this nala. Chainage wise details of conceptual nala diversion is furnished Plate No XVIII. A declaration in this regard from M/S WBPDCCL has been furnished in **Annexure-XVIII H**.

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Chapter 4

Exploration, Geology & Reserves



4.0 Geology & Exploration:

The Barjora North Coal Block of Barjora Coalfield is distributed over villages, namely Manohar, Baguli, Ghutgoria, Sitarampur, Sarjora, Tikargram and Barpukhuria villages. The coalfield was named after major village Barjora in the area which administratively falls under the Bankura district of West Bengal and confined within the southern side of the Damodar River. The coalfield appears to be a detached and localized depression within the archaeanmetamorphics in which Lower Gondwana sedimentaries were accumulated and preserved, which at present, has formed an outlier on crystalline metamorphic basement.

The coalfield was initially regionally explored by Geological Survey of India (G.S.I) during the period March 1956 to November 1957 and a total of 26 nos. of boreholes were drilled over an area of 59.0 Sq. km. existence of 9 carbonaceous horizons were established during the investigations.

The block was further taken up for detailed investigation when search of opencastable reserve were in great need to cater the need of Mejia Power Plant. The detail exploration has been taken up by CMPDI during the period September, 82 to September, 87. A total meterage of 10,060.60 meter drilling have been done to complete total 96 no. of boreholes. Out of 96 boreholes, 64 boreholes were falling within the Barjora North Coal Block, while remaining was falling in Barjora South Coal Block. The total meterage done within Barjora North Coal Block was 6299.60 meter. Overall borehole density within the Barjora North Coal Block comes to 8.0/ Sq. km. Out of the 64 boreholes within the block area, 60 number of boreholes are falling within the proposed leasehold area of 683.04 ha with an overall borehole density of 8.78 BH/Sq. KM. List of boreholes falling within the leasehold area are depicted below.

BOR/MA/01	BOR/MA/13	BOR/MA/28	BOR/MA/43	BOR/MA/55	BOR/MA/68
BOR/MA/02	BOR/MA/14	BOR/MA/29	BOR/MA/44	BOR/MA/58	BOR/MA/69
BOR/MA/03	BOR/MA/15	BOR/MA/31	BOR/MA/45	BOR/MA/59	BOR/MA/71
BOR/MA/04	BOR/MA/16	BOR/MA/33	BOR/MA/47	BOR/MA/60	BOR/MA/72
BOR/MA/05	BOR/MA/17	BOR/MA/35	BOR/MA/48	BOR/MA/62	BOR/MA/73
BOR/MA/08	BOR/MA/22	BOR/MA/36	BOR/MA/49	BOR/MA/63	BOR/MA/74
BOR/MA/09	BOR/MA/23	BOR/MA/38	BOR/MA/51	BOR/MA/64	BOR/MA/75
BOR/MA/10	BOR/MA/24	BOR/MA/39	BOR/MA/52	BOR/MA/65	BOR/MA/76
BOR/MA/11	BOR/MA/25	BOR/MA/40	BOR/MA/53	BOR/MA/66	BOR/MA/77
BOR/MA/12	BOR/MA/27	BOR/MA/42	BOR/MA/54	BOR/MA/67	BOR/MA/79

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Graphic lithologs of all 64 the boreholes are depicted in plate no. **VA1 to VA8** and seam structures are depicted in plate no. **VB1 to VB20**.

The geological plan and section of the block along with the borehole locations are furnished in **Plate no. IV & Plate no. X** respectively.

The detailed sub surface investigations carried out by CMPDIL in Barjora North Coal Block established a thickness of around 160 m for the sedimentary of Barakar formation contained therein.

Based on the regional and detailed exploration within the Barjora North Coal Block by G.S.I and CMPDIL respectively, the stratigraphic sequence of Barjora Coalfield is furnished below in table no. 4.1.

Table No.4.1

Stratigraphic Sequence of Barjora Coalfield.

Age	Formations	Lithology
Recent	Alluvium/Soil	Loose to sub-consolidated, light to reddish brown soil and sandy soil.
Quaternary	Laterite	Brown to dark brown, porous heterogeneous assemblage of iron and manganese rich materials.
<i>Unconformity</i>		
Permian/Lower Gondwana	Barren measures	Dark grey/Ironstone shale.
	Barakar formation	Sandstone, shale, carb. Shale and coal seams.
	Talchir Formation	Greenish shale, carb. Shale and argillaceous sandstone, greenish in colour.
<i>Unconformity</i>		
Pre-cambrian	Archeans	Granite, gneiss with mica schists, quartzite etc.

4.1 Description of the Formations:

4.1.1 Alluvium and Laterites:

Extensive lateritic cover in the form of thin capping associated with loose masses of sub-rounded quartz gravels and gritty sandstone occurs in Barjora Coalfield. The alluvial cover along with the weathered/detrital mantle, which is extensive and thick at places, varies by loose sand/clay as well as oxidized (iron rich) reddish sandstone. The feldspathic content being

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largely removed, the formation appears soft and friable. This is observed in course of drilling operation when the alluvial / detrital cover was recovered as sludge. Exfoliation is very commonly found on the eroded surface in the weathered zone, due to iron leaching from the iron rich brownish sandstone.

4.1.2 Barren Measures:

This formation is underlying the weathered mantle and has been encountered in only one borehole – BOR/MA/025 from which it becomes obvious that the formation has a restricted development in this coal basin and may occur only in patches overlying the Barakar formation. This formation is represented by thick dark grey to ironstone shale but barren of any well-defined coal seams.

4.1.3 Barakar Formation:

The litho units of Barakar Formation have been exposed in the nulla cuttings and Bad Lands while exploration, whereas the rocks are well exposed as on date in the working faces. Thick sandstones and coal measures are well observed in the worked out faces of the mining areas. The Barakar formation comprises of fine, medium, coarse to very coarse grained feldspathic sandstone, dominantly grey to white in colour along with micaceous and grey shale, carbonaceous shale, shaly coal, coal seams and occasional conglomerate beds.

4.1.4 The Talchir Formation:

Distinctive litho units of Talchir beds were intersected in a number of boreholes in the Barjora Coalfield. The maximum thickness intersected is 6.37 meter. The Talchirs have not been encountered in all the boreholes which intersected metamorphic. As such, apparently it has been preserved in localized patches with limited lateral extent. This formation consists of brown and greenish shale, greenish sandstone with unaltered feldspars.

4.1.5 Archeans:

The basement rocks on which Gondwana sediments rest unconformably in this coalfield consist of granite and granitic gneiss of Archean age. The granites are coarse grained and are



often found to be passed imperceptibly in the coarse grained gneiss.

4.2 Geological Structure of Barjora North Coal Blocks:

4.2.1 Dip & Strike:

In absence of sufficient rock exposures within the block, the dip and strike of the beds were derived from sub-surface data. The strike and dip of the beds are depicted in the floor contour plans furnished in **Plate No. IXA1 – IXA4.**

Strike of the beds roughly trend in N- S direction with local variation and swings from NE- SW to NW-SE at places. However, dip directions are broadly to the east and west in the western and eastern limbs of the block respectively. The strike of the beds is largely parallel to the basement contours with an axis being aligned similarly. However, a distinct shallowing up of the dips as well as marginal variation in the basin axis alignment is seen in shallower sediments. The bed dips normally between 2° to 7° though higher dips, i.e. up to 15° have been observed within sediments in the south-eastern corner of the block.

4.2.2 Faults:

Three numbers of faults F1-F1, F2-F2 & F3- F3 have been identified in and around the block. These faults have either been taken from the previous records or interpreted based on data generated during this phase of investigation. Fault F1-F1 (Trending NW-SE) has down throw towards south- west. Fault F2- F2 trending (E-W) delineates the southern boundary of Sector C of the block with down throws 5 – 20 m south. The other fault F3- F3 (trending almost E-W) forming southern boundary of Sector-B of the block has down throw varying 45 – 55 m towards north. Details of faults are given in the Table No.4.2.

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Table No. 4.2
Description of Faults

S.L. No.	Nomenclature	Strike of Fault	Down throw direction	Throw amount(m)	Linear extent	Remarks
1.	F1- F1	NW-SE	South westerly.	Not Known.	1.8 Km	Based on GSI Borehole.
2.	F2- F2	E-W	Southerly	5 – 20	2.2 Km	Seam-V faulted in BH No. BOR/MA/043 and reduction in parting between Seam I/II/III & seam-V in BH no. BOR/MA/011.
3.	F3- F3	E-W	Northerly.	45- 55	2.2 Km	Seam V faulted in BH No. BOR/MA/073.

4.2.3 Sector Divisions:

Based on the occurrence of faults especially F2-F2 and F3-F3, the block has been subdivided into three sectors namely sector-A, Sector-B and Sector-C. The abovementioned faults have formed a trough in the north central part which is termed as Sector-B. The southern section termed as Sector-A while the northern part is termed as Sector-C.

4.3 Geophysical Investigations:

Six numbers of boreholes were Geophysically logged with SPR, Natural Gamma and Density parameters by CMPDIL RI-I. Geophysical logging was mostly done in the boreholes where core loss was substantial.

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4.4 Sequence of Coal Seams:

The details in respect of coal seams of the area under report as per the published Geological Report, as per correlation considering Seam-I/II/III and Seam-V (with its splits V Bottom & top) as single units are provided in table no. 4.3.

Table No. 4.3
Sequence of Coal Seams at Barjora North Coal Block.

Seam	Thickness Range(m)	Parting Range (m)	Remarks
IX	0.26-2.78 (Avg. 1.43)		Impersistent, occurs only in north-eastern part of the block.
Parting between IX and VIII		4.70-11.56 (Avg. 7.29m)	
VIII	0.30-2.94 (Avg. 1.26m)		Forms an enclosure in the southern part of Sector-A occurs impersistently in the area north of fault F3-F3 .
Parting between VIII and VII		3.24-29.71 (Avg. 16.18m)	
VII	0.38-4.72 (Avg. 2.08m)		Splits locally around borehole no. 073. Thickness of top section is 1.02 and bottom section is 1.75m with only 1.92m parting in between the two splits.
Parting between VII and VI		4.69-24.53 (Avg. 13.21m)	
VI	0.25-4.42 (Avg. 1.52m)		Impersistent Workable only in Sector-A between borehole no.003 to 004 in east-west approximately.
Parting between VI and V		1.80-29.45 (Avg. 13.26m)	
VT	0.65-4.26 (Avg. 1.95m)		
Parting between VI and VT		4.45-23.43 (Avg. 14.19m)	

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VB	0.56-4.75(Avg. 2.07m)												
Parting between VB and IV		1.90-14.39 (Avg. 8.38m)											
V	0.50-6.29 (Avg. 3.68m)		Splits into top and bottom seams in considerable portion of the area. The top section shows a variation in thickness from 0.65m to 4.26m while the bottom section varies from 0.56m to 4.75m in thickness. The parting between the two ranges 0.00 to 8.05m.										
Parting between V and IV		2.13-14.02 (Avg. 6.44m)											
IV	0.20-1.30 (Avg. 0.67m)		Highly impersistent and has workable thickness only in one borehole.										
Parting between IV and I/II/III		12.60-19.45 (Avg. 16.24m)											
I/II/III	4.42-6.34 (Avg. 5.39m)		Splits into two to three sections (I, II & III) in major part the area but occurs as a combined unit in the central part of the area. The thickness of split sections as recorded in boreholes is as follows: <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Seam-III</td> <td>0.42-3.42-m</td> </tr> <tr> <td>Parting between III and II</td> <td>0.00-20.23M</td> </tr> <tr> <td>Seam-II</td> <td>0.28-2.75m</td> </tr> <tr> <td>Parting between II and I</td> <td>0.00-9.00m</td> </tr> <tr> <td>Seam-I</td> <td>0.55-5.06m</td> </tr> </table>	Seam-III	0.42-3.42-m	Parting between III and II	0.00-20.23M	Seam-II	0.28-2.75m	Parting between II and I	0.00-9.00m	Seam-I	0.55-5.06m
Seam-III	0.42-3.42-m												
Parting between III and II	0.00-20.23M												
Seam-II	0.28-2.75m												
Parting between II and I	0.00-9.00m												
Seam-I	0.55-5.06m												
Parting between I and LOCAL		1.95-19.75 (Avg. 7.11m)											

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Local	0.35-2.48 (Avg. 0.96m)		Impersistent has attained workable thickness only in 9 boreholes.
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4.4.1 Seam Descriptions:

A description of individual coal seams as per the above sequence is being discussed below with their salient features.

Seam – IX:

This seam is the youngest horizon found within Barjora North Coal block and confined in the north eastern part – especially in the sector C. The seam occurs at shallowest depth of 6.13 meter in Borehole no. BOR/MA/051 while it occurs at a depth of 40.78 meters in the borehole no. BOR/MA/027.

Salient Features of the coal seam is being furnished in Table No. 4.4.

Table No. 4.4
Salient Features of Seam IX

1	Seam Name	Units	Seam -IX
2	Borehole Intersections	Nos.	6
3	Depth Range	M	
i	Shallowest		15.40
ii	Deepest		41.21
4	Seam Thickness in Meters	M	
i	Minimum		0.26
ii	Maximum		2.03
iii	Average		1.43
iv	Average above 1.0 Meter		1.66
5	Parting with Overlying Seam in meters	M	
i	Minimum		-
ii	Maximum		-
ii	Average		-
6	Immediate Roof		Sandy Shale & Shaly Sandstone

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1	Seam Name	Units	Seam -IX
7	Immediate Floor		Shale & Sandstone
8	Dirt Bands	Nos.	1
	Range of Thickness of individual Bands (m)	M	0.09 - 0.75
	Range of Cumulative Thickness (m)		0.09 -0.75
	No. of Boreholes where seam is devoid of dirt bands (% of Total Boreholes.)	%	2 (33%)
	Lithology		Shale, Carb. Shale, Sandstone
9	Quality Parameters (Incl. of Calculated Values) – I ₃₀ basis		
	Moisture %	Wt.%	5.3 -8.25
	Ash%	Wt.%	23.61-46.8
	V.M. %	Wt.%	22.7
	UHV - Kcal/Kg - Minimum	Kcal/Kg	689
	UHV - Kcal/Kg - Maximum	Kcal/Kg	3049
	Grade Range - UHV Based.		F-G
	Grade Range - GCV Based		G-8 to G-14
	Usual Grade		G13
10	Net Proved+Indicated reserve in Million Tons	MT	
	Opencast		1.152
	UG		
	Total		1.152

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Thickness range of Seam IX has been shown graphically in figure no. 4.1.

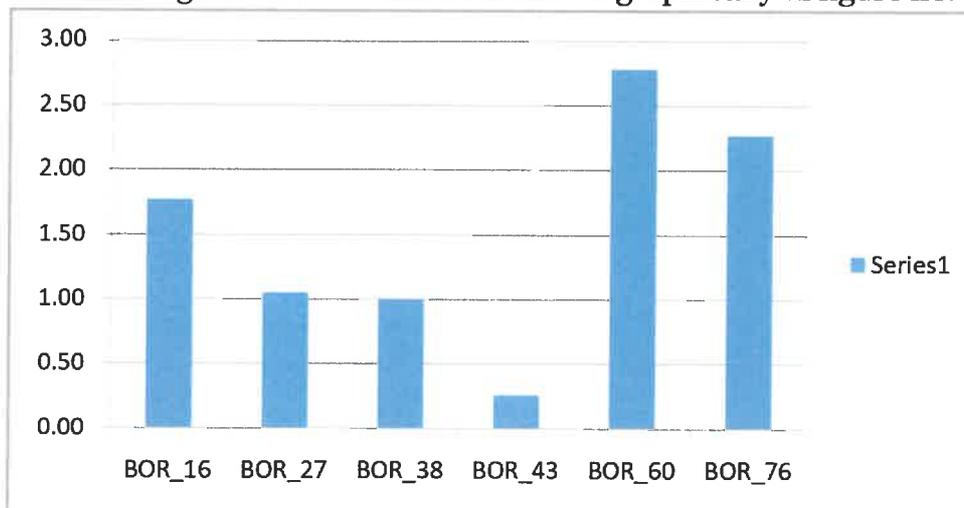


Figure No. 4.1: Thickness variation of Seam IX.

From the above graphical representation, it is evident that seam IX has developed erratically within Barjora North Coal Block.

Seam-VIII:

The in-crop of this seam has formed a closure along the central part while seems to be pinched out in the northern and eastern part of the block. The seam has attained a maximum thickness up to 2.94 meter and found to be occur in a depth range of 6.13 mete bgl to 46.09 m bgl. Salient feature of the seam is furnished below in Table no. 4.5.

Table No. 4.5
Salient Features of Seam-VIII

1	Seam Name	Units	Seam - VIII
2	Borehole Intersections	Nos.	15
3	Depth Range	M	
i	Shallowest		8.7
ii	Deepest		46.67
4	Seam Thickness in Meters	M	
i	Minimum		0.3
ii	Maximum		2.94
iii	Average		1.26
iv	Average above 1.0 Meter		1.62

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1	Seam Name	Units	Seam - VIII
5	Parting with Overlying Seam in meters.	M	
i	Minimum		4.7
ii	Maximum		11.56
ii	Average		7.29
6	Immediate Roof		Sandy Shale & Sandstone
7	Immediate Floor		Shale and Sandstone
8	Dirt Bands	Nos.	1 to 3
	Range of Thickness of individual Bands (m)	M	0.05 -0.39
	Range of Cumulative Thickness (m)		0.16 -0.55
	No. of Boreholes where seam is devoid of dirt bands(% of Total Boreholes.)	%	6 (40%)
	Lithology		Carb. Shale, Shale and Sandstone
9	Quality Parameters (Incl. of Calculated Values) - I ₁₀₀ basis		
	Moisture %	Wt.%	4.0 -6.56
	Ash%	Wt.%	34.9-56.0
	V.M. %	Wt.%	23
	UHV - Kcal/Kg - Minimum	Kcal/Kg	620
	UHV - Kcal/Kg - Maximum	Kcal/Kg	2690
	Grade Range - UHV Based.		F - Ungraded
	Grade Range - GCV Based		G-10 to G-16
	Usual Grade		G-12 to G-13
10	Net Proved + Indicated reserve in Million Tons.	MT	
	Opencast		2.173
	UG		-
	Total		2.173

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Seam thickness variation of seam-VIII is depicted in figure no. 4.2.

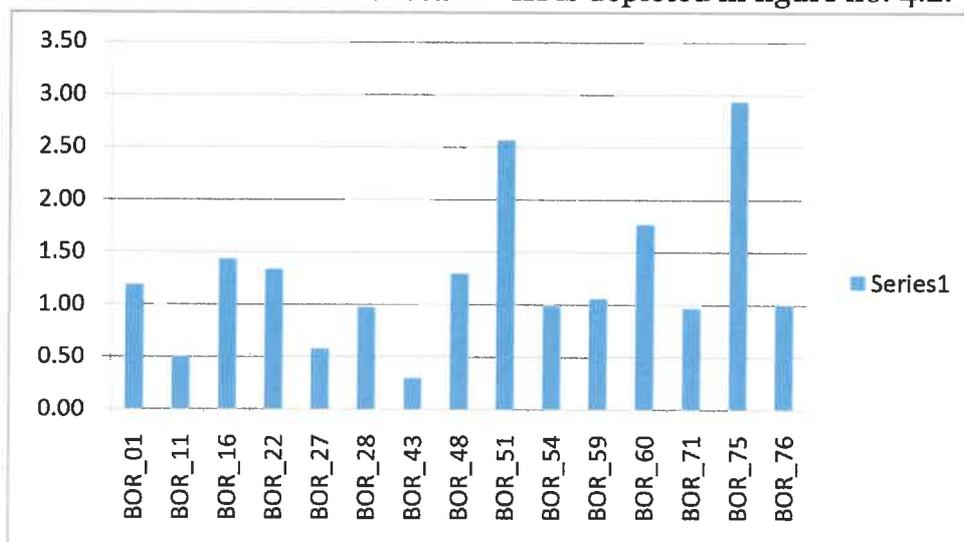


Figure No. 4.2: Thickness variation of seam VIII within Barjora North Coal Block.
Seam-VII:

This seam founds to be occur along with its in crop region in all the sectors of Barjora North Coal Block while in few boreholes it has been found to be deteriorated to carbonaceous shale. Total number of intersections within the block is 37. The seam has attained a thickness range of 0.55 m to 4.72 meter while depth range belongs to 3.20 m bgl to 29.70 bgl. Salient features of seam VII has been described in table no. 4.6.

Table No. 4.6
Salient Features of Seam VII

1	Seam Name	Units	Seam - VII
2	Borehole Intersections	Nos.	36
3	Depth Range	M	
i	Shallowest		11.3
ii	Deepest		77.6
4	Seam Thickness in Meters	M	
i	Minimum		0.38
ii	Maximum		4.72
iii	Average		2.08
iv	Average above 1.0 Meter		2.22
5	Parting with Overlying Seam in meters	M	

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1	Seam Name	Units	Seam - VII
i	Minimum		3.24
ii	Maximum		29.71
ii	Average		16.18
6	Immediate Roof		Varied Grained Sandstones
7	Immediate Floor		Shale & Shaly Sandstone.
8	Dirt Bands	Nos.	1 to 10
	Range of Thickness of individual Bands (m)	M	0.04-0.55
	Range of Cumulative Thickness (m)		0.07 -01.17
	No. of Boreholes where seam is devoid of dirt bands (% of Total Boreholes.)	%	9 (25%)
	Lithology		Carb. Shale, Shale & Sandstone
9	Quality Parameters (Incl. of Calculated Values) – I ₃₀ basis		
	Moisture %	Wt.%	4.03-7.6
	Ash%	Wt.%	24.9-55.44
	V.M. %	Wt.%	27.7
	UHV - Kcal/Kg - Minimum	Kcal/Kg	1075
	UHV - Kcal/Kg - Maximum	Kcal/Kg	3946
	Grade Range - UHV Based.		E - Ungraded
	Grade Range - GCV Based		G-8 to G-16
	Usual Grade		G10-G11
10	Net Proved + Indicated reserve in Million Tons	MT	
	Opencast		11.830
	UG		-
	Total		11.830

Seam thickness variation is depicted in figure no. 4.3.

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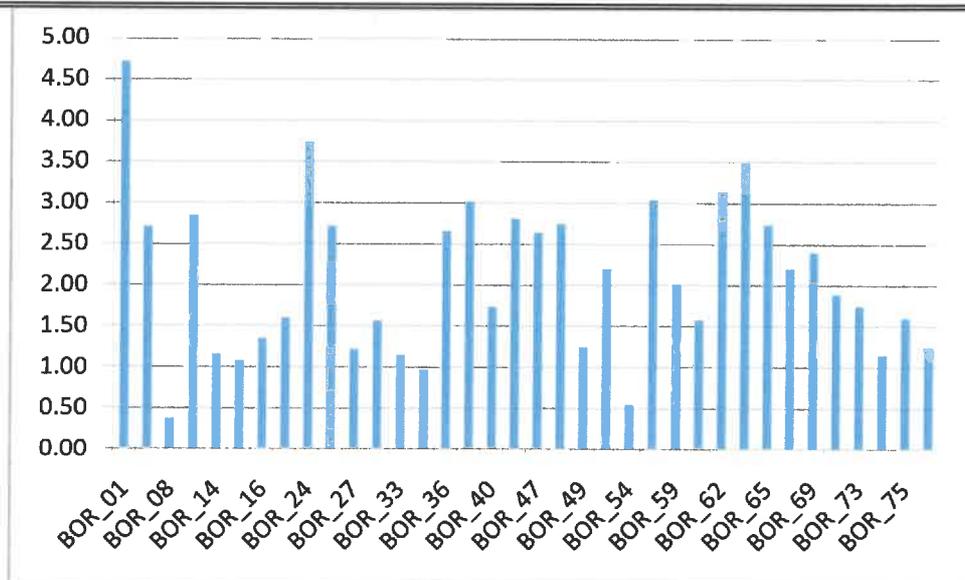


Figure No. 4.3: Seam Thickness variation of Seam VII.

Seam VI:

The seam occurs mostly as a single unit and well distributed in Sector-A. This seam has not developed in the sector-C. The seam thickness varies from 0.25 m to 4.42 m. total number of seam intersection found to be 32. Salient features of the coal seam are being furnished in table no. 4.7.

Table No. 4.7
Salient Features of Seam VI

1	Seam Name	Units	Seam - VI
2	Borehole Intersections	Nos.	31
3	Depth Range	M	
i	Shallowest		19.38
ii	Deepest		76.63
4	Seam Thickness in Meters	M	
i	Minimum		0.25
ii	Maximum		4.42
iii	Average		1.52
iv	Average above 1.0 Meter		2.39
5	Parting with Overlying Seam in meters	M	
i	Minimum		4.69

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1	Seam Name	Units	Seam - VI
ii	Maximum		24.53
ii	Average		13.21
6	Immediate Roof		Sandstone & Carb Shale
7	Immediate Floor		Sandstone & Shale
8	Dirt Bands	Nos.	1 to 7
	Range of Thickness of individual Bands (m)	M	0.04 -0.33
	Range of Cumulative Thickness (m)		0.05 -1.28
	No. of Boreholes where seam is devoid of dirt bands (% of Total Boreholes.)	%	17 (55%).
	Lithology		Carb. Shale, Shale & Sandstone.
9	Quality Parameters (Incl. of Calculated Values) - I ₁₀₀ basis		
	Moisture %	Wt.%	4.2 -6.6
	Ash%	Wt.%	24.27-43.6
	V.M. %	Wt.%	23.3 -25.5
	UHV - Kcal/Kg - Minimum	Kcal/Kg	1738
	UHV - Kcal/Kg - Maximum	Kcal/Kg	3780
	Grade Range - UHV Based.		D - G
	Grade Range - GCV Based		G-7 to G-12
	Usual Grade		G9-G10
10	Net Proved + Indicated reserve in Million Tons.	MT	
	Opencast		8.702
	UG		-
	Total		8.702

Seam thickness variation is being shown in Figure no. 4.4.

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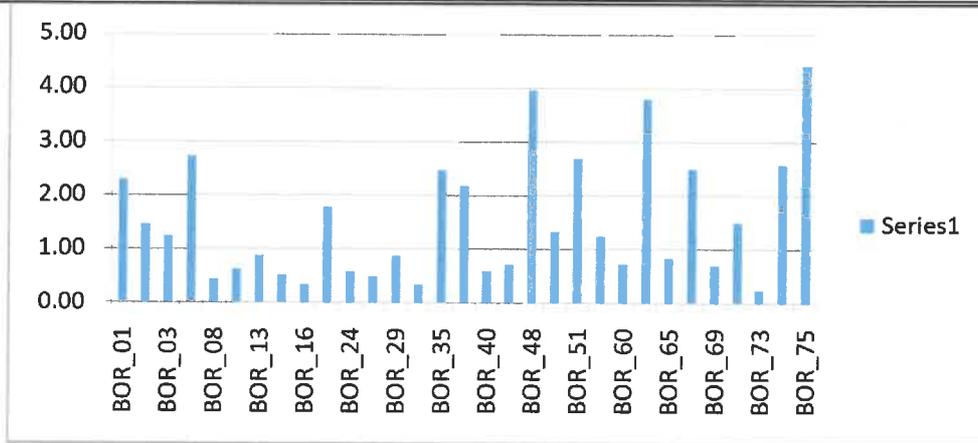


Figure No. 4.4: Graphical Representation of the Seam thickness variation of Seam VI.

Seam-V (Combined):

This seam is the most potential coal seam of this block along with its splits. Also V-combined occurs as a single unit mostly in the Sector-A & B. sector-C is having the in crop of the seam. Thickness of this seam varies from 1.70 m to 6.29 m while depth of occurrence varies from 12.96 m to 112.20 m. salient feature of this seam is being furnished in table no. 4.8.

Table No. 4.8
Salient Features of Seam V (Combined).

1	Seam Name	Units	Seam – V (Combined)
2	Borehole Intersections	Nos.	29
3	Depth Range	M	
i	Shallowest		15.6
ii	Deepest		115.55
4	Seam Thickness in Meters	M	
i	Minimum		0.5
ii	Maximum		6.29
iii	Average		3.68
iv	Average above 1.0 Meter		3.8

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1	Seam Name	Units	Seam – V (Combined)
5	Parting with Overlying Seam in meters.	M	
i	Minimum		1.8
ii	Maximum		29.45
ii	Average		13.26
6	Immediate Roof		Sandstone & Shale
7	Immediate Floor		Carb. Shale & Shale
8	Dirt Bands	Nos.	1 to 5
	Range of Thickness of individual Bands (m)	M	0.04 -0.80
	Range of Cumulative Thickness (m)		0.04 -1.46
	No. of Boreholes where seam is devoid of dirt bands (% of Total Boreholes.)	%	4 (14%)
	Lithology		Carb shale, Shale & Sandstone.
9	Quality Parameters (Incl. of Calculated Values) – I ₃₀ basis		
	Moisture %	Wt.%	3.7 -6.65
	Ash%	Wt.%	26.3 -54.1
	V.M. %	Wt.%	27.40
	UHV - Kcal/Kg - Minimum	Kcal/Kg	924
	UHV - Kcal/Kg - Maximum	Kcal/Kg	3822
	Grade Range - UHV Based.		E -Ungraded
	Grade Range - GCV Based		G-8 to G-15
	Usual Grade		G10-G11
10	Net Proved + Indicated reserve in Million Tons.	MT	
	Opencast		20.075
	UG		-
	Total		20.075

The reserve figures mentioned above comprise of all splits of Seam-V together.

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Seam V-combined has been remodeled into Seam V Top and V Bottom for with zero parting wherever V Combined was considered in the geological report. This is being done to simplify the software model.

Seam- V-Top & V-Bottom:

Thickness variation of Seam V-Top and V-Bottom are furnished in figure no. 4.5 and 4.6 respectively.

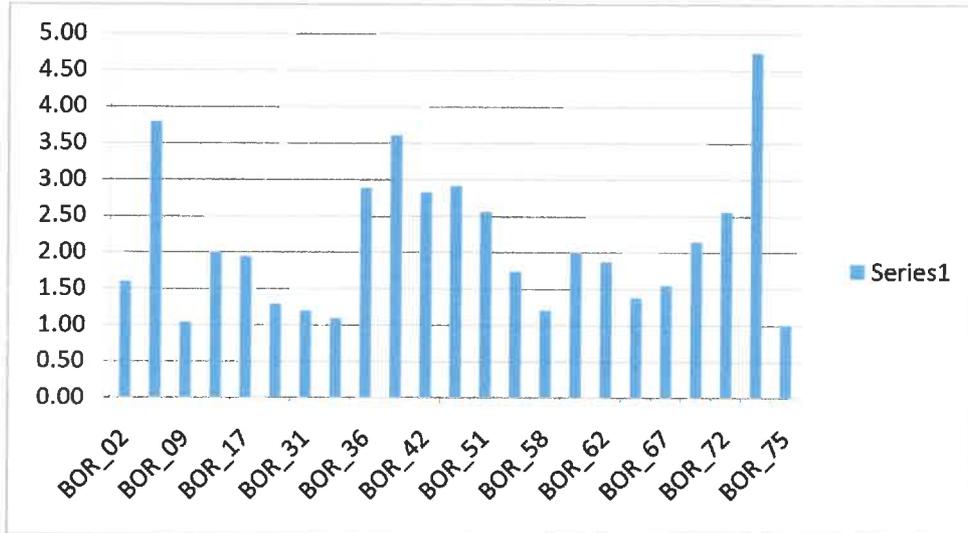


Figure No. 4.5: Graphical Representation of Seam Thickness variation of Seam V-Top.

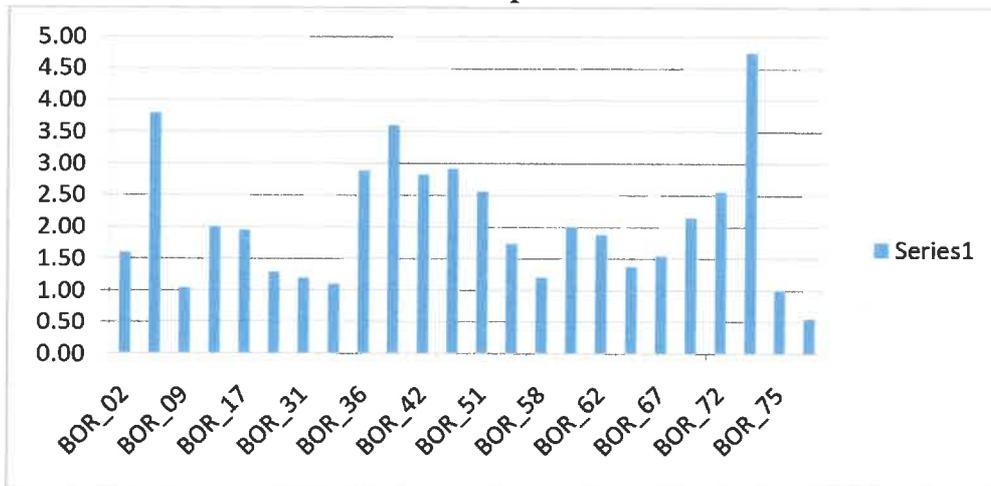


Figure No. 4.6: Graphical Representation of Seam Thickness variation of Seam V-Bottom.

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Seam-IV:

This seam occurs imperpersistently as a thin band just below seam V. the seam has several occasions merged with either seam V-Bottom or V-combined seam. The seam has attained a workable thickness in 15 boreholes out 16 occurrences as per Geological report. Salient features of the seam have not been furnished thus.

Seam-III, II & I:

The lower packet of Barjora North coal block comprises of three sections namely – Seam-III, Seam-II & Seam-I. Three seams occur as a combined seam along the central part while found completely pinched off in the south western sector and part of northern sector. Cumulative thickness range attains more than 8 meter in the central part. However, the split behavior found to be erratic and often either two seams found to be coalesced in different combination in different parts of the block. Salient features of Seam-III, II & I is furnished in table no. 4.9.

Table No.4.9
Salient Features of Seam-III, II & I

1	Seam Name	Units	Seam - III	Seam - II	Seam - I
2	Borehole Intersections	Nos.	29	22	35
3	Depth Range	M			
i	Shallowest		24.85	28.31	25.25
ii	Deepest		138.8	136.11	150.11
4	Seam Thickness in Meters	M			
i	Minimum		0.42	0.28	0.55
ii	Maximum		3.42	2.75	5.06
iii	Average		1.43	1.26	1.87
iv	Average above 1.0 Meter		1.82	1.78	2.19
5	Parting with Overlying Seam in meters	M			
i	Minimum		4.94	0	1.9

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1	Seam Name	Units	Seam - III	Seam - II	Seam - I
ii	Maximum		21.4	20.23	9.0
ii	Average		13.09	4.86	2.76
6	Immediate Roof		Shale, Shaly Sandstone & Carb. Shale	Sandy Shale, shale & Alternate Shale-Sandstone	Shale, Sandy Shale & Shaly Sandstone.
7	Immediate Floor		Shale, Sandstone & Carb. Shale	Shale, Sandstone & Shaly Sandstone	Mostly Sandy Shale and Sandstone
8	Dirt Bands	Nos.	1 to 6	1 to 3	1 to 6
	Range of Thickness of individual Bands (m)	M	0.04 -0.55	0.03 -0.36	0.04 -0.52
	Range of Cumulative Thickness (m).		0.06 -0.95	0.03 -0.68	0.08 -1.23
	No. of Boreholes where seam is devoid of dirt bands (% of Total Boreholes.)	%	10 (34%)	14 (63%).	16 (46%).
	Lithology		Carb. Shale, Sandstone and Sandy Shale.	Carb. Shale, shale and Sandstone.	Mostly carb. Shale, Shale & Sandstone.
9	Quality Parameters (Incl. of Calculated Values) - I ₁₀₀ basis				
	Moisture %	Wt.%	3.4 -6.5	4.2 -6.3	3.7 -8.0
	Ash%	Wt.%	20.94-47.8	22.7-38.2	20.66-51.5
	V.M. %	Wt.%	26.8 -30.0	23.50 -27.60	27.0 -30.0
	UHV - Kcal/Kg - Minimum	Kcal/Kg	1793	1572	1282
	UHV - Kcal/Kg - Maximum	Kcal/Kg	5105	4525	4939
	Grade Range - UHV Based.		C -G	D-G	D- Ungraded.
	Grade Range - GCV Based		G-6 to G-13	G-6 to G-11	G-6 to G-14
	Usual Grade		G-10	G-8	G9-G10

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Total geological reserve (Proved + Indicated) for these combined seams found to be 36.3563 million Tons.

Seam thickness variations for all sea III & seam I has been depicted in figure nos. 4.7 & 4.8 respectively.

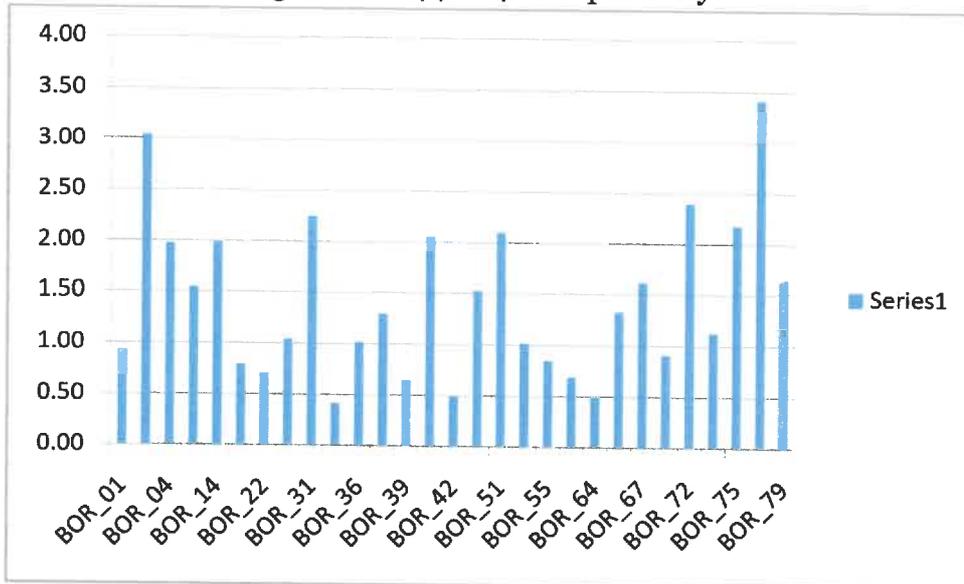


Figure No. 4.7: Graphical Representation on thickness variation of and Seam III in Barjora North Coal Block.

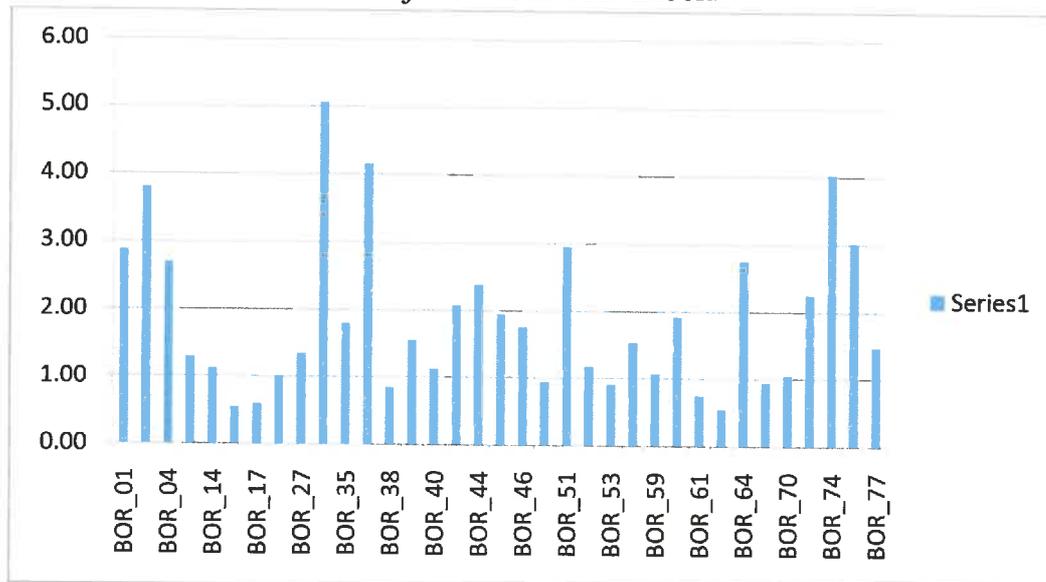


Figure No. 4.8: Graphical Representation on thickness variation of Seam-I in Barjora North Coal Block.

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From the above seam descriptions and figures, it reveals that seam thickness, split behaviors' and pinching off of a particular seam is very common in Barjora North Coal Block of Barjora Coalfield and this has to be dealt with proper planning in the operational stage to have optimum coal recovery from the block.

4.5 Seam Quality:

4.6.1 Proximate Analysis:

As per the Geological Report of Barjora North Coal Block quality as defined in UHV based grading system.

The seam-wise usual range of grade including bands up to 30cm (i.e. I₃₀ basis) varies from E to G. However, these grades are expected to be improved considerably during mining by surface miners by selective removal of in-seam bands.

The specific gravity for estimation of reserves has been considered as 1.6 instead of 1.7 to minimize the quantity of reserves, which may not be available due to erratic behavior of seams (both in thickness and quality).

Seam wise quality as given in the geological report of CMPDI is summarized in table no. 4.10.

Table No. 4.10

Seam wise summarized proximate analysis figures of Barjora North Coal Block.

Coal Seam	Proximate Analysis at 60% RH & 40°C			GCV (K.Cal/kg.)	Grade Range	Usual Grade
	M%	Ash %	VM%			
IX	5.3-8.25	23.61-46.8	22.7	3365-5131	G8-G14	G11-G13
VIII	4.0-6.56	34.9-56.0	23	2703-4317	G10-G16	G12-G13
VII	4.03-7.6	24.9-55.44	27.7	2750-5119	G8-G16	G10-G11
VI	4.2-6.6	24.27-43.6	23.3-25.5	3726-5305	G7-G12	G9-G10
V(Comb)	3.7-6.65	26.3-54.1	27.4	2926-5112	G8-G15	G10-G11
V Top	5.2-7.66	25.65-45.8	21.9-28.9	3488-5026	G8-G13	G10-G11
V Bottom	4.2-8.8	20.78-49.3	24.2	3305-5502	G6-G14	G9-G10
IV	2.8-7.06	22.4-51.9	-	3005-5669	G6-G15	G10
I/II/III	5.1-5.99	30.7-39.7	-	4077-4791	G9-G11	G9-G11
II/III	2.88	28.35	-	5468	G7	G7
III	3.4-6.5	20.94-47.8	26.8-30.0	3513-5654	G6-G13	G10

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I/II	4.8-6.68	21.97-40.41	-	4040-5515	G6-G11	G8-G9
II	4.2-6.3	22.7-38.2	23.5-27.6	4058-5501	G6-G11	G8
I	3.7-8.0	20.66-51.5	27.0-30.0	3170-5656	G6-G14	G9-G10

Note: 1) Ex-band values are show without brackets.

2) 1-100 values are show within brackets.

4.6.2 Special tests:

Special tests carried out in the workable coal seams encountered in boreholes of Barjora North Coal Block during the exploration stage. Ash fusion Temperature in 18 Samples), HGI in 18 Samples, Ultimate Analysis in 2 samples have been done. Results of these analysis tests are given in Table No. 4.11.

Table No.4.11

Details of the Special Tests carried out at Barjora North Coal Block.

Borehole No.	Depth (m)		M Thickness	Degree in Centigrade			HGI	Remarks
	From	To		IDT	HT	FT		
Seam- VIII								
BOR/MA/028	22.94	23.92	0.98	1320	1400	1400	60	EX-BAND
Seam- VII								
BOR/MA/028	35.62	36.77	1.15	1400	1400	1400	57	Part Special Teat team.
BOR/MA/036	25.75	27.1	1.35	1330	1400	1400	67	Part Seam.
Seam-VI								
BOR/MA/036	37.75	38.93	1.18	1400	1400	1400	69	Part Seam.
Seam- V								
BOR/MA/028	68.55	73.43	4.88	1290	1400	1400	62	Ex-Band, Seam V Combined.
BOR/MA/036	62.36	63.79	1.43	1290	1400	1400	70	INBAND - SEAM VT
BOR/MA/040	33.55	35.65	2.1	1400	1400	1400	71	SEAM V-T

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BOR/MA/040	40.8	41.8	1	1400	1400	1400	59	V B TOP SPLIT INCL. 0.15 M CARB. SHALE AT TOP.
	42.96	44.41	1.72	1350	1400	1400	67	VB SPLIT.
SEAM I/II/III								
BOR/MA/028	87.6	88.65	1.05	1400	1400	1400	-	EX. NC BAND SEAM-III
	93.35	95.66	2.31	1400	1400	1400	73	IN BAND SEAM II PART.
	100.2	102.5	2.36	1380	1400	1400	65	IN BAND SEAM -I PART
BOR/MA/036	83.63	84.65	1.02	1400	1400	1400	58	SEAM-III
	85.92	87.22	1.3	1350	1400	1400	71	SEAM-III
	94.4	95.4	1	1400	1400	1400	61	EX-BAND SEAM- LOCAL
BOR/MA/040	65.29	66.85	1.56	1260	1370	1400	63	SEAM III PART.
	70.2	71.86	1.68	1400	1400	1400	68	SEAM III
	72.53	73.66	1.43	1400	1400	1400	74	SEAM-I

4.6.3 Re-computed Coal Grades – as per new norms:

The Geological report and the earlier mining plan were prepared before the commencement of the GCV based grading system which was adopted since the year 2012. As a result, in both the reports, emphasis was not given to GCV based grading systems and even GCV's has not been determined systematically during the exploration stage. In absence of such systematic data, GCV values were derived from the well-established Shri B K Mazumdar's formula as per ISP. The formulae are given below:

$$\text{Gross CV in kcal/kg} = \frac{154 \times \{100 - (1.1 \times A + M)\} - 108 \times M}{1.8}$$

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Where, A is Ash and M is Moisture determined on 60% RH and 40°C, or calculated from band by band ash and moisture of seam after equilibration at 40°C and on 60% RH.

Relative density of the different bands (both carbonaceous and others) was calculated based on declared RD values with respect to the GCV range.

Seam-IX:

Though occurrence of seam IX found to be very limited in few boreholes, attempt has been made to establish the grade as per new system and is furnished below in Table no. 4.12.

Table No. 4.12

Re-calculated GCV and Grade of Seam-IX

Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_16	IX	6.8	35.6	4215.422	G11
BOR_27	IX	5.8	43.3	3636.322	G13
BOR_38	IX	5.3	45.2	3530.289	G13
BOR_43	IX	-	-	-	-
BOR_60	IX	8.3	23.61	5131.932	G8
BOR_76	IX	5.4	46.8	3365.156	G14
Total Number of Samples		6			
Minimum Value		5.3	23.61	3365.156	
Maximum Value		8.3	46.8	5131.932	
Mean Average		6.31	38.9	3976	
Usual Grade		G11-G13			
Standard Deviation		1.24	9.57	721.22689	

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Seam – VIII:

Seam overall analysis data for Seam-VIII are not much however, attempt has been made to classify the coal based on the available I100 data. Estimation details are furnished in table No. 4.13.

Table No. 4.13

Re-calculated GCV and Grade of Seam-VIII.

Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_01	VIII	5.26	45.95	3465	G13
BOR_11	VIII	5.09	47.40	3353	G14
BOR_16	VIII	4.00	56.00	2703	G16
BOR_22	VIII	5.10	46.40	3446	G13
BOR_27	VIII	-	-	-	-
BOR_28	VIII	6.56	34.90	4317	G10
BOR_43	VIII	-	-	-	-
BOR_48	VIII	5.70	42.60	3717	G12
BOR_51	VIII	4.60	51.10	3077	G15
BOR_54	VIII	5.20	45.50	3517	G13
BOR_59	VIII	5.64	42.77	3710	G12
BOR_60	VIII	6.00	39.90	3927	G12
BOR_71	VIII	6.00	39.00	4012	G11
BOR_75	VIII	4.81	49.79	3169	G14
BOR_76	VIII	4.30	53.50	2895	G15
Total Number of Samples		15			
Minimum Value		4.00	34.9	2703	

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
Maximum Value		6.56	56.00	4317	
Mean Average		5.25	45.75	3485	
Usual Grade		G12-G13			
Standard Deviation		0.72	5.98	458	

Seam-VII:

Number of available data is sufficient to judge the quality of seam VII on overall basis. Based on the 1100 data, GCV estimation done and is furnished on table No. 4.14.

Table No. 4.14

Re-calculated GCV and Grade of Seam-VII

Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_01	VII	5.04	46.58	3437	G13
BOR_02	VII	6.30	33.10	4523	G10
BOR_08	VII	5.83	39.71	3970	G12
BOR_11	VII	4.30	37.70	4382	G10
BOR_14	VII	6.57	33.20	4475	G10
BOR_15	VII	6.85	30.68	4670	G9
BOR_16	VII	5.00	33.40	4684	G9
BOR_22	VII	6.84	30.80	4661	G9
BOR_24	VII	6.62	32.75	4510	G10
BOR_25	VII	6.30	35.90	4260	G11
BOR_27	VII	5.60	36.70	4287	G11
BOR_28	VII	4.90	45.20	3589	G13
BOR_33	VII	6.20	29.70	4858	G9

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_35	VII	5.42	43.32	3690	G13
BOR_36	VII	7.14	28.15	4867	G9
BOR_38	VII	4.04	55.44	2750	G16
BOR_40	VII	5.50	49.90	3059	G15
BOR_43	VII	6.59	32.96	4493	G10
BOR_47	VII	5.10	45.60	3522	G13
BOR_48	VII	7.51	24.90	5119	G8
BOR_49	VII	5.00	48.30	3282	G14
BOR_51	VII	6.03	37.93	4108	G11
BOR_54	VII	4.40	52.28	2996	G15
BOR_58	VII	5.40	41.20	3892	G12
BOR_59	VII	6.10	41.90	3724	G12
BOR_60	VII	6.90	32.80	4464	G10
BOR_62	VII	5.20	46.80	3394	G14
BOR_63	VII	7.19	27.71	4901	G8
BOR_65	VII	6.11	37.19	4166	G11
BOR_68	VII	5.84	39.59	3979	G12
BOR_69	VII	5.60	40.00	3976	G12
BOR_71	VII	5.97	38.44	4069	G11
BOR_73	VII	-	-	-	-
BOR_74	VII	6.50	33.60	4447	G10
BOR_75	VII	7.60	34.10	4240	G11
BOR_76	VII	6.10	37.80	4110	G11
Total Number of Samples		36			

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
Minimum Value		4.04	24.90	2750	
Maximum Value		7.60	55.44	5119	
Mean Average		5.93	38.15	4102	
Usual Grade		G10-G11			
Standard Deviation		0.90	7.31	584	

Seam-VI:

Seam overall data of 18 numbers of samples has been considered for GCV calculation and grade estimation for seam-VI. The calculations are furnished in Table no. 4.15.

Table No. 4.15
Re-calculated GCV and Grade of Seam-VI.

Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_01	VI	5.19	38.79	4149	G11
BOR_02	VI	4.90	35.70	4483	G10
BOR_03	VI	6.04	30.29	4826	G9
BOR_04	VI	5.70	34.80	4451	G10
BOR_08	VI	5.53	35.40	4419	G10
BOR_11	VI	6.64	24.27	5305	G7
BOR_13	VI	5.69	33.81	4546	G10
BOR_15	VI	6.60	24.70	5271	G7
BOR_16	VI	-	-	-	-
BOR_22	VI	6.54	25.32	5222	G7
BOR_24	VI	5.63	34.39	4500	G10

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_28	VI	6.35	27.17	5074	G8
BOR_29	VI	6.60	32.40	4546	G10
BOR_31	VI	-	-	-	-
BOR_35	VI	6.08	29.88	4859	G9
BOR_36	VI	4.20	43.30	3869	G12
BOR_40	VI	-	-	-	-
BOR_47	VI	6.09	29.75	4869	G9
BOR_48	VI	5.98	30.86	4780	G9
BOR_49	VI	4.60	40.20	4103	G11
BOR_51	VI	4.90	39.20	4153	G11
BOR_58	VI	4.20	43.60	3841	G12
BOR_60	VI	5.70	42.50	3726	G12
BOR_62	VI	5.94	31.31	4745	G9
BOR_65	VI	5.43	36.36	4342	G10
BOR_68	VI	5.83	32.41	4657	G9
BOR_69	VI	6.33	27.37	5058	G8
BOR_72	VI	5.10	33.60	4651	G9
BOR_73	VI	-	-	-	-
BOR_74	VI	6.17	28.94	4933	G8
BOR_75	VI	4.90	42.80	3814	G12
Total Number of Samples		31			
Minimum Value		4.20	24.27	3726	
Maximum Value		6.64	43.60	5305	
Mean Average		5.66	33.67	4563	

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
Usual Grade		G9-G10			
Standard Deviation		0.71	5.78	455	

Seam- V (Combined):

Seam overall analysis of 29 samples has been considered for GCV determination and grade estimation for Seam V within Barjora North Coal Block. Details are furnished in Table No. 4.16.

Table No. 4.16

Recalculated GCV and Grade of Seam V (Combined).

Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_01	V	5.71	35.47	4386	G10
BOR_03	V	5.74	35.20	4408	G10
BOR_04	V	4.80	43.20	3791	G12
BOR_08	V	5.26	39.84	4040	G11
BOR_10	V	4.95	42.81	3805	G12
BOR_11	V	5.44	38.07	4181	G11
BOR_14	V	5.89	33.72	4524	G10
BOR_15	V	5.51	37.39	4235	G11
BOR_16	V	5.20	43.90	3667	G13
BOR_22	V	5.13	41.08	3942	G12
BOR_24	V	5.70	34.90	4441	G10
BOR_27	V	4.50	47.50	3430	G13
BOR_28	V	5.78	34.81	4438	G10
BOR_29	V	5.40	38.52	4145	G11

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_33	V	4.85	43.83	3725	G12
BOR_38	V	5.50	43.60	3652	G13
BOR_39	V	6.10	30.70	4778	G9
BOR_44	V	4.70	39.40	4163	G11
BOR_45	V	5.25	39.95	4032	G11
BOR_47	V	5.38	38.71	4130	G11
BOR_54	V	6.65	26.30	5112	G8
BOR_59	V	5.99	32.73	4603	G9
BOR_64	V	3.70	54.10	2926	G15
BOR_65	V	5.85	34.13	4493	G10
BOR_66	V	4.20	49.30	3305	G14
BOR_69	V	6.12	31.46	4703	G9
BOR_71	V	5.00	43.60	3725	G12
BOR_76	V	-	-	-	-
BOR_77	V	5.97	32.91	4589	G10
Total Number of Samples	29				
Minimum Value		3.70	26.30	2926	
Maximum Value		6.65	54.10	5112	
Mean Average		5.37	38.83	4120	
Usual Grade	G10-G11				
Standard Deviation		0.64	6.13	489	

Seam- V- Top:

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Seam overall analysis of 21 samples has been considered for GCV determination and grade estimation for Seam V within Barjora North Coal Block. Details are furnished in Table No. 4.17 and Table No. 4.18.

Table No. 4.17
Recalculated GCV and Grade of Seam V (Top)

Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_02	VT	5.60	33.50	4588	G10
BOR_05	VT	6.47	35.80	4244	G11
BOR_13	VT	6.40	33.50	4471	G10
BOR_17	VT	6.03	39.54	3956	G12
BOR_25	VT	6.46	35.85	4241	G11
BOR_31	VT	5.80	37.70	4163	G11
BOR_35	VT	7.10	30.20	4680	G9
BOR_36	VT	6.96	31.64	4565	G10
BOR_40	VT	6.40	39.00	3954	G12
BOR_42	VT	7.20	32.70	4430	G10
BOR_48	VT	6.69	33.90	4391	G10
BOR_49	VT	5.30	45.60	3493	G13
BOR_51	VT	7.66	25.65	5026	G8
BOR_53	VT	5.77	41.78	3784	G12
BOR_58	VT	6.00	37.30	4172	G11
BOR_60	VT	5.30	45.50	3502	G13
BOR_62	VT	7.60	28.20	4795	G9
BOR_63	VT	5.20	45.80	3488	G13

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_68	VT	6.20	40.10	3879	G12
BOR_72	VT	6.18	38.30	4052	G11
BOR_74	VT	5.80	43.50	3618	G13
BOR_75	VT	6.61	34.64	4334	G10
BOR_79	VT	5.75	41.90	3775	G12
Total Number of Samples		23			
Minimum Value		5.20	25.65	3488	
Maximum Value		7.66	45.80	5026	
Mean Average		6.28	37.03	4157	
Usual Grade		G10-G11			
Standard Deviation		0.70	5.55	433	

Table No. 4.18

Recalculated GCV and Grade of Seam V (Bottom)

Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_02	VB	5.73	37.61	4182	G11
BOR_05	VB	5.48	39.92	4000	G12
BOR_09	VB	8.80	21.40	5261	G7
BOR_13	VB	5.74	37.54	4187	G11
BOR_17	VB	5.92	35.84	4320	G10
BOR_25	VB	4.30	48.40	3375	G14
BOR_31	VB	6.80	33.20	4441	G10

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_35	VB	6.90	27.60	4954	G8
BOR_36	VB	5.60	34.30	4512	G10
BOR_40	VB	6.38	31.62	4651	G9
BOR_42	VB	6.47	30.80	4716	G9
BOR_49	VB	6.00	35.14	4375	G10
BOR_51	VB	5.20	46.00	3470	G13
BOR_53	VB	4.20	49.30	3305	G14
BOR_58	VB	6.30	31.80	4646	G9
BOR_60	VB	5.25	42.11	3828	G12
BOR_62	VB	5.94	35.66	4334	G10
BOR_63	VB	5.36	41.04	3912	G12
BOR_67	VB	5.00	36.60	4383	G10
BOR_68	VB	5.70	37.93	4156	G11
BOR_72	VB	4.70	43.90	3740	G12
BOR_74	VB	7.54	20.78	5502	G6
BOR_75	VB	6.60	30.00	4772	G9
BOR_79	VB	4.86	45.71	3546	G13
Total Number of Samples	24				
Minimum Value	4.20	20.78	3305		
Maximum Value	8.80	49.30	5502		
Mean Average	5.87	36.43	4274		
Usual Grade	G9-G10				
Standard Deviation	1.03	7.51	568		

Seam-I, II & III:

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As discussed earlier, the lower packet consists of three seams namely Seam-III, II & I are found to be coalesce and pinched off and often difficult to distinguish within this block. Though reporting has been done on the basis of combined seam, for better understanding of the coal seam distributions, three seams have been identified and quality aspects have been analyzed. Details of individual seams have been furnished in table nos. 4.19, 4.20, &4.21 respectively.

Table No. 4.19

Recalculated GCV and Grade of Seam III

Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_01	III	5.60	28.60	5049	G8
BOR_02	III	6.12	24.43	5366	G7
BOR_04	III	3.80	47.70	3513	G13
BOR_09	III	5.20	35.90	4420	G10
BOR_14	III	5.00	31.90	4826	G9
BOR_16	III	4.53	41.71	3971	G12
BOR_22	III	6.31	22.36	5533	G6
BOR_28	III	5.20	36.00	4411	G10
BOR_31	III	4.40	35.90	4537	G10
BOR_35	III	-	-	-	-
BOR_36	III	6.10	21.40	5654	G6
BOR_38	III	5.40	26.40	5285	G7
BOR_39	III	-	-	-	-
BOR_40	III	6.04	25.27	5298	G7
BOR_42	III	5.92	26.58	5192	G8

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_49	III	6.40	36.40	4198	G11
BOR_51	III	4.91	37.60	4303	G10
BOR_52	III	6.50	35.60	4259	G11
BOR_55	III	5.60	30.05	4912	G8
BOR_61	III	6.12	24.39	5369	G7
BOR_64	III	5.38	32.42	4721	G9
BOR_65	III	4.97	36.89	4360	G10
BOR_67	III	5.70	33.60	4564	G10
BOR_70	III	4.79	38.84	4202	G11
BOR_72	III	6.44	20.94	5648	G6
BOR_74	III	3.40	47.80	3562	G13
BOR_75	III	5.02	36.33	4406	G10
BOR_77	III	4.20	37.80	4387	G10
BOR_79	III	4.70	34.60	4615	G9
Total Number of Samples		29			
Minimum Value		3.40	20.94	3513	
Maximum Value		6.50	47.80	5654	
Mean Average		5.32	32.87	4687	
Usual Grade		G10			
Standard Deviation		0.83	7.28	592	

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Table No. 4.20
Recalculated GCV and Grade of Seam II

Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_01	II	4.94	37.49	4309	G10
BOR_02	II	4.90	26.80	5320	G7
BOR_04	II	5.63	30.02	4912	G8
BOR_14	II	5.60	34.90	4456	G10
BOR_28	II	5.95	26.46	5198	G8
BOR_35	II	5.62	30.03	4910	G8
BOR_36	II	5.70	28.50	5044	G8
BOR_40	II	5.80	38.20	4116	G11
BOR_44	II	4.30	29.00	5200	G7
BOR_45	II	5.76	28.58	5027	G8
BOR_51	II	6.20	38.20	4058	G11
BOR_53	II	5.95	26.47	5198	G8
BOR_55	II	5.94	26.65	5183	G8
BOR_60	II	6.30	22.71	5501	G6
BOR_61	II	5.63	29.99	4914	G8
BOR_64	II	5.63	30.02	4912	G8
BOR_65	II	6.10	29.60	4882	G9
BOR_70	II	5.62	30.05	4909	G8
BOR_71	II	5.16	35.09	4502	G10
BOR_74	II	5.33	33.28	4649	G9
BOR_75	II	4.20	36.80	4481	G10

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_77	II	5.34	33.14	4660	G9
Total Number of Samples		22			
Minimum Value		4.20	22.71	4058	
Maximum Value		6.30	38.20	5501	
Mean Average		5.53	31.00	4834	
Usual Grade		G8			
Standard Deviation		0.55	4.31	387	

Table No. 4.21

Recalculated GCV and Grade of Seam I

Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_01	I	5.57	31.37	4793	G9
BOR_02	I	5.72	29.75	4923	G8
BOR_04	I	3.70	51.50	3170	G14
BOR_05	I	5.20	41.10	3931	G12
BOR_14	I	5.10	34.10	4604	G9
BOR_16	I	6.40	22.43	5512	G6
BOR_17	I	8.00	29.30	4634	G9
BOR_22	I	5.90	24.30	5410	G7
BOR_27	I	4.70	39.70	4135	G11
BOR_28	I	6.57	20.65	5656	G6
BOR_35	I	4.20	37.50	4415	G10
BOR_36	I	6.48	21.64	5576	G6

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
BOR_38	I	5.70	23.00	5561	G6
BOR_39	I	4.90	41.50	3937	G12
BOR_40	I	6.20	31.80	4660	G9
BOR_43	I	4.90	36.50	4407	G10
BOR_44	I	5.80	28.92	4990	G8
BOR_45	I	4.80	34.20	4638	G9
BOR_46	I	5.30	29.30	5027	G8
BOR_50	I	5.60	25.00	5388	G7
BOR_51	I	5.05	36.87	4351	G10
BOR_52	I	4.20	39.90	4189	G11
BOR_53	I	4.43	43.48	3818	G12
BOR_55	I	4.58	41.89	3946	G12
BOR_59	I	5.60	28.40	5068	G8
BOR_60	I	5.40	33.17	4648	G9
BOR_61	I	4.87	38.81	4194	G11
BOR_63	I	3.87	49.48	3335	G14
BOR_64	I	5.28	34.43	4546	G10
BOR_65	I	5.20	32.00	4787	G9
BOR_70	I	5.16	35.73	4442	G10
BOR_71	I	5.80	27.30	5142	G8
BOR_74	I	4.88	38.71	4202	G11
BOR_75	I	4.81	39.52	4137	G11
BOR_77	I	5.30	34.50	4537	G10

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Borehole No.	Seam Name	Moisture%	Ash%	GCV (Kcal/Kg)	Grade
Total Number of Samples		35			
Minimum Value		3.70	20.65	3170	
Maximum Value		8.00	51.50	5656	
Mean Average		5.29	33.94	4592	
Usual Grade		G9-G10			
Standard Deviation		0.84	7.51	613	

Discussion on the Coal Grade and Deposit Characteristics:

While observing the seam wise coal grades after being recalculated empirically, it is found that, wide variations even within a single seam is existing. Almost all the seams are found to be falling in a wide range rather than a narrow grade range. Frequency distribution table of all the data of Seam Overall (172 nos.) shows that around 80% of the analytical data confined within a range of G-9 to G-13. Also, individual seams are lying in same range except few discrete coal samples in the lower packet seems to be of high range. On the other hand, few low-grade data also observed where seam has deteriorated to ungraded coal mostly on the younger horizons of this block.

Thus the deposit may be declared to be within a range of G-9 to G-13 which corresponds well when compare with the Geological Report where it was declared as Grade F-G based on UHV.

Graphical representation of the frequency distribution and percentage of occurrence has been shown in figure 4.9.

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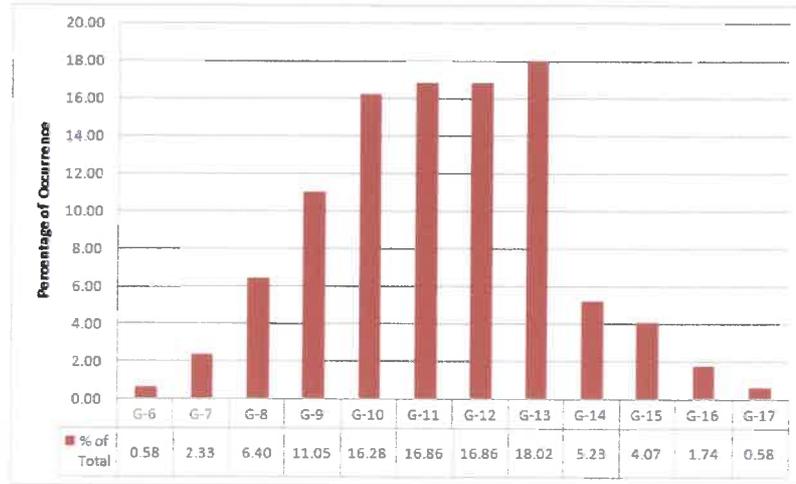


Figure No. 4.9: Graphical representation of Frequency distribution of all seams based on Grade of Barjora North Coal mine.

4.6.4 Ultimate Analysis:

Samples from three number of boreholes were selected for carrying out ultimate analysis covering the major workable coal seams of Barjora North Coal Block. Summarized analysis results are furnished in table no. 4.22.

Table No. 4.22

Ultimate Analysis results for the coal samples of Barjora North Coal Block.

Seam Name	Borehole No	From	To	Thickness	CO ₂ %	P%	C%	H%	N%	S%	O%
VIII	BOR/MA/028	22.94	23.92	0.98	0.44	0.152	80.54	5.36	1.98	0.88	11.24
VII	BOR/MA/028	35.62	36.77	1.15	0.32	0.470	81.01	5.30	2.06	0.96	10.67
	BOR/MA/036	25.75	27.10	1.35			81.09	5.08	1.96	0.83	11.04
VI	BOR/MA/036	37.75	38.93	1.18			80.98	5.10	1.93	0.76	11.25
V	BOR/MA/028	68.55	73.43	4.88	0.54	0.990	81.60	5.25	1.97	0.89	10.29
	BOR/MA/036	62.36	63.79	1.43			80.93	5.22	1.84	0.91	11.10
	BOR/MA/040	33.55	35.65	2.10	0.45	0.370	81.41	5.13	1.98	0.95	10.53
		40.80	41.80	1.00	0.75	0.460	81.44	4.96	2.21	0.83	10.56

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Seam Name	Borehole No	From	To	Thickness	CO ₂ %	P%	C%	H%	N%	S%	O%
		42.69	44.41	1.72	0.41	0.320	80.87	5.30	2.04	0.77	10.16
III	BOR/MA/028	87.60	88.65	1.05	0.40	0.390	82.06	5.01	2.00	0.77	10.16
	BOR/MA/036	83.63	84.65	1.02			81.12	5.15	1.95	0.81	10.97
	BOR/MA/040	65.29	66.89	1.60	0.53	0.870	82.01	5.15	2.18	0.92	9.74
II	BOR/MA/028	93.35	95.65	2.30	0.22	0.430	82.62	5.13	1.92	0.91	9.42
	BOR/MA/036	85.92	87.22	1.30			82.43	5.06	1.92	0.74	9.85
	BOR/MA/040	70.20	71.88	1.68	0.25	0.630	82.46	5.28	2.12	0.81	9.33
I	BOR/MA/028	100.15	102.51	2.36	0.60	0.280	82.40	5.21	1.90	0.73	9.76
	BOR/MA/040	72.53	73.66	1.13	0.48	0.119	82.94	5.16	1.98	0.78	9.14

4.6 Seam Wise Geological Reserve:

The erratic nature of coal seams and rapid variation in their lay and disposition make assessment of resources of Barjora North bit problematic and difficult. However, for reserve estimation, following considerations' have made as per the geological report.

- For reserve estimation purpose, the area has been divided into three sectors – mostly by the presence of Faults. Three sectors are named as Sector-A, Sector-B & Sector-C.
- Based on analytical data carbonaceous /non-carbonaceous litho units were delineated as:

Litho units:	Range of Ash%+Moisture%
Shale	> 75%
Carb. Shale	>55% to < 75%.
Shaly Coal	>40% to < 55%.
Coal	< 40%.

- All combustible and non-combustible dirt bands upto 1 meter have been included in the coal seams.
- Quality parameters considered for reserve estimation purpose is I₁₀₀ basis.
- Due to inadequate data and erratic nature of the coal seams, grade wise reserve estimation has not been attempted.

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- In absence of systematic seam wise relative density values, 1.60 is considered for reserve estimation.

Based on the above considerations, geological net proved and indicated reserves have been estimated for each sector after considering probable losses due to unforeseen geological disturbances.

Seam wise Geological reserve along with its UHV based grades and computed GCV based (usual) grades are provided in table no. 4.23.

Table No. 4.23

Grade Wise - Seam wise Geological Reserves (Proved + Indicated) of Barjora North Coal Block as per Geological Report.

Seam Name	Geological Reserve (Mtes)	Avg. UHV (Kcal/Kg)	Avg. GCV (Kcal/Kg).	Avg. Grade (As per GCV based Grading System)
IX	0.78	1897.80	3495.96	G-13
VIII	1.87	1680.45	3373.61	G-14
VII	7.05	2533.31	3923.33	G-12
VI	7.22	2752.44	4108.72	G-11
V	32.14	2526.97	3934.46	G-12
III	36.35	3166.00	4383.67	G-10
II		3312.83	4467.54	G-10
I		3162.92	4389.48	G-10
Total =	85.4			

Seam wise sector wise geological reserve has been depicted in table no. 4.24 below.

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Table No. 4.24
Summarized Sector wise Geological Reserves of Barjora North Coal Block.

Seam Name	Sector-A		Sector-B		Sector-C		Total		Avg. Grade
	Area	Reserves	Area	Reserves	Area	Reserves	Area	Reserves	
Seam-IX	-	-	-	-	0.3565	0.7849	0.3565	0.7849	G
Seam-VIII	0.3114	0.9302	0.1388	0.3000	0.3002	0.6484	0.7504	1.8786	G-UNGR
Seam-VII	1.1073	3.7622	0.4500	1.1231	0.8411	2.2106	2.3984	7.0959	F-G
Seam-VI	2.0270	6.8276	0.1844	0.3983	0.0000	0.0000	2.2114	7.2259	F-G
Seam-V	3.4842	18.4306	0.6313	4.1007	1.5263	9.1014	5.6418	31.6327	F-G
Seam-I/II/III	2.1903	17.3637	0.2197	1.5729	0.2107	1.3517	2.6207	20.2883	E-F
Seam-I+III	0.1741	0.8972					0.1741	0.8972	F-G
Seam-I+II	0.9211	4.3335	0.4421	0.0909	0.0784	0.2185	1.4416	4.6429	F
Seam-I	1.3492	3.1973	0.0675	0.1458	0.3466	2.1942	1.7633	5.5373	E-F
Total = Seam-I+II+III	4.6347	25.7917	0.7293	1.8096	0.6357	3.7644	5.9997	31.3657	E-F
Total=	11.5646	55.7423	2.1338	7.7317	3.6598	16.5097	17.3582	79.9837	F-G
Net Indicated Reserve									
Seam-V			0.1269	0.5168			0.1269	0.5168	
Seam-I/II/III	0.7387	4.5303	0.1254	0.4603			0.8641	4.9906	
Total =	0.7387	4.5303	0.2523	0.9771				5.5074	
TOTAL GEOLOGICAL RESERVE - PROVED+INDICATED									
Total proved & Indicated		60.2726		8.7088		16.5097		85.4911	

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4.7 Mineable Reserve as per Earlier Mining Plan:

As per the approved mining plan of Barjora North Coal Block, the estimated mineable reserve was 68.55 Million tons. Detail calculation for deriving the mineable reserve is being furnished in Table No. 4.25.

Table No. 4.25

Estimation of Mineable Reserve as per earlier Approved Mining Plan of Barjora North Coal Block.

Sl No.	Particulars	Coal reserves (Mt.)
1.	Net geological reserves considering 10% geological loss.	85.49 Mt.
2.	Less Geological Reserves to account for exclusion of incombustible dirt bands (presently considered within Net Geological Reserves).	8.55 Mt.
Net Available Geological Reserves (1-2)		76.94 Mt.
3.	Reserves blocked vertically below existing infrastructure (Cosmic Ferro Alloy Steel Factory)&Ghutgaria village and the 100m barrier zone.	4.59 Mt
4.	Reserves blocked within 45m surface barrier left from the existing road (between connectingBarjora and Mejia).	1.10 Mt.
5.	Reserves blocked within 7.5m surface barrier left from the Barjora Block Boundary.	2.06 Mt.
6.	Reserves Blocked within quarry batters .	4.87 Mt.
Net Available Quarriable/mineable coal reserves (1 - 2 - 3 - 4 - 5 - 6)		64.32 Mt.
7.	Less 5% Mining loss	3.22 Mt.
Net Available Extractable Coal Reserves		61.11 Mt.

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As per the information obtained from the prior allottee, the mine has produced about 6.11 Million Tons of coal since commencement of production in 2011 till end of March, 2015.

Thus as per the approved initial Mining Plan and earlier production by prior allottee, the remaining coal reserves in this mine comes around 55 Million Tons.

The first revision of the Mining Plan was confined only to the available non-forest land of 260.14 ha and estimated mineable reserve was 18.60 Million Tons. As this was only covered in a part of the block, no such comparison has been attempted.

4.7 Re-estimation of the Geological Reserve:

The Geological report of the block was prepared during the period 1999. The then basis for coal and band calculations are changed as on date as well as the grading system has been migrated from UHV based to GCV based. Thus, re-estimation of the Geological resources in line with the newly adopted system was inevitable. The requirement again coupled with WBPDCCL's requirement to re-assess the Geological reserve with a cut off range of 0.30 meter as they intend to use Surface Miner for coal extraction. Considering these two major aspects, the available data were re-interpreted to define the roof and floor including band statement. GCV values were empirically calculated using Shri B K Mazumdar's formulae as per ISP 2017. M_{100} values were calculated from the available GCV data.

4.7.1 Geological Reserve:

Reserve estimation were done based on following considerations:

- I. Estimation of reserves was restricted up to the workable limits of the seams. The workable limits of the thickness have been taken as 0.30 m as the property is being mined through surface miner.
- II. Shaly coal and Carbonaceous shale Low (having ash and moisture more than 40% and up to 65%) occurring at the roof and/or floor of a coal seam has been considered as part of the

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- seam while arriving at the thickness for estimating the reserves.
- III. Reserves have been calculated based on the in-band thickness (I-30) of seams. In-band (I-30) thickness of seam has been delineated including combustible bands (Ash +Moisture >65% to 75%) up to 0.30m.
 - IV. The areas of heave zones of faults have been excluded from the estimation of reserves.
 - V. Since the coal seams of Barjora North Coal Mine shows non-coking characteristics, the reserve has been determined on the basis of GCV values determined for the seam overall samples as well as from computed values by the empirical formula given by Sri B.K. Mazumder:

$$GCV = \frac{154(100 - 1.1A + M) - 108M}{1.8} \text{ KCal/Kg}$$

Where, A is Ash and M is Moisture determined on 60% RH and 40°C, or calculated from band by band ash and moisture of seam after equilibration at 40°C and on 60% RH.

- VI. For the purpose of tonnage estimation, grade wise specific gravity as defined in the ISP 2017 has been considered. Grade wise GCV range in Kcal/Kg and Specific gravity values are given in below table no. 4.26.

Table No. 4.26
GCV range and grading System

GCV from	GCV to	Grade	Sp. Gravity
2201	2500	G17	1.87
2500	2800	G16	1.84
2800	3100	G15	1.81
3100	3400	G14	1.78
3400	3700	G13	1.73
3700	4000	G12	1.69
4000	4300	G11	1.65
4300	4600	G10	1.61
4600	4900	G9	1.58
4900	5200	G8	1.56

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5200	5500	G7	1.53
5500	5800	G6	1.5
5800	6100	G5	1.47
6100	6400	G4	1.44
6400	6700	G3	1.43
6700	7000	G2	1.4
7000	10000	G1	1.36

Zones have been delineated where seam is deteriorated or not developed. The limit of the zone of non development has been done on the basis of half of influence zones from the two adjacent boreholes. Resources for each seam has been limited to the extent of that particular seam. Reserve estimation has been done from the geological model developed in Minex software. All the grids were limited to their extents and masked grids were generated for resource estimation.

Three seams are found to be splitted in nature and split model has been prepared as per the data distribution available in the geological report. One more merge section viz. III/II is also found but only in one BH intersection has not been considered for split model. Details of seam splitting along with their percentage of split is furnished in below table no. 4.27.

Table No. 4.27
Seam Split Behaviour.

Parent name	Seam	Split name	seam	Percentage distribution	of
V		V Top		60%	
		V Bottom		40%	
III/II/I		III		33%	
		II		33%	
		I		34%	
II/I		II		50%	
		I		50%	

Geological reserves within the Barjora North Coal Mine at depth range of 0 meter to 150 meter in different classes such as Grade wise, Class wise and Thickness wise is furnished below in Table no. 4.28.

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Table No. 4.28
Grade Wise- Seam Wise Remaining Net Insitu Coal Reserve of Barjora North Coal Mine.

SEAM	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	Total
IX		0.010	0.097	0.095	0.105	0.164	0.058	0.543	0.080			1.152
VIII					0.011	0.256	0.233	0.686	0.716	0.225	0.046	2.173
VII			0.204	1.259	2.630	3.096	2.511	1.379	0.464	0.270	0.017	11.830
VI		0.170	0.868	2.147	2.841	1.688	0.987					8.702
VTOP			0.033	0.569	1.468	2.039	1.743	0.475				6.327
VBOTTOM		0.189	0.382	0.809	2.559	2.463	0.696	0.267	0.128			7.494
V			0.076	0.789	5.865	5.498	3.498	2.627	0.902	0.819		20.075
IV	0.017	0.084	0.233	0.330	0.252	0.169	0.161	0.026	0.022	0.009		1.302
III	0.116	0.758	0.861	1.787	2.630	0.934	0.329	0.162				7.577
III/II												0.000
II	0.001	0.188	1.658	1.043	1.338	0.370						4.599
III/II/I				0.813	1.356	2.163						4.332
II/I	0.035	0.773	0.443	1.469	0.489	0.186						3.394
I	0.382	0.776	1.352	2.316	4.481	2.553	0.451	0.225	0.179			12.715
Gross Insitu	0.551	2.948	6.207	13.43	26.03	21.58	10.67	6.389	2.492	1.323	0.063	91.67

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The thickness wise reserve of Barjora North Coal Mine has been worked out into six various category as followed:

- T1 - > 6.0 Meter.
- T2 -3.0 – 6.0 Meter.
- T3 – 2.0 – 3.0 Meter.
- T4 – 1.0 – 2.0 Meter.
- T5 - 0.50 – 1.0 Meter.
- T6 – 0.30 – 0.50 Meter.

Seam Wise Thickness Wise coal reserve upto 150 meter depth is depicted in Table No. 4.29.

Table No. 4.29
Seam Wise-Thickness Wise Coal Reserve of Barjora North Coal Mine.

Thickness Wise Remaining Coal Reserve of Barjora North Coal Mine							
SEAM	T1	T2	T3	T4	T5	T6	Total
IX	-	-	0.077	0.929	0.130	0.017	1.152
VIII	-	-	0.436	1.075	0.626	0.037	2.173
VII	-	0.897	6.361	4.412	0.152	0.008	11.830
VI	-	2.349	3.230	1.874	1.090	0.159	8.702
V-TOP	-	1.732	1.784	2.530	0.280	-	6.327
V-BOTTOM	-	1.668	2.654	3.107	0.065	-	7.494
V	0.186	15.667	2.901	1.185	0.136	0.001	20.075
IV	-	-	-	0.120	1.053	0.129	1.302
III	-	-	1.433	4.996	1.133	0.016	7.577
III/II	-	-	-	-	-	-	-
II	-	-	0.377	3.389	0.825	0.007	4.599
III/II/I	0.645	3.687	-	-	-	-	4.332
II/I	-	1.530	1.419	0.446	-	-	3.394
I	-	1.769	5.459	4.714	0.772	-	12.715
Gross Insitu	0.831	29.301	26.130	28.776	6.262	0.375	91.67

The whole resources of Barjora North Coal Mine are falling under proved category as per the ISP 2017.

4.7.2 Mineable & Extractable Coal reserve:

Mineable reserve of the proposed lease area has been derived after considering the mining benches and an active pit area. A pit has been considered up to floor of Seam-I with 38° slopes from the surface

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elevation and individual bench slopes considered as 70°. Bench heights have been limited to 10 meters. Width in non-working benches considered as 10 meter and working benches considered as 30 meters. Estimation of mineable reserve (depleted reserve) from the gross in-situ geological reserve has been shown in the table No. 4.30.

Table No. - 4.30

Mineable and Extractable Reserves within the Mine boundary of Barjora North Coal Mine.

S. L. No.	Particulars	Coal Reserves (Mt.)
1	Net Geological Reserve of the Block.	91.67
2	Less Geological Reserves on account of 7.5 meter safety zone along the proposed lease boundary.	3.22
3	Less Geological Reserve on account of Nala Diversion and its safety barrier	3.18
4	Reserves blocked within 45m surface barrier left from the existing road (between connecting Barjora and Mejia).	4.56
5	Reserves Blocked within quarry batters.	5.24
Net Available Quarriable/mineable coal reserves		75.47
6	Less 5% Mining loss	3.77
Total Extractable Reserve of the Block		71.70
7	Already Extracted	6.11
Net Remaining Extractable Reserve for this Planned Period.		65.59

4.8 Estimation of Overburden:

The overburden is estimated within the block for the top OB as well as for the inter-burdens. For estimation of the Overburden, specific modules of the Minex software have been utilized. For estimation of Top OB, the volume between the two surfaces, namely, the Topography and the base of weathering has been derived. Few patches have been already mined in the past few months. There are patches where overburden are kept within the proposed mineable areas are not considered for insitu overburden estimation. The dump

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volumes are separately estimated and subtracted from the total volume. The top OB comes to about 65.56 Mcum.

The Inter-burden between the coal seams were estimated upto the bottom most seam for mining. In most of the mineable areas, the bottom most seam is found as Seam-I (Along with its merged sections). However, in few patches, seam-I is not developed and the floor of overlain workable seam has been considered for estimation of interburden.

The estimated volume of interburden comes to about 207Mcum. Thus, the total overburden comes to about 272.56Mcum.

Out of the total 272.56Mcum of Overburden, the mine has already produced about 29.06 Mcum of Overburden including Prior allottees period.

The overall stripping ratio considering the insitu overburden comes to about 3.71.

4.9 Need for Further Exploration:

The exploration of this block is well covered with 64 boreholes with the density of 8 BH/Sq. Km as well as the leasehold area is covered with 60 boreholes with a density of 8.78 BH/Sq. km.

However, production support drilling will be carried out as and when required to ascertain the coal thickness and coal quality, etc. as per the annual working plans.

Three number of boreholes has been proposed to explore the easternmost part of the block to prove the occurrence of coal seams. Details of the proposed boreholes are provided below:

Proposed Borehole No.	X	Y	Tentative depth of drill in m	Remarks
P-1	52940.32	2592318.80	70 m	For proving of Seam-I occurrence.
P-2	525758.44	2592036.22	65 m	For proving of Seam-I occurrence.
P-3	525786.66	2591634.87	70 m	For proving of Seam-I occurrence.

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Chapter 5

Mining

**5.1 Introduction:**

This chapter deals with the planning for mining activities within the allotted block area after considering the surface constraints and Geo-mining parameters. An area of around 683.04 ha has been proposed to be utilized for mining and allied activities within the planned period. Safety barriers along the State Highway connecting Barjora- Mejia, diverted TartoraNala and safety zone all along the mining lease boundary has been considered while deriving the workable zone. An existing dumping grounds and quarried area were also considered and included within the proposed mine boundary of 683.04 ha. Selection of mining technology, phasing of equipment, along with target schedule of production etc. are being discussed in this chapter. The technology described in the previous approved mining plan, will be adopted and continued. An excavation schedule has been worked out for this mining plan for the proposed lease area (combining both forest and non forest land) of 683.04 ha, in compliance with the direction of MOC, Govt. of India vide their 34011/19/2017-CPAM; dt 4thSeptember, 2017 furnished in **Annexure-IVB**.

Based on the existing conditions in the lease area, modification with respect to production schedule, internal dumping schedule etc. have been done and discussed subsequently in this chapter to cover mining within 683.04 ha of proposed lease area.

5.2 The proposed mine (683.04 ha):

Mine boundary of the Barjora North Coal Mine has been firmed based on certified geological block boundary, geographical extents of the workable coal seams within the block boundary, existence of Public road connecting Barjora to Mejia, considerations of TartoraNala diversion and few left out patches due to odd corner areas lying within the block boundary.

As per the Vesting order issued by Nominated Authority (NA) vide no. 103/75/NA; dt. 31stMarch, 2015 and its subsequent corrigendum (Corrigendum 01; dt. 07.03.2017), the total lease area of 663 ha has been transferred to WBPDCCL out of which only 260.14 ha was executed as because of its Non forest nature.

1. The revised mining boundary or in turn proposed lease boundary stands for 683.04 ha which is confined well within the certified block boundary of Barjora North Coal Mine.

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2. All lands utilized by prior allottee for mining activities within the Geological Block boundary has been considered and included in the mining boundary in this plan.

5.3 Boundary of proposed Mine area:

- i. In north, the mine boundary will be up-to the northern boundary of lease area.
- ii. In South, the boundary is merged with the southern boundary of the
- iii. Eastern boundary is parallel to the road joining Mejia – Barjora.
- iv. Western boundary will be along the lease boundary barring a bulb like zone where coal is not reported and also covered under forest.

5.4 Lease Area:

The proposed Leasehold area of 683.04 ha has been considered for the preparation of this mining plan which includes both forest and non-forest lands falling within the block boundary.

Lease of about 260.14 ha of non-forest land has already been transferred to WBPDCCL along with the vesting order and subsequently registered by the Government of West Bengal.

The mining lease document is being furnished in **Annexure-XVI**.

5.5 Present surface conditions – in the lease area:

At present land use pattern of the lease area is given below in table no. 5.1.

Table No. 5.1

Present Land Utilisation pattern of the 683.04 ha of lease area.

Type	Present Land Use
Safety Zone area	8.59
Quarry Area	40.27
OB Dump with plantation	-
OB Dump without plantation	43.66
Top Soil Dump	5.75
Forest Area	338.75
Water Bodies	1.89
Ponds	3.75
Nallah (Tartora)	11.53
Infrastructures	6.67
Other Establishment	34.82
Road	3.87

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Type	Present Land Use
Haul Road	0.31
HT Row	4.33
Other Untouched (Barring Forest Zone)	178.87
Total area	683.04

The present land use pattern is depicted in the Surface Plan furnished in Plate no. VI.

Prior allottee has started mining operation in Barjora North Coal Mine in the year 2011 and carried out till 31st March, 2015. After reallocation of the Block to M/S WBPDCCL, mining operation resumed from June, 2018. So far, only OB removal has been done till 31st of March, 2019.

Present surface condition (As on 31st of March, 2019) of the lease area is depicted in the figure no. 5.1.

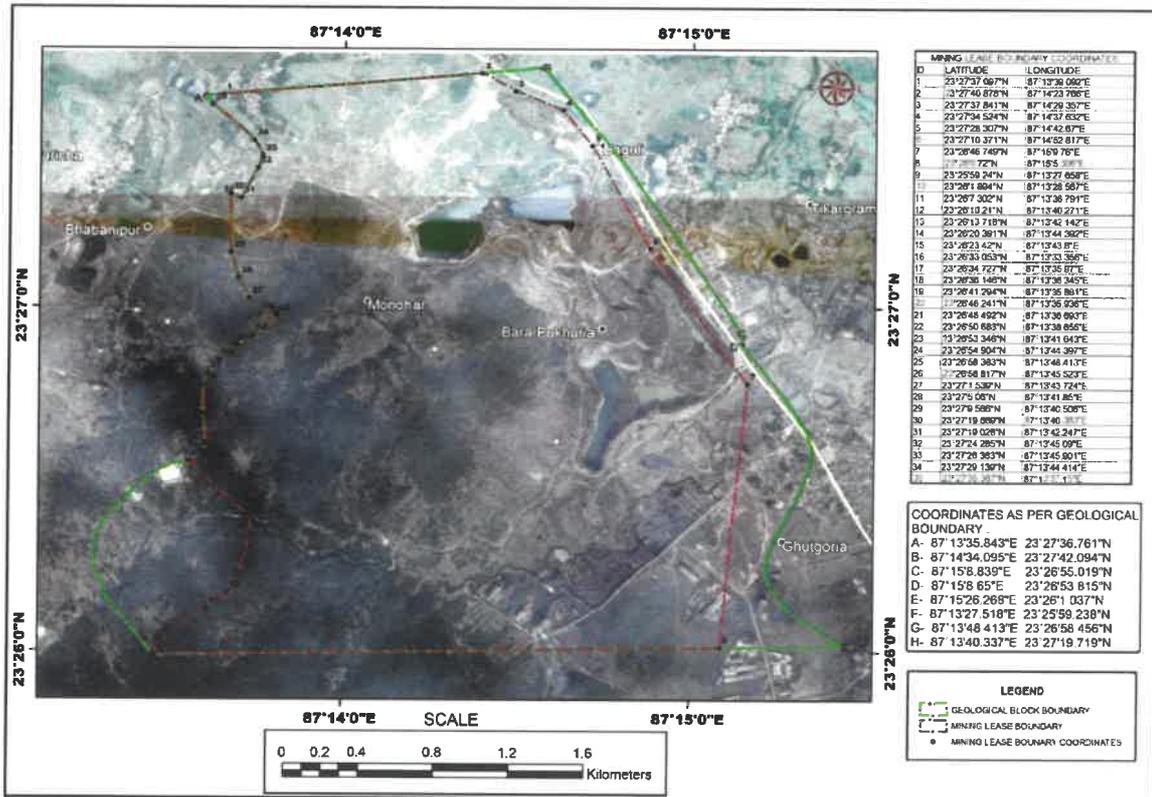


Figure No. 5.1 : Present Surface Condition of the Proposed Lease area.

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5.6 The Objective of Mining Plan:

The initial mining plan of Barjora North Coal Block during the tenure of previous allottee was approved for 927.50 ha including 663 ha of active mining area and 100 Ha of external dumping area. The mining plan was prepared by Shri. S. C. Chatterjee, (Registration No. 38011/4/2002 CA dt. 17.10.2002; valid for 10 years) and approved by Ministry of Coal vide their letter no. 47011/4/2003-CA-I; dt. 24-08-2006. Copy of the Mining Plan approval letter is furnished as **Annexure-IVA**.

After the reallocation of this Mine to WBPDCCL, the need for Revision-01 of the Mining Plan necessitated when MOEF & CC has directed to submit a separate mining plan for Non forest in order to grant of Environmental Clearance for the project where lease area of 260.14 ha of non forest land was already transferred to WBPDCCL. Accordingly, a revised mining plan was prepared by Shri Vijay Kumar Singh (RQP No. 3402/(03)/2014-CPAM; dt. 29.05.2015) for 260.14 ha of leasehold land (non forest area) and approved by Ministry of Coal vide their letter no. 34011/19/2017-CPAM; dt 4thSeptember, 2017. Copy of the Mining Plan approval letter is furnished as **Annexure-IVB**.

However, the need for Revision-02 of the Mining Plan including Mine Closure Plan was necessitated when WBPDCCL has started their work for obtaining forest clearance for the existing 338.75 ha of forest land within the Barjora North Coal project area. The justification for the forest diversion can only be established if a valid mining plan suggest the same. Based on the present-day site conditions and prevailing norms, the requirement of lease area was modified to 683.04 ha including 338.75 ha of forest land and 260.14 ha of already executed lease area. Thus, earlier lease area is reassessed and firmed to 683.04 ha. As per the conditions laid down in the mining plan approval letter of the 1st revision, WBPDCCL has to come out with a composite mining plan in order to obtain the Forest Clearance. A 2nd revision of the Mining Plan thus prepared hereunder and submitted for competent approval to MOC.

5.6.1 Coal reserves in the lease area:

Coal Reserves of Barjora North Coal Block has been re-assessed in line with the following requirements:

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- Ministry of Coal Suggested to include 7 Million Tons of Coal Reserves falling within the non-forest area of the Block.
- The coal quality grading system has been changed to GCV based from erstwhile UHV based grading system. Thus, Coal reserve has to be re-assessed in terms of grade wise reserve.
- Due to change in mining technology, cut off thickness for reserve has been reassessed in terms of 0.30 meter cut off thickness instead earlier 1.0 meter cut off thickness.

The Geological reserve of the Block has been re-assessed upto a depth range of 0 - 150 meter. Grade wise geological reserves are provided in table no. 5.2 below.

Table No. 5.2:

Seam Wise-Grade Wise Geological Reserve of Barjora North Coal Block.

Grade Wise- Seam Wise Remaining Net Insitu Coal Reserve of Barjora North Coal Mine												
SEAM	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	Total
IX		0.010	0.097	0.095	0.105	0.164	0.058	0.543	0.080			1.152
VIII					0.011	0.256	0.233	0.686	0.716	0.225	0.046	2.173
VII			0.204	1.259	2.630	3.096	2.511	1.379	0.464	0.270	0.017	11.830
VI		0.170	0.868	2.147	2.841	1.688	0.987					8.702
VTOP			0.033	0.569	1.468	2.039	1.743	0.475				6.327
VBOTTOM		0.189	0.382	0.809	2.559	2.463	0.696	0.267	0.128			7.494
V			0.076	0.789	5.865	5.498	3.498	2.627	0.902	0.819		20.075
IV	0.017	0.084	0.233	0.330	0.252	0.169	0.161	0.026	0.022	0.009		1.302
III	0.116	0.758	0.861	1.787	2.630	0.934	0.329	0.162				7.577
III/II	-	-	-	-	-	-	-	-	-	-	-	-
II	0.001	0.188	1.658	1.043	1.338	0.370						4.599
III/II/I				0.813	1.356	2.163						4.332
II/I	0.035	0.773	0.443	1.469	0.489	0.186						3.394
I	0.382	0.776	1.352	2.316	4.481	2.553	0.451	0.225	0.179			12.715
Gross Insitu	0.551	2.948	6.207	13.43	26.03	21.58	10.67	6.389	2.492	1.323	0.063	91.670

After considering the safety zone along the proposed lease boundary, safety barriers against the Major Road joining Mejia-Barjora, Blocked reserve for Nala Diversion and reserve blocked under quarry batters, the mineable reserve of the block has been estimated in a tune of 75.47 Million Tons. Seam wise – grade wise Mineable reserve is provided in table no. 5.3.

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Table no. 5.3

Seam Wise- Grade Wise Mineable Reserve of Barjora North Coal Block.

Grade Wise - Seam Wise Mineable Coal Reserve of Barjora North Coal Mine (in Million Tons)												
SEAM	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	Total
IX	0.000	0.008	0.080	0.078	0.086	0.134	0.048	0.445	0.066	0.000	0.000	0.945
VIII	0.000	0.000	0.000	0.000	0.009	0.210	0.191	0.562	0.587	0.184	0.038	1.782
VII	0.000	0.000	0.167	1.033	2.157	2.538	2.059	1.131	0.381	0.222	0.014	9.701
VI	0.000	0.140	0.712	1.761	2.330	1.384	0.809	0.000	0.000	0.000	0.000	7.135
VTOP	0.000	0.000	0.027	0.466	1.204	1.672	1.429	0.390	0.000	0.000	0.000	5.188
VBOTTOM	0.000	0.155	0.313	0.664	2.099	2.020	0.571	0.219	0.105	0.000	0.000	6.145
V	0.000	0.000	0.063	0.647	4.809	4.508	2.868	2.154	0.740	0.672	0.000	16.461
IV	0.014	0.069	0.191	0.271	0.206	0.139	0.132	0.021	0.018	0.007	0.000	1.068
III	0.096	0.629	0.715	1.465	2.183	0.766	0.273	0.134	0.000	0.000	0.000	6.262
III/II	-	-	-	-	-	-	-	-	-	-	-	-
II	0.001	0.155	1.359	0.855	1.097	0.304	0.000	0.000	0.000	0.000	0.000	3.771
III/II/I	0.000	0.000	0.000	0.666	1.112	1.774	0.000	0.000	0.000	0.000	0.000	3.552
II/I	0.028	0.633	0.363	1.205	0.401	0.152	0.000	0.000	0.000	0.000	0.000	2.783
I	0.321	0.652	1.136	1.945	3.764	2.145	0.379	0.189	0.150	0.000	0.000	10.681
Mineable Reserve	0.46	2.44	5.13	11.06	21.46	17.75	8.76	5.25	2.05	1.08	0.05	75.47

As observed from the above table, considering no dilution in the mining process, the majority of the coal reserve (about 64%) falls under the grade range of G9 to G12. However, during mining process, grade dilution is a very common process and with increase in ash% in product coal, GCV gets deteriorated. It is envisaged that about 2% ash dilution will be there as compared to the GCV values as projected in the Geological Report. Thus the majority of the product coal is planned to be in a grade range of G10 to G13.

Details of the blocked reserve under different barriers and safety zones are given in table no. 5.4.

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Table No. 5.4

Seam wise Blocked reserve under different barriers and surface constraints.

Seam name	Thickness Range (m)	Depth Range (m)	Net Insitu	Blocked Reserve Below (in Million Tons)				Total Blocked	UG	OC	Mining Losses
				Highwall /batter	Nala / River Road	Barrier	Uneconomic				
SEAM											
IX	0.26-2.78	15.14-41.21	1.152	0.066	0.040	0.098	-	0.204		0.047	
Parting	4.70-11.56										
VIII	0.30-2.94	6.13-46.67	2.173	0.124	0.075	0.184	-	0.384		0.089	
Parting	3.24-29.71										
VII	0.38-4.72	7.00-77.60	11.830	0.676	0.410	1.004	-	2.091		0.487	
Parting	4.69-24.53										
VI	0.25-4.42	17.20 -76.30	8.702	0.497	0.302	0.738	-	1.538		0.358	
Parting	1.80-20.45										
VTOP	0.65-4.26	12.00 -102.96	6.327	0.362	0.219	0.537	-	1.118		0.260	
Parting	4.45-23.43										
VBOTTOM	0.56-4.75	10.88 -108.61	7.494	0.428	0.260	0.636	-	1.324		0.308	
Parting	1.90-14.39										
V	0.50-6.29	12.06 -115.55	20.075	1.148	0.696	1.704	-	3.548		0.826	
Parting	2.13-14.02										
IV	0.20-1.30	12.95 -71.54	1.302	0.074	0.045	0.111	-	0.230		0.054	
Parting	12.60-19.45										
III											
III/II											
II	4.42-6.34	18.68 -150.11	32.616	1.864	1.131	2.770	-	5.765		1.343	
III/II/I											
II/I											
I											
			91.67	5.24	3.18	7.78	-	16.20		3.77	

Estimation of mineable and remaining extractable coal reserves from the geological reserves has been furnished in table no. 5.5 below.

Table No. 5.5

Estimation of Remaining Extractable Coal Reserve within Barjora North Coal Mine.

S. L. No.	Particulars	Coal Reserves (Mt.)
1	Geological Reserve of the Block.	91.67
2	Less Geological Reserves on account of 7.5 meter safety zone along the proposed lease boundary.	3.22
3	Less Geological Reserve on account of Nala Diversion and its safety barrier	3.18

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4	Reserves blocked within 45m surface barrier left from the existing road (between connecting Barjora and Mejia).	4.56
5	Reserves Blocked within quarry batters.	5.24
Net Available Quarriable/mineable coal reserves		75.47
6	Less 5% Mining loss	3.77
Total Extractable Reserve of the Block		71.70
7	Already Extracted	6.11
Remaining Mineable Reserve		65.59

5.7. Geo mining parameters:

During the revised mining plan period, excavation will be continued to be extended in both forest and non-forest land within the defined lease boundary of 683.04 ha. The mine opening has been suggested from the North – Central part and will be continued from the existing mining pit. Stage wise geo-mining parameters are given in table No. 5.6.

Table No. 5.6

Geo-Mining Parameters for the planned period till the Final stage of Excavation.

Geo-mining Parameters	End of Stage-I	End of Stage-III	End of Stage-V	End of Stage-X	End of Stage-XV	End of Stage-XX	End of Final Stage
Quarry Area – ha ; barring Backfilled area	57.67	93.51	80.57	116.39	195.71	142.13	93.19
Exposed Floor Area- ha	33.28	56.5	65.23	85.63	170.3	100	37.28
No. of working benches – Nos.	14	14	11	12	12	10	8
Ultimate pit depth-Meter.	70	95	105	120	120	95	80
Exposed Floor of seam.	VII	V Top	I	I	I	I	I
Strike length – Meter.	1070	1070	1296	1360	2188	3061	3061

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Geo-mining Parameters	End of Stage-I	End of Stage-III	End of Stage-V	End of Stage-X	End of Stage-XV	End of Stage-XX	End of Final Stage
Dip-rise length – Meter.	610	1294	1621	1621	1946.09	1516	1516
No. of Backfilled dump(s)	2	2	3	3	2	5	5
Total backfilled area in ha.	39.46	52.74	87.42	110.92	140.12	423.65	489.32
Backfilled Dump Volume in Mcum	40.56	63.56	86.56	144.06	201.56	252.56	272.56
Height of Internal Dump (max from Surface Level)	(+) 45 m RL	(+) 60 m RL	(+) 60 m RL	(+) 60 m RL	(+) 60 m RL	(+) 60 m RL	(+) 60 m RL
Extent of Water Body.	-	-	-	-	5.14	5.14	98.33

5.8 Description of Mining System:

Opencast mechanised mining method is selected in view of depth of coal seam occurrence a varying thickness of coal seams. The processes are described below.

Drilling and Blasting:

The uppermost layer of soil and weathered mantle (about 3 – 8 m) is soft and will not require drilling and blasting. So, it will be dozed and ripped by the dozer and ripper attachment. It will be kept separately in temporary top soil dump for the reclamation purpose. The total area of 5.75 Ha has been earmarked for top soil dump in the north-east corner of the project area in the initial stage. The remaining hard overburden and partings are to be drilled and blasted before excavation. Rotary blast hole drills of 250mm drill diameter has been proposed for O.B. benches and more than 10 m inter-seam partings and Rotary blast hole drills of 150-160 mm dia has been proposed for other inter seam parting blasting.

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A tentative blast pattern of 6.5 m spacing and 5 m burden is proposed for 10 m bench. Considering no mining in adjoining block, optimum blast pattern will have to be arrived at for horizons of different thickness after necessary field trials to determine parameters viz., peak particle velocity, maximum charge per delay etc.

Overburden Excavation:

The rock overburden and thick inter-burden below top soil will be excavated by 3.1 to 6.0 cum Diesel hydraulic shovels in conjunction with 31T – 60 T rear dumper as per thickness of Overburden and Partings.

Coal Mining: Surface Miner

It is envisaged to deploy surface miner for coal excavation. In this technology blasting is not required for excavation of coal. Surface miner will be provided for production of coal of uniform size i.e. 100 mm size. The inseam bands of +30sm size can also be removed separately. Due to utilization of selective mining the grade of the coal could improved. In this technology the coal face will be clean and wear & tear of dump trucks will also reduce. No crushing unit would be required in this method.

Overburden Removal: Shovel – Dumper System

As is well known, the combination of Shovel and Dumper technology offers convenient mining operations, to deal with sudden occurrence of unworkable and poor quality zones and offers flexibility for easy up gradation. During the initial year of quarry operation a temporary road will be developed near the access trench by dressing the top soil and some leveling of the undulating surfaces. The overburden from lower branches will be connected by ramps to the central dump road, which relates to the old quarry void, during the first two years of mine operation. By then central flank road will be developed gradually along with the mine advancement. Internal dumping will be continued from the very first year of operation.

The thickness of top & sub soil varies from 6 -10 meter within the planned excavation area. The top soil dump has been managed in the eastern part of Sector-C during previous operation as per approved mining plan and the same will be continued in this period as well. Once backfilling of the de-coaled area is completed and stabilized, this newly generated top soil will be

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spread over the stabilized dumps for biological/agro reclamation. Top & sub soil removal is being planned by 3 – 4 cum shovel in this planned period coupled with 35 T rear dump trucks.

Though equipment is provided separately under overburden and coal, the same shovel working in coal or OB may excavate the parting or coal seam below and above a particular horizon depending on work load and location.

5.9 Mining System & Stages of Mining:

To finalize the mining system, the following geo-mining conditions were considered:

- Multiple coal seams.
- Strike length.
- Presence of coal seams of variable thickness.
- Variable thickness of OB/Parting.
- Gradient of coal seams around 8°.
- Proposal for 100% internal dumping.

Based on the above factors Mining System has been developed and shall be implemented.

The top OB benches would be worked in horizontal slicing method. Horizontal slicing method will also be adopted for coal extraction by surface miner. Inter-seam partings will be dealt along inclined faces.

5.9.1 Stages of Mining:

5.9.1.1 Construction activity:

The mine is already in production and no construction period is envisaged for this planned period.

The Mine Layout:

Initially as per the Geological Report, the mine was divided into three sectors, viz. A, B & C. However, with the progress of the project development, the categorization has been made based on the forest and non forest land types. At present mining operation is being continued in the Non forest leasehold land.

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Mining will be continued from the Non forest land to the Forest Land. The Mine Lease boundary along with proposed mine infrastructure has been drawn and shown in the **Plate no -11.**

Mine working will be continued from the northern patch and progress towards southward direction.

During the initial year of quarry operation, a temporary road will be developed near the access trench by dressing the top soil and some leveling of the undulating surfaces. The overburden from lower benches will be connected by ramps to the central haul road, which is connected with the old quarry void, during the first two years of mine operation, and central flank road will be developed gradually along with the mine advancement along the seam gradient. Internal dumping will start from the very first Year of mine operation.

Previous Allottee has worked in the Eastern section of the lease area. Top Soil was stacked in the North East part of the coal block. Overburden were dumped in the voids of the mine working in Sector – A.

It is proposed that the old mine void, which is still in bgl depth, will be utilized for the initial year dumping after de-coaling. Top soil will be stacked in the old Top soil stack yard only. Old mine dump will also be utilized in subsequent year in a sequence to accommodate overburden.

The top soil will be spread over the filled up mine void in a progressive way. In the present mine plan all the mine voids and old dumping within the mine lease hold area will be utilized for backfilling in the sequence. No. external OB dump area has been proposed in this mine Plan.

Year wise mine operation along with area of operation are detailed below:

Opening of Mine Field:

Mine will be continued from the already opened mining pit and same access trench will be followed in this period. The existing mining pit is shown in the surface lay out plan of the block in **Plate No. VI.**

1st Year of Mine Operation:

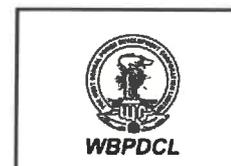
The mining operation will be continued from the existing mining pit of the north central part of the project area. The initial excavation will target to exhaust the remaining coal in the existing mine pit which was worked by the prior allottee. While working in the existing mining pit, OB removal will be continued to get the coal exposures in the north eastern corner. Initial OB will

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be dumped in the existing dumping ground in the second tire. The whole operation will be confined in the northern part of the faulted sector. At the end of the first-year operation, floor of seam-VII will be maintained. The depth of mining will be 70 meter from the average ground level. Total broken area at the end of the first year will be about 57.67 ha. Part of coal Seams IX, VIII, VI, will be worked in the stage. A central haul road will be maintained to have the mining operation on one side whereas the dumping will be continued on the other part. Average ground level in this part of the block is around 72-75 meter from AMSL. To attain the floor of Seam-VII and maintaining the same, the maximum mining depth of the pit will be around 70 meter out of which + 60 meter depth has already attained at present.

Infrastructure is planned to be installed and maintained in the area in between the 1st year quarry and existing dumping ground.

A total 3 million tons of coal is planned to be excavated in the first year with removal of 11.50 Million Cum of overburden with a strip ratio of about 3.83. 1st year Stage Plan is furnished in **Plate No. XIII A.**

3rd Year of Mine Operation:

Mine will further progress towards the western direction by moving in a down dip direction maintaining floor of Seam-I. Central haul road will be extended towards west to have simultaneous usage of the haul road in both the Overburden and coal hauling systems. An area of around 93.51 ha will be broken at the end of 3rd with a backfilled dumping ground of 13.28 ha. Backfilled dump will be heightened further during this stage to achieve about 45 meter height from the floor level. However, the height of the dump will not achieve the elevation level upto average ground level. Part of coal Seams IX, VIII, VII, VI, VT, VB, III and I will be worked in the stage.

Cumulative OB removal at the end of this year will be 34.50 Million Cum while cumulative coal production will be 9 Million Tons. Cumulative strip ratio at the end of this stage will be 3.83. Stage plan at the end of the 3rd year is furnished in **Plate No. XIII B.**

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5th Year of Mine Operation:

At the end of 5th year of operation, mine progress will be made towards west and towards south and abut in the safety zone boundary in the westernmost side. Central haul road will be extended towards further west and then will take a swing towards south to take care about the subsequent years of operation. Almost all the seams will be exploited in this phase and floor of Seam-I will be maintained as base of mining operation. Two backfilled dumps will be in place respectively in the northern and southern part of the central haul road comprising 18.93 and 10.23 ha of area. The total area including the backfilled area will be about 128.53 ha. The existing dump towards the east central part of the block will become inactive at this stage. The top soil preserved in the central part will be spread on the top of the dump for plantation purpose. Height of the dump (D1) sterilized dump will be 60 meter from the average ground level and will maintain 2 number of tiers. The deepest part of the mine will be covered under backfilled at this stage and depth of current mine will be around (-) 30 RL or say about 100 m depth. The whole of sector-c, i.e. north of the faulted block will be exhausted at this level. Cumulative coal production at the end of 5th year will be 15 Million tons and total OB removal will be 57.50 Million Cum. The end of 5th year stage is depicted in the **Plate No. XIII C**.

10thYear of Mine Operation:

During the 5th to 10 year, the mine will progress towards south and at the end of 10th year, the mine will almost reach towards the central part of the block. The whole of faulted zone will be worked during this period. Floor of seam-I will be maintained as a quarry floor. Maximum depth of mining will be restricted to 120 meter from the average ground level and the elevation level will be (-) 40 m RL. The internal backfilled dump will take plunge towards south for maintaining the future continuity. The central haul road will be shifted towards central part of the block and trends to southern side. During this stage, no OB will be dumped in the sterilized dumping ground. The top soil preserved till 5th year of operation will be spread over the sterilized dump in the eastern part. Plantation will be done in the sterilized dump. A new location for Top Soil dumping will be maintained in the southern part of the quarry boundary. The total disturbed area at the end of 10th year of operation

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will be 187.85 ha of mined out areas. The stage plan at the end of 15th Year is furnished in **Plate No. XIII D.**

15th Year of Mine Operation:

The mine will progress towards more south and almost cover the central part of the block. The total disturbed area at the end of this stage will be around 335.83 ha. Floor of Seam-I will be continued to maintain as quarry floor and the deepest part of the quarry will be at (-) 10 m RL. Both the backfilled dumping areas will be merged together to form a single dumping ground. Total backfilled dump area will be around 109.30 ha. Central Haul road will be pushed towards southward direction and it will terminate near the Infrastructure area at the coal stock yard. Diversion of TartoraNala is expected to be completed between 10th to 15th Year. At the end of 15th Year stage, TartoraNala will be shifted completely. Almost all the seams partially will be intersected in this period. Top soil spreading will commence in the northern patch of the merged dump. A water sump covering an area of 5.14 ha will be formed in between the two dumps.

The stage plan at the end of 15th Year is furnished in **Plate No. XIII E.**

20th Year of Mine Operation:

The mining operation at this level will reach to its southernmost extension. The southern limit will be defined by the safety barrier of the diverted nala at a distance of 15 meter from the bank. Central haul road will be extended till the southernmost tip of the mine. The establishment section in the southern part of the proposed lease boundary needs to be vacated by this period. Depth of mining will follow the floor of Seam-I and will be limited to (-) 15 m RL. Besides the merged dump in the previous stage, two more dumps of 62.45 ha and 50.45 ha respectively will be created in either side of the central haul road. Height of both the dumps will remain below the base level, however will not raise above the average ground level. Water sump will remain intact at this level and will be utilized as mine water arrestor.

The stage plan at the end of 20th Year is furnished in **Plate No. XIII F.**

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Final Stage Quarry Plan (22nd Year):

This is the final stage of the quarry operation. The remaining area in the south eastern corner will be excavated in this stage. Since, virgin area excavation is very less, generation of top OB is negligible. The top soil generated will be directly spread over the backfilled dump for plantation in the closure phase. at the end of this phase, the mine will enter into the closure phase. Floor of Seam-I will be exposed in part of the mine while the deeper part will be converted into water body. The southern part comprising an area of 93.19 ha will remain as mined out void at the end of this period and will be converted into water body. The depth of this water body will be around 80 meter from the average ground level. The backfilled dump in the northern patch will be sterilized within this period and plantation programme under closure activities will commenced.

5.10 Transportation:

For OB removal, it is envisaged to deploy 3.1- 6.0 Cum Hydraulic Shovel in conjunction with 30-60 T rear dumper. Coal winning will be done through 3800 series & 2200 Series Surface Miners. Surface Miners has been proposed to work in coal in conjunction with 25T rear dump trucks by winrowing method of mining using dozer and pay loaders.

Partings between various seams and top overburden would be transported along the benches and then through ramps to various dump location within the mine lease area in the excavated area, old dump and de-coaled area.

Since, coal seam and parting behavior are erratic in nature, equipment deployed in the mine will work interchangeably both in coal and OB as per site conditions and requirement.

5.11 Production schedule:

The Barjora North Coal mine has commenced initial production in the year 2011 and till 31st March, 2015, the mine has produced about 6.11 Million Tons of Coal. The block was reallocated to WBPDCCL and after obtaining necessary approvals from MOC, MOEF & CC, CCO and DGMS, mining operation in this mine resumed on 30th June, 2018 and till 31st March, 2019 about 1.2 Mcum of OB has been removed. Prior allottee has removed about 27.56 Mcum of OB during the operation period 2010- 2015.

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The calendar programme for this mining plan will start from 2020-21 after obtaining necessary forest clearance from the competent authority. The proposed production of OB and Coal are thus adjusted from the total volumes and production schedule from 2020-21 are proposed accordingly.

The calendar program is given below in Table no. 5.7.

Table No. 5.7

Calendar program for Coal excavation & OB removal for Barjora North Coal Mine.

Coal Production Plan " MT"					
S.L. Year	Financial Year	Coal Production		OB "MM³"	SR
		UG	OC		
Y-1	2019-20		3.00	11.50	3.83
Y-2	2020-21		3.00	11.50	3.83
Y-3	2021-22		3.00	11.50	3.83
Y-4	2022-23		3.00	11.50	3.83
Y-5	2023-24		3.00	11.50	3.83
Y-6	2024-25		3.00	11.50	3.83
Y-7	2025-26		3.00	11.50	3.83
Y-8	2026-27		3.00	11.50	3.83
Y-9	2027-28		3.00	11.50	3.83
Y-10	2028-29		3.00	11.50	3.83
Y-11	2029-30		3.00	11.50	3.83
Y-12	2030-31		3.00	11.50	3.83
Y-13	2031-32		3.00	11.50	3.83
Y-14	2032-33		3.00	11.50	3.83
Y-15	2033-34		3.00	11.50	3.83
Y-16	2034-35		3.00	11.00	3.67
Y-17	2035-36		3.00	10.00	3.33
Y-18	2036-37		3.00	10.00	3.33
Y-19	2037-38		3.00	10.00	3.33
Y-20	2038-39		3.00	10.00	3.33
Y-21	2039-40		3.00	10.00	3.33
Y-22	2040-41		2.59	10.00	3.86
Total			65.59	243.50	3.71

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5.12 Proposed HEMM with phasing :

Detail equipment list for this mining plan is given below in table no. 5.8. Separate equipment configuration has been suggested for coal and OB. The numbers are indicative based on the planned parameters. However, depending upon the actual site conditions, numbers may increase or decrease at any specific period of operation as well as specific equipment may be used interchangeably in between coal and OB as and when required basis.

Table No. 5.8:**HEMM Configuration of Barjora North Coal Mine.**

S. L. No.	Equipment	Capacity	Maximum Population
Overburden			
1	Diesel Hyd. Shovel	4.5- 6.0 Cum	3 Nos.
2	Diesel Hyd. Shovel	3.1 – 3.5 Cum	9 Nos.
3	Rear Dumper	50- 60 T	12 Nos.
4	Rear Dumper	31- 39 T	36 Nos.
5	Diesel Drill	250mm	1
6	Diesel Drill	160mm	4
7	Dozer	165 & 320 hp	4
Coal			
1	Surface Miner	3800 series	1
	Surface Miner	2200 series	1
2	Diesel Hyd Backhoe/Shovel	3.1 -3.5 cum	2
3	Rear Dumper	31- 39 T	12
4	FE loader	2.5 -3.5 Cum	2
5	Drill	160mm	1
6	Dozer	165 & 320 hp	4
Common			
1	Grader	120 - 150 hp	3
3	Crane	20T- 40T	2
4	Crane	8-10T	1
5	Diesel Backhoe	1 cum	1
6	FE loader	4-6 cum	2
7	Dozer	165 hp	1

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S. L. No.	Equipment	Capacity	Maximum Population
	Ripper Dozer	300 - 450 HP	1
8	Diesel Browser		2
9	Fire tender		1
10	Boom truck		2
11	Heavy duty toe truck		1
12	Fork lift truck	5T	1
13	Tipping truck		5
14	Vibratory Compactor		1
15	Tyre Handler		1
16	Water Sprinkler	12 KL	5
17	Maintenance Van		1
18	Farm Tractor		1
Reclamation			
	Grader	120 - 150 hp	1
	Dozer	165 HP	1
	Water Sprinkler	12 KL	1

5.13 Waste and Top Soil Management:

Stage wise top soil and OB production figures are provided in Table No. 5.9 below. Top Soil spreading programme including closure period is also provided.

Table No. 5.9
Stage Wise OB and Top Soil Generation Schedule.

Waste Management (Figures in MM ³)										
Year / Stage	Cumulative OB Removal			External Dump (Cumulative)		Internal Dump/Backfilling (Cumulative)			Embankment	
	Top Soil	OB	Total	OB	Top Soil	OB	Top Soil	OB	Top Soil	
Y-1	0.311	11.189	11.500	-	-	11.189	-	-	-	
Y-3	0.932	33.568	34.500	-	-	33.568	-	-	-	
Y-5	1.553	55.947	57.500	-	-	55.947	0.250	-	-	
Y-10	3.105	111.895	115.000	-	-	111.895	1.250	-	-	
Y-15	4.658	167.842	172.500	-	-	167.842	1.750	-	-	
Y-20	6.035	217.465	223.500	-	-	217.465	3.350	-	-	
Y-22	6.575	236.925	243.500	-	-	236.925	4.080	-	-	
Post Closure										
Y-23	-	-	-	-	-	-	5.250	-	-	
Y-24	-	-	-	-	-	-	5.900	-	-	
Y-25	-	-	-	-	-	-	6.575	-	-	

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5.13.1 Top Soil Management:

The process of mining starts from scrapping of top soil. Average topsoil in the proposed area of excavation found to be around 1.20 meter. Year wise proposed top soil excavation is furnished in table no. 5.9.

This stored top soil will be spread over the reclaimed areas 3rd year onward. Year wise top soil spreading will be done as furnished in table no. 5.10.

Table No. 5.10
Stage Wise Top Soil Spreading Schedule.

Top Soil Management-(Including Action Plan for Top Soil Management)						
Year/ Stage	Top Soil removal "MM³"	Top Soil Used "MM³"				Total UtilisedTS
		Embankment	Spreading over the Backfilled Area	Spreading over the OB Dump Area	Using for Green Belt Area	
Y-1	0.311	-	-			
Y-3	0.621	-				
Y-5	0.621	-	-	0.25		0.250
Y-10	1.553	-	1.000	-	-	1.000
Y-15	1.553	-	0.500	-	-	0.500
Y-20	1.377	-	1.600	-	-	1.600
Y-22	0.540	-	0.730	-	-	0.730
Post Closure						
Y-23	-	-	1.170	-	-	1.170
Y-24	-	-	0.650	-	-	0.650
Y-25	-	-	0.675	-	-	0.675

5.13.2 Minimising area of coverage:

The first guiding principle of designing an overburden dump is to minimize use of land area for dump accommodation. Keeping this in mind an attempt has been made to implement zero external dumping which is in continuation to the earlier mining process. An area of about 39.82 ha has already been backfilled and dumping in the initial years of this planned

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period will also be continued in the same dump. Concurrent backfilling is envisaged from the very beginning of the planned period.

5.13.3 Stability of Dump:

The second guiding principle is slope stability of the dumps. Initially dumping will be continued in the already de-coaled area to accommodate about 40 MBCM of OB till 3rd year of operation. Within this time, enough voids are expected to be created in the northern patch of the mining area where de-coaling is envisaged. Concurrent backfilling will be done in keeping safe distance of more than 100 meter within the working areas. A flat slope of less than 28° will be maintained all throughout the backfilled areas. A dump slope stability report has been prepared for the Project from BIT, Meshra under the supervision of Dr. Indrajit Roy and is furnished in **Annexure-XVIII I**.

5.13.4 Control of pollution arising from dumps:

Thirdly, in pre-mining stage itself, garland drain around dump area will be created, to arrest seepage waters from dump. A toe wall of 2.5 meter height and 2 meter width will be erected along the periphery of the bottom tier at surface level. The slopes and the berms will be vegetated. Gullies will be provided to guide water from higher deck to lower deck. These are some of the measures to control pollutions from dumps.

5.13.5 Nature of waste rock:

The bulk of the overburden rock are represented by sandstone and shale contributing cover 50% of the waste rocks, followed by their intermediate varieties, carbonaceous shale, thin coaly horizons and clays. Additionally, the block is mostly covered by soil/ weathered mantle which constitutes a part of the overburden strata.

5.14 Sequence of Dumping:

Dumping of Overburden in this period has been planned in both the existing internal dump as well concurrent backfilling within the mined-out pits Proposed to be excavated. Sequence of dumping is described in the stages. Total OB will be dumped in internal dumps. Stage wise OB dumping schedule is furnished in table no. 5.11. At the end of the mining sequence, the part of the excavated void will be technically reclaimed before it is utilized for Biological reclamation. Few degraded areas with infrastructure will be retained for community and company use.

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The Technical and biological reclamation details are depicted in Table no. 5.11 and 5.12 respectively.

Table No. 5.11
Details of degraded Land vs. Technical Reclamation Land.

Stage/ Year		Land Degraded (ha) - Cumulative				Technically Reclaimed Area (ha) - Cumulative			
		Excavation	Dump (External + Top Soil)	Infra/ Others	Total	Backfill	Dump (External + Top Soil)	Infra/ Others	Total
Stage-1	2019-20	133.31	2.40	33.94	169.65	35.03			35.03
Stage-3	2021-22	129.61	5.13	33.94	168.68	57.43			57.43
Stage-5	2023-24	147.31	5.13	33.94	186.38	82.69			82.69
Stage-10	2028-29	220.29	5.13	33.94	259.36	104.52			104.52
Stage-15	2033-34	365.01	5.13	33.94	404.08	145.41			145.41
Stage-20	2038-39	539.21	1.81	33.94	574.96	373.46			373.46
Final Stage	2040-41	609.66	1.81	33.94	645.41	431.32			431.32
Post Closure									
Closure (+ 3 Years)	2043-44	609.66	1.81	33.94	645.41	431.32	1.81	212.28	645.41

Table No. 5.11
Details of Biological Reclamation and land status.

Stage/ Year		Biologically Reclaimed Area (ha) - Cumulative					Forest Land (Return)	Undisturbed/ To be left for Public/ Community Use	Total
		Agriculture	Plantation	Water Body	Public/ Company Use	Total			
Stage-1	2019-20	-	-	-	-	0	-	-	0
Stage-3	2021-22	-	-	-	-	0	-	-	0
Stage-5	2023-24	-	-	-	-	0	-	-	0
Stage-10	2028-29	-	-	-	-	0	-	-	0
Stage-15	2033-34	-	35.70	2.50	-	38.2	-	-	38.2
Stage-20	2038-39	-	45.72	2.50	-	48.22	-	-	48.22
Final Stage	2040-41	95.07	56.50	2.50	-	154.07	-	-	154.07
Post Closure									
Closure (+ 3 Years)	2043-44	95.07	119.6	75.82	16.17	306.66	338.75	37.63	681.04

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Chapter 6

Blasting



6.1 Drilling:

Drilling and blasting would be required in OB benches before excavation by shovel. As per general strata conditions, 50% of rocks taken in category III and balance 50% in category IV for drilling and blasting.

6.2 Overburden Blasting details:

Top OB of soil & sub soil will be excavated directly while drilling & blasting will be required from the hard strata. 250 mm blasthole drilling will be carried out for the thick inter-burden while 160 mm blasthole drill will be utilized for thinner inter-burdens.

6.3 Blasting requirements:

Particulars	Requirements
Estimated peak rated annual OB including main burden and partings at 3.80 m ³ /T stripping ratio.	11.50 Mcum.
Max. weekly OB removal (52 weeks)	221153.84 Cum
Type of explosives – slurry/emulsion	Bulk explosives
Powder factor – assumed – Overburden.	0.3 Kg/Cum
Weekly explosives requirement (maximum at PRC).	66.34 Tons.
Suggested pattern for drilling	Spacing: 6-8 meter Burden: 7-8 meter

Drilling shall be suitably distributed in all OB benches to provide requisite workload for each shovel.

6.4 Storage of explosives:

It is envisaged that blasting operation will be carried out by SMS (site mix slurry) and will be transported to the mine site by the explosives agency. Magazine will be required only for storage of detonators, detonating fuse, cast boosters, cord relays etc. a magazine of 5 Te capacity is proposed for storing detonating fuses, detonators and other explosives for secondary blasting.

Deep hole blasting permission under regulation 196 (3) has been obtained from DGMS vide their letter number S-29018/196/50-2018/LIN-1270153/255; dt. 15/2/2019 and is furnished in **Annexure-XVIII D**.

Explosive license has been issued by Chief Controller of Explosives, East Circle, Kolkata, Ministry of Commerce and Industries, Petroleum and

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Explosive Safety Organization, vide their letter number E/EC/WB/22/506 (E90942); dt. 28.04.2017 and is furnished in **Annexure-XVIII E**.

6.5 Ground level vibrations:

Vibrations due to blasting may cause damage to the nearby structures if appropriate control measures are not adopted.

Flyrock is another possible damage causing outcome of blasting. There are many factors which influence flyrocks. These are like long explosive columns with inadequate stemming column, improper burden, loose material or pebbles near holes and long water columns in the holes.

6.6 Suggested measures to minimize ground vibrations:

The following control measures have been envisaged to reduce ground vibration within statutory limits:

- a. The peak particle velocity (PPV) of ground vibration will be kept below 10mm/s for 8-25 hz frequency range through optimally controlled blasting techniques, after necessary field trials.
- b. Drilling and charging pattern will be formulated, with less explosives charge etc, after field trials.
- c. Use of suitable initiating sequence and millisecond detonators.
- d. Reduction of amount of explosives charged per day optimally.
- e. To contain fly rocks, stemming column will not be less than burden of the hole. Blasting area will also be muffled, if necessary, to stop fly rocks propagation.
- f. Blasting will not be carried out when strong winds are blowing towards habitation areas. Blasting will be done during midday time and never at night.
- g. Surrounding villages within 1 km radius of blasting will be regularly inspected for any visual cracks on walls and feedbacks will be gathered to investigate the reasons for these and for reassessing the charge per delay from time to time.
- h. Vibration study will also be carried out at appropriate times to firm up most ideal and optimal blasting parameters.
- i. Controlled blasting to avoid tension cracks which may endanger the stability of bench slopes in the mine.
- j. Short delay detonators to be used in preference to detonating fuse.
- k. In case of using detonating fuse, it should be covered with 750 mm thick cover of sand or drill cuttings.

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- l. Proper care and supervision during blasting by a competent and experienced person.
- m. To maintain the stability of the dump slopes and benches, suggestions provided in the Pit and Dump Stability report will be adhered. The Dump and Pit Stability report is attached as **Annexure-XVIII I.**

By adoption of the above measures, it will be ensured that the ground level vibration due to blasting are maintained within the limits prescribed by DGMS. The Circular No. 7 dt. 29-08-1997 of DGMS giving permissible safe peak particle velocity (PPV) is given in the following table no. 6.1.

Table no. 6.1

Permissible Peak Particle Velocity (PPV) at the foundation level of structures in mining areas in mm/sec.

Type of structure	Dominant excitation frequency – hz.		
	< 8 hz	8 -25 hz	>25 hz
A. Building structures not belonging to the owners.			
Domestic houses/ structures (Kutchha brick and cement)	5	10	15
Industrial buildings (RCC and framed structures)	10	20	25
Objects of historical importance	2	5	10
B. Building belonging to the owner with limited span of life.			
Domestic houses/ structures (Kutchha brick and cement)	10	15	25
Industrial buildings (RCC and framed structures)	15	25	50

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Chapter 7
Mine Ventilation



7.0 Introduction

Barjora North Block is envisaged to be mined by opencast mining method. The maximum depth envisaged during proposed planned period of 22 years is 145 m on the floor of Seam-1. No artificial ventilation system will be required to establish for this depth. Natural ventilation will drive out the blasting fumes and polluted air out of the mine.

However, during subsequent years also, no artificial ventilation arrangement will be required.

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Chapter 8

Pumping & Mine Drainage

8.1 Introduction:

The planning of de-watering of the mine has been done in such a way that as far as possible the working faces and haul roads remain dry. The layout of the quarry, provides suitable gradient along the quarry floors and the benches to facilitate self-drainage of water to the lowest level of the quarry towards the eastern side.

The maximum rain water intake will be during the period of about four months (June to September) in a year. During dry season, say October to May, seepage from strata is expected to be moderate and the same can be dealt by running a few number of pumps provided for monsoon pumping. During this period repair & overhauling of the pumps will be done by rotation.

The southern section of the quarry face is proposed to act as the mine sump. The rain water inflow into the quarry workings will gravitate into this sump by natural drainage. The quantity of water inflow during a day of peak rainfall in monsoon in excess of sump capacity will be handled by the main pumps.

Although there is a fair variation from year to year, the average annual rainfall is around 1380 mm per annum as per data collected from Durgapur. As described in the approved mining plan, maximum rainfall in a day has considered as 170 mm.

8.2 Basic Considerations:

The following considerations have been made for calculating the pumping requirement and selection of pump for this interim period.

- Excavated mine area and its depth.
- Geographical location of the project.
- General climatic conditions, surface features of the terrain beyond the boundary of the mine.
- Calendar plan of excavation of quarry.
- Geological characteristics of OB and coal seams.
- Meteorological data of nearest rain-gauge stations.
- Catchment areas, mined out areas beyond excavation, spoil dump area etc., maximum depth of the quarry during this interim period.
- Water garland drains shall be developed in advance for each stage of mine working so that rain water is collected by the garland drains and get diverted to the adjoining Tartora nallah.

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- Desired location at surface where quarry water can be discharged after due settlement and considering the surface drainage system.
- Maximum rainfall per day (170mm continuous rainfall for 24 hours).
- Pumping requirement has been assessed on the basis that the make of water on the day of maximum rainfall will be pumped out in following five days.
- Within the quarry, the faces shall be so laid that water from the working areas shall flow into the sump by gravity. From the sump, the water would be pumped out to the surface and will flow into the surface drainage system.
- Concurrent backfilling will be done in the de-coaled areas of the quarries.
- For the purpose of pumping calculation, effective pumping hours per day has been adopted as 18.
- Adequate reserve pumping capacity has been provided.

8.3 Assessment of Volume of water for pumping:

For the Barjora North block in particular, the total average rainfall is about 1380 mm of which 90 % precipitation is during rainy season. For rainwater estimates for pumping purpose, a high of 170 mm of rainfall in a day has been considered. The volume of rain water entering to the mine and accumulating in the quarry has been estimated on the basis of direct catchment area, maximum daily precipitation and the run-off coefficient. An additional 20% additional make of water has been considered to account for ground water seepage and aquifer water.

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

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

Where,

A - Catchment area in m^2

H - Maximum daily precipitation in mm

∂ - Run-off co-efficient

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

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For mined out area	:	0.60
For area beyond excavation	:	0.15
For internal dumped area	:	0.10

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

Following parameters were considered:

Maximum broken area:	582.51 ha
Internal dump area:	489.32 ha
Other catchment area:	Nil.

Net area calculated for make of water in pit –
 $582.51 \text{ ha} - 489.32 \text{ ha} = 93.19 \text{ ha}$

Make of water within pit = $93.19 \times 10000 \times 0.17 \times 0.60 = 95053.80 \text{ m}^3$

Total accumulated water in pit = 95053.80 m^3

Additional 20% water for ground water and seepages = 19010.76 m^3 .

Total water estimated for pumping requirement = 114064.56 m^3 .

8.4 Pumping Capacity & Pump selection:

Main Pumps:

The pumping capacity has been designed in such a way that the maximum water can be pumped out in 7 days with 20 hours of pumping per day.

Table No. 8.1
Requirement of pumps

Year	Total required pumping capacity	Depth of excavation from surface	Specification of Pump	Basic Strength
	(cum/hr)	(m)		(No.)

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Upto 25 th year (Including Closure Period)	814.74	145.00	300 cum/hr cap. 180 m head, around 350 – 400 HP diesel operated pumps will be fitted.	3
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Requisite accessories will be fitted with these pumps to make it operational. Enough quantity of accessories will be maintained as inventory to deal with worst case scenario not only to continue the production but also to avoid happenings of disasters.

8.5 Water Discharge:

In usual condition of the mining, this mine will operate in a “Zero Discharge” Scenario. The mine pit accumulated water will be pumped and stored in the central sump for workshop, sprinkling and plantation use. Water discharge will happen only in the rainy season due to sudden inrush of storm water.

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Chapter 9

Coal Handling, Washing and Mode of Despatch



9.1 Despatch:

Coal will be dispatched to the trucks either to Bankura Railway Station at a distance of around 35 – 40 km or to Durgapur railway station at a distance of around 10- 12 km from project location by road. Coal will reach to end use plants by railway. Railway sidings are available in each of the end use plants. Distance of the different end use plants with respect to Bankura and Durgapur railway stations are given below in table no. 9.1.

Table No. 9.1

Distances of different End Use plants of WBPDCCL from Barjora North Coal Block.

Name of End Use Plants	Distance from Bankura Railway Station.	Distance from Durgapur Railway Station.
Santaldih TPS	76	105
Kolaghat TPS	172	218
Bakreswar	161	58
Bandel	274	171
Sagardighi TPP, Unit 1 & 2	367	264
Sagardighi TPP, Unit 3 & 4	367	264

Figure no. 9.1 shows the map of different end use plants along with Barjora North Coal Block superimposed in the administrative map of West Bengal.

9.2 Coal handling Arrangement:

Coal will be produced through surface miner, thus primary crushing units are not proposed at mine end. Secondary crushing whatever required will be done at Plant end. Produced coal size will vary within (-200) mm range.

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Existing infrastructure on ground such as platform for coal stack will be utilized for ground stocking of coal.

Coal will be loaded onto trucks through pay loaders for despatching out of the mine areas.

9.3 Quality Control:

Segregation of coal and bands will be done at mining face once the surface miner cut the coal surface. Selective mining methodology will be adopted to mine only the coal surface while stone bands will be removed through drilling & blasting. In case of thin dirt bands, manual vigilance will be adopted not to stack the material along with the coal stack yard.

9.4 Seam wise Quality:

Seam wise Grade wise geological reserve is furnished in table no. 9.2.

Table No. 9.2

Seam Wise – Grade Wise Geological Reserve of Barjora North Coal Block.

Grade Wise- Seam Wise Remaining Net Insitu Coal Reserve of Barjora North Coal Mine												
SEAM	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	Total
IX		0.010	0.097	0.095	0.105	0.164	0.058	0.543	0.080			1.152
VIII					0.011	0.256	0.233	0.686	0.716	0.225	0.046	2.173
VII			0.204	1.259	2.630	3.096	2.511	1.379	0.464	0.270	0.017	11.830
VI		0.170	0.868	2.147	2.841	1.688	0.987					8.702
VTOP			0.033	0.569	1.468	2.039	1.743	0.475				6.327
VBOTTOM		0.189	0.382	0.809	2.559	2.463	0.696	0.267	0.128			7.494
V			0.076	0.789	5.865	5.498	3.498	2.627	0.902	0.819		20.075
IV	0.017	0.084	0.233	0.330	0.252	0.169	0.161	0.026	0.022	0.009		1.302
III	0.116	0.758	0.861	1.787	2.630	0.934	0.329	0.162				7.577
III/II	-	-	-	-	-	-	-	-	-	-	-	-
II	0.001	0.188	1.658	1.043	1.338	0.370						4.599
III/II/I				0.813	1.356	2.163						4.332
II/I	0.035	0.773	0.443	1.469	0.489	0.186						3.394
I	0.382	0.776	1.352	2.316	4.481	2.553	0.451	0.225	0.179			12.715
Gross Insitu	0.551	2.948	6.207	13.43	26.03	21.58	10.67	6.389	2.492	1.323	0.063	91.670

As observed from the above table, considering no dilution in the mining process, most of the coal reserve (about 64%) falls under the grade range of G9 to G12. However, during mining process, grade dilution is a very common process and with increase in ash% in product coal, GCV gets deteriorated. It is envisaged that about 2% ash dilution will be there as compared to the GCV values as projected in the Geological Report. Thus the majority of the product coal is planned to be in a grade range of G10 to G13.

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Seam wise Grade wise mineable reserve of Barjora North Coal Block is furnished in table no. 9.3.

Table No. 9.3

Seam Wise-Grade Wise Mineable Reserve of Barjora North Coal Block.

Grade Wise - Seam Wise Mineable Coal Reserve of Barjora North Coal Mine (in Million Tons)												
SEAM	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	Total
IX	0.000	0.008	0.080	0.078	0.086	0.134	0.048	0.445	0.066	0.000	0.000	0.945
VIII	0.000	0.000	0.000	0.000	0.009	0.210	0.191	0.562	0.587	0.184	0.038	1.782
VII	0.000	0.000	0.167	1.033	2.157	2.538	2.059	1.131	0.381	0.222	0.014	9.701
VI	0.000	0.140	0.712	1.761	2.330	1.384	0.809	0.000	0.000	0.000	0.000	7.135
VTOP	0.000	0.000	0.027	0.466	1.204	1.672	1.429	0.390	0.000	0.000	0.000	5.188
VBOTTOM	0.000	0.155	0.313	0.664	2.099	2.020	0.571	0.219	0.105	0.000	0.000	6.145
V	0.000	0.000	0.063	0.647	4.809	4.508	2.868	2.154	0.740	0.672	0.000	16.461
IV	0.014	0.069	0.191	0.271	0.206	0.139	0.132	0.021	0.018	0.007	0.000	1.068
III	0.096	0.629	0.715	1.465	2.183	0.766	0.273	0.134	0.000	0.000	0.000	6.262
III/II	-	-	-	-	-	-	-	-	-	-	-	-
II	0.001	0.155	1.359	0.855	1.097	0.304	0.000	0.000	0.000	0.000	0.000	3.771
III/II/1	0.000	0.000	0.000	0.666	1.112	1.774	0.000	0.000	0.000	0.000	0.000	3.552
II/1	0.028	0.633	0.363	1.205	0.401	0.152	0.000	0.000	0.000	0.000	0.000	2.783
I	0.321	0.652	1.136	1.945	3.764	2.145	0.379	0.189	0.150	0.000	0.000	10.681
Mineable Reserve	0.46	2.44	5.13	11.06	21.46	17.75	8.76	5.25	2.05	1.08	0.05	75.47

Mining will be done through Surface Miner. Thus, selective mining will be adopted. There is a possibility of grade improvement. However, due to erratic nature of seams, quality deterioration may happen which may lead to shifting of grade as compared to geological report. It is envisaged that produced coal will be lying in a GCV range of G10- G13.

Sizing and beneficiation of coal is not envisaged in this project.

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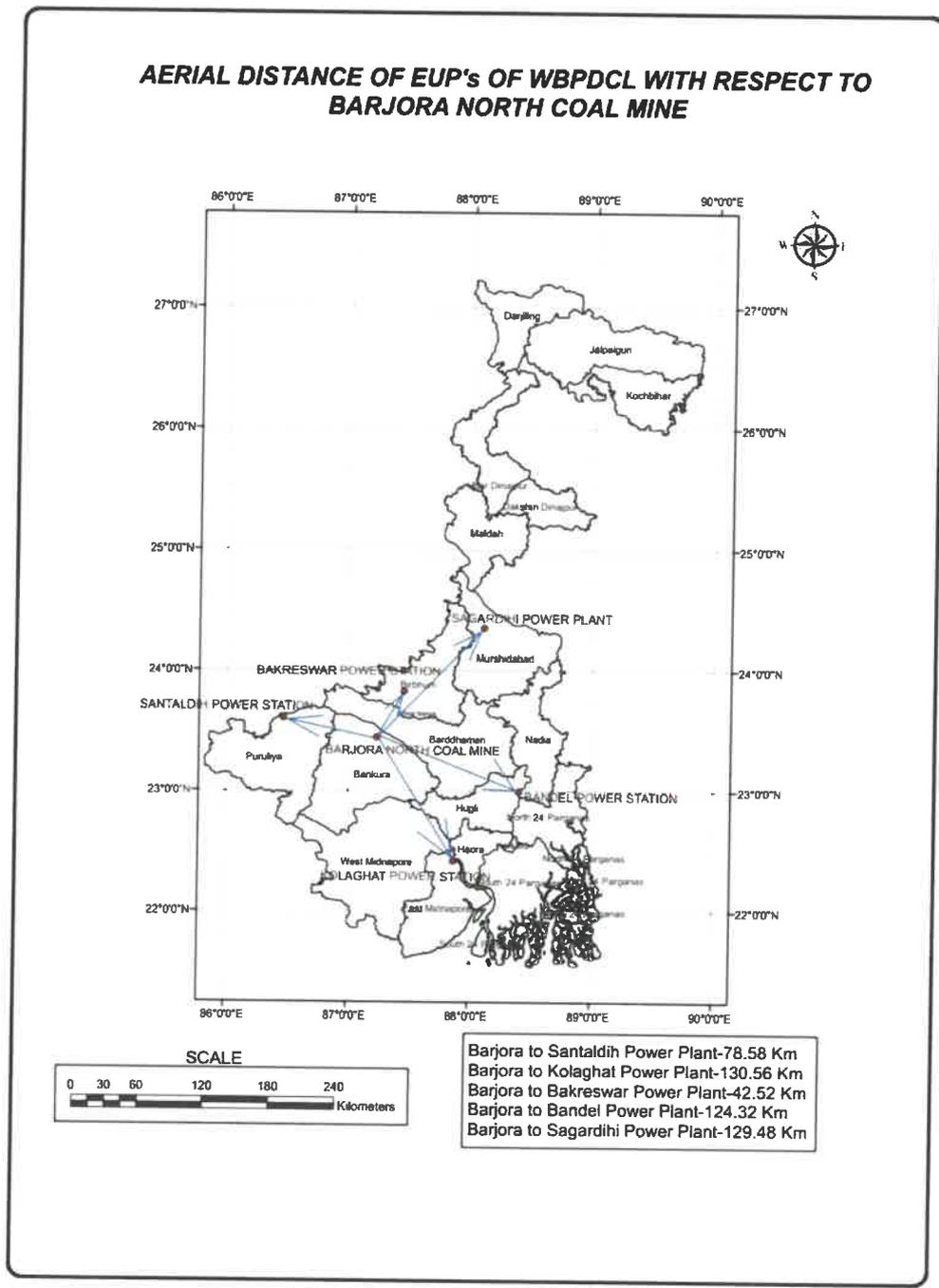


Figure No. 9.1: Distance of different End Use Plants of WBPDC with respect to Barjora North Coal Block.

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Chapter 10

Manpower, Supervision



10.1 General:

Man power requirements are assessed on the basic design criteria for a production of 3.0 MTPA and come to about 548. Break-up of total manpower requirement for the Barjora North Opencast Mine is given below in table no.10.1 .

Table 10.1

Summary of Total manpower requirement at PRC.

Category	Nos.
Management Staff	33
Mine Operations	384
Maintenance	75
Environmental	4
Safety	12
Training	3
Support	67
Total =	578

Standard norm of manpower calculation has been used for arriving at the manpower requirement in respect of HEMM operation and maintenance. Details of the manpower is furnished in table no. 10.2.

Table No. 10.2

Detail Estimation of Manpower of Barjora North Coal Mine.

Cadre	Designation	Nos.
Management Staff	Project Director	1
	GM (Mines)	1
	GM (Finance)	1
	DGM (Coal)	1
	DGM (OB)	1
	DGM (CHP)	1
	DGM (Equipment & Maintenance)	1
	DGM (Technical Services Support)	1
	DGM (Safety)	1
	DGM (Training)	1
	DGM (Geology & Quality Control)	1

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Cadre	Designation	Nos.
	DGM (Personnel and Welfare)	1
	DGM (Land reclamation and Environment)	1
	DGM (Civil and Administration)	1
	DGM (Stores and Procurement)	1
	DGM (Survey)	1
	DGM (Land acquisition and R&R)	1
	DGM (Finance)	1
	Manager (Coal)	3
	Manager (Drilling & Blasting)-Coal	3
	Manager (OB)	4
	Manager (Drilling & Blasting)-OB	3
	Manager (Finance)	2
	Total	33
	Mine Operations	Overman - Coal
Drilling Team - Coal		3
Blasting Team - Coal		3
Overman - OB		9
Drilling Team - OB		18
Blasting Team - OB		10
Sirdar - Coal		6
Sirdar - OB		15
Coal HEMM Operators		80
OB HEMM Operators		234
Total		384
Mine Maintenance	Excavation P & M Maintenance team (Workshop)	30
	P & M Maintenance Team	25
	P & M Maintenance Team (Field)	20
	Total	75
Environmental	Sr. Engineer (Environment)	1
	Asst. Manager (Environment)	1
	Environment Assistant	2
	Total	4
Safety	Manager (Safety) 1	3

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Cadre	Designation	Nos.
	Manager (Safety) 2	3
	Safety Officer 1	3
	Safety Officer 2	3
	Total	12
Training	Senior Manager (Training Centre)	1
	Asst. Manager (Training)	1
	Field Training Manager	1
	Total	3
	Sr. Manager (E & M Supervision)	4
	Mine Planning Team	5
	Asst. Manager (E&M Supervision)	4
	Engineer (Excavation/P&M)	4
	Instructor (Training)	1
	LDC/Typist (Training Centre)	2
	Peon (Training Centre)	2
	Manager (HR)	2
	Personnel Officer	2
	Recruitment Officer	1
	LDC/Typist (HR)	2
	Peon (HR)	2
	Sr. Manager (Watch & Ward)	2
	Asst. Manager (Transport)	6
	Sr. Medical Officer (Medical and Sanitation)	2
	Sr. Manager (Communications)	2
	Water Supply	4
	Sr. Survey Officer	2
	Surveyor	2
	Sr. Manager (Land Acquisition)	1
	Sr. Manager (R&R)	1
	Asst. Manager (Land Acquisition)	2
	Asst. Manager (R&R)	2
	Peon (Land Acquisition)	3
Peon (R&R)	3	
Accounts Officer	4	

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Cadre	Designation	Nos.
	Total	67
Total Manpower		578

10.2 Output per manshift (OMS):

Total manpower = 578.

Total man shifts (considering 300 working days) = 173400.

Output per man shift (OMS) = 17.30 (considering peak rated capacity of 3.0 MTPA).

10.3 Services proposed to be outsourced:

The following services are proposed to be outsourced for better management and results and improved efficiency in daily operations.

- a. Surface Transport
- b. Sizing & Shale Picking
- c. Maintenance of HEMM
- d. Security Services
- e. Canteen Services
- f. Rest house services
- g. Sweepers.

Considering the provisions for outsourcing, manpower in the project has been proposed.

10.4 Automation:

Efficient management and control of project depend upon the management of information system. Availability of accurate information at proper time is backbone for decision, implementation and control. In Barjora North Opencast Mine emphasis has been given on the use of modern information technology and other modern system as a tool to the management. Provisions have been made for the following:

- 1. Computer hardware and software for mine planning and design, maintenance, inventory control, data management, etc.
- 2. INTERNET, WAN/LAN support for integrated information system.

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3. Surface Mine Communication System for monitoring, control of line function, etc.
5. Modern survey equipment (TOTAL STATION) compatible with computer system.

10.5 Manpower Training:

In order to achieve higher productivity in mining operations, various tools of automation has been proposed. To successfully implement and use the envisaged level of automation proper training in each aspect of automation i.e. success in achieving higher productivity and efficiency will greatly depend on the training imparted. It is also proposed that suitable time bound up-gradation of hardware and software along with annual maintenance contracts, training contracts, and periodic exposure to technical enhancement is provided. A suitable feedback evaluation system is proposed to evaluate the efficiency of the automation proposed and its modification if required.

However, the benefits of automation can be assessed only if, proper management actions in real time frame is taken based on MIS information.

A conceptual organization structure of Barjora North Coal Mine is being furnished in figure no. 10.1.

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Chapter-10-Manpower & Supervision

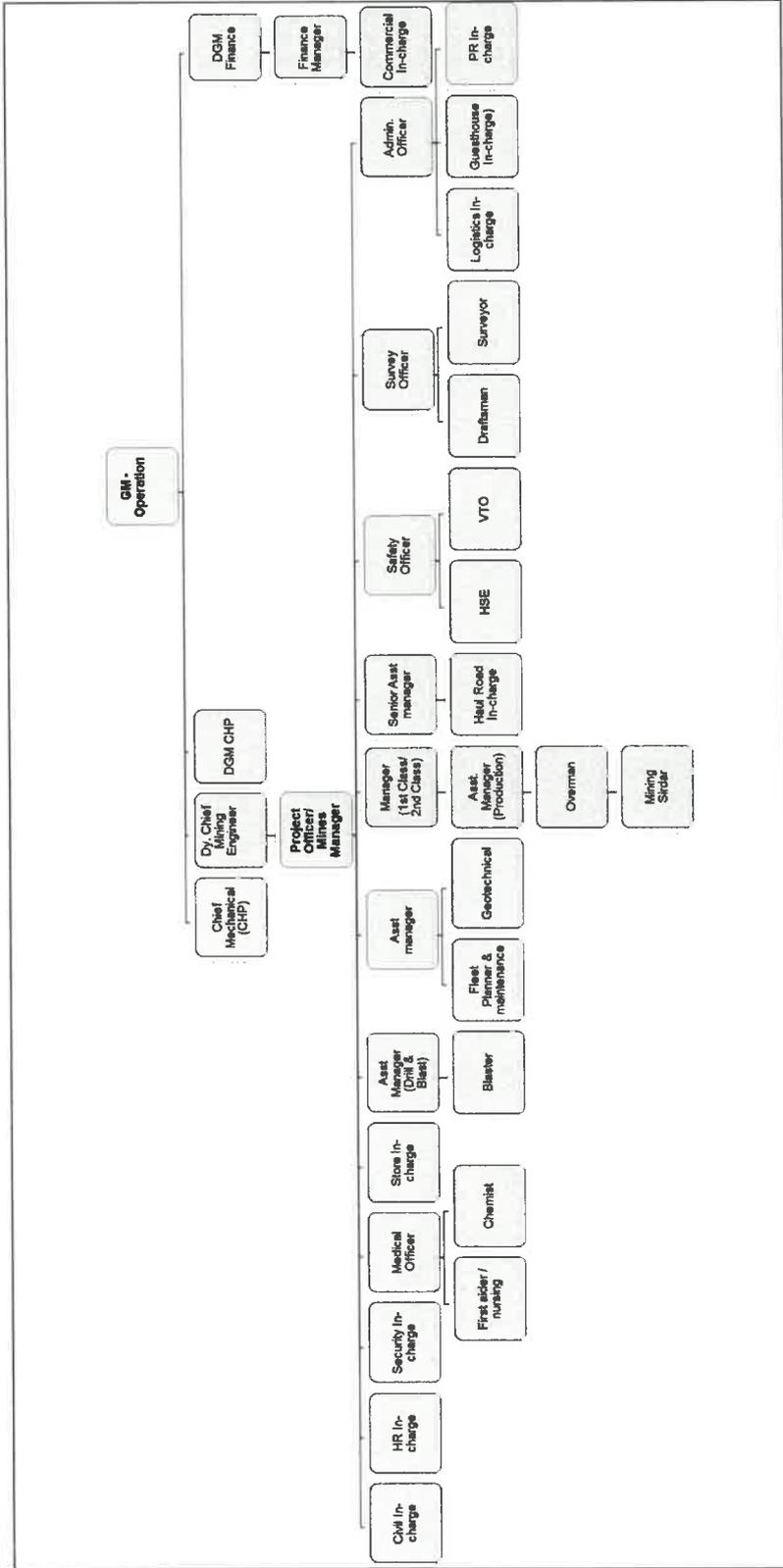


Figure No.10.1: Proposed Organisation Structure for Barjora North Coal Mine.

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11.1 Introduction:

Extraction of coal through opencast mining is generally taken to be safe compare to underground mining. The following however are considered areas of danger in opencast mining.

- Accidents on OB and coal benches due to failure.
- Failure of dump slopes.
- Flooring of the mine.
- Blasting in opencast mines.
- Fire in OB dump/Coal Yard/Coal benches.
- Accidents due to lack of proper space for movement for men and equipment in mine.

Opencast mining needs are:

- Coal bench top must be cleaned off before drilling & blasting is taken up.
- Coal blasting has to be well controlled for unwanted spread over OB benches.
- While cleaning toe of coal bench by shovel, the operator has to take special care so that minimum coal is picked up along with OB for disposal to the OB dump.

In order to assess the safe working in the mine and to derive the optimum height of the dumps and pit slopes, a "Dump and Pit Stability Study of Barjora North Opencast Mine" has been prepared by BIT, Meshra under the guidance of Dr.Indrajit Roy. Bench heights, dump slopes and dump heights are kept in accordance with the stability study report. The report is furnished in **Annexure-XVIII I**.

11.2 Failure of Benches of OB and Coal:

Bench height of OB and Coal must match with the bucket reach of the shovel so that it can pick up all loose materials from the coal / Ob benches. This reduces chances of accidents due to fall of loose materials. The blasting of

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OB and Coal faces must be dressed with bucket as shovel and dumpers reach the vertical face.

11.3 Failure of Dump Slopes:

The internal dump has been benched at 20 meter height. Although individual OB bench slopes at its natural angle of repose i.e- 37° the overall slope has been reduced to 27° by leaving a 30 meter wide berm between two successive benches. This reduces the chances of OB slope failure and subsequent damages. The dumps once sterile should be stabilized by bio reclamation.

11.4 Flooding of the Mine:

Flooding is envisaged from the proposed diverted nallah which flows along the south- central part of the Barjora North Coal Block. Tartora Nala will be diverted during this planned period. Nala diversion will be taken place during 10th year of Mining Operation. A conceptual Nala diversion plan is being furnished in plate no. 24 while the mine owner has provided a declaration to implement Nala Diversion and is furnished in **Annexure- XVIIIH**.

11.5 Blasting in Opencast Mines:

Blast design can be made carefully so that we get the fragmentation with desired features. By regulating the burden, spacing, column of explosives and stemming of blast holes and specific combination of explosives, any danger of fly rocks can be controlled. During blasting safety precautions of removing people out of danger zone shall be ensured. Detail safety precautions during blasting are being discussed in chapter no. 6 of this document. The mine has already obtained permission from DGMS regarding deep hole blasting and is furnished in **Annexure- XVIIIID**.

11.6 Fire in Coal Benches/Coal Stack Yard:

Spontaneous heating of coal may cause fire in its coal benches, coal yards etc. however, in the instant mine the work area is small and therefore, benches would remain during most of the operational period. Hence, chances of fire are rare. Never the less, if any coal benches are to remain idle for a period more than two months, the same shall be properly dressed and cleaned from loose coal or fines at the time of stoppage.

There would not be any sizeable coal in the stock yard as coal will continuously be dispatched to linked power houses of WBPDCCL. All of the end use plants are located within less than 400 km from the project site via

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Durgapur and Bankura railway sidings. Thus regular coal evacuation on first in first out basis will be followed to prevent old stockings of coal in the coal stackyard. However, provision of pumped water supply, with permanently laid pipe lines shall be ensured, in the coal stock yards to meet in eventuality.

11.7 Accidents due to lack of proper space in movement in Mine:

Workers around shovel, dumper, dozer, drill and cranes must be warned to keep out of blind area so that operator may be able to see them clearly. Audiovisual alarms are used for pre warning person around this machine. To overcome shortage of space, strict discipline will have to be inculcated in workmen and supervisors.

11.8 Disaster management Plan:

The disaster is an event which takes place without warning and confronts in an unforeseen manner. The following disasters can be imagined in the proposed project:

- Bench failure
- Dump failure
- Flooding of the mine

11.8.1 Bench Failure:

The benches in the overburden rocks are proposed upto 10 meter height 30 meter width for the operational zones. On these 30 meter horizontal benches, regular movement of dumpers and shovels takes place. Any sudden failures of the vertical face would cause dangerous situations to the top horizontal bench and would move large quantity of debris to the lower horizontal benches, thereby causing serious mishap to the equipment and persons deployed at both the horizontal bench. Following actions can be taken to avert this mishaps or disaster:

- i. Thorough inspection of the surface of the horizontal benches to detect sign of cracks, slips or fault lines. The failure along these fault lines or slips is sudden and can result into disaster.
- ii. Study of fault plane taking geo-investigation details and marking the same on the working plans. This will help to plan blasting in the faulted area so that the fault planes are taken care scientifically.
- iii. Benches to be continuously monitored through survey to detect any impending movement of the bench which might result into bench failure.

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11.8.2 Dump Failure:

The OB dumps, till they have been stabilized and become old or settled, is likely to fail and cause disaster. Failures can be averted by:

- i. Designing the height of internal dump within +60 mRL in tiers as compared to +90 meter suggestion in the Dump Stability study report.
- ii. Terracing of the dump will be done in each stage of 20 meter each.
- iii. Maintaining reverse slope throughout the mine life.
- iv. Ensuring that soil or sub soil does not get mixed up at deeper levels – say below 10 meter from proposed dump tops with rocks during dump formation.
- v. The dump should be having only hard rocks below 10 meters from their surface level.
- vi. Concurrent backfilling have been planned with sufficient lag distance (more than 100 meter) in between the dump toes and working faces.
- vii. Soil or sub soil to be put only on sterile dump top which are ready for bio reclamation.

11.8.3 Flooding:

The flooding is rare phenomenon in life of a mine. However, since the mine area is involving a Tartoranala which needs to be diverted in the later phase of mining, a proper safeguarding in future course is required. TartoraNala needs to be shifted from 10th Year onward. Suitable diversion plan has been suggested.

11.8.4 Disaster Management preparation:

Each coal mine prepare and emergency operational plan to be activated in case of major accidents or disasters. This plan is to be vetted by DGMS and is governed by the provision of the mine act 1952. This is to be prepared and submitted for approval by DGMS just after opening a mine. It is to be stated that, in case of any disaster, DGMS is the organization which is first to be informed. The emergency plan for disaster management is executed under guidance of best grade of the industry and senior officers of the regulator, the Directorate General of Mines Safety, GOI.

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11.9 Coal Conservation:

Estimated Extractable reserve within the leasehold area of 683.04.14 ha comes about 65.59 Mte. at present.

Table No. 11.1

Estimation of Mineable Reserve & Extractable reserve

S. L. No.	Particulars	Coal Reserves (Mt.)
1	Net Geological Reserve of the Block.	91.67
2	Less Geological Reserves on account of 7.5 meter safety zone along the proposed lease boundary.	3.22
3	Less Geological Reserve on account of Nala Diversion and its safety barrier	3.18
4	Reserves blocked within 45m surface barrier left from the existing road (between connecting Barjora and Mejia).	4.56
5	Reserves Blocked within quarry batters.	5.24
Net Available Quarriable/mineable coal reserves		75.47
6	Less 5% Mining loss	3.77
Total Extractable Reserve of the Block		71.70
7	Already Extracted	6.11
Remaining Extractable Reserve		65.59

The recovery percentage of coal from this proposed lease area comes to about 78.22 % after considering considerable blocked reserve in the road safety barrier, nala diversion along with its safety zone reserves blocked in different unapproachable areas.

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Chapter 12

Infrastructure Facilities with Location

**12.1 Introduction:**

The maintenance of all major equipment is proposed to be done by manufacturer. They will be provided space for maintenance in the HEMM (Excavation) workshop. Regular maintenance and repair of other plant and machinery can be carried out at E&M workshop. The project store shall be attached to the E&M workshop. The proposed E&M workshop and project store will be facilitate the maintenance and repair requirement of mining, mechanical, electrical, transport and other auxiliary equipment and storage of spare-parts, sub-assemblies and consumables.

In general, two-shift working has been envisaged for the workshop with only essential maintenance facilities in the 3rd shift and one shift working for project store.

12.2 Equipment maintenance planning:

Facility planning of workshop and project store has been done based on a comprehensive maintenance and repair programme to achieve the high level of availability, reliability and longer life.

Maintenance and repair load of unit workshop has been assessed on the basis of annual operating time, inter-repair period, life of the equipment / assemblies/ sub-assemblies, weight and size of the equipment / assemblies/ sub-assemblies, man- hours required per repair etc. Space requirement for maintenance and repair activities, parking facilities of HEMM and other equipment, washing of equipment and assemblies, requirement of open and covered storage space etc have also been considered. The size of Excavation workshop cum Project store has been given in Table 12.1 below.

Table 12.1

Layout dimensions of Excavation workshop & E&M workshop cum project Store.

Particular	Size (m x m)	Area (m ²)
A. Excavation workshop	180 x 50	9000
B. E&M Workshop cum project store	150 x 50	7500

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C. Mine office and common Facilities	50 x 40	2000
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A typical layout diagram of workshop is given in figure no. 12.1. However, project specific workshop will be designed separately before commencement of operation.

12.3 Scope of Work:

12.3.1 Excavation/ Workshop:

- Preventive maintenance.
 - a) Daily maintenance, routine lubrication and bi-weekly washing of equipment.
 - b) Technical inspection and running repair of transport equipment and checking of tyres.
 - c) Daily and fast filling of diesel at fuel delivery station for transport equipment and at site for field equipment.
 - d) Dismantling, opening and refitting of tyres.
 - e) Incidental minor repairs of assemblies and sub-assemblies of mining and mechanical equipment, i.e dumper, dozer, shovel, drill etc.
- Scheduled Maintenance.
- Medium repair and replacement of assemblies and sub-assemblies.
- Mobile repair team with crew and facilities to cater the maintenance of minor repair needs of field equipment at site.

12.3.2 E& M Workshop

- Minor repair, medium repair and replacement of components, assemblies and sub-assemblies of pumps and electrical equipment.
- Bi-weekly washing of LMVs and washing of equipment assemblies and sub-assemblies as and when required.
- Periodical lubrication
- Repairs and replacement of components/ assemblies for LMV.
- Minor and medium repair of switchgears, motors, self-starters and other electrical equipment.

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- Battery charges facilities and re-conditioning of batteries.

12.4 Facilities:

Following facilities have been provided in the excavation workshop and E&M workshop for maintenance and repair of equipment as envisaged in the scope of work:

12.4.1 Excavation Workshop

- Mechanized washing on specially constructed platform for dumpers and dozers.
- Daily maintenance bays for dumpers and dozers.
- Schedule inspection and lubrication bays for dumpers and dozers.
- Schedule maintenance, medium repair and minor repair facilities for dumpers and dozers.
- Minor repair and replacement of sub-assemblies and assemblies of shovels, drills and other field equipment at site by mobile repair team.
- Medium repair of overhauling of sub-assemblies and assemblies of field equipment.
- Machining section.
- Electrical and auto repair section.
- Engine section.
- Repair of hydraulics especially Surface miner.
- Radiator repair section.
- Welding and structural section.
- Tyre section.
- Condition monitoring section.
- Shovel repair section.
- Drill repair section.
- Dozer repair shop.
- Pavements for dumper and dozer parking.
- Overhead and u/g water reservoirs.
- Supporting facilities like computer room, electronics room, charge stores, tool room, offices, pump room, cycle stand, canteen, security post, fire fighting facilities, ventilation system etc.
- Material handling facilities

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- Machine tools, general and special purpose tools, diagnostic tools, master tool kits etc.
- Refueling station with pump and other necessary accessories.
- Mobile repair and servicing unit.

12.4.2 E&M Workshop:

- E&M maintenance and repair unit for maintenance and minor repair of CHP equipment, pumps, electrical equipment and other installations.
- Machining section, mechanical section and structural section, electrical and auto section etc.
- Washing platform for LMVs.
- Maintenance and repair shop for LMVs.
- Machine tools, general and special purpose tools, diagnostic tools, master tool kits etc for electrical and mechanical equipment.
- Supporting facilities like charge store, tool store, toilet, offices etc.

12.5 Workshops and projects stores layout:

The maintenance and repair bays and other facilities for dumpers and other HEMM have been designed based on the prevailing standard norms and OEM's /Equipment Manufacturer's recommendations.

Excavation workshop unit has been planned for maintenance and repair work of all major HEMM.

- **Excavation Workshop:**

The area of excavation workshop unit will be 9000m². This workshop has been designed to cater to the needs of dumpers upto 100 T capacity. Detail description of major functional shops is given in the table 12.2 below.

Table No. 12.2

General Plan for Layout for HEMM Workshop.

Major Shops	No. of Bays	Bay size (m x m)	Shop size(mx m)	Bracket height (m)	EOT crane capacity(t)
Dumper repair complex	12	10 x 18	60 x 40	11.5m	25/5 t-1 nos. 10/2 t-1 no.
Dozer and Face equipment repair	2	10 x 12	40 x 30	8.5 m	15/2 t-1 no.

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complex					
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• **E&M Workshop:**

It is proposed to deploy 5 nos. of trucks, 5 nos. of buses, 12 nos. of jeeps/cars/vans and a large nos. of pumps, transformers and other electrical equipment.

The maintenance and repair bays and other maintenance facilities required for LMVs, pumps and other electrical and mechanical equipment have been provided based on the prevailing standards and OEM's recommendations.

The overall area of E&M workshop will be 7500 m². Sizes of major functional shops of E&M workshop are given in the table 12.3 below.

Table No. 12.3

General Plan for layout for E&M Workshop.

Major shops	No. of bays	Bay size	Shop size	Bracket height (m)	EOT crane capacity (t)
E&M repair complex	-	-	20 m x 40 m	6 m	5t -1 no
LMV repair complex			15 m x 10 m	6 m	-

• **Project store:**

The project store will be integrated with the E& M workshop facilities for efficient and coordinated movement of material, equipment and spares to and from the stores. An area of 15 m x 55 m has been provided for the stores in the E& M workshop.

The storage capacity for the stores is envisages for 30-45 days consumption of materials. Due consideration we have to be given for proper working environment, cleanness and safety measures. Proper equipment and material handling facilities have also been provided.

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The size of main sheds/ buildings of the project store are given table no. 12.4 below.

Table No. 12.4
General Plan for layout of project store.

Major sheds	Shop size	Covered area	Height	EOT crane capacity (t)
Store shed	15 m x 30 m	450m ²	8m	5t-1 no.
POL store	15 m x 15 m	225m ²	4.5m	-
Cement store	15 m x 15 m	150m ²	3.5m	-

- Separate storage facility have been envisaged for the following items:
 - Bulk consumables
 - Light consumables.
 - Spares and assemblies of HEMM
 - Spares and assemblies of LMV.
 - Electrical equipment like motor, generators, switch gears etc.
 - Spares and assemblies of electrical equipment.
 - Cables and beltings.
 - Chemicals, paints etc.
 - Rubber materials.
 - Stationary and office material.
 - Float assemblies.
 - POL etc.

12.6 Plant & equipment for workshop:

The selection of plant and equipment (machine tools) for workshops has been done in accordance with the maintenance programme of various equipment, job wise requirement in respect of dimensions, nature of operations to be performed, frequency of such requirements and degree of precision.

Provision of E.O.T cranes , mobile cranes, tyre handler, fork- lift trucks, trolleys, electric hoist, chain pulling blocks, jacks etc . has been made for quick

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and effective handling of heavy materials and tyres within and outside the shops.

12.7 Power Requirement & Facilities:

The mine is at present in a developing stage after being re-allocated to WBPDC. Mine operation resumed in the month of June, 2018. Most of the equipment are diesel operated and power consumption are mostly for electrically operated Pumps, Mine Lighting, Workshop use, Office use, weigh bridge etc.

12.7.1 Power Distribution Details:

The details of sub-station capacities, distribution network, system of power supply and power factor improvement are as follows:

➤ Distribution and Utilisation Voltages:

- Incoming power supply for the project - 11 kV
- Pumps 265 kW & 180 KW - 3.3 kV
- Pumps 94 kW, 30 KW & Face pumps - 415 V
- Workshop/Colony water supply equipment - 415 V
- Lighting - 230 V

- 2 nos. of 33/3.3 kV, 1.6 MVA Capacity Transformers feed power to various loads. The sub-station will be established near the entry of the quarry.
- From the Sub-station, 3.3 kV overhead transmission line will be laid along the edge of the quarry to feed power to equipment inside the quarry. The surface loads of workshop, Office, stores etc., will be fed by distribution transformers.
- The system of power supply at all the voltages in the project i.e., 3.3 KV, 415 V and 230 V will be by earthing neutral as per statutory regulations.
- Due to inductive loads of pumps etc., it is proposed to improve overall power factor of the system above 0.9 by manually operated capacitor banks. No automatic power factor correction is proposed as the connected loads are less.
- The working areas of the quarry and haul road etc will be illuminated with energy efficient Sodium Vapour lamps mounted on 15 meter high towers, installed along the edge of the quarry. 2 Nos of 50 KVA transformers are provided for meeting the lighting loads of the quarry.

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- The power for lighting loads of roads, stores, workshop, Office etc., will be drawn from 315 KVA, 3.3 KV/440 V transformers installed at the Sub-station.

***Solar Panels are planned to cater the need of mine lighting.
Detail feasibility report is under preparation.***

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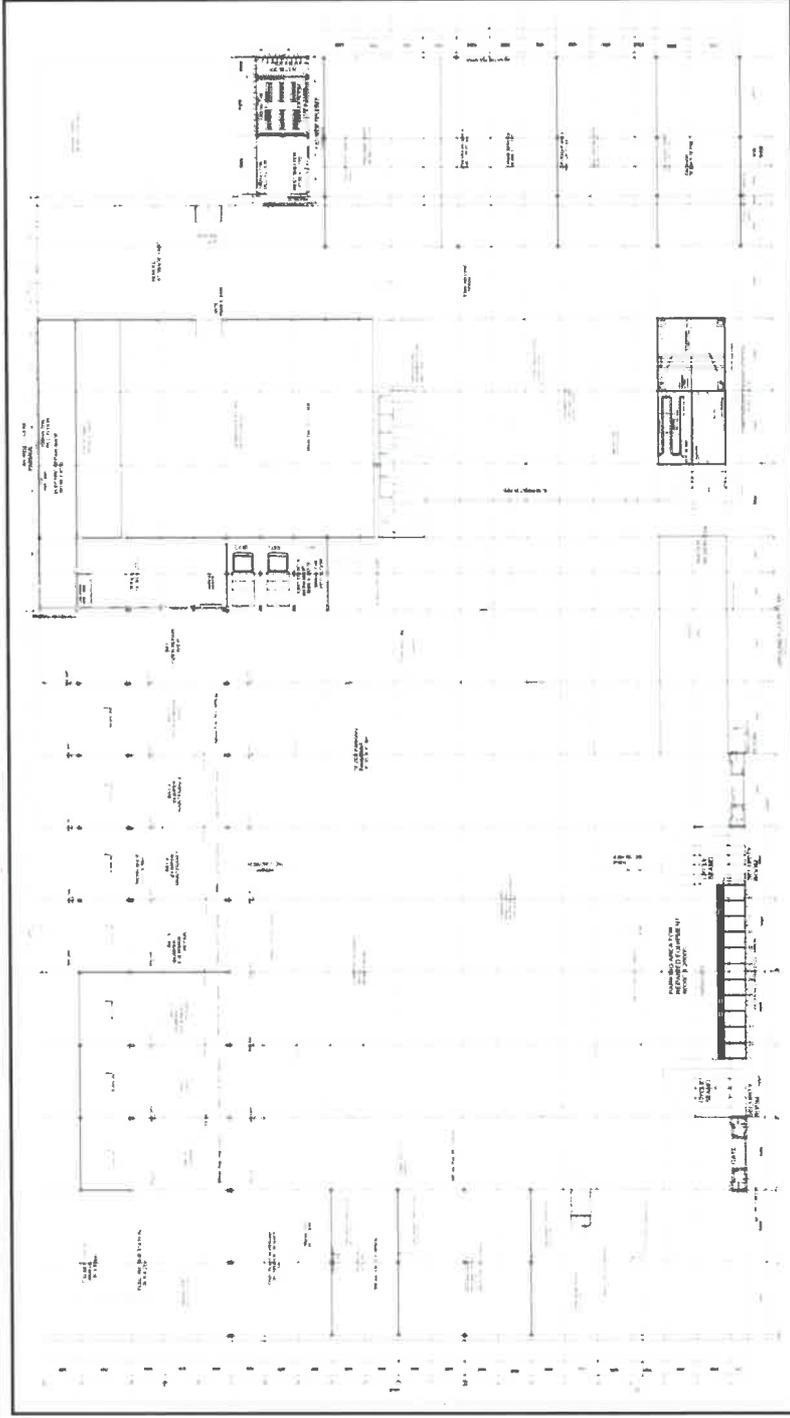


Figure No. 12.1: Typical Layout diagram for workshop in e mechanized mine.

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Chapter 13
Land Requirement



13.1 Mining Lease area:

The Barjora North Coal mine comprises of about 683.04 ha of land distributed over 6 nos. of villages. It administratively falls under the Barjora P.S of Bankura district, West Bengal.

13.2 Project Area:

This revised mining plan covers the whole leasehold area a project area of 683.04 ha. A village wise break up of 683.04 ha of leasehold area is being given below in table no. 13.1.

Table No. 13.1

Village wise break up of Proposed lease area, Barjora North Coal Mine.

All units are in ha.			
Village	Forest	Non Forest	Total
Baguli	0.00	36.27	36.27
Barapukhuria	13.47	88.17	101.64
Ghutgaria	24.25	116.23	140.48
Manohar	237.16	98.03	335.19
Sharjora	63.86	1.32	65.18
Tikargram	0.00	4.28	4.28
Total	338.75	344.29	683.04

All activities under this proposed plan will be restricted to the already granted leasehold area only.

At present, the project is having about 260.14 ha of land under executed lease which has been transferred after the issuance of the Vesting Order. Details of the leasehold area is furnished hereunder in Table No. 13.2.

Table No. 13.2

Village wise details of the leasehold area of 260.14 ha, Barjora North Coal Mine.

Village Name	Non Forest Land - ha	Total Land- ha
Baguli	29.29	29.3
Baraphukhuria	83.57	83.6
Ghutgoria	28.97	29.0
Manohar	114.43	114.4

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Village Name	Non Forest Land - ha	Total Land- ha
Saharjora	2.18	2.2
Tikargram	1.70	1.7
Total =	260.14	260.14

The present mining plan proposed to utilize about 683.04 ha of land of which 338.75 ha falls under Forest category. Besides the forest land, the project also involves about 84.15 ha of non forest land. Details of the non forest land needs to further add in the lease is given below in Table No. 13.3.

Table No. 13.3

Village wise details of the Non forest land to be included in the Lease of Barjora North Coal Mine.

Village Name	Private (in Ha)	Government (in Ha)	Additional Non-forest Land requirement (in Ha)
Ghutgoria	25.95	50.65	76.6
Sarjora	NIL	7.55	7.55
TOTAL	25.95	58.2	84.15

13.3 Present and Proposed Land use of the leasehold area:

At present, the leasehold area is having a mined out quarry areas, backfilled areas in the de-coaled sectors, mine infrastructure areas, and a soil and sub soil dump areas. The present land utilization pattern of the proposed lease area is given in table no. 13.4.

Table No. 13.4

Present Land Utilisation Pattern of Barjora North Coal Block.

Type	Present Land Use
Safety Zone area	8.59
Quarry Area	40.27
OB Dump with plantation	-
OB Dump without plantation	43.66
Top Soil Dump	5.75
Forest Area	338.75

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Water Bodies	1.89
Ponds	3.75
Nallah (Tartora)	11.53
Infrastructures	6.67
Other Establishment	34.82
Road	3.87
Haul Road	0.31
HT Row	4.33
Other Untouched (Barring Forest Zone)	178.87
Total area	683.04

Breaking up of fresh areas is envisaged during this plan period for coal production and OB removal. The land utilization pattern in pre-mining, during mining and post closure is provided in table no. 13.5.

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Table No. 13.5
Land Utilisation Pattern in pre-mining, during mining and post closure of Barjora North Coal Mine.

	Pre Mining Land Use "ha"	Type	Land Use during Mining	land use (End of Life)	Land Use (Post Closure)				Total			
					Agricultural Land	Plantation	Water Body	Public/ Company Use		Forest Land (Returned)	Undisturbed	
Tenancy	Agricultural Township	Excavation Area	609.66	-	95.07	100.02	-	-	216.23	-	431.32	
	Grazing	Backfilled Area	-	431.32	-	-	-	-	-	-	431.32	
	Barren	Excavated Void	-	178.34	95.07	100.02	-	-	216.23	-	178.34	
	Water Body	Without Plantation	-	-	75.82	75.82	-	-	192.52	-	178.34	
	Road	Top Soil Dump.	1.81	1.81	1.81	1.81	-	-	-	-	1.81	
	Community Inhabited	External Dump.	-	-	-	-	-	-	-	-	0	
	Village	Safety Zone/ Road Diversion.	8.59	8.59	8.59	8.59	-	-	-	-	8.59	
	Agricultural Township	Rationalisation Area.	0	0	0	0	-	-	-	-	0	
	Grazing/ Others	Road Diversion/ Below River / Nala / Canal.	11.27	11.27	11.27	11.27	-	-	-	-	11.27	
	Road	Road & Infrastructure area.	11.18	11.18	11.18	11.18	-	-	-	-	11.18	
Govt. Non Forest	Water Body	Gariand Drains.	2.25	2.25	2.25	2.25	-	-	-	-	2.25	
	Others.	Embankment.	0	0	0	0	-	-	-	-	0	
	Water Body	Green Belt.	-	-	-	-	-	-	-	-	0	
	Others.	Water Reservoir Near Pit/ Water Body.	-	-	-	-	-	-	-	-	0	
	Reserve Protected	UG Entry.	-	-	-	-	-	-	-	-	0	
	C.I.BJ	Pit Head Power Plant	-	-	-	-	-	-	-	-	0	
	Forest	Resettlement.	37.63	37.63	37.63	37.63	-	-	-	-	37.63	
	Field	Undisturbed / Mining Rights for UG.	0.65	0.65	0.65	0.65	-	-	-	-	0.65	
	Total	Others (Magazine, ETP, Access Trench etc.)	683.04	683.04	683.04	683.04	119.60	75.82	16.17	338.75	37.63	683.04

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Chapter 14

Environment Management Plan



14.0 General:

As per statutory stipulations of Ministry of Environment & Forests and Climate Change (MoEF& CC) it is mandatory to prepare Environmental Impact Assessment & Environmental Management Plan report and get its clearance for mining a coal block before commencement of any activities.

Environment Impact Assessment study and Environment Management Plan for total 927.50 ha of project area of Barjora North Coal Mine is already in place and the project has obtained Environmental Clearance from Ministry of Environment & Forest in the year 2008 vide their letter no. J-11015/312/2007-1A. II (M); dt 13/03/2008. The approved EIA/EMP also covers the leasehold area of 683.04 ha lease area. This revised mining plan is prepared for the leasehold area of 683.04 ha only. Impact assessment and mitigative measures are suggested in this mining plan section for the leasehold area of 683.04 ha.

Environment Impact Assessment study and Environment Management Plan for total 260.14 ha of non forest area of Barjora North Coal Mine is also already in place and the project has obtained Environmental Clearance from Ministry of Environment & Forest in the year 2018 vide their letter no. J-11015/90/2017-IA.II (M); dt 31st May, 2018.

14.1 Salient Features of the Leasehold area:

The mining activity in lease area of 683.04 ha shall be started by applicant on approval of this mining plan. This present Mining Plan envisages producing about 68.82 Mtes of coal and 240.50 Mcum of Overburden in the planned period of 25 years. Total area of operation will be limited within the leasehold area of 683.04 ha. Opencast Mining methodology will be followed with drilling & Blasting for Overburden excavation and Shovel-Dumper combination for OB removal. Coal winning will be done through Surface Miner.

In this present mining plan, dumping of waste has been planned partly over the existing internal dump, and partly in the mined out voids through concurrent backfilling. Final Mine Closure activities are envisaged post till 25th year along with 22 productive years.

The project site is undulating owing to the voids and dumps left after mining operation by previous lessee. The elevation of the site ranges from 70 m to 106 m amsl. The general slope of the site is from SW to NE.

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14.2 Baseline Information:

Environmental Impact assessment and Environment Management Plan is in place. Selective part of the report has been used in this mining plan for the description of environment, impact assessment and suggestive mitigative measures.

14.2.1 Existing Land Use:

The planned area of 683.04 ha is combined of forest and non forest land. The present land use of the leasehold area is given in the table no. 5.1 in previous chapter and is reproduced below in table no. 14.1.

Table No. 14.1
Present Land Use of the leasehold area.

Type	Pre Mining Land Use "ha"	
Tenancy	Agricultural	233.44
	Township	-
	Grazing	-
	Barren	0.065
	Water Body	55.88
	Road	3.15
	Community	-
	In-habitated	1.034
	Village	-
Govt. Non Forest	Agricultural	45.14
	Township	-
	Grazing/ Others	-
	Road	-
	Water Body	5.585
	Others.	-
Forest	Reserve	
	Protected	338.75
	CJBJ	
Free Hold		
Total =		683.044

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The project site covering an area of 683.04 ha is dominated by forest land covering about 49.59% (338.75 ha) of the project site. The other major landuse consists of 40.78 % (278.58 ha) of cultivated land of the project area.

14.2.2 Water Regime:

The water resources of the region are mostly covered by Damodar river and its tributaries. The main drainage is also controlled by Damodar River which flows at distance of around 5 km from the block boundary towards north. TartoraNala flowing almost along the central part of the block, flows in East north east direction. This nala has been proposed to be diverted in due course of time as suggested in the original approved mining plan. However, this nala will not affect in period of this mining plan.

The water quality was analysed in the report of “EIA of Barjora North Block” dated May, 2018. To assess the water quality of the area, ground water and surface water samples were collected and analysed from 4 sampling locations. The analysis was carried out in the laboratory and results are presented in table 14.3 and 14.4.

Surface water and Ground water samples were collected from the following places:

Table No. 14.2

Location of Surface water and Ground water collection

Station Code	Monitoring Station	Distance (km)	Direction
SW1	Damodar River	5.5	N
SW2	BarjoraNala	2	NE
SW3	Pond in Bathanbera	0.5	N
GW1	Maliara	1.5	NW
GW2	Ghutghoriya	1.0	E
GW3	Bathanbera	0.5	N
GW4	Barjora	4.0	ENE

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Ground water quality of the study area is depicted in Table no. 14.3 below.

Table No. 14.3
Ground water Quality of the Study Area

Sl. No.	Parameters	Unit	Code of Sampling Sites				IS 10500-2012	
			GW1	GW2	GW3	GW4	Acceptable limits	Permissible limits
			Maliara 1.5 km. NW	Ghutghoria 1.0 km. E	Bathanbera 0.5 km. N	Barjora 4.0 km. ENE		
Physical Parameters								
1	Color	Hazen	<5	<5	<5	<5	5	15
2	Turbidity	NTU	<1	<1	<1	<1	1	5
3	pH	-	8.1	7.5	6.7	7.7	6.5-8.5	NR
4	Conductivity	µS/cm	656	665	690	732	\$	\$
5	TDS	mg/l	439.52	445.55	462.3	490.44	500	2000
Chemical Parameters								
6	Alkalinity	mg/l	152.3	138	135.6	144.9	200	600
7	Total Hardness	mg/l	157.5	149.2	124.2	141.6	300	600
8	Calcium	mg/l	45	40	30	32	75	200
9	Magnesium	mg/l	11	12	12	15	30	100
10	Sodium	mg/l	38	45	43	41	\$	\$
11	Potassium	mg/l	11	19	17	14	\$	\$
12	Bicarbonate	mg/l	20.2	32.5	15.3	18	\$	\$
13	Chloride	mg/l	92.3	85.4	95.6	89.6	250	1000
14	Sulphate	mg/l	102.4	112	89.3	103.5	200	400
15	Nitrate	mg/l	1.9	1.3	1.1	2.9	45	NR
16	Fluoride	mg/l	0.91	1.02	0.65	0.88	1	1.5
17	Phenolic compound	mg/l	BDL	BDL	BDL	BDL	0.001	0.002

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Sl. No.	Parameters	Unit	Code of Sampling Sites				IS 10500-2012	
			GW1	GW2	GW3	GW4	Acceptable limits	Permissible limits
			Maliara 1.5 km. NW	Ghutghoriya 1.0 km. E	Bathanbera 0.5 km. N	Barjora 4.0 km. ENE		
18	Cyanide	mg/l	BDL	BDL	BDL	BDL	0.05	NR
19	Aluminum	mg/l	BDL	BDL	BDL	BDL	0.03	0.2
20	Arsenic	mg/l	BDL	BDL	BDL	BDL	0.01	0.05
21	Cadmium	mg/l	BDL	BDL	BDL	BDL	0.003	NR
22	Chromium	mg/l	BDL	BDL	BDL	BDL	0.05	NR
23	Iron	mg/l	0.49	0.21	0.85	0.65	0.3	NR
24	Copper	mg/l	BDL	BDL	BDL	BDL	0.05	1.5
25	Lead	mg/l	BDL	BDL	BDL	BDL	0.01	NR
26	Manganese	mg/l	BDL	BDL	BDL	BDL	0.1	0.3
27	Mercury	mg/l	BDL	BDL	BDL	BDL	0.001	NR
28	Zinc	mg/l	4.62	2.65	2.15	3.48	5	15

Ground Water Quality:

- **pH:** The data revealed that the pH value of ground water samples varied from 6.7 to 8.1. The water samples were slight acidic (GW3-Bathanbera) to slight alkaline in characteristic.
- **Conductivity:** Electrical conductivity of ground water ranged between 656 $\mu\text{S}/\text{cm}$ to 732 $\mu\text{S}/\text{cm}$. The maximum value of EC was observed in at GW4 (Barjora) and the minimum value found in the sample at village at GW1 (Maliara).
- **Hardness:** Hard water makes it difficult for domestic water users. Hardness is defined as the concentration of calcium and magnesium in water expressed as the equivalent of calcium carbonate (CaCO_3).

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Table No. 14.4

Surface water Quality of the Study Area.

Sl. No.	Parameters	Unit	SW1: Damodar River	SW2: Barjora Nala	SW3: Pond in Bathanbera
			5.5 km. N	2.0 km. NE	0.5 km. N
1	Color	Hazen	<5	<5	<5
2	Turbidity	NTU	<1	<1	<1
3	pH	-	6.89	7.8	7.9
4	Conductivity(at 25°C)	µS/cm	302	684.5	612.3
5	Total Dissolve Solids	mg/l	172	435	410
6	Alkalinity as CaCO ₃	mg/l	115	176.5	142.5
7	Total Hardness as CaCO ₃	mg/l	100.4	211.6	149.4
8	Calcium as Ca	mg/l	32	67.5	31.2
9	Magnesium as Mg	mg/l	5	10.5	17.4
10	Sodium	mg/l	25	37	32
11	Potassium	mg/l	9	10	12
12	Bi-Carbonate	mg/l	115	176.5	152.3
13	Chloride as Cl	mg/l	31	95.6	52.3
14	Sulphate as SO ₄	mg/l	28	15.2	35.6
15	Nitrate as NO ₃	mg/l	1.6	2.6	0.8
16	Fluoride as F	mg/l	0.65	1.08	0.46
17	Phenolic compound as C ₆ H ₅ OH	mg/l	BDL	BDL	BDL
18	Cyanide	mg/l	BDL	BDL	BDL
19	DO	mg/l	6.3	4.2	5.1
20	BOD	mg/l	5	6.5	4.7
21	COD	mg/l	15.2	9.6	10.9
22	Oil & Grease	mg/l	<5	<5	BDL
23	Arsenic	mg/l	BDL	BDL	1.1
24	Cadmium	mg/l	BDL	BDL	BDL
25	Total Chromium	mg/l	BDL	BDL	BDL
26	Iron	mg/l	1.22	1.05	BDL
27	Copper	mg/l	BDL	BDL	BDL

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Sl. No.	Parameters	Unit	SW1: Damodar River	SW2: Barjora Nala	SW3: Pond in Bathanbera
			5.5 km. N	2.0 km. NE	0.5 km. N
28	Lead	mg/l	BDL	BDL	2.3
29	Manganese	mg/l	BDL	BDL	2.1
30	Mercury	mg/l	BDL	BDL	71.9
31	Zinc	mg/l	BDL	BDL	27.4
32	Total Coliform	MPN/100ml	1063	1800	1725

Surface Water Quality:

- The pH of the sump water was found to be 7.9.
- Total suspended solids (96 mg/l) of the mine sump remains within the standard 100 mg/l.
- The biological oxygen demand and chemical oxygen demand concentration showed 22.9 mg/l and 115.7 mg/l respectively.
- The total Kjeldahl Nitrogen of the studied mine sump was 20.4 mg/l.
- Nitrate –Nitrogen and ammonical-nitrogen were 7.3 mg/l and 16.7 mg/l. Iron concentration of the mine sump of the study area was 1.8 mg/l.
- The concentrations of heavy metal (arsenic, chromium, cadmium, manganese) remained below detection limit. The fluoride concentration exhibited in mine sump water was 0.2 mg/l.

14.2.3 Air Regime:

While preparation of the environment Impact Assessment and Environment Management Plan for Barjora North Coal Project, one season data been obtained.

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Table No. 14.5
Air monitoring location of Barjora North Coal Mine.

Code	Name	Distance (km)	Direction	Selection Criteria
CAAQ1	Project Site	-	N	Upwind direction
CAAQ2	Project Site	-	S	Most predominant downwind direction
BAAQ1	Brindabanpur	6.5	NW	Pre-dominant upwind
BAAQ2	Ramkrishnapur	8	ENE	Least predominant upwind direction
BAAQ3	Gardardihi	8.5	SE	Dominant downwind direction
BAAQ4	Jangpur	6.5	NNW	Upwind direction
BAAQ5	Kulladihi	8	SW	Least predominant downwind direction
BAAQ6	Palasdanga	9	NNE	Pre-dominant upwind
BAAQ7	Radhakrishnapur	7.5	WSW	Settlement near ash pond of Mejia TPP
BAAQ8	Durgapur	7.5	NE	Least predominant upwind direction Major settlement
BAAQ9	Saharjora	2.5	S	Most predominant downwind direction
BAAQ10	Surya Alloy Industries	1	SE	Dominant downwind direction and industrial area
BAAQ11	Maliara	1.5	N	Major settlement Upwind direction
BAAQ12	Barjora	4	SE	Major settlement Dominant downwind direction

The summarized result of the AAQ monitoring is being furnished in table no. 14.6.

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Table No. 14.6

AAQ monitoring results of Barjora North Coal Mine.

Stations	Distance (km)	Direction	Units in $\mu\text{g}/\text{m}^3$					mg/m^3	
			PM ₁₀	PM _{2.5}	SO ₂	NO ₂	Pb	CO	
CAAQ1: Project Site	-	N	80.6	39.1	19.4	18.4	BDL	0.92	
CAAQ2: Project Site	-	S	126	53	14.6	19.2	BDL	0.88	
BAAQ1: Brindabanpur	6.5	NW	46.9	17.5	13.7	17.5	BDL	0.7	
BAAQ2: Ramkrishnapur	8	ENE	46.7	17.2	11.3	17.4	BDL	0.7	
BAAQ3: Gadardihi	8.5	SE	59	30	10.2	17.2	BDL	0.82	
BAAQ4: Jangpur	6.5	NNW	64.2	17.2	17.7	12.8	BDL	0.76	
BAAQ5: Kulladihi	8	SW	69.7	24.6	10.3	18.5	BDL	0.93	
BAAQ6: Palasdanga	9	NNE	69.1	24.3	16.4	18.2	BDL	0.93	
BAAQ7: Radhakrishnapur	7.5	WSW	51.9	18.7	10.6	19.2	BDL	1.02	
BAAQ8: Durgapur	7.5	NE	160	65	22.2	29.2	0.374	0.95	
BAAQ9: Saharjora	2.6	S	51.6	31	16.7	18.4	BDL	0.93	
BAAQ10: Surya Alloy Industries	1	SE	128	59.7	22.2	26.6	0.363	1.1	
BAAQ11: Maliara	1.5	N	72.5	29	14.2	26.6	0.7	0.7	
BAAQ12: Barjora	4	SE	103.3	44.7	26.8	53.4	1.2	1.2	
National Ambient Air Quality Standard									
Industrial, Residential, Rural & Other Areas			100**	60**	80**	80**	01**	04***	
Ecologically Sensitive Area (notified by Central Government)			100**	60**	80**	80**	01**	04**	

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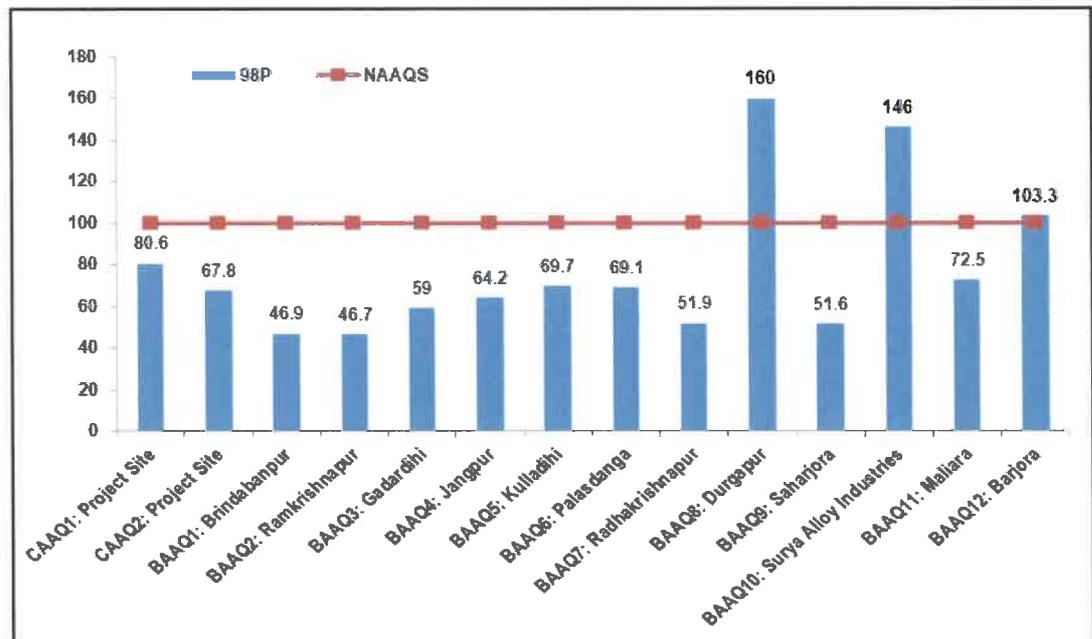


Figure No. 14.1: 98 Percentile of PM₁₀ in µg/m³

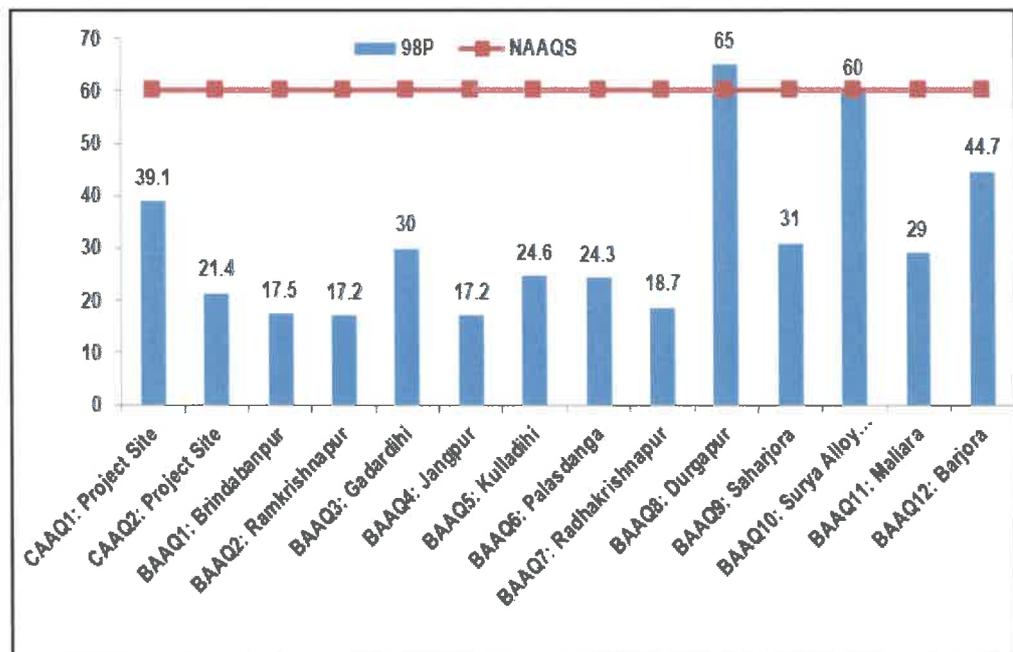


Figure No. 14.2: 98 Percentile of PM_{2.5} in µg/m³

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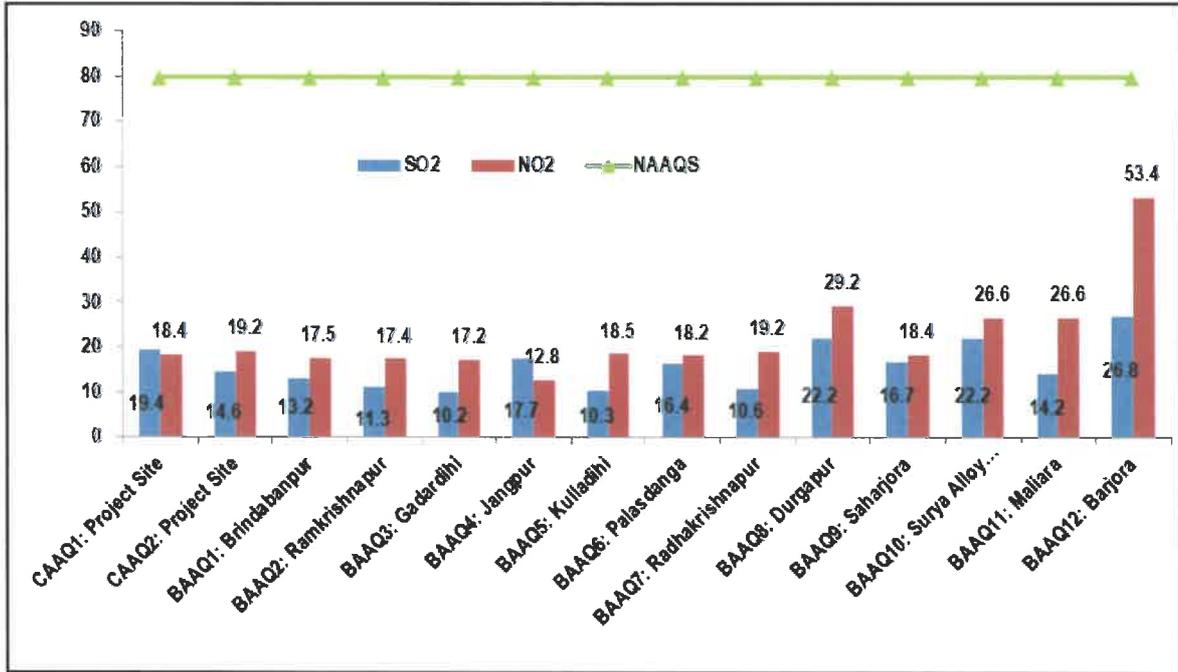


Figure No. 14.3: Percentile of Sulphur Dioxide (SO₂) & Nitrogen Dioxide(NO₂)in µg/m³

14.2.4 Ambient noise level:

Ambient noise monitoring done in ten locations at Barjora North Coal Mine.

Table No. 14.7
AAQ Monitoring stations

Station Code	Designation	Monitoring Station	Distance (km)	Direction
N1	CN1	Manohar (R)	0.1	N
N2	CN2	Ghutghoriya(R)	0.3	SE
N3	BN1	Brindabanpur(R)	6.5	NW

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Station Code	Designation	Monitoring Station	Distance (km)	Direction
N4	BN2	Ramkrishnapur(R)	8	ENE
N5	BN3	Gadardihi(R)	8.5	SE
N6	BN4	Jangpur(R)	6.5	NW
N7	BN5	Kulladiha(R)	8	SW
N8	BN6	Palasdanga(R)	9	NNE
N9	BN7	Radhakrishnpur(R)	7.5	WSW
N10	BN8	Durgapur (I)	7.5	NE

Detailed analysis of the noise reveals that there is no noticeable impact of noise in the surrounding environment. All the study sites in the residential areas exhibited a noise level well within the corresponding threshold limit value as prescribed by CPCB, both during day and night.

Table No. 14.8

Ambient Noise level data as per ELA- EMP of Barjora North Coal Mine.

Designation	Monitoring Station	Average Leq. value in dB (A)					
		Day			Night		
		Lmax	Lmin	Leq	Lmax	Lmin	Leq
CN1	Manohar (R)	52.3	41.3	48.3	36.2	31.3	34.3
CN2	Ghutghoriya(R)	49.9	40.2	46.4	35.3	29.1	32.5
BN1	Brindabanpur(R)	49.3	41.4	46.4	39.8	33.2	36.1
BN2	Ramkrishnapur(R)	53.8	39.3	50.3	38.9	34.5	37.5
BN3	Gadardihi(R)	53.9	41.8	50.8	44.5	32.1	39.3
BN4	Jangpur(R)	53.8	47.7	51.9	42.4	32.4	37.7
BN5	Kulladiha(R)	53.8	41.6	49.7	41.6	33.3	38.3
BN6	Palasdanga(R)	51.3	39.7	47.2	41.5	32.3	37.7
BN7	Radhakrishnpur(R)	53.4	42.1	49.4	41.5	30.7	36.2
BN8	Durgapur (I)	63.9	56.1	61.5	49.4	31.8	45.1

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Designation	Monitoring Station	Average Leq. value in dB (A)					
		Day			Night		
		Lmax	Lmin	Leq	Lmax	Lmin	Leq
Industrial Area				75			70
Commercial Area				65			55
Residential Area				55			45
Silence Zone				50			40

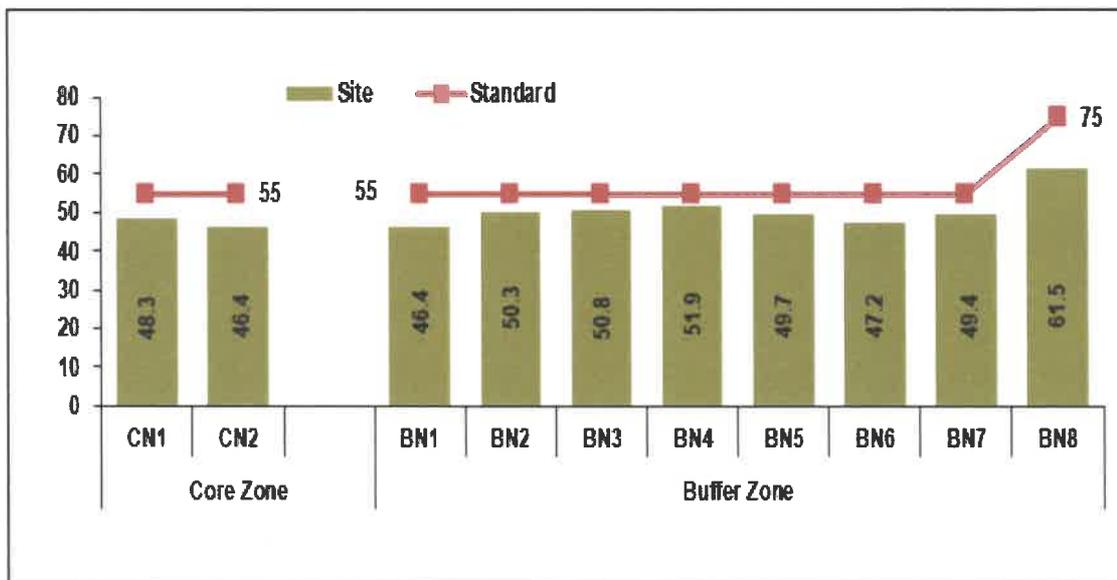


Figure No. 14.4: Leq during Day time versus prescribed Standard

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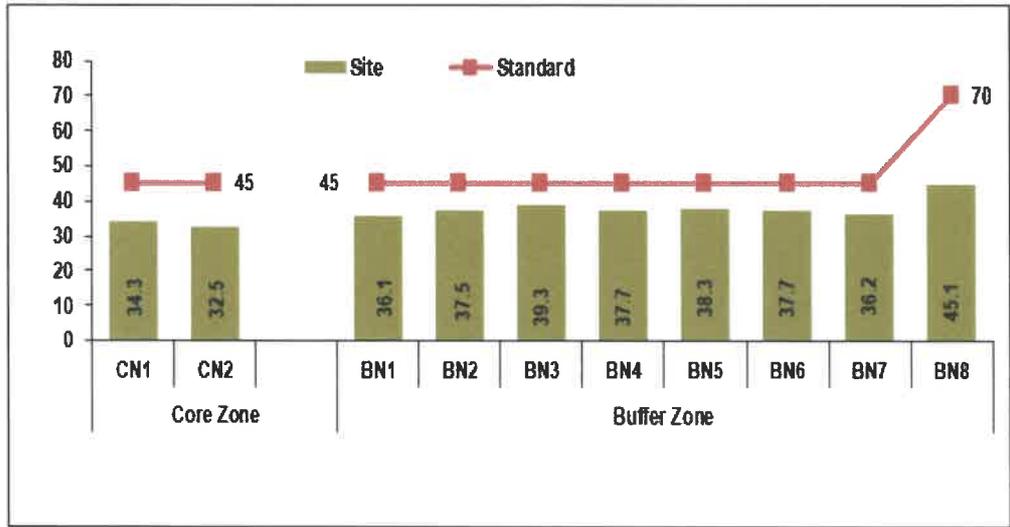


Figure No. 14.5: Leq during Night time versus prescribed Standard

14.2.5 Flora and Fauna:

Part of the core zone consists of forest area and vegetation growth is evident. Details of the flora and fauna list as described in the approved EIA- EMP report. However, the proposed area of operation in this modified period will be confined to the non forest area only.

14.2.6 Climatic Conditions:

Meteorological study of the area depicts the weather condition of a typical summer months and the climate of the area is dry humid and sub-tropical. It is characterized by hot and dry summer from March to May, rainy season from June to September, and winter spreading from November to February.

Winter temperature fluctuates between 15°C to 22°C and summer temperature fluctuates from 25°C to 43°C. Annual rainfall is around 1380 mm as described in the EIA- EMP report.

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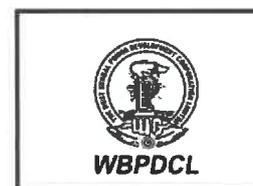


Table No. 14.9

Monthly and Yearly Rainfall Variations in Bankura District of West Bengal

YEAR	JAN		FEB		MAR		APR		MAY		JUN	
	R/F	%DEP										
2013	0.9	-93	15	-17	22.9	4	72.6	100	342.4	412	369.7	72
2014	0.8	-93	38.3	113	8	-64	3.3	-91	84.7	27	85.7	-60
2015	17.4	45	1.5	-91	7.1	-68	85.6	136	55.9	-16	152.2	-29
2016	6.1	-49	10.2	-43	15.6	-29	0.8	-98	101.3	51	175.1	-19
2017	0	-100	0	-100	16.9	-23	27.9	-23	76.3	14	228.8	6
YEAR	JUL		AUG		SEPT		OCT		NOV		DEC	
2013	289.8	-4	368.4	27	260.8	8	398	278	0	-100	0	-10
2014	313.7	3	323.4	11	164.1	-32	53.2	-49	0	-100	0.3	-97
2015	467.5	54	230.6	-21	96.5	-60	12.7	-88	0	-100	0.2	-98
2016	264.8	-13	445.5	53	268.9	11	46.9	-55	0.7	-93	0	-100
2017	634.2	109	330.4	14	186.1	-23	249.1	137	25.3	159	5.2	-45

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

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

Table No. 14.10

Monthly Temperature variations in Bankura District of West Bengal

	January	February	March	April	May	June
Avg. Temperature (°C)	19.20	21.80	27.10	31.20	31.60	31.10
Min. Temperature (°C)	12.40	14.90	19.80	24.10	26.10	26.40
Max. Temperature (°C)	26.10	28.70	34.50	38.40	37.10	35.80
Avg. Temperature (°F)	66.60	71.20	80.80	88.20	88.90	88.00
Min. Temperature	54.30	58.80	67.60	75.40	79.00	79.50

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(°F)						
Max. Temperature (°F)	79.00	83.70	94.10	101.10	98.80	96.40
Precipitation / Rainfall (mm)	11.00	20.00	16.00	27.00	75.00	182.00
	July	August	September	October	November	December
Avg. Temperature (°C)	28.90	28.70	28.70	27.10	22.90	19.60
Min. Temperature (°C)	25.70	25.60	25.30	22.80	16.90	13.00
Max. Temperature (°C)	32.10	31.90	32.20	31.50	29.00	26.30
Avg. Temperature (°F)	84.00	83.70	83.70	80.80	73.20	67.30
Min. Temperature (°F)	78.30	78.10	77.50	73.00	62.40	55.40
Max. Temperature (°F)	89.80	89.40	90.00	88.70	84.20	79.30
Precipitation / Rainfall (mm)	247.00	202.00	191.00	83.00	10.00	3.00

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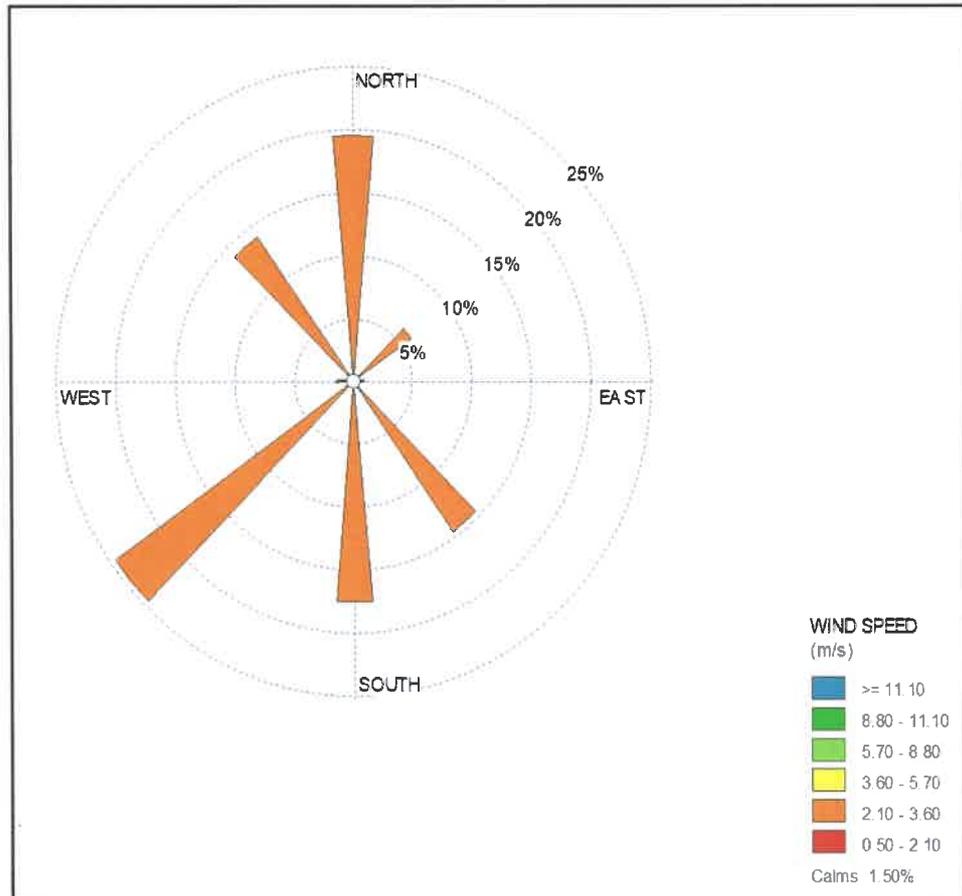


Figure No. 14.6: Annual Wind Rose

Generally light breeze prevails throughout the year. The dominant wind direction throughout the year is from SW to NE. The wind-speed was found to be highest during the summer and monsoon months with the average wind speed of 2.14 m/s.

The region has reasonably moist climate except with an average value of 72% during morning and the summer season is the driest part of the year when humidity levels go below 30% especially during March and April. July to September, being the rainiest months, experience humidity level of 73% to 82% respectively in the daytime.

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14.2.7 Human Settlements:

The proposed mining area within the leasehold of 683.04 ha doesn't have any human settlement as prior allottee already completed R & R as per approved plan. However, if any R & R is found to be implemented in due course, WBPDC shall be implementing as per approved R & R plan.

14.2.8 Historical monuments:

There are no historical monuments and archaeological sites within the proposed area of operation.

14.3 Environmental Impact Assessment:

An essential step in Environmental Impact assessment (EIA) is to identify all potential environmental impacts (both beneficial and adverse), resulting from project activities. Assessed impacts due to project activities are discussed herewith.

14.3.1 Impact on land use:

Part of the leasehold area of 683.04 ha has already broken for mining activities by prior allottee. Detail of the existing land use pattern of the lease area discussed in table no. 14.1. During this planned period, further area will be added under quarry while part of the mined out areas will be backfilled. Post production mine will undergo final closure activities. The production operation will be suspended at the end of 22nd year while closure activities will be continued till end of 25th year. A detail land utilization pattern in pre mining stage, during mining and post closure phase is shown in table no. 14.11.

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Table No. 14.11

Land Utilisation pattern in pre-mining, during mining and post mining stages at Barjora North Coal Mine.

	Pre Mining Land Use "ha"	Type	Land Use during Mining	Land use (End of Life)	Land Use (Post Closure)				Total	
					Agricultural Land	Plantation	Water Body	Public/ Company Use		Forest Land (Returned)
Tenancy	233.44	Excavation Area	609.66	-	-	-	-	-	-	-
	-	Backfilled Area	-	431.32	95.07	100.02	-	-	236.23	431.32
	-	Excavated Void	-	178.34	-	-	75.82	-	102.52	178.34
	0.065	Without Plantation	-	-	-	-	-	-	-	0
	55.88	Top Soil Dump.	1.81	1.81	-	1.81	-	-	-	1.81
	3.15	External Dump.	-	-	-	-	-	-	-	0
	-	Safety Zone/Rationalisation Area.	8.59	8.59	-	8.59	-	-	-	8.59
	1.024	Road Diversion.	0	0	-	-	-	-	-	0
	-	Diversion/ Below River / Nala / Canal.	11.27	11.27	-	-	-	11.27	-	11.27
	45.14	Road & Infrastructure area.	11.18	11.18	-	9.18	-	-	-	11.18
Govt Non Forest	-	Garland Drains.	2.25	2.25	-	-	-	-	-	2.25
	-	Embankment.	0	0	-	-	-	-	-	0
	-	Green Belt.	-	-	-	-	-	-	-	0
	5.585	Water Reservoir Near Pit/ Water Body.	-	-	-	-	-	-	-	0
Forest	-	UG Entry.	-	-	-	-	-	-	-	0
	-	Pit Head Power Plant	-	-	-	-	-	-	-	0
	338.75	Reserve Protected	-	-	-	-	-	-	-	0
	-	Resettlement.	37.63	37.63	-	-	-	-	-	37.63
	-	Undisturbed / Mining Rights for UG.	0.65	0.65	-	-	-	-	-	0.65
Free Hold	-	Others (Magazine, ETP, Access Trench etc.)	-	-	-	-	-	-	-	0
	683.044		683.04	683.04	95.07	119.60	75.82	16.17	338.75	683.04

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14.3.2 Impact on water quality:

Washing of coal has not been envisaged in this project. Thus pollution of surface water from the effluent discharged from washery gets ruled out.

The major sources of water pollution due to mining activities will be as follows:

- Generation of industrial effluent water from workshops.
- Mine discharge water to be pumped out from opencast.
- Washouts from Overburden, coal stockpile etc.
- Domestic effluents from office and townships.

At the end of the mine life, water body will be created in the left out voids and will be utilized for community use.

14.3.3 Impact on Surface water Regime:

The proposed mining area contains TartoraNala which has been planned for diversion. Suitable diversion scheme will be opted after detail study. However, a conceptual plan has been furnished in **Plate No. XVIII**.

14.3.4 Impact on Air Environment:

The integrated mining operations in the leasehold area are likely to result in deterioration of air quality due to pollution arising from the operations. The principal sources causing air pollution in the area, i.e generation of dust due to mining and allied activities are envisaged as:

- Drilling and blasting operation.
- Loading and unloading operation.
- Movement of HEMM, such as shovels, dumpers etc.
- Overburden/coal transportation.
- Wind erosion of dumps.

14.3.5 Vibration Levels (due to blasting)

Blasting pattern has been designed to minimize vibration levels. However, vibration levels will be studied once the blasting is done in the lease area to know the actual impacts and mitigation measures would be taken up accordingly.

14.3.6 Impact on socio economics:

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As there is no involvement of R & R, socioeconomic impact will be only on the positive side by generating direct and indirect employment. Local people will be benefited due to implementation of this project.

Local people were benefited during the earlier mining operations carried out by prior allottee. Resuming of mining operation will be beneficial to the local community.

14.4 Environmental Management Plan:

To maintain ecological balance & to check harmful effects due to mining and allied activities, environmental control measures must be taken to safeguard clean environment in process of mining.

14.4.1 Storage & preservation of Top soil:

To minimize adverse impacts on land, reclamation of degraded area should be resorted to. To achieve the same, top soil will be excavated and segregated separately. Top soil will be scrapped by dozer before the ground preparation for infrastructure or drilling and blasting or OB dumping is undertaken. Scrapped top soil will be transported to the top soil storage area designated in the north eastern corner of the leasehold area. As and when backfilled areas and main dump areas will be stabilized, the stored top soil will be spread over the dump to facilitate plantation and assist early bio-reclamation. Year wise top soil generation is furnished in table no. 14.12.

Table No. 14.12

Stage Wise Top Soil Generation.

Year / Stage	Cumulative OB Removal		
	Top Soil	OB	Total
Y-1	0.791	10.710	11.500
Y-3	0.932	33.569	34.500
Y-5	1.553	55.948	57.500
Y-10	3.105	111.895	115.000
Y-15	4.658	167.843	172.500
Y-20	6.008	216.493	222.500
Y-22	6.494	234.007	240.500

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14.4.2 Proposal for reclamation of land affected by mining activities:

This mining plan is modified in nature and final layout of the dumps in a totality has been worked out. Within this period, stage dumping will be continued to be taken up in the existing dumping ground and part of the mined out areas will backfilled concurrently. Efforts were made to keep the dumps around ground level for technical and biological reclamation at the end of the period, dumping ground will be converted to agricultural and plantation areas. Land reclamation will fully be done except the areas where water harvesting will be carried out in the post closure period. Few infrastructure areas will be handed over the society for public use. Details of the land reclamation are given in table no. 14.13.

Table No.14.13

Details of stage wise Land Degradation and Technical Reclamation at Barjora North Coal Mine.

Stage/ Year		Land Degraded (ha) - Cumulative				Technically Reclaimed Area (ha) - Cumulative			
		Excavation	Dump (External + Top Soil)	Infra/ Others	Total	Backfill	Dump (External + Top Soil)	Infra/ Others	Total
Stage-1	2019-20	133.31	2.40	33.94	169.65	35.03			35.03
Stage-3	2021-22	129.61	5.13	33.94	168.68	57.43			57.43
Stage-5	2023-24	147.31	5.13	33.94	186.38	82.69			82.69
Stage-10	2028-29	220.29	5.13	33.94	259.36	104.52			104.52
Stage-15	2033-34	365.01	5.13	33.94	404.08	145.41			145.41
Stage-20	2038-39	539.21	1.81	33.94	574.96	373.46			373.46
Final Stage	2040-41	609.66	1.81	33.94	645.41	431.32			431.32
Post Closure									
Closure (+ 3 Years)	2043-44	609.66	1.81	33.94	645.41	431.32	1.81	212.28	645.41

A comprehensive Stage Wise biological reclamation is furnished below in table no. 14.14.

Table 14.14

Comprehensive Stage Wise Plantation Plan, Barjora North Coal Mine.

Stage/ Year		Biologically Reclaimed Area (ha) - Cumulative					Forest Land (Return)	Undisturbed/ To be left for Public/ Community Use	Total
		Agriculture	Plantation	Water Body	Public/ Company Use	Total			
Stage-1	2019-20	-	-	-	-	0	-	-	0
Stage-3	2021-22	-	-	-	-	0	-	-	0
Stage-5	2023-24	-	-	-	-	0	-	-	0
Stage-10	2028-29	-	-	-	-	0	-	-	0
Stage-15	2033-34	-	35.70	2.50	-	38.2	-	-	38.2
Stage-20	2038-39	-	45.72	2.50	-	48.22	-	-	48.22
Final Stage	2040-41	95.07	56.50	2.50	-	154.07	-	-	154.07
Post Closure									
Closure (+ 3 Years)	2043-44	95.07	119.6	75.82	16.17	306.66	338.75	37.63	683.04

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14.4.3 Management of Water regime:

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

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

14.4.4 Management of air quality:

During the mining operations, impact on air quality will be effectively controlled both by preventive and suppressive measures listed below:

- Usage of drill bits of good conditions.

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- Wet drilling to prevent dust generation.
- Well designed blast by effective stemming and use of milli second delay detonators – every blast should be properly designed to see that the optimum breakage occurs without generating fines.
- Avoiding blasting during high wind period.
- Conducting muffled blasting to avoid disturbances.
- Proper maintenance of haul roads.
- Development of extensive green belts/barriers around the mine, coal handling plants, workshops, along the roads, periphery of the mine, OB dumps etc.

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

14.4.5 Protective measures for ground vibration likely by blasting:

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

14.4.6 Socio-Economic benefits arising out of the project:

The activities involved in mining the proposed leasehold area will generate employment potential both directly and indirectly. Local people have employment opportunities as skilled, semi skilled and unskilled labourers. Resuming the mining operation at Barjora North will improve the socio economic conditions of the area. With the continuation of mining operation, employment opportunities, communication, medical facilities, schooling etc. will be improved further.

14.4.7 R & R Activities:

Prior allottee has already implemented R & R as per approved plan. However, if any further R & R is involved, WBPDCCL shall implement R & R as per approved plan.

14.4.8 CSR Action Plan:

At present, the West Bengal Power Development Corporation Limited is preparing a comprehensive CSR action plan for the area. This plan involves the activities as listed:

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- ❖ Improvement in medical and health care system.
- ❖ Improvement un-educational services.
- ❖ Infrastructural betterment through better roads, lighting and communicational systems.
- ❖ Betterment of drinking water facilities.
- ❖ Vocational training facilities for local eligible youth of local community to enable them to seek employment in suitable project operations and elsewhere.
- ❖ Improvement in irrigational facilities.

14.5 Monitoring schedule for the environmental activities:

The efficacy of management of environmental attributes, e.g- air, water, land and social activities is assessed by monitoring schedule for these components of environment. The physical attributes e.g. air, water, noise, etc. shall be guided by CPCB/SPCB norms and permissions. Progress on social upliftment shall be monitored by a team of project people, land losers, and other local representatives of the area.

A tentative monitoring schedule is furnished in table no. 14.15 below.

Table No. 14.15

Monitoring Schedule

Aspect	Parameter	Location	Monitoring & Frequency
Meteorology	Wind speed & direction, temperature, rainfall and Humidity	Continuous at project site	Continuous hourly monitoring
Ambient Air Quality	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ and CO	-One location at site	Fortnightly 24 hrs at each station.
		-One nearest settlement in downwind direction	
		-One at nearest densely populated area	
Surface Water Quality	Physical, chemical and biological parameters including heavy metals	-Mine sump	Once in three months
		-Upstream & downstream of nearest water body	

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Aspect	Parameter	Location	Monitoring & Frequency
Ground Water Quality and level	Physical, chemical and biological parameters including heavy metals	2 locations around waste storage location	Once in three months
		·Project Site	
		·Nearest village	
		Ground water level from these sites will be measured through Peizometers.	
Liquid Effluents	Physical, chemical and biological parameters	Input and output of ETP	Once in every week
Noise Level	Noise	<ul style="list-style-type: none"> • Inside the mines pit and administrative building 	Once in a three months
		<ul style="list-style-type: none"> • Road in nearest settlement through which coal will be transported 	
Soil	Physical and chemical parameters with organic content	Two location near to OB dump area and coal stack yard	Once in three months
Ecology	Visual Impact on flora and fauna	10 km radius from the project site	Once in a year
Tree Plantation	Survival rate of tree saplings	Tree plantation locations	Yearly
Social Profile	Disease monitoring and social audit	Study Area (10 km radius)	Yearly

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Chapter 15

Progressive Mine Closure Plan

Chapter-15-Mine Closure Plan



15.1 Introduction:

Final Mine closure plan in support with the Approved Mining Plan comprising 927.50 ha of project area for Barjora North Coal Mine has been approved by Ministry of Coal, vide their letter no. 34011/26/2016-CPAM; dt. 8.11.2016.

The mine closure plan covering the progressive and final closure for Barjora North Coal Mine covering 683.04 ha of lease area is discussed herewith as part of the revision 2 of this mining plan.

15.1.1. Owner (Proponent):

Barjora North Coal mine (683.04 ha lease area) is owned by M/S "The West Bengal Power Development Corporation Limited (WBPDC)". It is a Government of West Bengal undertaking. It has an existing installed capacity of 4860 MW with 5 (five Nos.) thermal power station.

15.1.2 Location:

The proposed coal mine is located in 6 (six) revenue villages of Barjora Tehsil in Bankura district of State of west Bengal. details are covered in chapter-3.

15.1.3 The present land use of the lease area:

The lease area covering 683.04 ha has following land uses in present stage. A total 338.75 ha of forest land is involved. Details of present land uses are given hereunder in table no. 15.1. All project activities are covered within this lease area of 683.04 ha.

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Table No. 15.1
Pre-mining land use of the leasehold area.

	Pre Mining Land Use "ha"	
Tenancy	Agricultural	233.44
	Township	-
	Grazing	-
	Barren	0.065
	Water Body	55.88
	Road	3.15
	Community	-
	Inhabitated Village	1.034
		-
Govt. Non Forest	Agricultural	45.14
	Township	-
	Grazing/ Others	-
	Road	-
	Water Body	5.585
	Others.	-
Forest	Reserve	
	Protected	338.75
	CJBJ	
Free Hold		
Total project area in Ha		683.04

Present mining operation will also be confined in this leasehold boundary which forms lease for the proposed project area.

15.1.4 Likely Reasons for closure:

The mine is planned to be closed only after the exhaustion of recoverable coal reserves.

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However, the following can be envisaged as some of the likely possible circumstances which may lead to premature closure of the mine:

- Safety: “ Mine” may have to be closed down, under order of DGMS, on account of unexpected adverse geo-technical condition which may make continuation of the mining operations unsafe.
- Economy: “Mine” may be require to be closed down on account of some change in the economic environment at national/ international level.
- Regulatory and Policy issues: “ Mine” may have to be closed down on account of Environmental and other regulatory considerations where the proponent is directed to do so by the concerned Govt. authorities.
- Social Pressure: “ Mine” may be forced to be closed down on account of disturbances caused by the anti social elements and the situations may go beyond the control of administrative machinery of the State Govt. with complete breakdown of the law and order.
- Force Majeure: “ Mine” may closed down on occurrences of circumstances leading to Force Majeure. These causes or circumstances could include acts of god, acts of war, hostilities (whether war be declared or not), blockage, invasion, insurrection, military or usurped power, riot, lockout, sabotage, restrictions in the use of power and other causes beyond the reasonable controls of the project authority.

Nevertheless, in the present scenario, in this planned mine, we do not foresee any of the above circumstances leading to mine closure operations. However, this conceptual Mine Closure Plan would be able to guide the closure

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activities even for such unforeseen situations and would help to tide over the problem.

15.1.5 Statutory Obligation:

At present this proposed mine with 683.04 ha of project area, is having all the requisites statutory clearances which include the followings:

- i. A vesting order from NA, MOC (Furnished in **Annexure I**).
- ii. Approved Revised mining plan (Furnished in **Annexure IVB**).
- iii. Environmental Clearance from MOEF & CC (Furnished in **Annexure XIX**).
- iv. Opening permission from CCO, GoI (Furnished in **Annexure XVIII A**).
- v. DGMS permission for deep hole blasting (Furnished in **Annexure XVIII D**).
- vi. CTE & CTO from State Pollution Control Board (Furnished in **Annexure XVIII B & XVIII C**).
- vii. Explosive license (Furnished in **Annexure XVIII E**).

The second revision of this mining plan is being submitted for approval which includes the involvement of forest land. Once this mining plan is approved, M/S WBPDC will apply for Stage-I forest Clearance to MOEF & CC. On obtaining the Forest Clearance, Environmental clearance will be obtained.

However, the applicant, M/S WBPDC hereby undertakes to comply with all the statutory obligations which would arise after grant of various

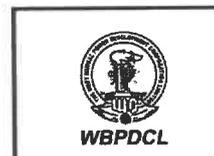
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permissions/clearances to the applicant (WBPDCCL) for running this mine. The compliance status of the various statutory obligations other than the Mining Plan approvals (discussed in chapter-2 of this document) related to Barjora North Coal Mine are furnished below.

- a. Compliance status to the conditions in the Lease Deed signed with the state Government, West Bengal.

S. L. No.	Conditions	Compliance Status
1	No building or thing shall be erected, set up or placed and no surface operations shall be carried on in or upon any public pleasure ground, burning or burial ground or place held scared by any class of persons or any house or village site, public road or other place which the state government may determined as public ground nor in such case a manner as to insure or prejudicially effect any buildings works property or rights of other persons and no land will be used for surface operations which is already occupied by persons other than the state government for works or purposes not included in this lease. The lease shall not also interfere with any right of way, well or tanks.	Shall be complied.
2	Before using for surface operations any land which has not already been used for such operations, the lessee shall give to Deputy Commissioner/ Collector of the District two calender months previous notice in writing specifying the name or other description of the situation and the extent of the land proposed to be so used if objection is issued by the Deputy Commissioner/ Collector within two months after the receipt by him of such notice unless the objections so stated shall on reference to the State Government be annulled or waived.	Shall be complied.

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S. L. No.	Conditions	Compliance Status
3	The lessee shall not without the express sanction of the Deputy Commissioner / Collector cut down or injure any timber or trees on the said lands but may without such sanction clear away any brushwood or undergrowth which interferes with any operations authorised by these presents. The Deputy Commissioner / Collector or the State Government may require the lessee to pay for any trees or timber felled and utilised by him/them at the rates specified by the Deputy Commissioner / Collector of the District.	Shall be complied.
4	Notwithstanding anything in this Schedule contained the lessee/lessees shall not enter upon any reserved forest included in the said lands without previous sanction in writing of the District Forest Officer nor fell, cut and use any timber or tree without obtaining the sanction in writing of that Officer nor otherwise than in accordance with such conditions as the State Government may prescribe.	Shall be complied.
5	The lessee shall allow existing and future holders of Government licenses or leases over any land which is comprised in or adjoins or is reached by the land held by the lessee reasonable facilities of access thereto:	Shall be complied.
	PROVIDED THAT no substantial hindrance or interference shall be caused by such holders of licenses or lease to the operations of the lessee/lessees under these presents and fair compensation (as may be mutually agreed upon or the event of disagreement as may be decided by the State Government) shall be made to the lessee/lessees for loss or damage sustained by the lessees by reason of the exercise of this liberty.	Shall be complied.

b. Compliance status to the conditions laid down in the Notice of DGMS Permission are as follows:

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SL. NO.	CONDITIONS	Compliance Status
1	No working shall be extended to any point within 45 m of structures / buildings not belonging to M/s West Bengal Power Development Corporation Ltd, or any public road / Railway / HT electric line & structures supporting them unless permission, as required under the provisions of Regulation 105 (1) of the Coal Mines Regulations, 1957, has been obtained from this Directorate.	Shall be complied with.
2	Opencast workings shall not be extended to any area which is not fully acquired by the owner of the mine.	Shall be complied with.
3	No blasting shall be carried out with more than 2 kg of explosives per hole / delay, if permanent building or structure of permanent nature not belonging to M/s West Bengal Power Development Corporation Ltd. lies within 300 m (danger zone) without obtaining permission for the same under regulation 170 (1B) of the Coal Mines Regulations, 1957.	Shall be complied with.
4	No Site Mixed Slurry / Emulsion explosive along with other primer / booster explosive shall be used in blasting without obtaining permission under regulation 168 (5) and 161 (1) of the Coal Mines Regulations, 1957.	Shall be complied with.
5	To prevent danger from the flying fragments from blasting, precautions as prescribed in Regulation 170 (1A) of the Coal Mines Regulations, 1957 shall be strictly complied with.	Shall be complied with.
6	Water tanks and discontinued waterlogged opencast workings, if any, lying within the precincts of the OCP shall be filled up and kept free of accumulation of water or any	Shall be complied with.

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	other material likely to flow when wet.	
7	Garland drains of adequate size shall be provided on the surface on the periphery of the opencast workings to divert rain water from flowing down the slopes. The drains shall be made impervious to minimize seepage of water through the strata. Workings in an area shall be stopped when there is abnormal seepage of water through the strata and this Directorate shall be informed about the same.	Shall be complied with.
8	Owners of structures and dwellings and land, not belonging M/s West Bengal Power Development Corporation Ltd, and habitants / occupants of such dwellings / buildings shall be indemnified against damage to property / injury to persons, if any, arising out of mining operations.	Shall be complied with.
9	In addition to the deployment of required statutory personnel in the mine as required under the Coal Mines Regulations, 1957, the opencast workings shall be placed under the charge of an Assistant Manager during every working shift, who shall be responsible to see that all the regulations and orders made there under are complied with.	Shall be complied with.
10	Each and every operation in the mine, including operations carried out through contractor or outside agency, shall be placed under the charge of a competent supervisor, duly appointed and authorized by the manager, with his jurisdiction being clearly demarcated.	Shall be complied with.
Besides the above conditions, restrictions specified for the contractual services will be strictly adhered.		

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c. Compliance status to the conditions laid down in the Notice of CCO Permission are as follows:

S. L. No.	Conditions	Compliance Status
1.	Uninterrupted meaning in the proposed region keeping conservation of all underlying overlying virgin Developed seams in view must be ensured.	Shal be complied with.
2.	Before starting mining operation, surface right on the proposed area of working must be ensured.	Shal be complied with
3.	The mining company shall take all necessary precautions regarding safety of mine workings, persons deployed therein and also guard against dangers from inundation, fire, gas, roof side fall etc.	Shal be complied with
4.	All mining operations must be restricted within the limits bounded on the working plan. CB is to be dumped as per approved plan. In due course, any permission / relaxation is required under the Mines Act, 1952 and the Coal Mines Regulation, 2017, the same shall be obtained by the project proponent from the DGMS.	Shal be complied with
5.	The date of production from the above seams shall be communicated forthwith. Periodical information on production, dispatch, stock etc. as the case may be, should be submitted by the owner of the mine to the office of Coal Controller as and when required.	Shal be complied with
6.	All the conditions of Escrow Account agreement as per the approved Mine Closure Plan (progressive and final submitted to Coal Controller should be strictly complied.	Shal be complied with

d. Compliance conditions laid down in the Environmental Clearance of Barjora North Coal Mine.

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(a) Mining:		
(i)	Mining shall be carried out under strict adherence to provisions of the Mines Act 1952 and subordinate legislations made there-under as applicable.	Complied with.
(ii)	No change in mining method, calendar programme and scope of work shall be made without obtaining prior approval of the Ministry of Environment, Forest and Climate Change.	Mining Methodologies being followed as per Mining Plan and EC conditions. Actual mining operation commenced on June, 2018.
(iii)	Mining shall be carried out as per the approved mining plan including Mine Closure Plan, abiding by mining laws related to coal mining and the relevant circulars issued by Directorate General Mines Safety (DGMS).	Complied with. Mining activities are mostly abided by the Coal Mines Regulation, 2017 and other conditions as prescribed in the Mining Plan and EC.
(iv)	No mining shall be carried out in forest land without obtaining Forestry Clearance as per Forest (Conservation) Act, 1980 and also adhering to The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of	Presently mining is being carried out in the Leasehold Non Forest Area only.

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	Forest Rights) Act, 2006 read with provisions of Indian Forest Act, 1927.	
(a) Mining:		
(iii)	Conditions	Compliance Status
(iv)	Mining shall be carried out under strict adherence to provisions of the Mines Act 1952 and subordinate legislations made there-under as applicable.	Complied with.
(v)	No change in mining method, calendar programme and scope of work shall be made without obtaining prior approval of the Ministry of Environment, Forest and Climate Change.	Shall be complied with.
(iii)	Mining shall be carried out as per the approved mining plan including Mine Closure Plan, abiding by mining laws related to coal mining and the relevant circulars issued by Directorate General Mines Safety (DGMS).	Shall be complied with.
(iv)	No mining shall be carried out in forest land without obtaining Forestry Clearance as per Forest (Conservation) Act, 1980 and also adhering to The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 read	Shall be complied with.

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	with provisions of Indian Forest Act, 1927.	
(b) Land reclamation and water conservation:		
(i)	Digital Survey of entire lease hold area/core zone using Satellite Remote survey shall be carried out at least once in three years for monitoring land use pattern and report in 1:50,000 scale shall be submitted to Ministry of Environment, Forest and Climate Change/Regional Office (RO).	Shall be complied with.
(ii)	The surface drainage plan including surface water conservation plan for the area of influence affected by the said mining operations, considering the presence of river/rivulet/pond/lake etc. shall be prepared and implemented by the project proponent. The surface drainage plan and/or any diversion of natural water courses shall be as per the approved Mining Plan/EIA/EMP report and with due approval of the concerned State/Gol Authority. The construction of embankment to prevent any danger against inrush of surface water into the mine should be as per the approved Mining Plan and as per the permission of DGMS.	Shall be complied with.
(iii)	The final mine void depth should preferably be as per the approved Mine Closure Plan, and in case it exceeds 40 m, adequate engineering interventions shall be provided for sustenance of aquatic life	Shall be complied with.

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	therein. The remaining area shall be backfilled and covered with thick and alive top soil. Post-mining land be rendered usable for agricultural/forestry purposes and shall be handed over to the respective state government as specified in the guidelines for Preparation of Mine Closure Plan issued by the Ministry of Coal dated 27 th August, 2009 and subsequent amendments.	
(iv)	The entire excavated area, backfilling, external OB dumping (including top soil) and afforestation plan shall be in conformity with the “during mining”/“post mining” land-use pattern, which is an integral part of the approved Mining Plan and the EIA/EMP submitted to this Ministry. Progressive compliance status vis-a-vis the post mining land use pattern shall be submitted to the Ministry of Environment, Forest and Climate Change/Regional Office on six monthly basis.	Shall be complied with.
(v)	The top soil shall temporarily be stored at earmarked site(s) only and shall not be kept unutilized for long. The top soil shall be used for land reclamation and plantation purposes. Active OB dumps shall be stabilised with native grass species to prevent erosion and surface run off. The other overburden dumps shall be vegetated with native flora species. The excavated area shall be backfilled and afforested in line with the approved Mine Closure Plan.	Complied with. Top soil so far generated is stored separately in the designated area.

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	Monitoring and management of rehabilitated areas shall continue until the vegetation becomes self-sustaining. Compliance status shall be submitted to the Ministry of Environment, Forest and Climate Change/ Regional Office on six monthly basis.	
(c) Emissions, effluents, and waste disposal		
(i)	Transportation of coal, to the extent permitted by road, shall be carried out by covered trucks/conveyors. Effective control measures such as regular water/mist sprinkling/rain gun etc. shall be carried out in critical areas prone to air pollution (with higher values of PM ₁₀ /PM _{2.5}) such as haul road, loading/unloading and transfer points. Fugitive dust emissions from all sources shall be controlled regularly. It shall be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central/State Pollution Control Board.	Shall be complied with.
(ii)	Greenbelt consisting of 3-tier plantation of width not less than 7.5 m shall be developed all along the mine lease area in a phased manner. The green belt comprising a mix of native species shall be developed all along the major approach/ coal transportation roads.	Shall be complied with.
(iii)	The transportation of coal shall be carried out as per the provisions and route proposed in the approved Mining Plan. Transportation of the coal through the	Shall be complied with.

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	existing road passing through any village shall be avoided in case, it is proposed to construct a 'bypass' road, it should be so constructed so that the impact of sound, dust and accidents could be appropriately mitigated.	
(iv)	Vehicular emissions shall be kept under control and regularly monitored. All the vehicles engaged in mining and allied activities shall operate only after obtaining 'PUC' certificate from the authorized pollution testing centers.	Being Complied.
(v)	Coal stock pile/crusher/feeder and breaker material transfer points shall invariably be provided with dust suppression system. Belt-conveyors shall be fully covered to avoid air borne dust. Side cladding all along the conveyor gantry should be made to avoid air borne dust. Drills shall be wet operated or fitted with dust extractors.	No coal handling plant is suggested in the proposed mining activity as coal will be won by Environment Friendly Surface Miner equipment. However, sprinkling arrangement in the coal stock yard is proposed to be installed at mine site.
(vi)	Coal handling plant shall be operated with effective control measures viz. bag filters/water or mist sprinkling system etc to check fugitive emissions from crushing operations, conveyor system, transfer points, etc.	No applicable. However, all coal transfer points are planned to be provided with mist type sprinkling system.
(vii)	Ground water, excluding mine water, shall not be used for mining operations. Rainwater harvesting shall be implemented for conservation and augmentation of ground water resources.	Shall be complied with.

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(viii)	Catch/garland drains and siltation ponds of appropriate size shall be constructed around the mine working, coal heaps & OB dumps to prevent run off of water and flow of sediments directly into the river and water bodies. Further, dump material shall be properly consolidated/ compacted and accumulation of water over dumps shall be avoided by providing adequate channels for flow of silt into the drains. The drains/ ponds so constructed shall be regularly desilted particularly before onset of monsoon and maintained properly. Sump capacity should provide adequate retention period to allow proper settling of silt material. The water so collected in the sump shall be utilised for dust suppression measures and green belt development. Dimension of the retaining wall constructed, if any, at the toe of the OB dumps within the mine to check run-off and siltation should be based on the rainfall data. The plantation of native species to be made between toe of the dump and adjacent field/habitation/water bodies.	Shall be complied with.
(ix)	Industrial waste water generated from CHP, Workshop and other waste water, shall be properly collected and treated so as to conform to the standards prescribed under the Environment (Protection) Act, 1986 and the Rules made there under, and as amended from time to time. Oil and grease trap shall be installed and maintained fully functional with effluents	Shall be complied with.

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	discharge adhering to the norms. Sewage treatment plant of adequate capacity shall be installed for treatment of domestic waste.	
(x)	Adequate groundwater recharge measures shall be taken up for augmentation of ground water. The project authorities shall meet water requirement of nearby village(s) in case the village wells go dry to dewatering of mine.	Shall be complied with.
(d) Illumination, noise & vibration		
(i)	Adequate illumination shall be ensured in all mine locations (as per DGMS standards) and monitored weekly. The report on the same shall be submitted to this ministry & its RO on six-monthly basis.	Shall be complied with.
(ii)	Adequate measures shall be taken for control of noise levels below 85 dB(A) in the work environment. Workers engaged in blasting and drilling operations, operation of HEMM, etc. shall be provided with personal protective equipment (PPE) like ear plugs/muffs in conformity with the prescribed norms and guidelines in this regard. Adequate awareness programme for users to be conducted. Progress in usage of such accessories to be monitored.	Shall be complied with.
(iii)	Controlled blasting techniques shall be practiced in order to mitigate ground vibrations and fly rocks as per the guidelines prescribed by the DGMS.	Shall be complied with.
(iv)	The noise level survey shall be carried out as per the prescribed guidelines to assess	Being practised.

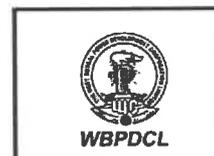
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	noise exposure of the workmen at vulnerable points in the mine premises, and report in this regard shall be submitted to the Ministry/ RO on six-monthly basis.	
(e) Occupational health & safety		
(i)	The project proponent shall undertake occupational health survey for initial and periodical medical examination of the workers engaged in the project and maintain records accordingly as per the provisions of the Mines Rules, 1955 and DGMS circulars. Besides regular periodic health check-up, 20% of the workers identified from workforce engaged in active mining operations shall be subjected to health check-up for occupational diseases and hearing impairment, if any.	Shall be complied with.
(ii)	Personnel (including outsourcing employees) working in dusty areas shall wear protective respiratory devices and shall also be provided with adequate training and information on safety and health aspects.	Complied with.
(iii)	Skill training as per safety norms specified by DGMS shall be provided to all workmen including the outsourcing employees to ensure high safety standards in mines.	Complied with.
(f) Ecosystem and biodiversity conservation		
(i)	The project proponent shall take all precautionary measures during mining operation for conservation and protection of endangered flora/fauna, if any, spotted/reported in the study area. The	Not applicable. The project area belongs to Non Forest in nature. Lease has been granted only for the Non Forest Areas.

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	Action plan in this regard, if any, shall be prepared and implemented in consultation with the State Forest and Wildlife Department.	
(g) Public hearing, R&R and CSR		
(i)	Implementation of the action plan on the issues raised during the public hearing shall be ensured. The project proponent shall undertake all the tasks/measures as per the action plan submitted with budgetary provisions during the public hearing. Land oustees shall be compensated as per the norms laid down in the R&R policy of the company/State Government/Central Government, as applicable.	Shall be complied with.
(ii)	The project proponent shall ensure the expenditure towards socio-economic development in and around the mine, in every financial year in pursuance of the Corporate Social Responsibility Policy as per the provisions under Section 135 of the Companies Act, 2013.	Shall be complied with.
(iii)	The project proponent shall follow the mitigation measures provided in this Ministry's OM No. Z-11013/57 12014-IA.I1 (M) dated 29 th October, 2014, titled 'Impact of mining activities on habitations-issues related to the mining projects wherein habitations and villages are the part of mine lease areas or habitations and villages are surrounded by the mine lease area'.	Being complied.

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(iv)	The project proponent shall make necessary alternative arrangements, if grazing land is involved in core zone, in consultation with the State government to provide alternate areas for livestock grazing, if any. In this context, the project proponent shall implement the directions of Hon'ble Supreme Court with regard to acquiring grazing land.	No grazing land is involved in the leasehold area of 260.14 ha where at present mining operation is being confined.
(h) Corporate environment responsibility		
(i)	The Company shall have a well laid down environment policy duly approved by Board of Directors. The environment policy should proscribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental or forest norms/conditions. Also, the company shall have a defined system of reporting of non-compliances/violations of environmental norms to the Board of Directors and/or shareholders/stakeholders.	WBPDCCL is having well defined Environmental Policy and Corporate Social Responsibility policy in place.
(ii)	The hierarchical system or Administrative Order of the company to deal with environmental issues and for ensuring compliance with the environmental clearance conditions should be displayed on website of the Company.	Shall be complied with.
(iii)	A separate environmental management cell both at the project and company headquarter level, with suitable qualified personnel shall be set-up under the control	Designated officers for reporting the Environmental aspects is in place who is reporting to the Director

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	of a Senior Executive, who will report directly to the Head of the Organization.	Mining, WBPDCCL.
(iv)	Action plan for implementing EMP and environmental conditions shall be prepared and shall be duly approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose. Year wise progress of implementation of action plan shall be reported to the Ministry/Regional Office along with the Six Monthly Compliance Report.	Shall be complied with.
(v)	Self environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.	Shall be complied with.
(i) Statutory Obligations		
(i)	The environmental clearance shall be subject to orders of Hon'ble Supreme Court of India, Hon'ble High Court, NGT and any other Court of Law from time to time, and as applicable to the project.	Shall be complied with.
(ii)	This environmental clearance shall be subject to obtaining wildlife clearance, if applicable, from the Standing Committee of National Board for Wildlife.	Not applicable.
(iii)	The project proponent shall obtain Consent to Establish/Operate under the Air Act, 1981 and the Water Act, 1974 from the concerned State Pollution Control Board.	Consent to Establish and Consent to Operate already been obtained from State Pollution Control Board of West Bengal.

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(iv)	The project proponent shall obtain the necessary permission from the Central Ground Water Authority (CGWA).	No ground water withdrawal is envisaged in this project.
(j) Monitoring of project		
(i)	Adequate ambient air quality monitoring stations shall be established in the core zone as well as in the buffer zone for monitoring of pollutants, namely PM ₁₀ , PM _{2.5} , SO ₂ , and NO _x . 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. Online ambient air quality monitoring stations may also be installed in addition to the regular monitoring stations as per the requirement and/or in consultation with the SPCB. Monitoring of heavy metals such as Hg, As, Ni, Cd, Cr, etc. to be carried out at least once in six months.	Being complied.
(ii)	The Ambient Air Quality monitoring in the core zone shall be carried out to ensure the Coal Industry Standards notified vide GSR 742 (E) dated 25.9.2000 and as amended from time to time by the Central Pollution Control Board. Data on ambient air quality and heavy metals such as Hg, As, Ni, Cd, and other monitoring data shall be regularly reported to the Ministry/Regional Office and to the CPCB/SPCB.	Complied with.

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(iii)	The effluent discharge (mine waste water, workshop effluent) shall be monitored in terms of the parameters notified under the Coal industry Standards vide GSR 742 (E) dated 25.9.2000 and as amended from time to time by the Central Pollution Control Board.	So far no water has been discharged from the mine site. Shall be complied with.
(iv)	The monitoring data shall be uploaded on the company's website and displayed at the project site at a suitable location. The circular No. J-20012/1/2006 IA, 11 (M) dated 27.05.2009 issued by Ministry of Environment, Forest and Climate Change shall also be referred in this regard for its compliance.	Shall be complied with.
(v)	Regular monitoring of ground water level and quality shall be carried out in and around the mine lease area by establishing a network of existing wells and constructing new piezometers during the mining operations. The monitoring of ground water levels shall be carried out four times a year I.e. pre-monsoon, monsoon, post-monsoon and winter. The ground water quality shall be monitored once a year, and the data thus collected shall be sent regularly to Ministry of Environment, Forest and Climate Change/Regional Office.	Shall be complied with.
(vi)	Monitoring of water quality upstream and downstream of water bodies shall be carried out once in six months and record of monitoring data shall be maintained and submitted to the Ministry of	Being complied.

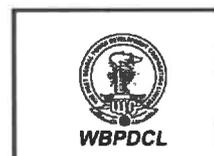
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	Environment, Forest and Climate Change/Regional Office.	
(vii)	The project proponent shall submit six monthly reports on the status of the implementation of the stipulated environmental conditions to the Ministry of Environment, Forest and Climate Change/Regional Office. For half yearly monitoring reports, the data should be monitored for the period of April to September and October to March of the financial years.	Being complied.
(viii)	The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data / information/monitoring reports.	Shall be complied with.
(k) Miscellaneous		
(i)	Efforts should be made to reduce energy consumption by conservation, efficiency improvements and use of renewable energy.	Shall be complied with.
(ii)	The project authorities shall inform to the Regional Office regarding commencement of mining operations.	Being complied.
(iii)	A copy of the environmental clearance shall be marked to concerned Panchayat. A copy of the same shall also be sent to the concerned State Pollution Control Board, Regional Office, District Industry Sector and Collector's Office/Tehsildar Office for information in public domain within 30	Being complied.

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	days.	
(iv)	The EC shall be uploaded on the company's website. The compliance status of the stipulated EC 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.	Complied.
(v)	The project authorities shall advertise at least in two local newspapers widely circulated, one of which shall be in the vernacular language of the locality concerned, within 7 days of the issue of this clearance, informing that the project has been accorded environmental clearance and a copy of the same is available with the State Pollution Control Board and also at website of the Ministry.	Complied.
(vi)	The environmental statement for each financial year ending 31 March in Form-V is mandated to be submitted by the project proponent for the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be uploaded on the Company's website along with the status of compliance of EC conditions and shall be sent to the respective Regional Offices of the MoEF&CC by e-mail. Concerns raised during public hearing.	Shall be complied with.

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(vii)	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 and any other orders passed by the Hon'ble Supreme Court of India/High Courts and any other Court of Law relating to the subject matter.	Shall be complied with.
(viii)	The project proponent shall abide by all the commitments and recommendations made in the EIA/EMP report and also that during presentation to the EAC. All the commitments made on the issues raised during public hearing shall also be implemented in letter and spirit.	Shall be complied with and being practiced.
(ix)	The project proponent shall obtain all necessary clearances/approvals required before start of the project. The Ministry or any other competent authority may stipulate any further condition for environmental protection. The Ministry or any other competent authority may stipulate any further condition for environmental protection.	Complied with.
(x)	Any appeal against this environmental clearance lies with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.	Shall be complied with.

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(xi)	The coal company/project proponent shall be liable to pay the compensation against the illegal mining, if any, and as raised by the respective State Governments point of time, in terms of the judgment dated 2 nd August, 2017 of Hon'ble Supreme Court in WP (Civil) No. 114/2014 in the matter of Common Cause Vs Union of India & others'.	Shall be complied with.
(xii)	The concerned State Government shall ensure no mining operations to commence till the entire compensation for illegal mining, if any, is paid by the project proponent through their respective Department of Mining & Geology, in strict compliance of the judgment of Hon'ble Supreme Court.	Noted.
(xii)	This environmental clearance shall not be operational till such time project proponent complies with the above said judgment of Hon'ble Supreme Court, as applicable, and other statutory requirements.	Not applicable. Mining operation commenced from June, 2018.

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15.1.6 Closure Plan Preparation:

The preparation of this mining plan including progressive mine closure plan is being prepared with due authorization of the owner (WBPDC). The concerned matter is supported by a Board Resolution (please refer to **Annexure-III**)

A final Mine Closure plan shall be prepared 5 years before the likely cessation of mining operations. However, a conceptual Mine Closure Plan has been prepared hereby for competent approval.

15.2 Mine Description:

15.2.1. Geology:

Details of the Geology are provided in chapter -4 of this mining plan.

15.2.1.1 Topography and Drainage:

Details are provided in chapter-3 of this mining plan. Please refer to page no. 5 of chapter-3.

15.2.1.2 Geology:

Details are provided in Chapter-4 of this mining plan.

15.2.2 Coal Reserves:

Details are provided in Chapter-4 of this mining plan.

15.2.3. Method of Mining:

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Please refer to chapter-5 of this mining plan.

15.2.4 Choice of equipment for O.C. mining:

Details are provided in chapter-5 of this mining plan.

15.2.3.3 Calendar plan of production:

Details provided in chapter-5 of this mining plan. Calendar program for five years as per this revised mining plan is given in table no. 15.2.

Table no. 15.2

Calendar program for the planned period.

Coal Production Plan " MT"					
S.L. Year	Financial Year	Coal Production		OB "MM3"	SR
		UG	OC		
Y-1	2019-20		3.00	11.50	3.83
Y-2	2020-21		3.00	11.50	3.83
Y-3	2021-22		3.00	11.50	3.83
Y-4	2022-23		3.00	11.50	3.83
Y-5	2023-24		3.00	11.50	3.83
Y-6	2024-25		3.00	11.50	3.83
Y-7	2025-26		3.00	11.50	3.83
Y-8	2026-27		3.00	11.50	3.83
Y-9	2027-28		3.00	11.50	3.83
Y-10	2028-29		3.00	11.50	3.83
Y-11	2029-30		3.00	11.50	3.83

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Y-12	2030-31		3.00	11.50	3.83
Y-13	2031-32		3.00	11.50	3.83
Y-14	2032-33		3.00	11.50	3.83
Y-15	2033-34		3.00	11.50	3.83
Y-16	2034-35		3.00	11.00	3.67
Y-17	2035-36		3.00	10.00	3.33
Y-18	2036-37		3.00	10.00	3.33
Y-19	2037-38		3.00	10.00	3.33
Y-20	2038-39		3.00	10.00	3.33
Y-21	2039-40		3.00	10.00	3.33
Y-22	2040-41		2.59	10.00	3.86
Total			65.59	243.50	3.71

15.3 Mine Closure:

15.3.1 Progressive closure:

Activities which get completed during the productive life of mine and relate to land management and other environment management are termed as progressive closure. The following activities of progressive closure will be undertaken during 22 years of productive mine life.

Backfilling of the void areas will commence from the 1st year itself as mined out voids are available on ground.

i. Reclamation of mined out voids:

As such no waste will be dumped outside the leasehold area and from the very first day of development of this mine, internal dumping is envisaged.

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In the initial 2 (two) years of development, dumping will be done in the already mined out voids whereas concurrent backfilling is envisaged from 3rd year onward of production. Details of reclamation of mined out voids are furnished in table no. 15.3 a and 15.3b.

Table No. 15.3 a
Land Degradation and Technical Reclamation details of Barjora North Coal Mine.

Stage/ Year		Land Degraded (ha) - Cumulative				Technically Reclaimed Area (ha) - Cumulative			
		Excavation	Dump (External +Top Soil)	Infra/ Others	Total	Backfill	Dump (External +Top Soil)	Infra/ Others	Total
Stage-1	2019-20	133.31	2.40	33.94	169.65	35.03			35.03
Stage-3	2021-22	129.61	5.13	33.94	168.68	57.43			57.43
Stage-5	2023-24	147.31	5.13	33.94	186.38	82.69			82.69
Stage-10	2028-29	220.29	5.13	33.94	259.36	104.52			104.52
Stage-15	2033-34	365.01	5.13	33.94	404.08	145.41			145.41
Stage-20	2038-39	539.21	1.81	33.94	574.96	373.46			373.46
Final Stage	2040-41	609.66	1.81	33.94	645.41	431.32			431.32
Post Closure									
Closure (+ 3 Years)	2043-44	609.66	1.81	33.94	645.41	431.32	1.81	212.28	645.41

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Table No. 15.3 b
Biological reclamation details of Barjora North Coal Mine.

Stage/ Year		Biologically Reclaimed Area (ha) - Cumulative					Forest Land (Returned)	Undisturbed/ To be left for Public/ Community Use	Total
		Agriculture	Plantation	Water Body	Public / Company Use	Total			
Stage-1	2019-20	-	-	-	-	0	-	-	0
Stage-3	2021-22	-	-	-	-	0	-	-	0
Stage-5	2023-24	-	-	-	-	0	-	-	0
Stage-10	2028-29	-	-	-	-	0	-	-	0
Stage-15	2033-34	-	35.70	2.50	-	38.2	-	-	38.2
Stage-20	2038-39	-	45.72	2.50	-	48.22	-	-	48.22
Final Stage	2040-41	95.07	56.50	2.50	-	154.07	-	-	154.07
Post Closure									
Closure (+ 3 Years)	2043-44	95.07	119.6	75.82	16.17	306.66	338.75	37.63	683.04

ii. Green Belt & Green Block Plantation:

About 431.32 ha of backfilled area have been envisaged for complete reclamation. Reclamation of the mined out voids are planned from 3rd year onward while plantation on the barren lands and safety zone will be undertaken from the 1st year itself. Stage wise plantation details are furnished in table no. 15.4 below which covers about 370.42 ha of area.

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Table No. 15.4

Stage Wise Comprehensive Plantation Details of Barjora North Coal Mine.

Stages	Cumulative Area for Plantation in Ha				No. of Plants (Cumulative) @ 1600
	Backfilled Dump	Undisturbed area	Safety Zone	Total area in Ha	
Y-1			8.59	8.59	13744
Y-3		7.65		16.24	25984
Y-5		6.93		23.17	37072
Y-10		10.01		33.18	53088
Y-15	27.70			60.88	97408
Y-20	8.00			68.88	110208
Y-22	33.12			102.00	163200
Y-25	268.42			370.42	592672

15.3.2 Final Mine Closure Plan:

After receipt of approval for this mining plan and getting E.C from MOEF & CC, mining will be undertaken in the forest area.

A final closure plan with required activities and funding shall be submitted to MOC, GOI, five years before the mine closes. However, the conceptual final mine closure is being covered under this plan.

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15.3.3 Activities under Final Mine Closure Plan:

15.3.3.1 Water Regime

The proposed mining area is not dissecting any natural streams. The storm water and ground water intersected during the mining operation will be the source of water accumulation within the active mining pit. Accumulated mine pit water during the active mining period will be pumped while post mining operation, there will be accumulated water in the left out voids. An area of about 93.19 ha of land will be converted to water body at the end of mine life. Out of the total water body about 88.05 ha will be mine pit accumulated water while 5.75 ha will be utilized for water harvesting.

During operational phase, all waste water coming from mine or workshop shall be treated in suitably designed effluent treatment plant.

In post project phase the water accumulated in the lagoon shall be regularly sampled and analysed to monitor development of any acidity or toxicity in the accumulated water. As post planned period, most of the broken areas will be backfilled and left out water bodies will be much less, development of toxic water is not anticipated.

The accumulated water will be utilised for the local community for agriculture and other usage. Regular monitoring of the water quality will be carried out as per the CPCB norms. Once the mine is closed, outside water shall be prevented to

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enter into the mined out pits which in turn will reduce the TDS and other solvents.

15.3.3.2 Air Regime:

Due to mining operation, the quality of air, especially the SPM/ RPM part in ambient air increases. Generally, the generation and emissions of gaseous pollutants like SO₂ and NO_x is not pronounced, to need control measures in coal mining sector. However, as dust is a by product of mining operations, increase in SPM is natural and control measures are put in place to minimize the impact and bring air quality within CPCB standards for coal mines during mine operations. For control of air pollution, in post project period, all the OB dumps, shall be covered with vegetation. This shall be completed within 3 years post mining activities. Other than dump stabilization by greening, and vacant land stabilization by vegetation growth no action for air quality control would be needed in post mining period.

15.3.3.3 Waste Management:

During the planned period of twenty five years (Including 3 years of Closure Period), total volume of OBR comes to about 240.50 Mcum including 6.494 MCum of Top Soil. The total generated waste will be accommodated internally through backfilling of mined out voids. Details of the waste management is being depicted in chapter no. 5 of this mining plan. An area of about 489.93 ha is planned to backfilled during this period. No external dumping is involved.

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Details of the dumping strategy and top soil management is being furnished in table no. 15.5 below.

Table No. 15.5

Details of Dumping during the planned period.

Waste Management (Figures in MM ³)									
Year / Stage	Cumulative OB Removal			External Dump (Cumulative)		Internal Dump/Backfilling (Cumulative)		Embankment	
	Top Soil	OB	Total	OB	Top Soil	OB	Top Soil	OB	Top Soil
Y-1	0.311	11.189	11.500	-	-	11.189	-	-	-
Y-3	0.932	33.568	34.500	-	-	33.568	-	-	-
Y-5	1.553	55.947	57.500	-	-	55.947	0.250	-	-
Y-10	3.105	111.895	115.000	-	-	111.895	1.250	-	-
Y-15	4.658	167.842	172.500	-	-	167.842	1.750	-	-
Y-20	6.035	217.465	223.500	-	-	217.465	3.350	-	-
Y-22	6.575	236.925	243.500	-	-	236.925	4.080	-	-
Post Closure									
Y-23	-	-	-	-	-	-	5.250	-	-
Y-24	-	-	-	-	-	-	5.900	-	-
Y-25	-	-	-	-	-	-	6.575	-	-

During the planned period dumping will be carried out both in the existing mined out voids and the voids which are subject to be created during the planned period of twenty two years. About 39.49 ha of existing dumping ground will be utilised for further dumping during this planned period. About 481.09 ha of backfilled land will be completely reclaimed at the end of the mine life including closure phase.

15.3.3.4 Top soil Management:

Soil including weathered mantle is the material to be used for reclamation of the OB dumps. The generated soil including weathered mantle in this planned period will be continued to store in the existing soil and sub soil dump. Top soil as generated during the planned period will be utilized in for spreading over the reclaimed areas from 3rd year onward.

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15.3.3.5 Management of Infrastructures:

Infrastructures consists of mine office, workshops, electrical transformers, weighbridge, VT center, rest shelters, etc. will be decommissioned. Only the mine office and the VT centers will be handed over to State Government for public use. the decommissioned areas will be covered by plantation during the post closure activities.

15.3.3.6 Disposal of Mining Machinery's:

This mine will be operated through Mine Developer and Operator (MDO). Machinery's will be shifted to other operational mines during the closure phase.

15.3.3.7 Safety of Mine Closure:

- Thorough inspection of the mine and OB dump areas for assessing the left over closure jobs of already reclaimed internal dump areas.
- Inspection of infrastructure and water body areas for their safe reclamation and abatement of any leftover dangers.
- Action required to make drainage and any fire areas safe for future period.
- Making 2 meter high fencing wall against excavated void area to prevent inadvertent entry as per requirement.
- Making safe approach road from surface to left out pit bottom for future uses, as void becomes a water body.
- Completing the survey of total reclaimed areas like mined areas, internal dumps, mine faces, quarry fencing and other areas to complete and update the Mine Plans under Coal Mine Regulation.

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15.3.4 Economic Repercussions of Closure of the Mine:

As per the estimates, about 578 persons are likely to be deployed in the project for this planned period. The total number of employees will be distributed through mine developer as well as through direct role of WBPDC.

15.3.4.1 Number of local residents employed in the mine during this planned period would likely to continue their service beyond this planned period towards monitoring of the mine during the closure and post closure phase as watch & yard and safety personnel. Few locals will also be engaged towards CSR activities for water distribution.

15.3.4.2 Compensation to be given to the employees for their sustenance and for their family:

Employees will be provided with full retiring benefits while closure of mines.

15.3.4.3 Satellite Occupations connected to the mining industry- continuation of such business:

People in the satellite occupations shall continue as such, as people in these occupations will have developed their expertise for various services, e.g, auto mechanic, welders, drivers, electronic repairing etc.

15.3.4.4 Continued engagement of employees in rehabilitated status of the mining area and other remnant activities:

Some locals may be on roll of the project at time of mine closure. Some of them shall be retained for carrying out mine closure operations. Major closure operation is bio reclamation of

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degraded land which would continue for about 3 years of cessation of mining operations. The locals could be deployed with the agencies carrying out these activities.

15.3.4.5 Expectation of society after the mine closure

For supporting the neighboring community (society), CSR activities would be taken up during the mining operations. Even after mine closure, it is proposed to have a corpus fund for sustaining some of the CSR activities.

15.3.5 **Time scheduling for abandonment:**

Tentative details of likely closing activities with stage wise schedule as envisaged has been estimated based on the present mine closure plan. Actual closing activities may change during the preparation of Final Mine Closure Plan which will be prepared 5 years before the likely cessation of mining operation. Manpower requirement is covered under detailed manpower list in relevant chapter. Schedule of mine closure activities are shown in figure 15.1.

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Head	Parameters	Stage-1	Stage-3	Stage-5	Stage-10	Stage-15	Stage-20	Stage-Final	Closure-1	Closure-2	Closure-3
Progressive Closure	Water Quality Management										
	Air Quality Management										
	Waste Management										
	Ditch and Plant Fencing around dump										
	Biological fencing around the Lease Area										
	Filling of voids										
	Top Soil management										
	Technical and Biological Reclamation of mined out of land and OB dump										
	Plantation over virgin area including green belt.										
	Manpower cost and supervision										
	Toe wall around the dump										
	Garland Drain										
Garland Drain around the dump											
Any Other Activities											
Dismantling of Infrastructure & Disposal or rehabilitation of Mining Machinery	Dismantling of Workshop										
	Rehabilitation of the dismantled facility										
	Dismantling of pumps and pipes / Other Facilities										
	Dismantling of Stowing bunkers/ provisioning of pumps for borewell pumping arrangement.										
	Dismantling of UG equipment										
	Rearranging water pipeline to dump top park / Agricultural land										
	Dismantling of power lines.										
	Barbed wire fencing around dump										
Safety & Security	Barbed wire fencing around the pit										
	Barbed wire fencing with masonry pillars										
	Concrete wall with masonry pillar around the pit										
	Securing air shaft and installation of borewell pump										
	Securing of Incline										
	Concrete wall fencing around the water body										
	Boundary wall around the water body										
	Stabilisation (Viz. Benching, Pitching) of side walls of the water body.										
	Toe wall around the dump										
	Garland drain										
Garland drain around the dump											
Drainage channel from main OB dump											
Technical & Biological Reclamation of Mined out of land and OB Dump	Filling of void.										
	Top Soil management										
	OB rehandling for backfilling.										
	Terracing, Blanketing with soil, and vegetation of External OB dump										
	Peripheral road, gates, view point, cemented steps on bank.										
	Expenditure on development of agricultural land Landscaping and plantation.										
Post Closure Management and Supervision	Power Cost										
	Post mine water quality management										
	Post mine air quality management										
	Subsidence monitoring for five years										
	Waste Management										
Others	Manpower cost and supervision.										
	Entrepreneurship development (Vocational/Skill development/training for sustainable income of affected people).										
	Golden Handshake / Retrenchment benefits to OC employees.										
	Golden Handshake / Retrenchment benefits to UG employees.										
	One time financial grant to societies / Institutions/ Organisations which is dependent upon the project.										
	Provide Jobs in other mine of the company. Continuation of other services like running of schools etc.										

Figure No. 15.1 : Closure Schedule of Barjora North Coal Mine.

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15.3.6 Abandonment cost:

The activities covered during the progressive closure will all be met by normal operational funds. The physical and biological reclamation of concurrent dumping areas and for green belts or block plantation is provided from the ongoing expenses.

Tentative closure cost as envisaged from the activities mentioned in table no. 15.6 is considered from the know how rates with base date of March, 2019. Activity wise cost schedule is provided in table no. 15.6 below.

Table No. 15.6

Estimated Fund Requirement for Closure Activities
(Without Escalation- Base Year March, 2019).

Head	Activities	Unit	Qty	Rate Rs. (Lakhs)	Amount Rs. In Lakhs
Progressive Closure	Water Quality Management	LS	25	1.25	31.25
	Air Quality Management	LS	25	3.75	93.75
	Waste Management	MM3	5.5	45	247.50
	Ditch and Plant Fencing around dump	M	3750	0.00375	14.06
	Biological fencing around the Lease Area	M	11483	0.004	45.93
	Filling of voids	MM3	0.5	45	22.50
	Top Soil management	MM3	6.575	260	1709.50
	Technical and Biological Reclamation of mined out of land and OB dump	ha	489.32	2.5	1223.30

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Head	Activities	Unit	Qty	Rate Rs. (Lakhs)	Amount Rs. In Lakhs
	Plantation over virgin area including green belt.	ha	35.63	2	71.26
	Manpower cost and supervision	PM	120	5	600.00
	Toe wall around the dump.	M	4878	0.05	243.90
	Garland Drain	M	7450	0.025	186.25
	Garland Drain around the dump.	M	4878	0.025	121.95
	Any Other Activities.				0.00
A.	Sub-Total =				4611.15
	Dismantling of Workshop.	LS			75.00
	Rehabilitation of the dismantled facility.	LS			1.25
	Dismantling of pumps and pipes / Other Facilities	LS			50.00
	Dismantling of Stowing bunkers/ provisioning of pumps for borewell pumping arrangement.	LS			0.00
	Dismantling of UG equipment				0.00
	Rearranging water pipeline to dump top park / Agricultural land	LS			24.09
	Dismantling of power lines.	LS			350.00
B.	Sub-Total =				500.34
	Net fencing around dumps	M	4878	0.02	97.56
	Biological fencing around the pit.	M	15000	0.02	300.00
	Net fencing with masonry pillars	M	5000	0.25	1250.00
	Concrete wall with masonry pillar around the Water Harvesting area.	M	1500	0.35	525.00

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Head	Activities	Unit	Qty	Rate Rs. (Lakhs)	Amount Rs. In Lakhs
	Securing air shaft and installation of borewell pump				0.00
	Securing of Incline				0.00
	Concrete wall fencing around the water body				0.00
	Boundary wall around the water body				0.00
	Stabilisation (Viz. Benching, Pitching) of side walls of the water body.	LS	-	-	75.00
	Toe wall around the dump.	M	1200	0.1	120.00
	Nala Diverion	M	6834	0.25	1708.50
	Garland drain around the dump.	M	500	0.05	25.00
	Drainage channel from main OB dump.	M	250	0.04	10.00
C.	Sub-Total =				4111.06
	Filling of void.	Ha			0.00
	Top Soil management	MM3			0.00
	OB rehandling for backfilling.	MM3			0.00
	Terracing, Blanketing with soil, and vegetation of External OB dump	Ha			0.00
	Peripheral road, gates, view point, cemented steps on bank.	LS			247.00
	Expenditure on development of agricultural land.	Ha	112.59	0.75	84.44
	Landscaping and plantation.	Ls			0.00
D.	Sub-Total =				331.44
Post Closure Management and Supervision	Power Cost	Year	3	12	36.00
	Post mining water quality management	Year	3	1.5	4.50

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Head	Activities	Unit	Qty	Rate Rs. (Lakhs)	Amount Rs. In Lakhs
	Post mining air quality management	Year	3	5.5	16.50
	Subsidence monitoring for five years.	Year	5	16	80.00
	Waste Management	LS	3	20	60.00
	Manpower cost and supervision.	Year	3	120	360.00
E.	Sub-Total =				557.00
Others	Enterpreneurs development (Vocational/Skill development/training for sustainable income of affected people)	Year	10	20	200.00
	Golden Handshake / Retrenchment benefits to OC employees.	Nos.	50	7.5	375.00
	Golden Handshake / Retrenchment benefits to UG employees.	Nos.	0	28	0.00
	One time financial grant to societies / Institutions/ Organisations which is dependent upon the project.	LS			25.00
	Provide Jobs in other mine of the company.				0.00
	Continuation of other services like running of schools etc.	Year	10	2.5	25.00
	F.	Sub-Total =			
Total Mine Closure Cost in Rs. Lakhs. (A+B+C+D+E+F)					10736.00

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15.3.7 Annual Closure Cost:

The annual closure cost has been calculated as per the guideline issued by MOC. As per the norms closure cost has been calculated based on the wholesale price index of March, 2019 as notified by Government of India.

Detail calculation for the ESCROW account is being shown in Table No. 15.7 below. Total amounts as per WPI, March 2019 comes about to 66.77 Crores including compounding @ 5%. WBPDCCL has already deposited an amount of 7.03 Crores in the said account.

Table No. 15.7
Calculation for ESCROW account (Rs. In Crores)

WPI as on			Aug-09		129.6
WPI as on base date	Base year 11-12	156.13	01-04-2019 *	121.7	190.01
Escalation rate of Closure cost					1.47
				UG	OC
Base Rate of Closure Cost "Rs. Crs./Ha"					0.06
Closure Cost "Rs. Crs./Ha"					0.09
Project Area					683.04
Amount to be deposited into Escrow Account "Rs. in Crs"					61.47
Rate of compounding of Annual Closure Cost					5.00%
Balance Life of the project "in Yrs"					22
Annual Closure Cost					2.79
Amount to be deposited into Escrow Account after compounding @ of 5% "Rs. in Crs"					107.43
Amount already deposited into Escrow Account "Rs. in Crs"					7.03
Net Amount to be deposited into Escrow Account "Rs. in Crs"					100.40

Year wise deposit and expenditures amount into ESCROW account is shown in Table no. 15.8.

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Table No. 15.8
Year wise ESCROW Account. (Rs. In Crores).

Year	OC	UG	Total	Already deposited	Balance to be deposited
2019-20	2.79		2.79	7.03	0.00
2020-21	2.93		2.93		0.00
2021-22	3.08		3.08		1.77
2022-23	3.23		3.23		3.23
2023-24	3.39		3.39		3.39
2024-25	3.56		3.56		3.56
2025-26	3.74		3.74		3.74
2026-27	3.93		3.93		3.93
2027-28	4.12		4.12		4.12
2028-29	4.33		4.33		4.33
2029-30	4.54		4.54		4.54
2030-31	4.77		4.77		4.77
2031-32	5.01		5.01		5.01
2032-33	5.26		5.26		5.26
2033-34	5.52		5.52		5.52
2034-35	5.80		5.80		5.80
2035-36	6.09		6.09		6.09
2036-37	6.39		6.39		6.39
2037-38	6.71		6.71		6.71
2038-39	7.05		7.05		7.05
2039-40	7.40		7.40		7.40
2040-41	7.77		7.77		7.77
Total=	107.43		107.43		100.40

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WBPDCCL is already maintaining the ESCROW account with scheduled bank. The beneficiary of this account is Coal Controllers organization (on behalf of Central Government). The proponent shall deposit the amount detailed in table no. 15.9 on yearly basis after deduction of the amount paid so far. An agreement outlining the detailed terms and conditions of operating the Escrow Account shall be finalized and executed. Release of funds may be sought from CCO while commencement of the mine closure activities.

15.3.7 Responsibility of Owners:

The mine owner, the WBPDCCL, undertakes the responsibility of the mine closure as per the prevailing rules and regulations with respect to Mine Closure activities. Reclamation and rehabilitation works will be carried out as per the provisions of the Mining plan and Mine closure plan. Necessary fund arrangements will be made by the Owner. Certificate to this extent has been provided by the authorized person of WBPDCCL and is furnished in **Annexure-III and XI**.

Periodical reports to this extent will be submitted to the Coal Controllers Organisation stating the progress of the closure activities.

The mine owner will obtain a mine closure certificate from the coal controller to the effect that the protective, reclamation and rehabilitation works have been carried out by the mine owner in accordance with the mine closure plan/final mine closure plan for surrendering the reclaimed land to the concerned State Government.

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Dt 07.10.2009


हिटलर सिंह / HITLAR SINGH
अवर सचिव / Under Secretary
कोयला मंत्रालय / Ministry of Coal
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