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**GEOLOGICAL REPORT
ON COAL EXPLORATION
GONDALPARA BLOCK
NORTH KARANPURA COALFIELD
DISTRICT HAZARIBAGH
BIHAR**

(98)

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VICE PRESIDENT
GONDALPARA COAL PROJECT
ADAM ENTERPRISES LIMITED**



International Consultants
Exploration, Mining, Engineering



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**SALIENT FEATURES OF GEOLOGICAL REPORT
ON COAL EXPLORATION, GONDALPARA BLOCK
NORTH KARANPURA COALFIELD**

1. **Location:** Located in north-eastern part of North Karanpura Coalfield in Hazaribagh District of the Bihar State. It is bounded by 23°50'30" & 23°51'30" N and longitude 85°18'30" & 85°20'30" E.
2. **Accessibility/Communication :**

The block can be approach from Hazaribagh town by road. The distance is 35Km. of which 3 Km. through kutcha road. The block becomes cut off during rainy season due to non-existence of bridge at Badmahi river.
3. **Objective:** Geological investigation for possible opencast exploitation.
4. **Period of Investigation :** 1996-98.
5. **Status of Mining :** Virgin.
6. **Area of the Block:** 4 Sq.Km. (Effective area excluding burnt/heat affected zone 1.59 Sq.Km.).
7. **Details of Drilling:**

Agency	Period of Drilling	No. of Boreholes	Meqerage
CMPDI	1996-98	66	8,473
GSI	1962-64	4	1,394
Total		59	9,867

Location of GSI boreholes could not be traced on ground and hence not considered for interpretation.

8. Borehole Density: 14 boreholes/Sq Km.
9. Other Investigations: Surface geophysical survey (HRSS, Resistivity & magnetic)
10. Geological Formations: Karharbari, Barakar and Barren Measures.
11. Geological Structure: Strike - Northeast – Southwest
Dip-6° to 16° due west.
12. Faults: Seven numbers. 170m is maximum throw.
13. Intrusives: Dolerite and micapenidotite. About 50% of the area affected by intrusives.
14. Coal seams and Quality:

Coal Seams/ Partings	Thick- ness (m)	No of Inter section	Depth of Occur- ence (m)	(Including Dirt bands -1-100)							
				Proximate Analysis (on 80% RH & 40°C)			Gv (K.Cal Kg.)	UHH K.Cal / Kg.	Grade	CI	SI
				MM%	As 1%	VM% (UVM%)					
1	2	3	4	5	6	7	8	9	10	11	12
V	3.91	10	Incrop- 150	2.3-3.5	36.4-41.3	20.5-22.4	4330- 4795	2860- 3580	E-F	A	0
Parting	41.93- 58.68										
IVD	4.30- 15.44	17	Incrop- 200	1.6-4.3	29.1-36.6	21.2-25.4	4675- 5510	3270- 400	D-F	B-C	0.1
Parting	1.87- 3.97										
IVC	Nil- 4.11	11					5180- 5990		C-D	B	0
Parting	Nil- 4.90										
IVB	Nil- 2.53	2		Not available					B-D	C	1

1	2	3	4	5	6	7	8	9	10	11	12
Parting	NII-10.63										
IVA	NII-2.88	13					5455- 6820		B-D	C	1
Parting	2.93-15.11										
IV	3.25-5.46	16	Incrop- 200	1.8-4.3	20.9- 30.4	23.4- 26.2	5010-5690 (8165)	4290- 5645	B-D	-	-
Parting	1.97-25.11										
III Top	2.45-4.80	12	Incrop- 210	1.7-4.7	26.0- 42.6	21.1- 27.4	4370-5555 (8275- 8355)	2787- 5010	C-F	B-D	1/2-1
Parting	NII-5.04										
III Bot	4.15-6.82	18	Incrop- 220	1.8-4.4	30.8- 35.1	23.4- 28.9	3685-5090 (8210)	3545- 5645	B-E	C	1
III (Comb.)	8.67-11.34	6	Incrop- 240	1.2-2.5	33.3- 36.8	21.3- 25.5	4815-5055	3560- 3960	E	-	-
Parting	2.87-32.24										
II	7.39-18.16	19	Incrop- 250	1.9-3.5	29.3- 35.8	22.7- 26.5	4520-5380 (8340)	3575- 4430	D-E	C	1
Parting	3.78-33.08										
I	11.07-20.43	29	Incrop- 250	1.2-2.9	34.8- 44.0	19.9- 25.0	3990-5105 (8235- 8825)	2510- 3780	E-F	C-D	1/2-1
Parting	20.43-29.43										
K5	NII-2.07	33		1.7-2.9	36.1- 44.4	21.2- 39.9	4375-4745	2540- 3571	E-F	C-D	1/2-1
Parting	7.70-8.43										
K4	NII-0.54	2	Not available								
Parting	-										
K3	NII-1.42	9		2.8	40.0	18.5	4460	2995	F		
Parting	4.99-17.20										
K2	NII-2.70	15		2.8	33.2	20.6		3,930	E		
Parting	2.68-10.28										
K1	NII-3.40	13		1.6	43.6	20.3	4030	2660	F		
(2&K1 (Comb.)	2.34-11.81	3	Not available								

**DEPTHWISE SECTORWISE RESERVE OF COAL SEAMS IN
GONDALPARA BLOCK, NORTH KARANPURA COALFIELD**

SEAMS	DEPTH WISE & SECTOR WISE RESERVES					
	≤50 M.	50-100 M.	100-150 M.	150-200 M.	200-250 M.	TOTAL
SEAM - I						
SECTOR-A	2.818	-	-	-	-	2.818
SECTOR-B	0.031	1.169	0.434	0.270	-	1.904
SECTOR-C	0.472	9.380	7.378	7.367	4.790	34.387
TOTAL	0.321	10.549	7.812	7.637	4.790	39.109
SEAM - II						
SECTOR-A	0.260	-	-	-	-	0.260
SECTOR-B	-	0.268	0.277	0.128	-	0.663
SECTOR-C	0.016	4.321	6.716	3.474	2.070	16.599
TOTAL	0.276	4.579	6.995	3.602	2.070	16.522
SEAM - III BOT.						
SECTOR-A	-	-	-	-	-	-
SECTOR-B	-	0.150	0.144	0.072	-	0.366
SECTOR-C	-	0.296	1.830	1.012	0.477	3.615
TOTAL	-	0.446	1.974	1.084	0.477	3.981
SEAM - III COMB.						
SECTOR-A	-	-	-	-	-	-
SECTOR-B	-	-	-	-	-	-
SECTOR-C	-	-	0.462	0.643	1.048	2.043
TOTAL	-	-	0.462	0.643	1.048	2.043
SEAM - III TOP						
SECTOR-A	-	-	-	-	-	-
SECTOR-B	-	0.078	0.144	0.074	-	0.296
SECTOR-C	-	0.053	1.080	0.742	0.334	2.209
TOTAL	-	0.131	1.224	0.816	0.334	2.505
SEAM-IV						
SECTOR-B	-	-	0.105	0.038	-	0.144
SECTOR-C	-	0.003	1.459	1.294	0.641	3.397
TOTAL	-	0.003	1.565	1.332	0.641	3.541
SEAM-IV D						
SECTOR-B	-	-	0.134	0.185	-	0.319
SECTOR-C	-	-	0.331	2.911	1.327	6.589
TOTAL	-	-	1.465	3.096	1.327	6.888
SEAM-V						
SECTOR-B	-	-	0.018	-	-	0.018
SECTOR-C	-	-	-	0.354	0.916	1.270
TOTAL	-	-	0.018	0.354	0.916	1.288
G. TOTAL	8.897	15.708	20.505	16.464	11.603	74.877

**RATIOWISE, SECTORWISE RESERVE OF COAL SEAM
NORTH KARPURA COALFIELD..**

SEAMS	RATIOWISE		SECTORWISE RESERVE S	
	1:1-1:2	1:2-1:3	>1:3	TOTAL
SEAM-I				
SECTOR-A	0.311	2.475		2.818
SECTOR-B	1.934			1.904
SECTOR-C	19.378	11.388	3.620	34.387
TOTAL	21.623	13.863	3.620	39.109
SEAM-II				
SECTOR-A	0.034	0.201	-	0.260
SECTOR-B	0.633			0.663
SECTOR-C	9.516	4.181	1.898	15.599
TOTAL	10.233	4.391	1.898	16.522
SEAM-III BO T.				
SECTOR-B	0.356			0.366
SECTOR-C	2.113	1.041	0.453	3.613
TOTAL	2.479	1.041	0.453	3.981
SEAM-III CO MB.				
SECTOR-C	0.547	0.601	0.890	2.043
TOTAL	0.547	0.601	0.890	2.043
SEAM-III TO P				
SECTOR-B	0.236			0.290
SECTOR-C	1.215	0.681	0.305	2.209
TOTAL	1.511	0.681	0.305	2.505
SEAM-IV				
SECTOR-B	0.144			0.144
SECTOR-C	1.706	1.141	0.550	3.397
TOTAL	1.850	1.141	0.550	3.541
SEAM-IV D				
SECTOR-B	0.319			0.319
SECTOR-C	1.140	2.551	1.075	5.569
TOTAL	2.259	2.551	1.075	5.888
SEAM-V				
SECTOR-B	0.018			0.018
SECTOR-C	-	0.561	0.710	1.270
TOTAL	0.018	0.561	0.710	1.288
G. TOTAL	40.510	24.851	9.499	74.877

**GRADEWISE, SECTORWISE RESERVES OF COAL SEAM IN
GONDALPARA BLOCK, NORTH KARANPURA COALFIELD.**

SEAMS/ SECTOR	G	H	A	D	E	TOTAL
	C	D	E	F	G	
SEAM - I						
SECTOR-A	-	-	-	2.818	-	2.818
SECTOR-B	-	-	0.491	1.405	-	1.896
SECTOR-C	-	-	5.151	29.229	-	34.387
TOTAL	-	-	5.651	33.462	-	39.109
SEAM-II						
SECTOR-A	-	-	0.259	-	-	0.259
SECTOR-B	-	-	0.663	-	-	0.663
SECTOR-C	-	2.411	13.101	-	-	15.597
TOTAL	-	2.411	14.101	-	-	16.519
SEAM-III BOT.						
SECTOR-B	-	-	0.301	-	-	0.301
SECTOR-C	-	0.183	3.401	-	-	3.585
TOTAL	-	0.183	3.621	-	-	3.801
SEAM-III COMB.						
SECTOR-C	-	-	2.041	-	-	2.042
TOTAL	-	-	2.041	-	-	2.042
SEAM-III TOP						
SECTOR-B	-	0.151	0.051	0.094	-	0.295
SECTOR-C	0.149	1.383	0.521	0.148	-	2.200
TOTAL	0.149	1.534	0.571	0.242	-	2.504
SEAM - IV						
SECTOR-B	0.038	0.041	0.001	-	-	0.144
SECTOR-C	0.264	3.143	-	-	-	3.397
TOTAL	0.292	3.184	0.001	-	-	3.541
SEAM-IV D						
SECTOR-B	-	-	0.311	-	-	0.319
SECTOR-C	-	0.200	5.301	-	-	5.509
TOTAL	-	0.200	5.681	-	-	5.880
SEAM-V						
SECTOR-B	-	-	-	0.018	-	0.018
SECTOR-C	-	-	0.311	0.958	-	1.271
TOTAL	-	-	0.311	0.976	-	1.289
G.TOTAL	0.441	7.488	32.271	34.670	-	74.873

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Sl.No.	Plate No.	Particulars	Scale RF	Drawing No. RI-III/G/
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CHAPTER - I

INTRODUCTION

1.1 OBJECTIVE

The North Karanpura Coalfield is the western most coalfield of Damodar Valley Coal basins. It is bounded by Latitude $23^{\circ}38'40''$ - $23^{\circ}58'40''$ "N and Longitude $84^{\circ}46'20''$ - $85^{\circ}24'15''$ E and covers an area of 1230 Sq.Km. Administratively, the coalfield falls in the districts of Hazaribagh, Chatra, Palamau & Ranchi of Bihar State. It is elliptical in shape with 64 Km. axis in east-west direction and 32 Km in north-south direction. The coalfield has drawn maximum attention during the last three decades on account of existence of thick quarriable coal seams with favourable geological setting. The mining activities are presently restricted to the south central part of the coalfield where both opencast and underground mines are operating.

The coalfield came into prominence after the nationalisation of coal industry and also due to spurt in demand for power grade coal in the country. As a sequel to this, large areas were identified for exploration and exploitation at shallower depth. During late nineties thrust was also given to prove the high ash medium coking coal available in the eastern part of the North Karanpura Coalfield. It is in this context the Badam Block (51.2 Sq.Km.) originally identified by the Geological Survey of India was studied in detail and was further subdivided into four number of potential blocks viz. Moitra (4.07 Sq.Km.), Badam (3.5 Sq.Km.), Gondalpara (3.5 Sq.Km.) and Babupara (3.0 Sq.Km.). While the geological report on Badam and Moitra blocks have been submitted, the present report deals with the geological findings of the Gondalpara block.

1.2 LOCATION

The Gondalpara block is bounded by latitude $23^{\circ}50'30''$ & $23^{\circ}51'30''$ N and longitude $85^{\circ}18'30''$ & $85^{\circ}20'30''$ E. It is located in the north eastern

part of the North Karanpura Coalfield and within the administrative jurisdiction of Hazaribagh district (Plate-I).

The Gondalpara block is covered by Survey of India toposheet No.73E/5 (RF 1:50000) and special sheet No.27 (RF 1:10000).

1.3 COMMUNICATION

The Gondalpara block is approachable from Badam village through a 3 Km Kutcha road. The Badam village in turn is connected by a fair weather road to Barkagaon village located on Tandwa-Hazaribagh metalled road at a distance of about 12 Km. The Barkagaon village is located on the Tandwa-Hazaribagh metalled road. The block, however, becomes unapproachable during the rainy season due to non-existence of a Bridge over the Badmahi river flowing along the northern and western part of the Block.

The distance from the block to Hazaribagh town is about 35 Km. The nearest Railway Station is Patratu at a distance of about 35 Km. towards south from the block on Daltonganj Barkakana-Dehri-On-Sone loop line of the North Eastern Railway. The road leading to the Patratu Railway Station is partly through fair weather and partly through Kutcha road. The nearest Airport with regular Indian Airlines flight is Ranchi located at a distance of about 120 Km. from the block.

1.4 AREA OF THE BLOCK

The Gondalpara block covers 3.5 Sq.Km. area. The east-west dimension of the block is about 2.7 Km. and the north-south dimension is about 1.6 Km (Plate-II). The Gondalpara block is surrounded by Moitra block towards north, the Badam block towards west, and virgin Lower Barakar/Karharbari formation rocks towards east and south (Plate-I).

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1.5 PHYSIOGRAPHY AND DBAINAGE

The Gondalpara block represent a rugged topography with hills in the eastern part and river valley toward west and north. A hill range traverses along the eastern and southeastern parts covering substantial area of the block. Hills are steep with maximum elevation of over 516 m. southeast of borehole CMKB-144. The difference between foot hills and the highest peak is about 60m. The minimum elevation along the Badmahi river is about 417m.

The Badmahi river, flowing southerly through the block in the northern and western parts control the main drainage of the area. Many rivulates originate from the hill range and feed the Badmahi river. The Badmahi river in turn joins the Damodar river towards south. The Badmahi river is perennial water sources for the region.

1.6 CLIMATE

The climate is tropical with severe summer. The temperature during summer (March to June) goes as high as 45°C. Summer days are hot with dusty winds but nights are generally pleasant. The minimum summer temperature is around 20°C. The winters (November to February) are cold and the minimum temperature recorded is 1°C. The rainy season is generally June to October. The total rainfall on an average is about 1100mm. of which 69% precipitation is during rainy season only.

1.7 PREVIOUS WORK

The North Karanpura Coalfield was first studied by D.H. Williams in 1840. Since then, numerous geologists of the Geological Survey of India have studied this Coalfield. The most important amongst them were T.W.H/ Hughes (1867-68), Dr.A. Jowett (1915-16) and Fr.L.L. Fermor. Based on the recommendations of the above studies, Indian Bureau of Mines (IBM) initiated drilling investigations in western part of the coalfield (now Pinderkom-Ganeshpur Block) in 1957-58 and the

findings were incorporated in their report of March, 1958. Subsequently, the Geological Survey of India (GSI) carried out regional investigations during 1963-65 and 1970-73. These activities were confined to the fringes of the coalfield where Barakar rocks are generally exposed. The findings from these explorations were found encouraging except in the Piparwar-Bhagea Sector (Piparwar, Ashok, Purnadih and Banti Blocks) where large scale surface burning was encountered in the boreholes. This region was geologically mapped in detail by the GSI in 1975 and regional drilling was again undertaken during 1977-79 at the instance of CMPDI to prove the potentiality of this region. The above efforts as well as drilling done by CMPDI culminated into identification of four quarriable blocks in this region, viz. Piparwar, Mangardaha, Ashok and Purnadih. In pursuance of the recommendations made by the Sub-committee on coal held in May 1979, the GSI initiated drilling investigations in Ursu-Manatu, Surajpura and Ara-Devalgara sectors of Tandwa area to confirm continuity of thick coal seams as established by earlier regional drilling. This investigation was carried out during 1979-81 and its findings were incorporated in the GSI Report of September, 1983.

The exploration activities of GSI in the eastern, northern and western fringes of the coalfield resulted into identification of a series of quarriable blocks, starting from Chitrapur-Chakla in the west to Ronhe-Chanorikba blocks in the east (Plate-I). Out of these blocks, Magadh and Amrapali Geological blocks, located in the northern part of the coalfield, were identified for detail drilling by CMPDI in the exploration programme of 1983-84. The exploration in part of Magadh Geological Block (Tandwa, Magadh and Saradhu) was completed in August, 1989 while in Amrapali Block, it was conclude in February, 1994. Number of geological reports have since been prepared and submitted for project formulation and execution.

The exploration in major Badam block was taken up by the GSI in 1962 and the report for this area was submitted in the year 1972. This report indicated presence of 1706.58 million tonnes of geological in situ reserve. The present report pertains to the north-eastern part of the main GSI block Plate-I.

1.8 MINING HISTORY OF THE BLOCK

The Gondalpara block is totally virgin from mining point of view. The area presently lack infrastructure for development of any mechanised mine.

1.9 EXPLORATION DESIGN

The original Badam block of the Geological Survey of India was considered having large resources of high ash medium coking coal. The present block is a part of the original Badam block which was undertaken for detailed exploration to evaluate the scarce coal resources of medium coking variety. The detailed exploration was aimed at providing opencast resources for the block.

1.10 IMPORTANT FEATURES OF THE AREA

The block is surrounded by small and medium size villages without proper infrastructure. There is practically no industrial development in this region of the North Karanpura Coalfield. An archaeological site ISKO is located at a crow fly distance of 3 Km from the block toward south-south-east (Plate-I). The site has old cave and paintings on the wall of the cave. The archaeological site is not developed and at present does not attract tourists.

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1.11 PRESENT INVESTIGATION

Table 1.11 A
The Quantum and Schedule of Exploration Activities by CMPDI,
Gondalpara block, North Karanpura Coalfield

SLNo.	Activity/	Duration		Quantum
		From	To	
1	Borehole Survey	1997	1998	53 bhs.
2	Geological mapping	1997	1998	3.5 Sq.Km.
3	Surface geophysical survey:			
(a)	HRSS	1991	1992	3.5 line Km
(b)	Resistivity	1997	1998	12.9 line Km.
(c)	Magnetic	1997	1998	5.2 line Km.
4	Drilling	1996	1998	8192m
5	Geological logging	1996	1998	8192m

1.12 QUANTUM OF TOTAL EXPLORATION INPUTS

Table 1.12A
Agency wise number of boreholes drilled in Gondalpara block,
North Karanpura Coalfield

Agency	Period	Drilling		Remarks
		No. of Borehole	Meterage	
CMPDI	1996-98	53	8,192.00	
CMPDI	1996	2	280.95	Drilled for adjoining blocks.
GSI	1962-64	4	1394.30	Position not found on ground.
TOTAL		59	9,867.25	

OBJECTIVE OF EXPLORATION

The present exploration in Gondalpara block was taken up with the following objectives :-

- To prove the lay, disposition and thickness of potential coal seams by geological mapping, exploratory drilling and surface geophysical surveys.
- To delineate seam incrops and faults.
- To demarcate zone of burning to the extent possible.
- To generate appropriate quality data for proper assessment of qualitative behaviour of seam with special reference to coking coal, if present.
- To establish the quantum of reserves available for each potential coal seams at different coal to GB cut off ratio for quarriable prospect vis-a-vis volume of overburden.

1.13 SCOPE AND LIMITATIONS

As a part of the regional exploration, the Geological Survey of India drilled some boreholes in this part during 1962-64. Four number of boreholes are reported to have been drilled within the block boundary, these are KBM-8, KBM-16, KBM-22, KBM-26. The above four boreholes could not be located on the ground and hence not considered in the present report for interpretation purpose. However, the basic data and GSI map showing tentative location have been provided.

In addition to above old GSI boreholes, CMPDI drilled 53 numbers of boreholes during the course of present investigation. All relevant geological information for these boreholes along with 2 number of boreholes falling within the block boundary from the adjoining blocks and other nearby boreholes located within a distance of 200m from the

block boundary have been considered for geological modelling of the Gondalpara block.

Due to round the year excessive cultivation no borehole could be drilled near river bank in the northern part of the block. This area has less confidence level but there is evidence of pronounce burning of coal seams and strata in this region of the block. Proper pattern of burning could not be ascertained by drilling and also by surface geophysical studies. The burning zone is delineated tentatively utilising the position of boreholes only which cannot be considered as firm. No proved reserve for burnt zone or heat affected zone has been assessed in the present study. The boreholes falling within burnt zone have been considered for structural interpretation only and not utilised for quality or reserve estimation. The possibility of getting some unburnt coal deposit in this zone cannot be ruled out particularly in view of having unburnt coal deposits in borehole No. CMKB-126 and CMKB-129 located on the river bed of Badmahi River immediate adjoining the boundary of the block. Moreover, faults depicted in the region is not in total conformity with the adjoining northern part due to paucity of boreholes which required to be proved by additional boreholes in order to ascertain regional structural set up. The structural elements picked up from the geophysical investigation could not be well accommodated in the present interpretation due to technical limitations. However, all the relevant data have been provided in the present report which may be utilised in future with or without additional inputs.

In some boreholes the recovery in coal seams and associated strata is quite low due to their nearness to faults and burning zone. their thickness may differ to certain extent from the extrapolated thickness shown in the report.


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Additional drilling to the tune of 3000m. may be required to properly delineate faults, precise positioning of incrops and burnt zone. The geophysical logging and magnetic survey involving additional profiles may also be required.

Chemical analyses received till February 2000 have been considered in the present report. Many special test results are still awaited from CPRi laboratories at Ranchi and Dhanbad.

The area lying immediate up dip side of Seam-I should not be considered non-coal bearing as the Karharbari Seam (K1 & K2 combined) in this region becomes thick. This seam is required to be proved by additional boreholes to assess the potentiality of the area. There is possibility of repetition of major seams as per the regional structural set up, which also requires to be proved. For this area alone about additional 3000 m., of drilling will be required. There is minor change in correlation of coal seams in borehole No. CMKB-68 from the earlier correlation done for Moltra block. This was done in view of the fact that further data were generated in this region which necessitated this change.

1.14 ACKNOWLEDGEMENT

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1.15 PERSONNEL ASSOCIATED WITH THE INVESTIGATION

1. **Overall Supervision**
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2. **Coordinator**
Dr A.K. Roy, : Chief of Geology & Drilling
3. **Field Geology**
Late Deepak Prasad, : Suptdg. Geologist
Shri A. Kumar, : Sr. Geologist
Shri R.R. Sinha, : Sr. Geologist
4. **Drilling**
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5. **Geophysicist**
Dr O.P. Rath, : Suptdg. Geophysicist
Shri S.P. Keshri, : Sr. Geophysicist
6. **Survey**
Shri M. Kamal, : Sr. Surveyor
7. **Documentation**
Shri Shailendra Nath, : Superintending Geologist
Shri P. Shankar, : Superintending Geologist
Shri K.C. Jain, : Dy Superintending Geologist

CHAPTER - 2

GEOLOGY AND STRUCTURE

2.1 REGIONAL GEOLOGY

2.1.1 General

The North Karanpura Coalfield forms a prominent east-west trending valley between Hazaribagh plateau in the north and Ranchi plateau in the south. The Aswa Pahar in the south east separates the north and south Karanpura Coalfields by an east-west elongated metamorphic patch. However, they are inter-connected near Bachra and Hindegir by a narrow tongue of Talchir outcrops (Plate-I). On the eastern side, North Karanpura Coalfield is separated from the West Bokaro coalfield by narrow stretch of metamorphic rocks having several outliers of Talchir Formation. In the west, it is separated by a stretch of about 20 kms wide metamorphic belt from the Auranga Coalfield.

2.1.2 Rock Formations

The North Karanpura coalfield contains youngest Mahadeva Formation down to the older Talchir Formation of Gondwana succession. The Barakar and Karharbari Formations contain potential coal seams within the coalfield. The Barakar coals are usually thick but highly interbanded with high ash whereas Karharbari seams are usually thin with low ash content.

2.1.3 Stratigraphy

The generalised stratigraphic sequence of the North Karanpura Coalfield is as under :-

Table No. 2.1 Geological succession of North Karanpura Coalfield.

Period	Group	Sub-group	Formation	Lithology
Recent	-	-	Alluvium	Detrital & Alluvium soil and sub-soil
Jurassic	-	Co-evals of Rajmahal Trap	Igneous intrusives	Dolerite & Mica peridotite.
Upper-Triassic	Upper Gondwana	-	Mahadeva	Massive coarse to conglomeratic feldspathic ferruginous sandstone with shale intercalation

Period	Group	Sub-group	Formation	Lithology
Lower Triassic	Lower Gondwana	Damuda	Panchet	Yellowish to white coarse grained sandstone, red, chocolate coloured plastic clays. In upper part, yellowish friable sandstone whereas greenish yellow sandy shale in the lower part with sand dune structure.
Upper Permian			Raniganj	Fine to medium grained quartzofeldspathic and quartzitic sandstone often micaceous and mottled, interbedded shale and sandstone, carbonaceous shale and thin coal seams.
Lower Permian			Barren Measures	Dark shale, sandy micaceous shale with siderite, interbedded shale and sandstones. Conglomerates, shale, greywacke, sandstones, interbedded with shale, carbonaceous shale, fire clay & coal seams
			Barakar	
			Upper Carboniferous	Karharbari
Talchir				
Unconformity /				

Period	Group	Sub-group	Formation	Lithology
Pre Cambrian	-	-	Meta-morphics	Granite pegmatites, micaschist limestones, bearing amphibolites and quartzites
				gneisses, phyllites, and chromite rocks, and

2.1.4 Description of formations

Out of the 1230 sq.km. area of the coalfield, the coal bearing formation viz. Karharbari, Barakar and Raniganj crop-out over an area of about 500 sq.km. (Plate-I). The Karharbari formation is well developed in the south-central and eastern part of the coalfield. It contains only one coal seam which is often splitted in two to three sections in south central part and three to five number of sections/seams in balance area. The Barakar formation contains good number of coal horizons and contributes the major bulk of reserves of this coalfield. Nine important coal seams have been established in the south central part of the coalfield in this formation. In remaining part of the coalfield, only five persistent coal horizons have been established so far. However, the total coal column is more or less the same in both these regions. Raniganj formation contains three to four coal seams which are generally shaly in nature and often impersistent.

2.1.5 Intrusives

The coalfield is mostly free of igneous intrusions excepting small dolerite intrusives around Nawakshap*, Rrahm* & Manatu* villages near Tandwa* township and Beltu* village in Kerendari Geological Block. The activity is pronounced in the eastern region. Mica periodite have also been reported from boreholes of the Badam, Moltra and Gondalpara blocks with extensive effect of burning.

Note :* Refer Plate -I

2.2 REGIONAL STRUCTURES

2.2.1 Tectonic set-up

The present structural set up of the coalfield indicates that it has undergone substantial modification mainly due to faulting which might have took place after the deposition. The southern boundary of the coalfield is characterised by east-west trending major fault between Khalari* and Mahuamilan* villages. It has brought the Raniganj Formation at places in direct juxtaposition with Metamorphics. The northern boundary of the coalfield is also faulted but mostly causing repetition of out-crops of Barakar, Karharbari and Talchir Formations. Besides above, there are two more important structural features viz. Karkatta-Piparwar anticline in the south-central part and Indratoli Dome near Ronha block observed in the eastern part of the coalfield. The Karkatta-Piparwar anticline is WNW plunging anticline whose southern limb is steeper (3deg. to 9 deg.) than the northern limb (almost sub-horizontal). The Manki colliery is situated almost on the axis of this anticline. The axial region of this can be seen in the cuttings of southern bank of the Damodar river about 1 Km. north-east of Jaindh village where both the limbs are clearly exposed. Indratoli Dome exhibits a metamorphic core at the centre with quaquaversal centrifugal dips of Gondwana rocks. It is dissected by numerous radial faults. In addition to above, there are many prominent faults trending mostly WNW-ESE. The throw of some of these faults is over 100 metres.

2.3 GEOLOGY OF GONDALPARA BLOCK

2.3.1 General

The surface and sub-surface data generated for the block have established the existance of Karharbari, Barakar and Barren Measures formations. While Barakar and Barren Measure rocks are exposed in the block, the Karharbari do not outcrop within the block but are available immediate adjacent in the

*Note : * Refer Plate -1*


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eastern part. The exposures available, likely incrop of coal seams, structural details including inferred position of faults are shown in Plate-III.

2.3.2 Description of Formation

The Karharbari Formation comprises of arenaceous facies represented predominantly by hard and compact medium to coarse grained sandstones which are silicified at places. Besides above, very coarse grained sandstone as well as pebble beds with loose cementing materials also occur. Five numbers of thin coaly horizons have been intersected in this formation and have been designated as seams K1-K5 in ascending order. Towards eastern part one or combination of Karharbari seams develop as a thick seam having 6 to 10m. thickness. This seam, however, has not been established properly due to its occurrence restricted to the east, generally beyond the block boundary.

The predominant rock types of Barakar Formation are sandstone followed by shales, intercalations of shale and sandstone, carbonaceous horizons, etc. The sandstone are often current bedded with symmetrical rythmites. Shales are generally sandy or carbonaceous in nature. The Barakar column has been intersected in western part of the property which normally varies from 10m to 200m as per borehole record. This formation contains five number of standard coal horizons (seams-I to V) within the block.

The Barren Measures have restricted occurrence in the western and northern part of the block and are mostly comprised of shale, grey shale, sandy shale, carbonaceous sandy shale and intercalation of shale and sandstone. Fine to medium grained sandstones also occur in some places.


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23.3 FIRE CLAY

Fire clay horizons have been reported to occur normally below seam-I and the distribution is usually patchy and erratic in the coalfield. In the present block no fire clay horizon has been identified in out crops or borehole cores. However, some shale/clay occurrences observed below seam-I have physical characters similar to inferior quality fire clay.

2.3.4 BURNING OF COAL SEAMS

The northern and western parts all along the river Badmahi is infested by both basic and ultra basic dykes. Almost all the coal seams within this zone have either been totally burnt out or are affected adversely by heat. The zone is demarcated clearly in all relevant plans and its tentative reserve is given under "Indicated" category.

2.4 GEOLOGICAL STRUCTURE

2.4.1 Strike and Dip

The strike of the strata is generally NE-SW over major part which it changes to almost N-S in the south-western part of the block with localised variation due to rolls of strike. The dip varies from 8 deg. to 25 deg. towards west & Northwest respectively. Fluctuations in dip and strike are mainly due to rolling and inter-seam parting variations.

2.4.2 Description of Faults

The block appears to be moderately disturbed from geological structure point of view. Altogether, seven number of faults F₁ to F₇ have been interpreted in the block. The fault F₇ shown largely beyond the northern boundary of the block.

The description of faults is given in Table no. 2.4.2A.

Table - 2.4.2A

Description of Faults in Gondalpara Block, N.K. Coalfield.

Fault No.	Extent of the Fault	Trend of the Fault	Direction of Down throw	Amount of throw	Evidence of Fault	Remarks
F1	All along southern part of the block	West-north west-East-south east	North-easterly	90m to 100m	Fault interpreted in Badam block and also found correct considering FRC on either side of the fault.	Corresponds to F5 of Badam block.
F2	All along south-western boundary of the block	West-north west-east South-east	North-easterly	90m to 100m	CMKB-115 seams II & I faulted. Continuing from Badam block. Also indicated in HRSS profile with much less amount of throw.	Corresponds to F6 of Badam block and F11 of Moitra block.
F3	Originate from fault F1 near borehole CMKB- 104 and continues southern part beyond the block boundary	Almost parallel to fault F1	North-easterly	Upto 30 m.	CMKB-114 seam-II part & seam-I faulted. An indication of fault is also given in HRSS profile but its distance is little away.	Corresponds to F10 of Moitra block.
F4	Originate near borehole no. CMKB- 121 and extend north easterly beyond block boundary	ENE-WSW	Southerly	Nb- 40 m.	Stratum contours on either side of faults are not matching	
F5	About against fault F2 near borehole No. CMKB-104 in the west and extends beyond block boundary in the east.	Curvilinear with ENE- WSW	Southerly	Upto 30m	Stratum contours on either side are not matching. Also indicated in HRSS profile with reverse direction of throw	

Fault No.	Extent of the Fault	Trend of the Fault	Direction of Down throw	Amount of throw	Evidence of Fault	Remarks
F6	Towards the northern boundary with east-west direction.	East-west	Northerly	About 60 m.	Continued from Moitra block and disposition of stratum contour.	Corresponds to F9 of Moitra block.
F7	Largely beyond the northern boundary.	East-west	Southerly	About 100m.	Continued from Moitra block and disposition of stratum contour.	Corresponds of F8 of Moitra block.

Note : An unnumbered fault has been shown west of borehole GMKB-142 beyond the north-eastern block boundary having downthrow towards north-east. This fault is suggested as per borehole record, Q&A interpretation and HRSS study. The fault requires to be confirmed in future, if necessary.

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CHAPTER – 3

DESCRIPTION OF COAL SEAMS

3.1 GENERAL

Coal seams occur in both Karharbari and Barakar Formations. The coal seams of Karharbari Formation are thin and erratic in nature except towards eastern part where one or combination of the seams have recorded thickness around 10m.

3.2 CORRELATION

Five number of thin seams viz. K1 to K5 have been correlated in Karharbari formation. The Barakar Formation contains thick correlatable coal seams. Altogether, ten number of correlatable coal seams viz. I, II, III Bottom, III Top, IV, IVA, IVB, IVC, IVD and V exist in Barakar formation within the block. Seam-III Top & Bottom merges at places and becomes Seam-III (Combined).

3.2.1 Karharbari Seams

Five number of Karharbari seams are known to occur in this region of North Karanpura Coalfield", the block also contains five number of correlatable seams. Out of five coal seams, K1 is the lower most seam. The seam is impersistent in development. Usually the thickness of the seam is less than 1m except in and around the eastern part where K1 & K2 or may be few other upper seams merge and become around 10m. The seam is likely to incrop towards east beyond the block boundary. Since the major area where thick seam is developed fall beyond the present study area, the detail exploration has not been done for this seam for the present. Unlike the quality of Karharbari seams reported from other part of North Karanpura Coalfield, the seams of Gondalpara block contain comparatively high ash percentage and also are interbanded.

The Seam K2 occurs above K1 with a parting ranging from 2.68 to 10.28m. The seam is developed towards southern and eastern parts. The seam is below 1m thickness over major part of the block. Quality data is similar to those of K1 seam. The seam as an independent seam is not potential from mining point of view within the block.

The K3 seam occurs above K2 seam with parting ranging from 4.99 to 17.20m. The seam is generally less than 1m thick over major part of the area. The range of thickness for the seam is nil to 1.42m. The seam has more than 2% moisture and 35 to 40% ash. K4 seam is correlated only in two boreholes. K5 seam is comparatively better developed but seldom reaches potential thickness of more than 1 m. The quality of seam is also that of K1 seam.

In view of inconsistent development, the Karharbari seams have not been considered potential and hence not dealt in detail.

3.2.2 Barakar Seams

The Barakar formation contains five number of standard coal horizons viz. Seam-I to Seam-V in the entire northern, eastern and western parts of North Karanapura Coalfield. The same set of seams are also present in the Gondalpara block alongwith some additional seams totalling ten in numbers.

3.3 WORKABLE SEAM PARAMETERS

The coal seams of the GSI Badam block of which Gondalpara block belongs was considered to contain high ash medium coking coal with usually low moisture (2-3%). As such, further sub-division to shaly coal, carbonaceous shale and beyond were done on ash percentage only e.g. >35% to 50% shaly coal, >50% to 75% carbonaceous shale and beyond 75% shale or sandstone.


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Coal seams of Gondalpara block are generally thick except few seams indicated above. The thickness considered for quality and quantity estimation is minimum 1 m, spread over considerable area within the block. The quality assessed is for excluding all dirt bands and shaly coal (Ex-band), excluding all dirt bands but including shaly coal (BCS) and including all carbonaceous shale upto 1 m. thickness but excluding all non-combustible dirt bands over 5 Cm. thickness (including band).

The thickness range mentioned under table 3.4 A provides for extreme range as observed in boreholes and the general range means most predominant range as per eye estimation from isochore plans.

3.4 SEQUENCE OF COAL SEAMS

Five number of standard coal horizons viz. Seam-I to V in Barakar Formation and five numbers viz. Seam-K1 to K5 in Karharbari Formation occur in this block. Few split sections/local seams also occur in the block which are III Top, IVA, IVB, IVC and IVD. Altogether, 15 number of coal seams are available within Lower Permian strata. Of the 15 numbers of seams, 7 number of seams viz. I, II, III Top, III Bottom, IV, IVD and V are economically potential. Sequence of coal seams is given in Table-3.4A.

Table 3.4A

Sequence of Coal Seams in Gondalpara Block, N.K. Coalfield

Seam	Thickness & Parting (m)		General Range (m)	No. of boreholes encountered/ full thickness
	Minimum	Maximum		
Seam-V	3.91 (CMKB-98)	6.30 (KBM 125)	4-5	3
Parting	41.93 (CMKB-114)	59.68 (KBM 125)		

Seam	Thickness & Parting (m)		General Range (m)	No. of boreholes encountered full thickness
	Minimum	Maximum		
Seam-IVD	4.107 (KBM-114)	15.44 (KBM-96)	5-10	10
Parting	1.67 (CMKB-96)	3.97 (KBM-99)		
Seam-IVC	Nil	4.11 (CMKB-102)		6
Parting	Nil	4.96 (CMKB-128)		
Seam-IVB	Nil	2.53 (CMKB-128)		1
Parting	Nil	10.63 (CMKB-128)		
Seam-IVA	0.95 (CMKB-93)	2.88 (CMKB-98)		1
Parting	2.93 (CMKB-94)	15.12 (CMKB-98)		
Seam-IV	3.25 (CMKB-114)	5.46 (CMKB-94)	3.5-4.5	11
Parting	1.97 (CMKB-124)	25.11 (CMKB-104)		
Seam-III Top	2.45 (CMKB-98)	4.80 (CMKB-108)	3-3.5	9
Parting	Nil	5.04 (CMKB-124)		
Seam-IIIB	4.15 (CMKB-126)	6.82 (CMKB-108)		17+1*
Seam-III (Combined)	8.67 (CMKB-95)	11.34 (CMKB-125)		
Parting	2.87 (CMKB-105)	32.24 (CMKB-108)		6
Seam-II	7.39 (CMKB-99)	18.10 (CMKB-22)		
Parting	3.78 (CMKB-102)	33.08 (CMKB-94)	12-15	19+3**
Seam-I	11.07 (CMKB-105)	20.43 (CMKB-123)		
Parting	20.43 (CMKB-123)	29.46 (CMKB-108)	15-18	29
K3	Nil	2.07 (CMKB-134)		
Parting	7.70 (CMKB-95)	8.43 (CMKB-94)		26
K4	Nil	0.54 (CMKB-95)		
Parting	-	-		2

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Seam	Thickness & Parting (m)		General Range (m)	No. of boreholes encountered full thickness
	Minimum	Maximum		
K3	Nil	1.42 (CMKB-141)		7
Parting	4.99 (CMKB-111)	17.20 (CMKB-138A)		
K2	Nil	2.70 (CMKB-144)		9
Parting	2.68 (CMKB-144)	10.28 (CMKB-135)		
K1	Nil	3.40 (KBM-126)		11
K3 & K1 (Combined)	2.34 (CMKB-118A)	11.81 (CMKB-141)		4

* One borehole CMKB-114 has encountered two splits of Seam-IIIB. This borehole has not been considered for range estimation.

** Three boreholes viz. CMKB-102, 105 & 106 have recorded two splits of Seam-II. These boreholes have not been considered for range estimation.

- Note :-**
1. The seams IVA to IVC are thin and erratic in development.
 2. The Karharbari seams have not been properly developed within the block.
 3. Thickness of burnt seam/heat affected seams encountered in boreholes has not been considered for the table No.3.4.A.
 4. General range is most predominant range as per eye estimation from Isochore plan.
 5. "Nil" thickness mentioned for boreholes are for seams where the coal seams are not developed. Those boreholes which have not encountered seams due to non-development has not been projected under column "No of boreholes thickness."


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Detail description of individual coal seams are given below.

3.5 SEAM-I

3.5.1 Reference:

- | | | |
|-------------------|---|-----------------------|
| 1. Floor contours | - | Plate VI |
| 2. Seam Folio | - | Plate XIII |
| 3. Seam structure | - | Plates XXVIA to XXVID |

3.5.2 Details of Boreholes

- | | | |
|-----------------------------------|---|---------|
| 1. Seam intersection in boreholes | - | 29 Nos. |
| 2. Band by band analysis | - | 26 Nos. |
| 3. Seam overalls | - | 24 Nos. |
| 4. Ultimate analysis | - | 3 Nos. |
| 5. Washability test | - | 1 No. |
| 6. Special tests | - | 1 No. |

3.5.3 Depth of Occurrence

The seam incrops within the block and the maximum depth of occurrence is over 250m.

3.5.4 Stratigraphic Position

Seam-I is the bottom most Barakar seam. It occurs above K5 seam with parting ranging from 20m to 30m. The seam incrops in the eastern part of the block.

3.5.5 Thickness

The thickness of the seam varies from 11.07m to 20.43m, the general thickness range being 15m to 18m. Maximum thickness of over 19m recorded in two isolated patches in the central part around boreholes CMKB-106 and CMKB-122. The thickness reduces both towards northeastern and southeastern parts.

3.5.6 Roof & Floor

The immediate floor is generally represented by carbonaceous shale or dark grey shale and the roof by fine or medium grained sandstone.

3.5.7 Pyrolitisation

Both basic and ultrabasic intrusives occur in Gondalpara block. Such dykes have intensively damaged the coal seams towards northern and western part of the property. The zone of burning has been shown in seam folio plan. The reserve of heat affected coal has been tentatively assessed under "Indicated" category.

3.5.8 Dirt Bands

The seam is interbanded. It contains usually carbonaceous shale bands having less than 1m thickness. Grey shale bands have also been encountered in few boreholes but their occurrences are much less.

Detail dirt band position is given in Annexure-V and a summary is given in Table - 3.5.8A.

Table - 3.5.8A
Dirt bands within Seam-I, Gondalpara Block,
North Karanpura Coalfield

Thick- ness of Seam (m)	Carbonaceous Shale Band			Shale/Sandstone Band			Total Band		
	No.	Thick- ness (m)	% age	No.	Thick- ness (m)	% age	No.	Thick- ness (m)	% age
11.07- 20.43	2-17	1.32- 4.94	6.5- 32.22	0-3	0-0.80	0-3.96	2-17	1.33- 4.94	9.73- 32.22

Generally, 15 to 20 percent dirt bands are present in this seam.

3.5.9 Proximate Analysis

After obtaining band by band results, overall analysis were advised to the laboratory. Boreholewise results received from laboratory are given in Annexure-VI and a summary is given in Table - 3.5.9A.

Table- 3.5.9A

Overall Proximate Analysis of Seam-I,
Gondalpara Block

Particular	On 60% RH & 40°C			UHV K.Cal/Kg.	Grade
	M%	A%	VM%		
Ex-Band	1.5-3.1	23.5-30.6	24.2-30.1	4305-5230	C-D
BCS	1.4-3.0	29.1-39.8	23.1-27.3	3145-4070	E-F
Including Band	1.2-2.9	34.8-44.0	19.9-25.0	2510-3780	E-F

Moisture content of the seam is normally within 2.5 percent. The ash percentage normally varies from 35% to 40% for including band seam and the grade varies from E to F. The volatile matter percent for the block is around 26% ex-band. Towards the northern part the seam is totally burnt / heat affected around boreholes CMKB-88, 104, 107, 110 to 113, 115 and 116. In this region, the VM content is less than 10 percent. The seam having around 20% VM has been considered as normal coal. This has been followed for all the relevant seams.

3.5.10 Ultimate Analysis & Special tests

Ultimate analysis on 3 number of samples has been carried out. The results are representative for the respective area. The boreholewise details are given in Annexure-VII and summary of the same is given in Table-3.5.10A.

Table-3.5.10A

Ultimate Analysis and other Special Test results of Seam-I,
Gondalpara Block

Ultimate Analysis (DMMF)					VM% (DMMF)	CV K.Cal/Kg (Unit coal)	CO ₂ % as carbo nates	Phos- phorus	Total Sulphur	CT	SI
C%	H%	N%	S%	O%by diff.							
85.49-	5.3	0.8-	0.5-	6.9-	34.1-	8235-	0.56-	0.069-	0.41-	C-D	1/2-
86.30		0.9	0.6	7.9	36.0	8825	0.64	0.271	0.62		1

Normal range of carbon percentage is 85 to 86. Unit VM percentage is generally high and ranges from 34 to 35. The lower value recorded towards northern part where seam is just beyond heat affected zone.

3.5.11 Sulphur

Two boreholes have been subjected to sulphur determination. Total sulphur for two boreholes varies from 0.42 to 0.62%.

3.5.12 Washability Study

Coal cores from one borehole viz. CMKB-126 located within the block has been subjected to the washability test. Detail washability characteristic is given in Annexure-IX and summary of screen and yield percentage on 100% raw coal are given in Table - 3.5.12A and 3.5.12B respectively.

Table- 3.5.12A

Screen analysis of raw coal, Seam-I, Gondalpara Block

Particulars	Size in mm			
	Raw Coal	13-6	6-0.5	-0.5
Weight %	100	56.5	38.3	5.2
Ash%	42.2	43.0	41.6	37.7

Table-3.5.12B
Washability result on 100% raw coal basis, Seam-I,
Gondalpara Block

Particulars	Clean Coal	Middlings	Rejects
Weight %	17.2	45.6	32.0
Ash%	17.0	36.0	65.2

It may be seen from the above tables that there is about 1.5 units improvement in ash content in 6mm and below size with yield at 44 percent. About 17% yield is expected with 17% ash on whole coal basis.

Chemical analysis of clean fraction, middlings and rejects are given in Annexure-IX. A few important analytical parameters of clean coal fraction is given in Table - 3.5.12C.

Table-3.5.12C
Analytical results of Clean Coal, Seam-I,
Gondalpara Block

Particulars	As Analysed			On Unit Coal			CT	SI
	M%	A%	VM%	C%	H%	CV K Cal/Kg		
Clean Coal	3.3	16.9	38.0	85.5	5.3	8,375	E/F	1 1/2

If the above data is compared with table 4.5.10.A of raw coal analysis, it may be observed that while there is improvement in CT from C-D to E/F other parameters remained almost similar. No marked improvement in basic quality of coal is evident in clean coal from that of raw coal.


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3.5.13 Ash Fusion Range and HGI

Results awaited from CSL, Ranchi

3.5.14 Ash Analysis

Ash analysis result for one borehole CMKB-105 is available. The same is given in Annexure-VII and at Table - 3.5.14A

Table- 3.5.14A

Ash Analysis Results for Seam-I, Gondalpara Block

Major Oxides	Percentage
SiO ₂	55.52
Al ₂ O ₃	17.23
Fe ₂ O ₃	4.8
TiO ₂	2.4
CaO	12.60
MgO	1.30
PO ₅	1.97
SO ₃	0.79
Alkalies & Errors	1.39
Total	100.00

3.5.15 Sectional Make-up

On close examination of seam structures, it reveals that three sections of almost equal thickness can be identified. While the top and bottom sections are usually inferior coal and contain large number of carbonaceous shale, the middle section is comparatively clean and free from dirt bands.

The ash content of the middle section is expected to vary between 31 and 34 percent i.e. 4 to 5 percent reduction in ash content from the overall seam.

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3.5.16 Discussion

The seam contains high VM (unit coal) ranging between 37 & 36 percent. The carbon content is between 85 & 87 percent. The CV (on unit coal) is rather low ranges from 8235 to 8825 K.Cal/Kg. One borehole CNKB-119 has recorded 8825 K.Cal/Kg. which appears to be on higher side as other boreholes have unit CV around 8250 K.Cal/Kg. only. The coke type is also low i.e. C-D. The coal as such can be placed between semi coking and high volatile medium coking. However, because of inferior coke type and low CV, the coal seam appears to be of semi-coking nature. The clean coal fraction though show some improvement in quality yet it does not satisfy the parameters for medium coking coal. Since the ash content is over 35%, the coal from this seam is, therefore, considered non-coking coal as per commercial classification and the relevant information is given accordingly.

3.6 Seam-II

3.6.1 Reference

1.	Floor contour	:	Plate-VII
2.	Seam folio	:	Plate-XIV
3.	Iso-parting Seam-I & II	:	Plate-XX
4.	Seam structure	:	Plates-XXVIIA to XXVIIC

3.6.2 Details of Boreholes

1.	Seam Intersection in boreholes	-	19Nos.
2.	Band by band analysis	-	19Nos.
3.	Seam Overalls	-	14Nos.
4.	Ultimate analysis	-	1 No.
5.	Washability test	-	1 No.
6.	Special tests	-	3 Nos.

3.6.3 Depth of Occurrence

The seam incrops within the block and its maximum occurrence recorded within the block is 250m.

3.6.4 Stratigraphic Position

Seam-II occurs above Seam-I with parting ranging from 3.70m to 33.00m. The seam incrops in the eastern part of the block. The seam splits into two sections toward south-western part of the property around boreholes CMKB-102, 105 & 126. Due to its restricted occurrence these splits have not been considered separately for quality and quantity evaluation.

3.6.5 Thickness

The thickness of the seam varies from 7.30m to 18.10m. However, the normal range is between 12m and 15m. Maximum thickness of around 15m is recorded in the central part which decreases towards north central directions.

3.6.6 Roof & Floor

Immediate floor and roof are generally constituted by the shale, carbonaceous shale and sandstone.

3.6.7 Pyroclitisation

Like Seam-I, Seam-II is also affected by igneous intrusives towards northern and western part of the property affecting over 50% of the area of the block.

3.6.8 Dirt Bands

The seam is interbanded with 1 to 12 number of usually carbonaceous shale dirt bands. Generally, the number varies from 3 to 6. One number of shale band (non-combustible) has been

encountered in one borehole with minor thickness. Total thickness of dirt bands varies from 0.90m to 2.46m and the percentage to seam thickness from 5.76 to 14.62. Borehole wise detail statement is given in Annexure-V and brief is given in Table - 3.6.8A.

Table- 3.6.8A

Dirt bands within Seam-II, Gondalpara Block

Thick- ness of Seam (m)	Carbonaceous Shale Band			Shale/Sand stone Band			Total Band		
	No.	Thick- ness (m)	% age	No.	Thick- ness (m)	% age	No.	Thick- ness (m)	% age
7.39- 18.10	1-12	0.90- 2.46	5.76- 14.62	Nil-1	0-0.10	0-2.3	1-12	0.90- 2.96	5.76- 14.62

Normally, the percentage to seam thickness varies from 10 to 14. There is one dirt band having more than 1m thickness is recorded in almost all boreholes.

3.6.9 Proximate Analysis

Most of the seam overall results were obtained from the laboratory. The boreholewise seam overall result is provided in Annexure-VI and the relevant summary is given in Table - 3.6.9A.

Table - 3.6.9A

Overall Proximate Analysis, Seam-II, Gondalpara Block

Particulars	On 60% RH & 40°C			UHV K.Cal/Kg	Grade
	M%	A%	VM%		
Ex-Band	1.9-4.4	21.5-28.4	25.0-28.2	4565-5490	C-D
BCS	1.9-3.6	25.9-33.6	24.0-27.3	3850-5035	C-E
Including Band	1.9-3.5	29.3-35.6	22.7-26.5	3575-4430	D-E 3-14

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The including band moisture and ash generally varies from 2 to 3 percent and 30 to 35 percent respectively. The grade (including band) is generally D to E. The quality is generally better in central part. Quality deteriorates towards northern part in the close vicinity of heat affected area.

3.6.10 Ultimate Analysis and Special Tests

Ultimate analysis results are available for one borehole only. The result for other boreholes are awaited. The boreholewise details are given in Annexure-VII and the relevant summary is given in Table-3.6.10A.

Table -3.6.10A
Ultimate Analysis and other Special test results of Seam-II,
Gondalpara Block

Ultimate Analysis (DMMF)				VM%	CV	CT	SI
C%	H%	N%	S%	(DMMF)	K.Cal/Kg		
					(Unit coal)		
85.5	5.4	1.0	0.8	36	8,340	C	I

The carbon content is recorded at 85%. VM content is also comparatively high 36%.

3.6.11 Sulphur

Total sulphur determination for three boreholes are available which ranges from 0.55 to 0.62%.

3.6.12 Washability Study

Coal cores from one borehole CMKB-128 were subjected to washability test. Detail result is given in Annexure-VII and the salient parameters are given in Table - 3.6.12A and 3.6.12B.

Table -3.6.12A

Screen analysis of raw coal, Seam-II, Gondalpara Block

Particulars	Size in mm			
	Raw coal	13-6	6-0.5	-0.5
Weight %	100	56.4	37.1	6.5
Ash%	32.9	34.0	32.0	29.2

Table - 3.6.12.B

Washability Result on 100% raw coal basis, Seam-II,
Gondalpara Block

Particulars	Clean Coal	Middlings	Rejects
Weight %	48.2	24.8	20.5
Ash%	17.0	37.9	65.3

There is hardly any improvement in lower size i.e 6mm and below. The yield of 48 percent is expected at 17 percent ash level.

Chemical analysis of clean fraction, middlings and rejects are incorporated in Annexure-IX. Some salient details of clean coal is reproduced in Table - 3.6.12C.

Table- 3.6.12C

Analytical Results of Clean Coal, Seam-II, Gondalpara Block

Particulars	As Analysed			On Unit Coal		
	M%	Ash%	VM%	C%	H%	CV K.Cal/Kg
Clean Coal	3.6	17.0	30.8 (36.9)	85.7	5.3	8320

The above result if compared with table - 3.6.10A, it could be observed that there is hardly any improvement in quality in clean coal. Further, the moisture content is also high.

3.6.14 Ash analysis result for one borehole CMKB-105 is available, the same is given in Annexure-VII and at table - 3.6.14A.

Table -3.6.14A
Ash Analysis Results for Seam-II, Gondalpara Block

Major Oxides	Percentage
SiO ₂	59.80
Al ₂ O ₃	12.17
Fe ₂ O ₃	6.80
TiO ₂	2.40
CaO	7.20
MgO	7.43
P ₂ O ₅	1.89
SO ₃	0.88
Alkalies & Errors	1.41
Total	100.00

3.6.15 Sectional Make up

Seam-II has virtually two distinct sections, the top interbanded inferior and bottom clean and comparatively better section. At the extreme bottom part of the bottom section having about 20cm to 50cm thickness deteriorates to either carbonaceous shale or interbanded horizon of shaly coal and carbonaceous shale. This bottom most section should be excluded for assessing the quality of better section coal. The boreholewise detail of better section coal is provided with seam structure plates.

Normally, the thickness of better section ranges from 5 to 7m, the moisture and ash content varies from 2 to 3% and 25 to 28% respectively. There is about 5 unit reduction in ash content from the overall seam.

3.6.16 Ash Fusion Range and HGI

Results awaited from CSL Laboratories.

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3.7 Seam-III Bottom

3.7.1 Reference

1.	Floor contour	:	Plate-VIII
2.	Seam Folio	:	Plate-XV
3.	Isoparting seam-II & III	:	Plate-XXI
4.	Seam structure	:	Plate-XXVIII A TO XXXVIII C

3.7.2 Details of Boreholes

1.	Seam intersection in boreholes	-	18nos.
2.	Band by band analysis	-	18nos.
3.	Seam overall	-	8 nos.
4.	Ultimate analysis	-	1 no.
5.	Washability tests	-	1 no.
6.	Special tests	-	3 nos.

3.7.3 Depth of Occurrence

The seam incrops within the block and extends upto the depth of 220 m.

3.7.4 Stratigraphic Position

Seam-III Bottom occurs above Seam-II with parting ranging from 2.87 to 32.24m. The seam incrops in the eastern part.

3.7.5 Thickness

The thickness of the seam varies from 4.75m to 6.82 m. The normal range of thickness, however, varies from 3 to 4m. Thickness is more in the north eastern region which reduces towards south western and south eastern parts.

3.7.6 Roof and Floor

The immediate floor is represented by shale or carbonaceous shale. The immediate roof is also generally made of shale and occasionally fine grained sandstone.

3.7.7 Pyrolitisation

Like seam I & II, seam III Bottom is also affected by igneous intrusions towards northern and southern parts of the property.

3.7.8 Dirt Bands

The seam contains 1 to 2 number of dirt bands in 40 percent boreholes. Remaining 60% boreholes are free from dirt bands. The dirt bands wherever present are carbonaceous shale and are less than 1m in thickness excepting in one borehole viz. CMKB-115 where 1 no. of thick band 2.16m has been encountered. Boreholewise detailed statement is provided in Annexure-V and a summary range is given in Table - 3.7.8A.

Table - 3.7.8A
Dirt Bands within Seam-III Bottom, Gondalpara Block

Thickn ess of Seam (m)	Carb onaceous Band Thickn ess (m)	Shale %age	Shale No.	/Sandstone Thickness (m)	Band %age	No.	Total Band Thickn ess (m)	%age
			Nil-		Nil-	Nil-2		0-31.62

3.7.9 Proximate Analysis

Seam overall analysis results were obtained from the chemical laboratory & same is given in Annexure-VI. The relevant range of analytical data is given in Table - 3.7.9A.

Table - 3.7.9A
Overall Proximate Analysis, Seam-III Bot., Gondalpara Block

Particulars	On 60% RH & 40 deg.C			UHV KCal/Kg	Grade
	M%	Ash%	VM%		
Excluding	1.9-4.5	19.9-27.2	24.8-30.3	4455-5890	B-D
BCS	1.8-4.4	19.9-34.6	24.3-28.9	3820-5890	B-E
Including Band	1.8-4.4	30.8-35.1	23.4-28.9	3545-5645	B-E

The including band moisture generally varies from 2 to 3.5 percent and the overall grade generally falls in E. The quality is more or less uniform over the area 0

3.7.10 Ultimate Analysis & Special Tests

Ultimate analysis results are available for 1 borehole CMKB-105. The borehole detail is given in Annexure-VII and the range is given in Table-3.7.10.

Table -3.7.10
Ultimate Analysis and other Special Test-Results, Seam-III Bot., Gondalpara Block

Ultimate Analysis (DMMF)					VM%	CV	CO ₂ %	Phosp	CT	SI
C%	H%	N%	S%	O%	(DM MF)	kal/K g (Unit Coal)	as carbon %	horous %		
85.4	5.4	1.0	0.7		42.1	82.0	0.58	0.251	B-C	1/2-1

The coke type, unit CV and SI are rather low for coking coal. The VM is a Iso very high for medium to weakly coking variety.

3.7.11 Sulphur

Determined value for total sulphur is available for 3 boreholes which ranges from 0.51 to 0.68%.

Washability Study

Coal cores from one borehole CMKB-128 were subjected to washability study, the result of which is given in detail in Annexure-IX. The salient points of the observations are given in Table - 3.7.12A and 3.7.12B.

Table-3.7.12A

Screen Analysis of Raw Coal, Seam-III Bot, Gondalpara Block

Particulars		Size in mm		
	Raw Coal	13-6	6-0.5	+0.5
Weight %	100	49.8	42.6	7.8
Ash %	34.6	36.2	32.7	28.6

Table-3.7.12B

Washability Result on 100% Raw Coal Basis,
Seam-III Bottom, Gondalpara Block

Particulars	Clean Coal	Middling	Rejects
Weight %	28.1	47.0	17.1
Ash%	17.0	35.4	61.2

About 25% yield is expected with 17% ash which is not very encouraging. Moreover, the analysis of clean coal also do not show much improvement in quality after washing. The result is given in Table - 3.7.12C.

Table-3.7.12C

Analytical Results of clean coal, Seam-III Bottom,
Gondalpara Block

Particular		As analysed			On Unit	
	M%	Ash%	VM%	C%	11%	CV Kcal/Kg
Clean	3.6	16.9	31.4	85.1	5.3	8225

The moisture in clean coal is high restricting its use for metallurgical purpose.

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3.7.12 Washability Study

Coal cores from one borehole CMKB-128 were subjected to washability study, the result of which is given in detail in Annexure-IX. The salient points of the observations are given in Table - 3.7.12A and 3.7.12B.

Table-3.7.12A
Screen Analysis of Raw Coal, Seam-III Bot, Gondalpara Block

Particulars		Size in mm		
	Raw Coal	13-6	6-0.5	-0.5
Weight %	100	49.8	42.6	7.8
Ash %	34.6	36.2	32.7	28.6

Table-3.7.12B
Washability Result on 100% Raw Coal Basis,
Seam-III Bottom, Gondalpara Block.

Particulars	Clean Coal	Middings	Rejects
Weight %	28.1	47.0	17.1
Ash%	17.0	35.4	61.2

About 25% yield is expected with 17% ash which is not very encouraging. Moreover, the analysis of clean coal also do not show much improvement in quality after washing. The result is given in Table - 3.7.12C.

Table-3.7.12C
Analytical Results of clean coal, Seam-III Bottom,
Gondalpara Block

Particular		As analysed			On Unit	
	M%	Ash%	VM%	C%	H%	CV Kcal/Kg
Clean	3.6	16.9	31.4	85.1	5.3	8225

The moisture in clean coal is high restricting its use for metallurgical purpose.

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As per the available quality parameter, the seam is being considered as non-coking coal.

3.8 Seam-III Top

3.8.1 Reference :

1.	Floor contour	-	Plate-IX
2.	Seam Folio	-	Plate -XVI
3.	Isoparting seam-III Bottom & III Top	-	Plate-XXII
4.	Seam structure	-	Plate-XXVIII A TO XXVIII C

3.8.2 Details of Boreholes :

1.	Seam intersection in boreholes.	-	12 nos.
2.	Band by band analysis	-	12 nos.
3.	Seam overall	-	7 nos.
4.	Ultimate analysis		
5.	Washability Test	-	1 No.
6.	Special Tests	-	2 nos

3.8.3 Depth of Occurrence

The seam incrops within the property and extends upto a depth of 210m as per borehole records.

3.8.4 Stratigraphic Position

Seam-III Top occurs above III Bottom with parting ranging from nil to 5.04m. The seam incrops generally towards the central part of the property.

3.8.5 Thickness

Thickness of the seam varies from 2.45m, to 4.80m. The normal range of thickness, however, lies between 3 and 3.5 metres. The thickness is more or less consistent. The thickness is less towards south northern part and increases towards north eastern part around borehole CMKB-100.

3.8.6 Roof and Floor

The immediate floor is generally represented by shale and alternate bands of shale and sandstone and the roof is generally constituted by fine to medium grained sandstone or sandy shale.

3.8.7 Pyrolitisation

Like other seams, seam-III Top is also affected adversely by igneous intrusives towards northern and western parts of the property.

3.8.8 Dirt Bands

The seam contains 1 to 2 number of dirt bands. In all boreholes only 1 carbonaceous shale band is present. Boreholewise dirt band statement is given in Annexure-V and the relevant range is given in table - 3.8.8A.

Table - 3.8.8A Dirt Bands within seam-III Top,

Gondalpara Block,

Thickn ess of seam (m)	Carbonaceous shale band			Shale/Sands one Band			Total Band		
	No.	Thick. (m)	Percent age	No.	Thick. (m)	Percent age	No.	Thick. (m)	Percent age
2.45- 4.80	Nil-2	0-0.77	0-21.6	Nil	Nil	Nil	Nil-2	0-0.77	0-21.6

3.8.9 Proximate Analysis

Seam overall results were determined in the laboratory, the seams are incorporated in the Annexure-VI. The ranges for individual parameters are given in Table - 3.8.9A.

Table - 3.8.9A.

Overall Proximate Analysis, Seam-III Top, Gondalpara Block.

Particulars	On 60% RH & 41 deg.C			UHV KCal/Kg	Grade
	M%	Ash%	VM%		
Excluding Band	2.8-4.7	22.7-25.7	26.6-28.1	4910-5230	C-D
BCS	1.7-4.7	24.1-32.4	22.4-21.4	3450-5020	C-E
Including Band	1.7-4.7	2.60-42.5	21.1-27.4	2787-5010	C-F

The Ex-band (BCS) grade is generally D whereas inband grade is E.

3.8.10 Ultimate Analysis and Special Tests

The ultimate analysis result is awaited from CSL laboratory Ranchi. The result from adjoining Badam block is given in Table - 3.8.10 A.

Table-3.8.10A

Ultimate Analysis and other Special Tests, Seam-III Top from adjoining Badam block.

Ultimate Analysis (DMMP)					VM% (DM MP)	CV kcal/K g. (Unit Coal)	CO ₂ % as carbon ate	Phosp horous %	CI	ST	CS
C%	H%	N%	S%	O%							
83.9-	5.1-	1.7-	0.6-	5.9-	34.3-	8275-	0.30-	0.009-	10	B-D	1/2-1
86.5	5.4	2.0	0.8	8.2	36.6	8355	1.89	0.042			

3.8.11 Sulphur

Total sulphur determination for two boreholes are available which ranges from 0.50 to 0.54%.

3.8.12 Washability Study

Coal cores from one borehole (CMKB-12B) was studied for washability characteristics. The result is given in Annexure-IX and the salient points are given in Table - 3.8.12 A and 3.8.12B.

Table-3.8.12A
Screen Analysis of Raw Coal, Seam-III Top,
Gondalpara Block.

Particulars		Size in mm		
	Raw Coal	13-6	6-0.5	-0.5
Weight %	100	55.8	37.6	6.6
Ash%	24.4	25.6	23.2	21.1

Table-3.8.12B
Washability Result on 100% Raw Coal Basis, Seam-III Top,
Gondalpara Block.

Particulars	Clean Coal	Middling	Rejects
Weight	64.9	24.6	4.6
Ash%	17.0	38.9	58.1

About 65 % yield is expected with 17% ash. In fact the total cal (100% raw coal) is having 24.4% ash, as such, the washing may not be of much use since the coal is considered as non-coking. The analysis of clean coal is also available and is given in the Annexure-IX. The relevant result is also given in the Table - 3.8.12C.

Table-3.8.12C
Analytical Results of Clean Coal, Seam-III Top,
Gondalpara Block.

Particulars	Ash				On Coal	
	M%	Ash%	VM%	C%	H%	CV Kj/Kg
Clean Coal	3.6	16.9	30.4 (36.8)	85.0	5.4	8185

3.9 Seam-III (Combined)

3.9.1 Reference:

1. Floor Contour	:	Plate -XV
2. Seam Folio	:	Plate - XXIII
3. Seam structure	:	Plate - XXVIII A to XXVIII C

3.9.2 Details of Boreholes:

1. Seam intersection in boreholes-	6 nos.
2. Band-by-band Analysis	- 5 nos.
3. Seam Overall	- 3 nos.
4. Ultimate Analysis	
5. Special Tests	- 1 no.

3.9.3 Depth of Occurrence:

The seam incrops within the block and its maximum depth of occurrence recorded is about 240 m.

3.9.4 Stratigraphic Position

The Seams-III Bottom and III Top merge towards north central part and forms a combined seam having combined thickness without remarkable parting between them.

3.9.5 Thickness

Thickness of the seam varies from 8.67m to 11.34m. The normal thickness range being 8m to 9m.

3.9.6 Roof and Floor

Immediate roof and floor are generally represented by shale or alternate bands of shale and sandstone.

3.9.7 Pyrolitisation

This seam is also burnt due to igneous activities towards northern and western parts of the property.

3.9.8 Dirt bands

Maximum 2 number of dirt bands are preset within the seam. The dirt bands are always carbonaceous shale having less than 1m thickness. Boreholewise details of dirt bands is given in Annexure-V and the range is given in Table - 3.9.8(A).

Table - 3.9.8A

Dirt Band within seam-III (comb.) Gondalpara Block.

Thick- ness of seam (m)	Carbonaceous shale band			Slate /Sands tone Band			Total Band		
	No.	Thick. (m)	Percent- age	No.	Thick. (m)	Percent- age	No.	Thick. (m)	Percent- age
8.67- 11.34	1-2	0.20- 0.57	1.76-5.94	Nil	Nil	Nil	1-2	0.20- 0.59	1.76-5.94

3.9.9 Proximate Analysis

Most of the seam overall results were determined in the chemical laboratory. Boreholewise details of the same is given in Annexure-VI and the range is given in Table - 3.9.9A.

Table - 3.9.9A

Overall Proximate Analysis Seam-III (Comb.)
Gondalpara Block.

Particulars	On 60% RH & 43 deg.C			UHV	Grade
	M%	Ash%	VM%	KCaVKg	
Excluding Band	1.4-3.3	25.3-30.7	23.4-28.3	4400-5090	C-D
BCS	1.3-3.0	29.9-34.1	22.5-26.6	3903-4443	D-E
Including Band	1.2-2.5	33.3-36.3	21.3-23.5	3560-3960	E

The including band moisture generally varies from 1.2 to 2.5%. The general lower range of moisture may be due to the occurrence of combined seam near burning zone. VM% is also lower in these boreholes. The grade(including band) is generally E.

3.9.10 Ultimate Analysis and Special Tests

The ultimate analysis results is awaited from Coal Survey Laboratories. For reference and broad idea the date of seam III Bottom may be considered.

3.10 Seam-IV

3.10.1 Reference:

1. Floor contour	:	Plate - X
2. Seam Folio	:	Plate -XVII
3. Isoparting seam III Top & IV	:	Plate - XXIII
4. Seam structure	:	Plate - XXVIII A to XXVIII C

3.10.2 Details of Boreholes

1. Seam intersection in boreholes	-	16 nos.
2. Band by band analysis	-	16 nos.
3. Seam overall	-	9 nos.
4. Washability Test	-	1 no.
5. Special tests	-	2 nos.

3.10.3 Depth of occurrence

The seam incrops within the block and extend upto a depth of about 200m.

3.10.4 Stratigraphic Position

Seam-IV occurs above seam-III top with parting ranging from 1.9 to 25.11 m. The seam incrops in the central part of the property.

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3.10.5 Thickness

Thickness, of the seam varies from 3.25m to 5.46m. One borehole CMKB-98 however, has encountered only carbonaceous shale having more than 1m. thickness, which appears to be anomalous and hence not considered in involving the range. The normal range of thickness is 3.5-4.5. Thickness is maximum towards up dip side.

3.10.6 Roof and floor

Immediate floor and roof strata are generally composed of shale, alternate bands of shale and sandstone and occasionally fine to medium grained sandstone.

3.10.7 Pyrolytisation

Like other seams, this seam is also affected by igneous intrusions towards northern and western parts of the block.

3.10.8 Dirt Bands

Normally, 1 number of dirt band is present within the seam. Few boreholes, however, are without dirt bands also. Non-combustible dirt bands are not present within the seam. Boreholewise details of dirt bands are given in Annexure-V and the range is given in Table - 3.10.8A.

Table-3.10.8A

Dirt Bands within Seam-IV, Gondalpara Block.

Thick- ness of seam (m)	Carbonaceous shale band			Shale/Sandstone Band			Total Band		
	No.	Thick. (m)	Percent age	No.	Thick. (m)	Percent age	No.	Thick. (m)	Percent age
3.25- 5.46	Nil-1	0-0.30	0-6.56	Nil	Nil	Nil	Nil-1	0-0.30	0-6.56

3.10.9 Proximate analysis

Most of the seam overall results were obtained from the Chemical Laboratory. Boreholewise data is given in Annexure-VI and the range is given in Table - 3.10.9A.

Table-3.10.9A
Overall Proximate Analysis, Seam-IV, Gondalpara Block

Particulars	On 60% RH & 40 deg.C			UHV KCal/Kg	Grade
	M%	Ash%	VM%		
Excluding Band	1.9-4.5	19.9-26.3	24.1-27.4	4790-5890	B-D
BGS	1.9-4.3	19.9-30.4	23.9-26.4	4415-5890	B-D
Including Band	1.8-4.3	20.9-30.4	23.4-26.2	4290-5645	B-D

The including band grade is normally D.

3.10.10 Ultimate Analysis and Special Tests

The test result is awaited from CSL, Ranchi.

3.10.11 Sulphur

Total sulphur analysis result for two boreholes available which varies from 0.54 to 0.73%.

3.10.12 Washability Test

Coal cores from one borehole (CMKB-128) was studied for washability characteristics. The result is given in Annexure-IX and the relevant points are given in Table - 3.10.12A and 3.10.12B.

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Table-3.10

12A Screen Analysis of Raw Coal, Seam-IV, Gondalpara Block

Particulars	Size in mm			
	Raw coal	13-6	6-0.5	-0.5
Weight	100	56.9	36.8	6.3
Ash%	28.7	29.4	28.3	24.0

Table-3.10.12B

Washability Result on 100% Raw Coal Basis Seam-IV,
Gondalpara Block

Particulars	Clean Coal	Middlings	Rejects
Weight %	47.6	36.2	9.9
Ash%	17.0	36.4	59.6

The raw coal subjected for washability Test was having ash 28.7%. Yield of clean coal is 47.6% at 17% ash level. The clean coal sample was analysed for specific tests and there result is incorporated in Annexure-IX and the relevant data are given in Table - 3.10.12C.

Table-3.10.12C

Analytical Results of Clean Coal, Seam-IV, Gondalpara Block

Particulars	As analysed			On Unit Coal		
	M%	Ash%	VM%	C%	H%	CV Kcal/Kg
Clean Coal	4.7	17.3	30.3 (37.4)	83.1	5.4	8165

The moisture content is high and the basic quality does not show much improvement from raw coal.


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3.11 Seams IVA, IVB and IVC

In between seams IV and IVD, three number of comparatively thin seams occur viz, IVA, IVB and IVC in ascending order. The seams are generally thin less than 1m over major part of the area and are not developed in many boreholes. The details of all the seams are given in relevant annexures. No detail exercise was carried out for these seams for evaluation of reserve and quality. Whatever reserve is available, the same have been incorporated alongwith the overburden.

3.12 Seam - IVD

3.12.1 Reference:

1. Floor contour	:	Plate - XI
2. Seam Folio	:	Plate-XVIII
3. Isoparting seam IV & IVD	:	Plate - XXIV
4. Seam structure	:	Plate - XXIXA to XXIXB

3.12.2 Details of Boreholes

1. Seam intersection in boreholes	-	17nos.
2. Band by band analysis	-	17nos.
3. Seam overall	-	6 nos.
4. Ultimate Analysis	-	1 no.

3.12.3 Depth of Occurrence

The seam incrops within the block and extend upto depth of 220m as per the borehole record.

3.12.4 Stratigraphic Position

The Seam-IVD occurs after a parting ranging from 12.62m to 33.88m above seam IV. This seam is potential and incrops in the central part of the property.

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3.12.5 Thickness

Thickness of the seam varies from 4.30m to 15.44m. The normal range of thickness is 5 to 10m. Maximum thickness is reported in borehole CMKB-96 located in the south-central part whereas the minimum thickness is reported from borehole CMKB-98 in the central part. In this borehole the upper 5m. section has been deteriorated to carbonaceous shale and shaly coal.

3.12.6 Roof and Floor

Immediate floor is generally represented by shale or alternate bands of shale and sandstone. The immediate roof is constituted by shale or fine to medium grained sandstone.

3.12.7 Pyrolitisation

Like other seams, the seam IVD is also burnt due to igneous activities towards north and western parts affecting over 70% of the property.

3.12.8 Dirt Bands

The seam is highly interbanded and contain 1 to 6 number of dirt bands. Normally, the number varies from 3 to 4. Both combustible and non-combustible dirt bands occur within the seam. Boreholewise details is given in Annexure-V and the relevant range is given Table - 3.12.8A.

Table-3.12.8A

Dirt Band within seam-IVD, Gondalpara Block.

Thickness of seam (m)	Carbonaceous shale band			Shale/ Sandstone Band			Total Band		
	No.	Thick. (m)	Percentage	No.	Thick. (m)	Percentage	No.	Thick. (m)	Percentage
4.30-15.44	1-6	0.35-5.28	3.30-45.91	Nil-1	0-0.69	0-6.08	1-6	0.35-5.28	3.30-45.91

Only one borehole CMKB-96 is devoid of any dirt bands. The thickness of this borehole is also very low (4.30m). The date of this borehole is not incorporated while making different ranges.

3.12.9 Proximate Analysis

Proximate overall results were determined in chemical laboratory. Boreholewise result is given in Annexure-VI and relevant range is given in Table-3.12.9A.

Table-3.12.9A
Overall Proximate Analysis, Seam-IVD, Gondalpara Block

Particulars	On 60% RH & 40 deg C	UHV	Grade
	M% Ash% VM%	KCal/Kg	
Excluding Band	1.8-4.7 18.5-24.5 24.7-27.3	4650-5090	C-D
BCS	1.8-4.6 26.4-29.5 22.5-26.1	4330-4675	D
Including Band	1.6-4.3 29.2-36.5 21.2-25.4	3270-4400	D-F

Moisture content is normally 3 to 4 and the including band grade is generally

E. 3.12.10 Ultimate Analysis

The analytical data for one borehole received from CSL, Ranchi, which is given in Annexure VII A and relevant data is also given in Table - 3.12.10 A.

Table-3.12.10 A
Ultimate Analysis and other Special Tests, Seam-IVD, Gondalpara Block.

Ultimate Analysis (DMM F)					VM% (DM M)	CV kcal/Kg. (Unit Coal)	CO2% as carbonate	Phosphorus %	CT	SI
C%	H%	N%	S%	O%						
53.6 (63.8)	3.3 (5.2)	1.4 (2.2)	0.5 (0.9)	(8.3)	-	8,115	0.4	-	B-C	0-1


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3.13 Seam-V

3.13.1 Reference:

1. Floor contour	:	Plate -XII
2. Seam Folio	:	Plate -XIX
3. Isoparting seam IVD & V	:	Plate - XXV
4. Seam structure	:	Plate - XXX

3.13.2 Details of Boreholes

1. Seam intersection in boreholes	-	10 nos.
2. Band by band analysis	-	11 nos.
3. Seam overall	-	5 nos.
4. Ultimate	-	1 no.

3.13.3 Depth of Occurrence

The seam incrops within the block and extend upto a depth of about 150m.

3.13.4 Stratigraphic Position

Seam-V is the youngest seam of Barakar Formation. The seam is thick and inter-banded. It occurs above seam- IVD after a parting from 41.93m. to 59.68 m. The seam incrops in western and central parts of the property.

3.13.5 Thickness

Thickness of the seam varies from 3.91m to 6.30m. Normal thickness range, however, varies from 4m. to 5m.

3.13.6 Roof & Floor

Immediate roof and floor strata are generally constituted by shale or alternate bands of shale and sandstone. Occasionally fine grained sandstone also forms the roof strata.

3.13.7 Pyrolitisation

The seam is much affected by igneous intrusives. Virtually 90% of the area of occurrence of seam V is represented by burnt coal /heat affected coal.

3.13.8 Dirt Bands

Two or three number of dirt bands generally occur within the seam. Boreholewise details of the dirt bands are given in Annexure-V and the general range is given in Table - 3.13.8A.

Table-3.13.8A

Dirt bands within seam-V, Gondalpara Block

Thick-ness of seam (m)	Carbonaceous shale band			Shale/Sandstone Band			Total Band		
	No.	Thick. (m)	Perce-ntage	No.	Thick. (m)	Perce-ntage	No.	Thick. (m)	Perce-ntage
1.91-6.30	Nil- 4	0-0.64	0-15.34	-	-	-	Nil-3	0-0.64	0-15.34

3.13.9 Proximate Analysis

The seam overall proximate analytical result are given in Annexure-VI, the relevant ranges are given in Table - 3.13.9A.

Table-3.13.9A

Overall Proximate Analysis, Seam-V, Gondalpara Block

Particulars	On 60% RH & 41 deg.C			UHV KCal/Kg	Grade
	M%	Ash%	VM%		
Excluding Band	2.3-3.6	30.5-32.1	23.5-24.0	3975-4345	D-E
BCS	2.4-3.5	32.9-39.4	21.1-24.0	2980-4030	E-F
Including Band	2.3-3.5	36.4-41.3	20.5-22.4	2800-3560	E-F

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The moisture content is generally 3% and the including band grade is F.

3.13.10 Ultimate Analysis

Jest results for one borehole received from CBL, Ranchi, which is given in Annexure-VIIA and also in Table - 3.13.10A.

Table-3.13.10 A

Ultimate Analysis and other Special Test, Seam-V,
Gondalpara Block

Ultimate Analysis (DM/MP)					VM% (DM MP)	CV kcal/ Kg. (Unit Coal)	CO ₂ % as carbon ate	Phospho rous%	CT	SI
C%	H%	N%	S%	O%						
46.3- (82.8)	2.9- (5.2)	1.2- (2.1)	0.6 (0.8)	9- (9.1)	-	10880	0.3	-	A	0

CHAPTER 4

RESERVE AND OVERBURDEN

RESERVES

4.1 GENERAL

The reserve estimation has been carried out for all the potential coal seams of Barakar Formation viz. Seam-I, II, III Bottom, III Top, IV, IVD and V. Seam-IVA, IVB, IVC and few local bands within Barakars have not been considered for reserve estimation because of their inconsistent nature and less than 1m thickness. Similarly, Karharbari seams were also not considered on the same reason.

4.2 BASIC ASSUMPTIONS AND NORMS FOLLOWED

- 4.2.1 Minimum thickness considered for any individual seam was 1m. The effective thickness of the seam has been considered by excluding 1m and above dirt bands and all non-combustible bands having more than 5 cm in thickness.

4.2.2 Seams affected by Intrusives

About 50% of the area is affected by the igneous intrusives. All the coal seams in this area are either burnt or adversely heat affected. The reserve of heat affected seams have been tentatively assessed under "Indicated" category.

4.2.3 Categorisation of Reserves

The entire coal reserve estimated for unburnt/unheat affected zone is placed under "proved" category and the heat affected coal reserve is placed under "Indicated" category.

4.2.4 Grade Estimation

The Gondalpara area represent a part of original Badam Block of the Geological Survey of India. The coal of this block was placed by the G.S.I. as high as medium coking coal. The coal seams of this area exhibits caking nature particularly, for lower seams. Since the quality data do not conclusively support the medium coking or weakly coking nature and there is no grading for coking and beyond 35% ash level, for the present assessment all the coal seams have been graded as per high moisture non-coking long flame coal grading.

53 PROCEDURE

53.1 Block Boundary

The Badmahi river forms the northern and western boundaries of the block. The trace of incrop Seam-I represents the eastern block boundary. The fault F1 which forms the southern boundary also demarcates the boundary between Badam and Gondalpara blocks.

4.3.2 Barriers

The Badmahi river flows all along the northern and western boundaries of the block and the area adjoining the river is all burnt heat affected for which only "Indicated" reserve has been estimated. The area having about 500 m. average width is required to be explored further to ascertain any unburnt zone, if present.

The HPL for the Badmahi river could not be collected from local administration. As per the available information from the local villagers the HPL is around 415 m.

4.3.3 Sector

There are three sectors demarcated for Gondalpara block. The Sector-A is narrow patch covered between two faults D1 and F₂. The Sector-B is the only patch which practically represent the Gondalpara block. The Sector is demarcated as burnt/heat affected zone for which no estimation has been made.

Table 4.3.3 A

Description of Sectors, Gondalpara Block,
North Karanpura Coalfield

Sector	Area of Sector (Sq.Km.)	Limiting Boundary of Sector
A	0.15	Fault F ₁ towards south line of burning towards west, fault F ₂ towards north and incrop of Seam-I towards east.
B	0.09	Line demarcating burnt zone towards west, fault F ₂ towards south, F ₃ towards north and incrop of Seam-I towards east.
C	1.35	The line demarcating burning zone towards north and west, fault F ₃ towards south and incrop of Seam-I towards east.
D	1.62	The Badmahi river represents the northern & western boundaries, the line demarcating burning zone forms the southern boundary and trace of burnt/heat affected incrop of Seam-I represent the eastern boundary.

4.3.4 Methodology

For the purpose of estimating coal reserves within the block, isochores for individual coal seams including all combustible dirt bands having 1 m or more in thickness were prepared and are depicted in Plate No.XIX to XXVI. The reserve estimation for each seam was carried out separately by adopting isochore method. The area between the two successive isochores were determined with the help of planimeter which was multiplied with the average thickness of the two successive isochores to arrive at the volume of coal including admissible dirt bands. The volume of reserve, thus arrived for individual areas between the isochore lines were multiplied with the corresponding specific gravity of the coal seams to get the 'gross' geological reserves. From this, a standard deduction of 10% was made for unforeseen elements to get the 'net' geological reserve. The estimation has been done by taking the sides of excavation as vertical.

4.3.3 Average Specific Gravity

The specific gravity used for reserve estimation is calculated by a formula $28 \pm 1\%$ average ash of the individual coal seams including all admissible dirt bands and for different grades. The calculated values thus arrived are given in Table 4.3.5A.

Table 4.3.5A

Seam wise, Grade wise Average Specific Gravity,
Gondalpara Block, North Karanpura Coalfield

Sl.No.	Coal Seam	Specific Gravity for 100				
		B	C	D	E	F
1	V	-	-	-	1.64	1.7
2	IVD	-	-	1.57	1.63	-
3	IV	1.50	1.50	1.56	-	-
4	III Top	-	1.52	1.54	1.61	1.70
5	III Bot.	-	1.54	1.57	1.60	-
6	III Comb.	-	-	-	1.63	-
7	II	-	-	1.58	1.62	-
8	I	-	-	-	1.64	1.69

The volume and reserve (both 'gross' and 'net') estimated for individual areas between two successive isochores were added to arrive at the total figures for each isodepthlines within the block. This in turn, was further added to get the total reserves within each sectors and also for the entire block. Similar procedures were used to get the reserves within each isograd line, within each cut-off ratio line and for individual sectors of the block which in turn were added to get the total reserves for the block.

4.3.6 Summarised Tabulated Statements of Reserves

The seamwise, sectorwise and gradewise reserves are given in Table No.4.3.6A and 4.3.6 B.

TABLE 4.3.6 A

DEPTHWISE SECTORWISE RESERVE OF COAL SEAMS IN GONDALPANA BLOCK, NORTH KARANPURA COALFIELD.

SEAMS	DEPTH WISE & SECTOR WISE RESERVE					TOTAL
	< 50 M.	50-100 M.	100-150 M.	150-200 M.	200-250 M.	
SEAM I						
SECTOR-A	2.818	-	-	-	-	2.818
SECTOR-B	0.031	1.160	0.414	0.270	-	1.904
SECTOR-C	5.472	9.380	7.318	7.307	4.700	34.307
TOTAL	8.321	10.540	7.732	7.637	4.700	39.109
SEAM-II						
SECTOR-A	0.260	-	-	-	-	0.260
SECTOR-B	-	0.258	0.217	0.138	-	0.603
SECTOR-C	0.016	4.321	5.718	3.474	2.070	15.599
TOTAL	0.276	4.579	5.935	3.602	2.070	16.522
SEAM-III BOT.						
SECTOR-A	-	-	-	-	-	-
SECTOR-B	-	0.160	0.114	0.072	-	0.306
SECTOR-C	-	0.200	1.810	1.012	0.477	3.615
TOTAL	-	0.440	1.924	1.084	0.477	3.961
SEAM-III TOP						
SECTOR-A	-	-	-	-	-	-
SECTOR-B	-	-	-	-	-	-
SECTOR-C	-	-	0.412	0.543	1.048	2.043
TOTAL	-	-	0.412	0.543	1.048	2.043
SEAM-III TOP						
SECTOR-A	-	-	-	-	-	-
SECTOR-B	-	0.078	0.114	0.074	-	0.290
SECTOR-C	-	0.053	1.010	0.742	0.234	2.209
TOTAL	-	0.131	1.124	0.816	0.234	2.505
SEAM-IV						
SECTOR-B	-	-	0.118	0.038	-	0.144
SECTOR-C	-	0.003	1.419	1.294	0.641	3.397
TOTAL	-	0.003	1.537	1.332	0.641	3.543
SEAM-IV D						
SECTOR-B	-	-	0.114	0.186	-	0.319
SECTOR-C	-	-	1.211	2.911	1.327	5.560
TOTAL	-	-	1.325	3.096	1.327	5.880
SEAM-V						
SECTOR-B	-	-	0.018	-	-	0.018
SECTOR-C	-	-	-	0.354	0.918	1.270
TOTAL	-	-	0.018	0.354	0.918	1.289
G. TOTAL	8.597	15.708	20.915	18.464	11.603	74.877

TABLE 4.3.6B

**RATIOWISE, SECTORWISE RESERVE OF COAL SEAM
NORTH KARANPURA COALFIELD.**

SEAMS	RATIOWISE &		SECTORWISE RESERVE S	
	1:1 -1: 2	1:2-1:3	>1:3	TOTAL
SEAM-I				
SECTOR-A	0.341	2.477	-	2.818
SECTOR-B	1.904	-	-	1.904
SECTOR-C	19.378	11.389	3.610	34.387
TOTAL	21.623	12.866	3.610	39.109
SEAM-II				
SECTOR-A	0.054	0.206	-	0.260
SECTOR-B	0.663	-	-	0.663
SECTOR-C	9.516	4.187	1.816	15.519
TOTAL	10.233	4.393	1.816	16.422
SEAM-III BOT.				
SECTOR-B	0.306	-	-	0.306
SECTOR-C	2.113	1.049	0.413	3.575
TOTAL	2.479	1.049	0.413	3.941
SEAM-III COMB.				
SECTOR-C	0.547	0.606	0.810	2.143
TOTAL	0.547	0.606	0.810	2.143
SEAM-III TOP				
SECTOR-B	0.206	-	-	0.206
SECTOR-C	1.215	0.689	0.315	2.219
TOTAL	1.511	0.689	0.315	2.515
SEAM-IV				
SECTOR-B	0.144	-	-	0.144
SECTOR-C	1.706	1.141	0.530	3.377
TOTAL	1.850	1.141	0.530	3.521
SEAM-IV D				
SECTOR-B	0.319	-	-	0.319
SECTOR-C	1.940	2.554	1.015	5.169
TOTAL	2.259	2.554	1.015	5.828
SEAM-V				
SECTOR-B	0.018	-	-	0.018
SECTOR-C	-	0.560	0.710	1.270
TOTAL	0.018	0.560	0.710	1.288
G. TOTAL	40.520	24.858	9.419	74.797

TABLE 4.3.6.0

GRADEWISE, SECTORWISE RESERVES OF COAL SEAM IN
GONDALPARA BLOCK, NORTH KARANPURA COALFIELD ..

SEAMS/ SECTOR	G C	H D	A E	D F	E G	TOTAL
SEAM-I						
SECTOR-A				2.818	-	2.818
SECTOR-B			0.409	1.405	-	1.814
SECTOR-C			0.158	29.219		29.377
TOTAL			0.567	33.442		34.009
SEAM-II						
SECTOR-A			0.259			0.259
SECTOR-B		-	0.663	-	-	0.663
SECTOR-C		2.411	11.198	-	-	13.609
TOTAL		2.411	11.457			13.868
SEAM-III BOT.						
SECTOR-B			3.366			3.366
SECTOR-C		0.153	1.462	-		1.615
TOTAL		0.153	4.828			4.981
SEAM-III COMB.						
SECTOR-C			2.042			2.042
TOTAL			2.042			2.042
SEAM-III TOP						
SECTOR-B		2.151	1.050	0.014		3.215
SECTOR-C	0.149	1.383	1.529	0.118	-	3.179
TOTAL	0.149	3.534	2.579	0.132		6.394
SEAM-IV						
SECTOR-B	0.038	2.041	1.095	-		3.174
SECTOR-C	0.254	1.143		-	-	1.397
TOTAL	0.292	3.184	1.095			4.571
SEAM-IV D						
SECTOR-B			2.319			2.319
SECTOR-C		0.200	1.383	-		1.583
TOTAL		0.200	3.702			3.902
SEAM-V						
SECTOR-B	-			0.018		0.018
SECTOR-C	-		2.313	0.918		3.231
TOTAL	-		2.313	0.936		3.249
G.TOTAL	0.441	3.488	11.274	34.619		49.822

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NORTH KARANPURA COALFIELD

Seam-I and Seam-II are the most potential seams of Gondalpara block I and they together contribute over 74 % of the total reserve of the block which stands at 74.88 million tonnes excluding burnt and heat affected coal. Over 52 % of the proved reserve is located between the depth 100 m. and 200 m. The 54.1 % of reserve is assessed within 1:2 cut off ratio and another 33% is estimated within 1:2 and 1:3 cut-off ratio. Similarly E& F grade together contribute about 87 % of the coal reserve.

Another 101.46 million tonnes of coal reserves are estimated as heat affected coal/shaly coal having around 10% VM and are placed as indicated reserve. If demand of such coal is felt in future, the area will have to be explored further to precisely delineate the limiting boundary of volatile matter. The indicated reserve is placed as Table No. 4.3.6D

**SEAMWISE INDICATED RESERVEES IN GONDALPARA BLOCK
NORTH KARNAPURA COALFIELD.**

TABLE 4.3.6D

SEAM	GROSS RESERVES
I	28.651
II	26.973
III BOTTOM	2.840
III COMBINED	6.837
III TOP	2.590
IV	7.575
IVD	15.893
V	10.099
TOTAL	101.458

4.4 OVERBURDEN

4.4.1 Nature

All the five coal seams of Barakar Formation occur within the block. In addition, three seams/split seams are also present within the block. Lower most Barakar seam considered for opencast exploitation is Seam-I followed upward by Seam-II, III Bottom, III Top, IV, IVD & V. Seams IVA, IVB and IVC are comparatively thin and inconsistent, these seams do not offer much potential for planned exploitation and hence their volume wherever present have been considered as overburden along with other non-coal strata.

Overburden Strata

The bulk of the O.B. rocks are represented by sandstone and shale followed by their intermediate varieties, carbonaceous shale, thin coaly horizons and clays. In addition to above, the block is mostly covered by soil/weathered mantle which would also contribute a sizeable chunk of the overburden as revealed by the borehole data and surface mapping. The sandstone normally constitutes about 50% of the O.B. rocks while the different shales and intermediate varieties constitute about 45%.

Soil/Alluvium

Almost the entire block is covered by soil/alluvium as could be seen from Plate No.10. The maximum depth of soil/weather mantle as per borehole records comes to 21.0m. However, generally it varies from 8m to 12m. It is commonly dirty white to redish brown in colour.

Shale

The shales vary in composition from argillaceous to arenaceous varieties. The argillaceous shales dominate over the arenaceous varieties. The carbonaceous shale occur both as in seam burden as well as in partings between coal seams. Intercalation of shales and sandstones and sandy shales are more common in the O.B. rocks as compared to other varieties.

The sandstone are generally fine to coarse grained with commonly dirty white to light grey in colour. Coarse to medium grained sandstone dominate over the fine grained sandstone. Greywackes, gritty sandstone and conglomerates are also present within the overburden rocks. The ferruginous sandstones, wherever present, are hard & compact and are responsible for giving rise to reddish brown soil due to iron leaching.

The carbonaceous shale generally constitutes bulk of the in-seam burden. Shale and sandstone seldom occur as a thick dirt bands within the seam. Overall the dirt bands which are excluded from the seam thickness represent hardly 1% of the total overburden.

The volume of overburden (external) has been calculated from the isopachytes of total excavation (coal+non-coal) drawn on the floor of Seam-I being the bottom most seam of the quarriable packet. It is shown in Plate No. XXXII. The total volume of overburden has been arrived after deducting the volume of coal from the volume of total excavation (i.e. coal as well as non-coal strata). The volume of O.B. has been estimated sectorwise, isodepthline wise and within each depthlines, isopachyteline wise.

The volume of overburden was estimated from the plan using planimetry method. Detail overburden estimates is given in Annexure-IX, the sector wise and depth wise volume of overburden is given in Table 4.4.3A.

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Table 4.4.3A

**Sector wise and Ratio wise Volume of External Overburden
in Gondalpara Block**

Sectors	1:1-1:2	1:2-1:3	>1:3	Total
Sector-A	0.450	2.081	-	2.531
Sector-B	5.046	-	-	5.046
Sector-C	42.312	34.744	20.709	97.765
Total	47.808	36.825	20.709	105.342

Table 4.4.3B

**Sector wise Coal Reserves vis-a-vis Overburden Volume in
Gondalpara Block**

Sector	Area (Sq.Km.)	Coal Reserve(m)	Volume of Overburden (mm3)	Stripping Ratio
A	0.15	3.08	2.53	0.82
B	0.09	3.71	5.05	1.36
C	1.35	68.09	97.77	1.44
Total	1.59	74.88	105.35	1.41

The total overburden for the block excluding burnt/heat affected area estimated at 105.35 million tonnes. Thus the average stripping ratio comes to 1.41 Cu.m. per tonne of coal.

(Reference: Memo No. 1000/2014)

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CHAPTER - 5 ENVIRONMENTAL CONSIDERATIONS

General

The exploitation of coal by opencast method leads to considerable damage to the environment of the area. Since Gondalpara Block contains quarriable and non quarriable coals, the damage to the environmental set-up is expected to be of greater magnitude. Normally, the damage is done to the land and forest, quality of air and water, flora and fauna and the village population.

With a view to minimise the environmental degradation, while mining, the Govt. of India constituted, Advance Environmental Planning Groups in the Department of Coal for developing coalfields of which, North Karanpura is one. The task assigned to this Group Coalfield,

- 1 To examine in details and assess environmental impact of development of oal mines in North Karanpura Coalfield,
- 2 To suggest measures that should be taken to minimise degradation of forest as a result of mining operation and also to finalise the plan for compensatory afforestation.
- 3 To suggest population control measures to be taken by the coal company to ensure that the mining activities are carried out in a environmentally compatible manner,
- 4 To suggest an organisational set-up which would expedite and acquisition and compensatory afforestation in the North Karanppura Coalfield,

The report of the Advance Environmental Planning Group of North Karanpura Coalfield was submitted in October, 1987. The objective of the Group was fully achieved excepting plan for compensatory afforestation which could not be drawn up because of non-availability of information on revenue

waste land and degraded forest land. The Group has suggested setting up of a North Karanpura Development Authority to ensure orderly growth and development within this region. Similarly, necessity for promoting Plantation, Development Agencies at CCL level has also been stressed by the Group.

For proper study of the likely impacts of mining and other allied activities on environment for Gondalpara property, basic data required are as follows :

1. Village population
2. Water analysis from rivers/nalas/ponds/dugwells
3. Air quality and noise level
4. Soil quality
5. Flora and fauna
6. Land use pattern

No data is available pertaining to water analysis, air quality, noise and soil quality for this area under report. Details available pertaining to these parameters have been discussed in detail in Geological Report on Magadh Block in this coalfield.

Population

The main village within the block is Gondalpara, situated along Badmahi river in North Western part of the block. Another small village Gali is also situated in the eastern part of the block. The adjoining villages are Babupara situated near north western boundary & Hahe on the other side of Badmahi river in Northern side. The population details all the four villages are given in enclosed tables.

1. Details of population within & around Gondalpara Block
2. Land use pattern of villages falling within & around Gondalpara Block.

The total population of Gondalpara, Gali, Phulang & Hahe is 1531, 192, 0 & 233 respectively. These villages comprise mainly of Hindus, Muslims, Tribals and few Christians. The main livelihood is agriculture, agrobased products and forest produce. The entire area of Gondalpara Block falls in Hazaribagh district of Bihar. Gondalpara property falls under Barkagaon Thana located at a distance of about 14 Km.

Flora & Fauna

This block is characterised mainly by shrubs and bushes particularly as eastern & southern side of the block. The trees are generally of Sai (*Shorea robusta*), Asan (*Terminalia tomentosa*), Bija (*Petrocarpus marsupium*), Mahua (*Madhuka Indica*), Kendu (*Diospyrus malaoxylon*), Piar (*Buchanania Larizan*), Dhawra (*Anogisusia/Erfolia*), Khair (*Acacia catechu*), Amla (*Emblica officinale*), Mango, Jamun, Semal, Bargad, Pipal, Eucalyptus etc. The shrubs are mainly of Pulus, Karonda etc. Different types of grasses and climbers are also present within the block. Wild life within the block is meagre, however, some wolves, foxes, rabbits etc. are occasionally seen within the block.

Land Use Pattern

Gondalpara Block comprises both of forest and non-forest land as depicted in Plate No. XXXIV. It may be seen from this plate that the forest occurs in an area of about 1.76 Sq.Km. amounting to about 44% of the total area of the block. The remaining area is either fallow land (0.44 Sq.Km.) , cultivated (1.77 Sq.Km.) and non-cultivable land (0.03 Sq.Km.). It is worth mentioning here that almost the entire area of the block is covered by soil/alluvium and necessary steps have to be taken for removal of top soil separately while quarrying, so that the same could be used during land reclamation.

Table No.5.2

DETAILS OF POPULATION IN & AROUND THE BLOCK
(Based on Census Report of 1991)

WITHIN & PERIPHERY OF BLOCK				
NAME OF THE VILLAGE				
	GONDALPURA	GALI	PHULANG	
BLOCK CODE	140	140	140	140
VILLAGE CODE	142	144	141	140
4	201.65	476.07	37.18	251.27
5	202	26	0	19
6	208		0	33
7	1,531	192	0	233
8	783	100	0	115
9	748	92	0	108
10	176		0	26
11	170	19	0	32
12	122	85	0	0
13	120	82	0	0
14	53	0	0	0
	56	0	0	
16	265	23	0	62
17	62	2	0	9
18	367		0	40
19	11	22	0	6
	278	11	0	35
21	9	3	0	6
22	55	31	0	0
23	1	19	0	0
24	1	0	0	0
25		0		0
	14	0	0	4
27	0	0	0	0
28	2	0	0	0
29	0	0	0	0
30	2	0	0	0
31	0	0		0
32	0	0	0	0

	GONDALPARA	GAJI	PHULANG	HAHIL
BLOCK CODE	140	140	140	140
VILLAGE CODE	142	144	144	140
	0		0	0
34	1		0	0
35	0	0	0	1
36	0	0	0	0
37		0	0	0
38	2	1	0	1
39	0	0	0	0
40	0	0	0	0
41	72	0	0	0
42		56	0	75
43	605	70	0	102

5.5


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4. Area in sq. km.
5. Residential House
6. House holds
7. Total population
8. Total male population
9. Total Female population
10. Population M (0-6)
11. Population F (0-6)
12. Male Schedule Caste
13. Female Schedule Caste
14. Male Schedule Tribe
15. Female Schedule Tribe
16. Male Literate
17. Female Literate
18. Male main worker
19. Female main worker
20. Male cultivator
21. Female cultivator
22. Male agriculture labour
23. Female agriculture labour
24. Male livestock/Forest Free/Fish/hunt/Plant/Allied/Others
25. Female livestock/Forest Free/Fish/hunt/Plant/Allied/Others
26. Male Mining & Quarrying
27. Female Mining & Quarrying
28. Male Manufacture/PROC/SERV/Repairs in house hold industry
29. Female Manufacture/PROC/SERV/Repairs in house hold industry
30. Male Manufacture/PROC/SERVE/Other than household Industry
31. Female Manufacture/PROC/SERVE/Other than household Industry
32. Male construction
33. Female constructions
34. Male Trade & commerce
35. Female Trade & commerce
36. Male transportation/storage/communications
37. Female transportation/storage/communications
38. Male other Services
39. Female other Services
40. Male marginal workers
41. Female Marginal workers
42. Male non-workers
43. Female non-workers

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Table 5.1

**LAND USE PATTERN OF VILLAGES FALLING IN & AROUND
GONDALPARA BLOCK, NORTH KARANPURA COALFIELD.**

(Based on Census Report 1981)

Sl. No.	Village	Land (Hect.)	Land under different types of use (Hectare)				a) available for cultivation
			Forest	Irrigated by source	Un-irri- gated	Cult-vable waste land	
1	Phulang	57.18		W-4.10 TK-12.18 R-2.08	5.56	10.51	2.75
2	Hahe	251.27	151.16	W-0.85 TK-4.13 R-0.51	6.97	22.78	65.77
3	Gondalpara	201.66	39.19	W-15.43 TK-2.07 R-25.50	106.70		10.60
4				TK-13.02		17.07	

W = Well (Without electricity)
TK = Tank (Without electricity)

WE = Well (With electricity)
R = River

HYDROGEOLOGY

The determination of some of the hydrogeological elements were taken up during the exploration in Molra and Badam Blocks. The main thrust is to know the hydrogeological characteristics of the block. However, due to the various constraints some of the parameters could not be generated. No pumping test was conducted within the block.

Physiography and Drainage

Topographically, the area is rather hilly in the east and south western part and the northern & eastern part is characterised by more or less flat terrain with gentle undulations. The ground in general slopes towards North. The maximum elevation of 462 m is noticed in the eastern part of the block near GMKB-144. The minimum elevation of 413m & 415m is noticed in the

northern part of the block. The widespread alluvial cover within the block is responsible for development of gullies at places leading to adverse land forms.

The drainage of the block is controlled by the Badmahi river in the north. It is one of the major tributary of mighty Damodar river flowing in the south central part of the coalfield. It meets Damodar river north of Hindegir Railway Station. There are a few nalas which discharge their land into the Badmahi river. All the nalas of the block are seasonal. However, few detached pools of water are noticed in river beds of Badmahi river even during acute summer. One pond is also available within the block. The water table in the nalas of the block and in the Badmahi river is generally at very shallow depth and water is tapped by the local villages by removing sand of about 2-3 feet height.

The dug wells are also available within the block but most of them become dry during summer. However, dug wells located close to major nalas/streams of the block sustain water even during acute summer but water table is at depth.

The sub-surface information about the hydrogeology is rather meagre. The water levels recorded in boreholes while drilling indicate that the water table is generally available at a depth of 15 to 25 m from surface. The water bearing horizon have been recorded between the different coal seams. The confinement of these aquifers appear to be the result of interfingering facies as well as due to lateral variations of coarse grained to fine grained facies and vice-versa. The water level generally goes down as soon as the seams are punctured. The fluctuation in the water table is more in the upper aquifers than in the lower aquifers.

Drainage pattern refers to the particular design which the individual stream course collectively form by observing the spatial arrangements of the stream courses in the topographical map (Plate-XXXIV), different pattern

names can be assigned to them. Pattern has a direct relation with the underlying structure and rock formation.

Mostly the drainage pattern is dendritic. It is characterised by irregular branching of tributary streams in many directions and at almost any angle, usually less than a right angle.

Rainfall

Gondalpara Block being a virgin block has no rain gauging station. The nearest station is at Barkagaon block office, Barkagaon village, District Hazaribagh where the daily recording of rainfall have been done during 1979 to 1995 and the same is utilised in this report. The details of daily rainfall from 1979 to 1995 is given in Annexure-X. This rain gauging station is located about 14 Km. south west of the Gondalpara Block. The available informations of Barkagaon rain gauging station (Block Office) is summarised in the table 5.3 below:

Table 5.3

**SUMMARISED DATA OF RAINFALL AS RECORDED AT BARKAGAON BLOCK
OFFICE RAIN GAUGING STATION (1979-1995),
NORTH KARANPUR COALFIELD**

Sl. No.	PARTICULARS	MAXIMUM RAINFALL IN ONE YEAR	MINIMUM RAINFALL IN ONE YEAR	MEAN
1	<i>Annual Rainfall</i>	2017.50 mm (1994)	731.00 mm (1992)	1263.91 mm
2	<i>Monthly Rainfall</i>			
	a) For monsoon period (June to October)	820.30 mm (August-1994)	5.60 mm* (October-1992)	327.73 mm
	b) For Non-monsoon period (November to May)	132.20 mm (March-1998)	NIL	16.48 mm
3	<i>Number of Rainy Days</i>	91 (1994)	60 (1993)	79
4	<i>Daily Rainfall</i>			
	a) For monsoon period	501.60 (57.86)	-	-
	b) For Non-monsoon period	60.00 (23.82)	-	-

It may be seen from Table 5.3 that the maximum annual rainfall of 2037.50 mm was recorded in 1994 and the minimum was 731.00 mm in 1992. The average rainfall based on data of 17 years as recorded at Barkagaon Block Office comes to 1253.91 mm. The maximum rainfall in a month during monsoon period (June to October) was recorded 820.30 mm in August 1994 and the minimum of 5.60 mm in October 1992, excluding one dry month (October 1981). During non-monsoon period (November to May), the maximum rainfall of 132.20 mm was recorded in March 1988. The maximum and minimum number of rainy days during one year comes to 99 (1994) and 60 (1993) respectively and the average number of rainy days per year comes to 79. The maximum rainfall in one day during the period of 17 years (1979-1995) was 201.60 (5-7-1986) during monsoon period and 60.00 (2-3-1982) during non-monsoon period.

The summarised monthwise and annual statement of rainfall data for 17 years from 1979-1995, monthly precipitation chart and maximum rainfall (in mm) in a day, month and year are given in Table 5.4, 5.5, & 5.6.


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「この本は、大抵の事柄について、その歴史をたどる。そして、その歴史を通じて、その事柄の本質が明らかになる。」

Endreksen, Betsy Olson, North Hennepin College

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CHAPTER-6

GEOPHYSICAL INVESTIGATION

6.1 RESISTIVITY SURVEY

6.1.1 GENERAL

Electrical resistivity profiling was carried out in Gondalpara Block of North Karanpura coalfield to delineate coal seam incrops and faults present in the area. Altogether 12.90 line kms. was covered along 6 profiles. Conventional Schlumberger configuration with current electrode spacing AB/2= 30 mts. and 50 mts. and potential electrode spacing MN/2= 5.0 mts. were used in the survey. Details of the profiles are shown in plate-XXXV

6.1.2 FIELD INVESTIGATION

Resistivity observations were taken by using an Aquameter (A.C.), manufactured by M/S Sparconix, Pune. Steel rods were used for current as well as potential electrodes.

All six profiles were laid on the ground by using Theodolite survey. Resistivity survey was conducted by employing Schlumberger configuration with current electrode spacing AB/2=30 mts and 50 mts and potential electrode spacing MN/2=5.0 mts. The data were collected at 10 mts intervals.

6.1.3 DETAILS ABOUT THE PROFILES

Profile-01

Origin of the profile is at b.h.no.-CMKB-142. The orientation of the profile is East-West. Profile length is 2500 mts.(i.e. 800E to 1700W). Only one incrop of coal seam has been encountered along the profile and is located from 1440W to 1506W with some parting. Four nos. of faults have also been interpreted along the line and are located at F1-1136W, F2-80W, F3-130E and F4-550E. Faults have been interpreted due to abrupt change in resistivity values. Profile-02

Origin of the profile is at 1350 mt. West of borehole CMKB-142 along the profile-01. Orientation of the profile is North-South. The profile length is 460 mts(i.e. 160N to 300S). No coal seam incrop has been encountered along the profile, however a fault F4 has been encountered at 240S of the origin. High resistivity at 90N is due to sand.

Profile-03

Origin of the profile is at bh.no.- CMKB-114. Orientation of the profile is East- West. Profile length is 1420 mts.(i.e. 610E to 810W). Coal seam incrop has been encountered along the line from 380E to 480E with parting & 496E to 536E. No fault has been interpreted along the profile.

Origin of the profile is at b.h.no.-CMKB-99. Orientation of the profile is East-West. The profile length is 760 mts. (i.e. 260E to 500W). No coal seam incrop or fault has been encountered along the profile. At places high resistivity is due to local irregularities.

Origin of the profile is at b.h.no. CMKH-28. Orientation of the profile is East-West. Profile length is 400mts. (i.e. 230E to 170W). Coal seam incrops have been encountered from 70E to 30W with parting, 120E-140E and 170E to 190 E. In this profile due to thick soil cover resistivity is low with AB/2 = 30 mts.

Origin of the profile is at 1410 mts. West of b.h.no.-CMKB-142 along the profile-01. Profile length is 340 mts. (i.e. 140N to 200S). Orientation of the profile is North-South. Due to high fluctuation in resistivity values no meaningful interpretation could be made in this profile.

For both the electrode spacing the resistivity values observed at each point along the profile were plotted on a centimeter graph sheet to find the change in resistivity values along the profile. These plots are then interpreted to locate the coal seam incrop and faults. Resistivity plots along these profiles are shown in figure 6.1 3a to 6.1 3f.

Affirmation
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TABLE A.1.1.2b

Results of profiles A, their interpretation for individual surveys

Profile no.	Origin	Orientation	Length	Interpretation
1	B.1.1.N0-CARUS-142	E4.02-W4.02	200 Mts (width is 1700m)	Coal seam thickness: 1400m to 1500m with perching. Faults: F1-F12, F16, F17-18, F19-20, F21-22
2	COSE at CARUS-142 along profile-11	N0.02E-S0.17E	400 Mts (width is 2000)	No coal seam along interpreted faults: F1-2, F3-5
3	B.1.1.N0-CARUS-154	E4.02-W4.02	400 Mts (width is 1700m)	Coal seam thickness: 2000 to 4000 with perching. Faults: F16-F18, F19-F21 with perching. Faults: Not interpreted
4	B.1.1.N0-CARUS-161	E4.02-W4.02	700 Mts (width is 2000)	No coal seam along and faults interpreted.
5	B.1.1.N0-CARUS-21	E4.02-W4.02	600 Mts (width is 1700m)	Coal seam thickness: 100 to 200m with perching. 1200 to 1400 and 1700 to 1900. No faults encountered along the line.
6	1400 Mts. West of B.1.1.N0-CARUS-240 along profile-21	N0.02E-S0.17E	300 Mts (width is 2000)	There is high fluctuation of top. Any interpretation could not be done.

APPROVED FOR
SUBMISSION
DATE: 11/05/2016
BY: [Signature]

6.2 MAGNETIC SURVEY

6.2.1 INTRODUCTION

Magnetic survey at Gondalpara Block of North Karanpura Coalfield was carried out to explore the possibility of locating concealed dyke. While there was no exposure of dyke available in the field but its presence was indicated by intersection in boreholes CMKB-110 and CMKB-101 at depth 150 mts and 95 mts respectively. In total 5.18 line kms was covered along different profiles and along the river Badmahi by taking vertical intensity of magnetic field at 10 mts spacing.

6.2.2 FIELD INVESTIGATION

The magnetic survey was carried out by using a digital type MFD-4 Fluxgate magnetometer, manufactured by M/S Scintrex, Canada. This measures relative changes in vertical component of magnetic field with a precision of 10 gamma. At first a base station at a place free from magnetic materials was established. Variation in magnetic intensity at base station were monitored at regular intervals for correcting diurnal variation of Earth's magnetic field. The value at base station represent the value of host rock.

The survey was carried out along profile-01 and profile-02 laid on the ground by Theodolite survey and also along the southern bank of river Badmahi. The data were generally collected at 10 mts. interval.

6.2.3 RESULTS & DISCUSSION

The magnetic anomalies so observed were found to vary within range of 300 gammas with a maximum value of 26350 gammas. No diurnal correction were applied to the data as the variation in data at base station was found to vary within +/- 30 gamma.

The variation in magnetic anomalies does not confirm the presence of dyke encountered in borehole while drilling. This may be due to either the greater depth of the burial of dyke or non-magnetic nature of the same.

The profiles were plotted and presented in figure 6.2.3a to 6.2.3g.

6.3 HRSS SURVEY

6.3.1 INTRODUCTION

High Resolution Shallow Seismic (HRSS) Survey was conducted in Gondalpara block and adjacent Badam block of North Karanpura Coalfield in order to map the subsurface discontinuity and structural disposition of the potential coal seams, during December '1991 to March'1992.

The field data acquisition was carried out by CMPDI, (HQ) team by using CDP technique along eight profiles covering a total of 15.05 line kms of surface coverage in both the blocks. Out of this only profile 1, 2 and part of profile 4 falls in Gondalpara block. The distance covered was 3.99 line kms.

6.3.2 FIELD DATA ACQUISITION

At first the profile lines were laid on the ground with the help of NI Theodolite. RI, of each stations were taken with the help of dumpy level and leveling staff. The recording of data was done with 48 channel MDS-10 digital recording seismograph of M/S Geosource, USA using dynamite as the energy source. The details of HRSS data acquisition parameters are given in Table-6.3.2a and profiles are shown in Plate-XXXV

6.3.3 DATA PROCESSING

HRSS data were processed on VAX/780 Computer and DISCO(Version 7.3) software of M/S Digicon, USA at CMPDI Computer Centre, Ranchi. The raw data were passed through different filters after applying necessary corrections. The traces were utilised for structural interpretation. Faults were identified on the basis of the discontinuity of the correlated events, diffraction patterns and also bow-tie type noise pattern at places. Interpreted faults have been classified in to two categories i.e. high confidence and low confidence. Minor faults, with throw less than 10 mts., have been traced as low confidence features. Particulars of the faults encountered along each seismic profile are given in Table-6.3.3a

REFERENCES :

Report on High Resolution Shallow Seismics Survey in Badam Block, North Karanpura Coalfield, Bihar, CMPDI(HQ), July'1994.

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TABLE-6.3.2a**HRSS DATA AQUISITION PARAMETERS, GONDALPARA BLOCK
NORTH KARANPURA COALFIELD**

Sl. no.	Item	Parameters
1	Sub-surface coverage	100% / 2400%
2	Geophone Interval	10m / 5m
3	No. of geophone per group	Single
4	Pattern of geophone	Single
5	Geophone	40 Hz frequency with 70% damping
6	Shot hole pattern	Single hole
7	Shot hole depth	0.8 m to 9.8 m
8	Spread configuration	Split-spread
9	Spread length	235 m/470 m
10	Minimum offset	2.5 m/5.0 m
11	Maximum offset	117.5 m/23 m
12	Energy Source	Dynamite (Special Gelatine- 80%)
13	Charge size	200 gms.
14	Stemming/ Tamping	Soil/cutting/water
15	Filters	a) Low cut- 50 Hz, 36 db/octave b) High-cut- Alias, 72 db/octave
16	Notch	Out
17	Pre-Amplifier gain	36 db
18	Tape Format	SECB, 800 bpi
19	Sample rate	2 ms
20	Record length	1 sec
21	Uphole recording	Line
22	Gain mode	Float
23	Type of detonator	Instantaneous seismic detonators


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TABLE-6.3.3a

**Summarised Details Of Faults Interpreted From HRSS Data Gondalpara Block
North Karanpura Coalfield**

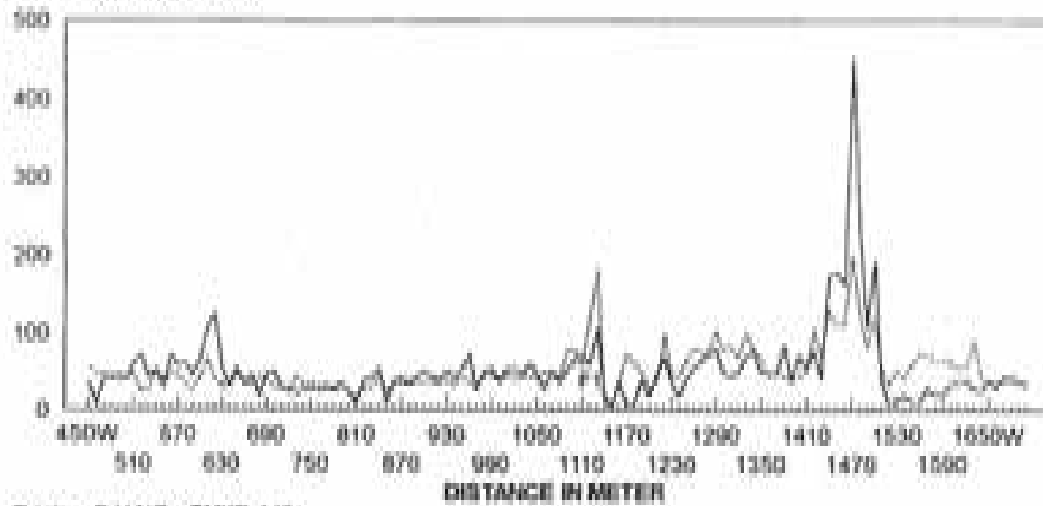
Profile No.	Fault No.	Pkt. no.		Throw		Confidence Level	Likely Lateral Continuity/ Extension
		Floor	Roof	Amount (m)	Direction		
92-BDM-01	F01a	176	166	75-80 ?	NW	Low	F02c
	F01b	258	248	15-20	NW	High	F02b
	F01c	469	461	40-45	NW	High	F04b, F02a
92-BDM-02	F02a	164	170	40?	NE	Low	F01c
	F02b	351	358	35-40	NE	High	F01b, F04b
	F02c	407	412	40	NE	High	F01a, F04a
92-BDM-04	F04a	265	259	40	NW	High	F02c, F03e
	F04b	337	329	30-40	NW	High	F01c, F03d
	F04c	521	517	30-35	NW	High	F03b
	F04d	553	567	30	SE	High	F03a


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**RESISTIVITY PROFILE-01
GONDALPARA BLOCK
NORTH KARANPURA COALFIELD**

Figure 6.1.3a

RESISTIVITY IN OHM-M



AB/2=50

AB/2=30M

Origin - B.H.N.O. - CMKB-142
Coal Seam incrop- 1440w to 1500w
Fault F1 at 1135w

Continued

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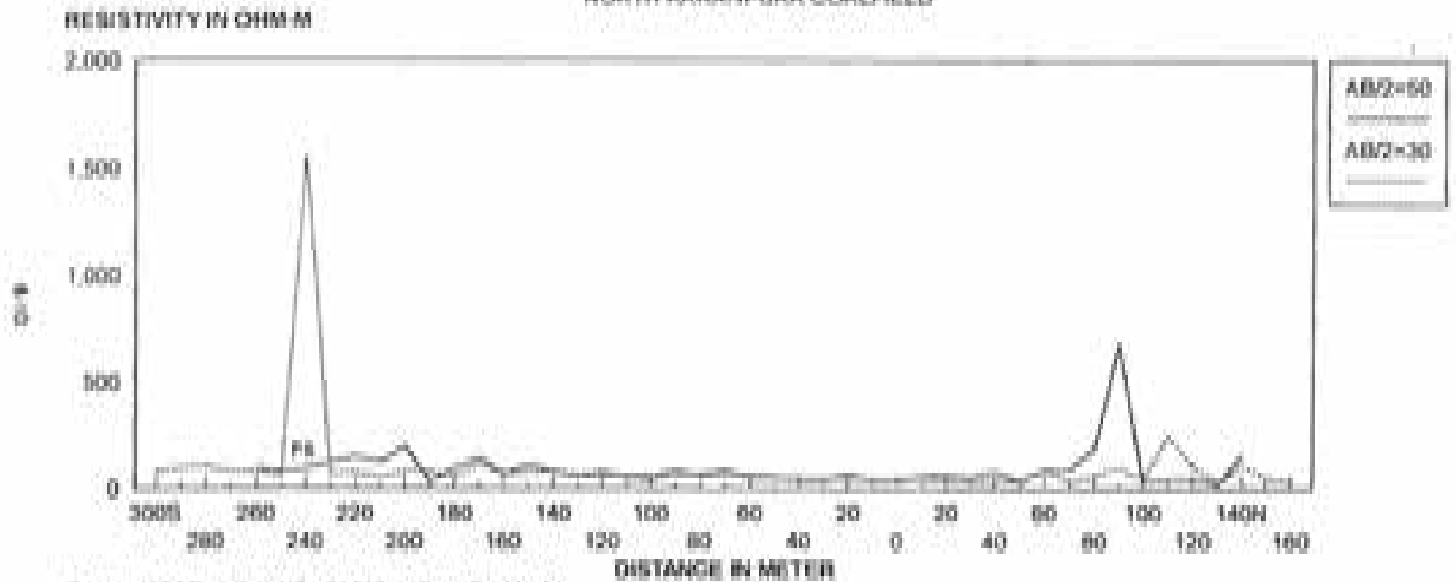
Figure 1



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RESISTIVITY PROFILE-02
GONDALIPARA BLOCK
NORTH KARANPURA COALFIELD

Figure-6.1.30



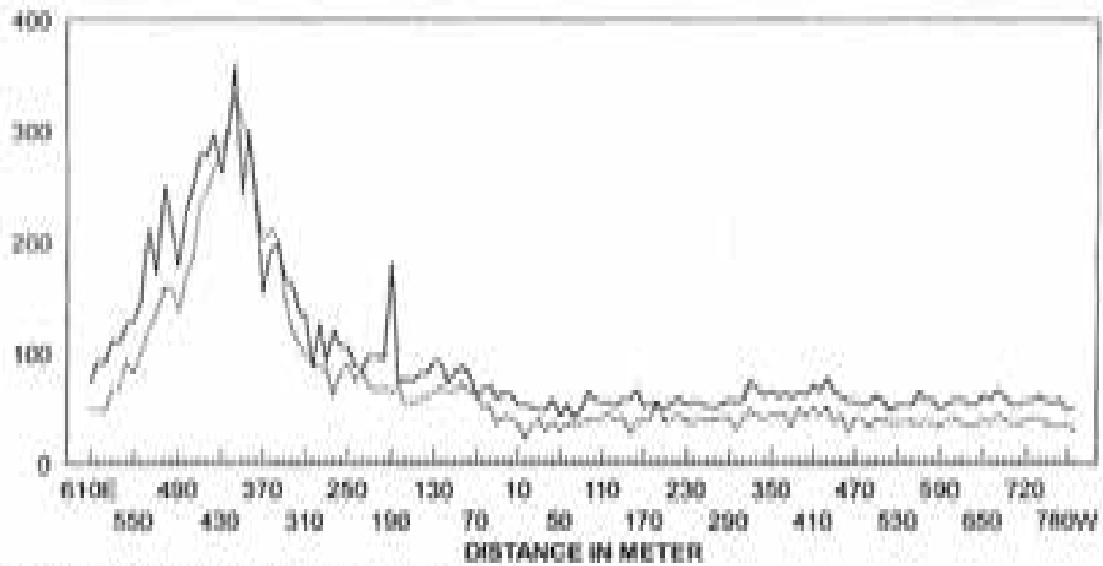
Origin: 1350E of B.H.NO -CMKB-142 on Profile-01
Fault F5 at 2400

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RESISTIVITY PROFILE-03 GONDALPARA BLOCK NORTH KARANPURA BLOCK

Figure-8.1.36

RESISTIVITY IN OHM-M



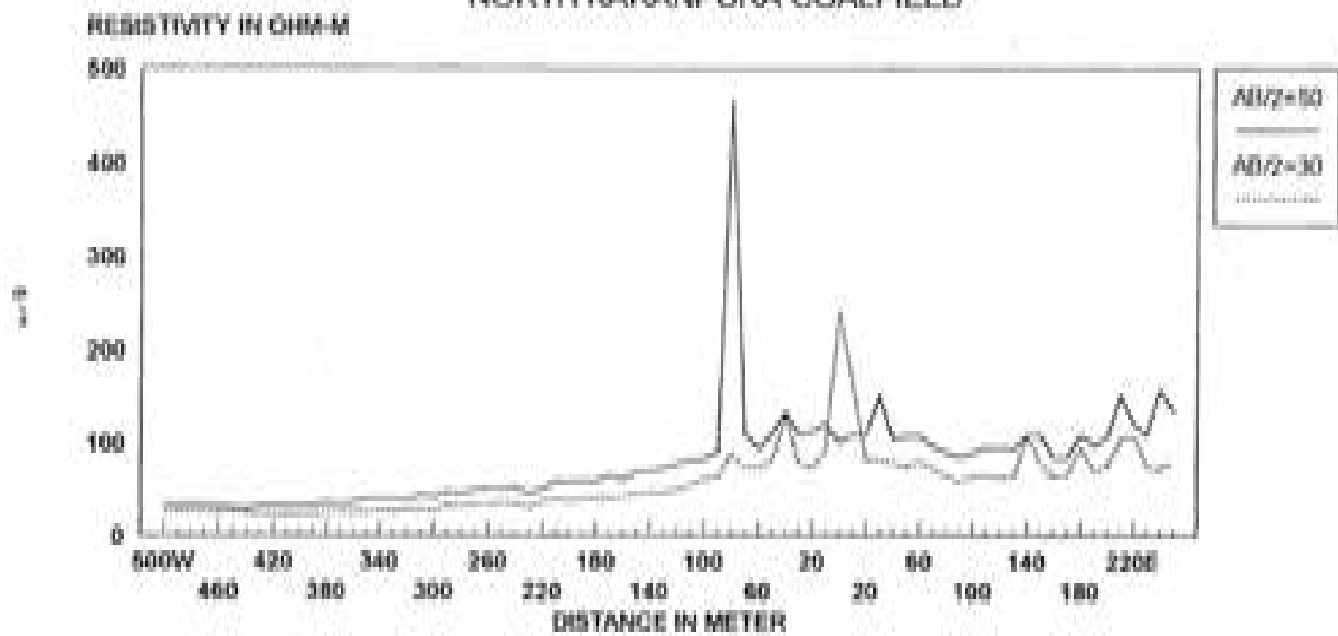
Origin- B.H.NO -CMKB-114

Coal Seam Incrop- 380E to 480E & 490E to 530E

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RESISTIVITY PROFILE-04
GONDALPARA BLOCK
NORTH KARANPURA COALFIELD

Figure-B.1.3d



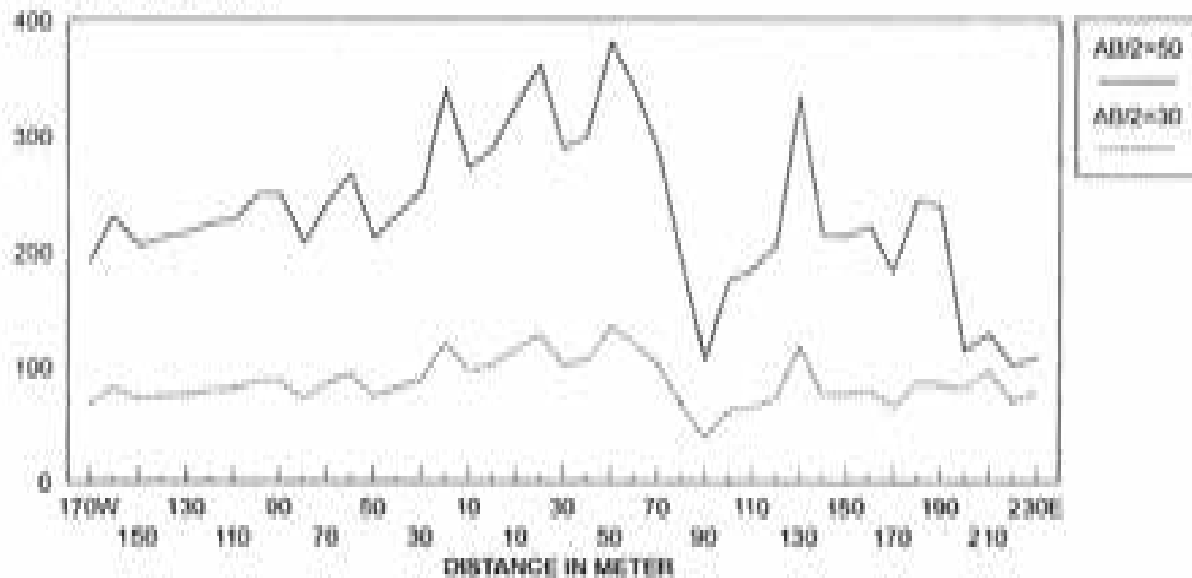
ORIGIN- B.H.NO.-CMKD-99

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RESISTIVITY PROFILE-05
GONDALPARA BLOCK
NORTH KARANPURA BLOCK

Figure 4.13a

RESISTIVITY IN OHM-M



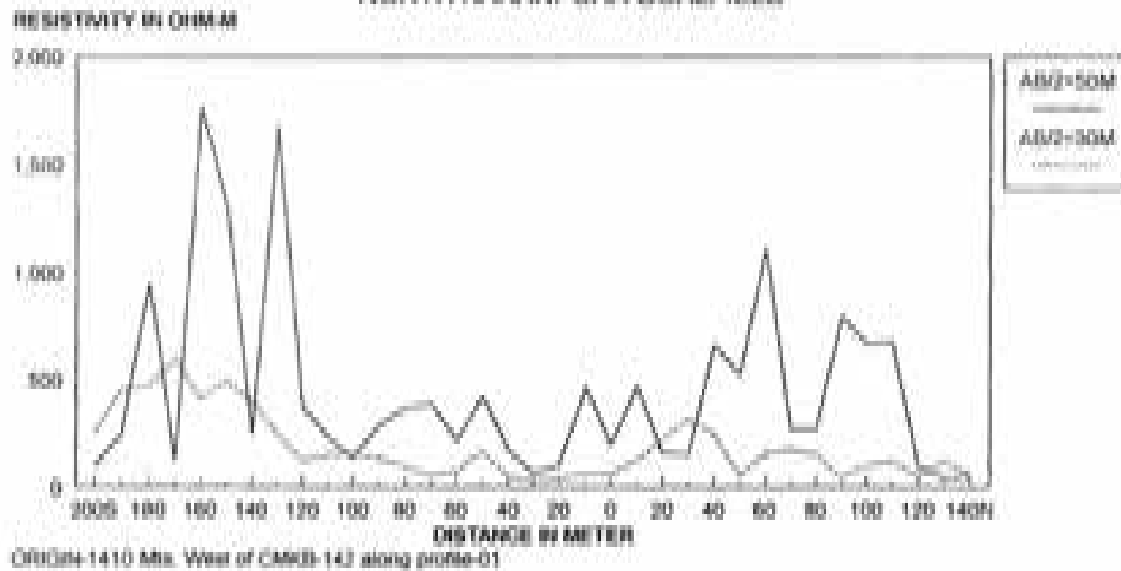
ORIGIN-CMKB-28

Coal Seam Inexpore-70E to 30W, 120E to 140E & 170E to 190E

[Signature]
VINEY HILL COAL PROJECT
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RESISTIVITY PROFILE-06
GONDALPARA BLOCK
NORTH KARANPURA COALFIELD

Figure B.1.2

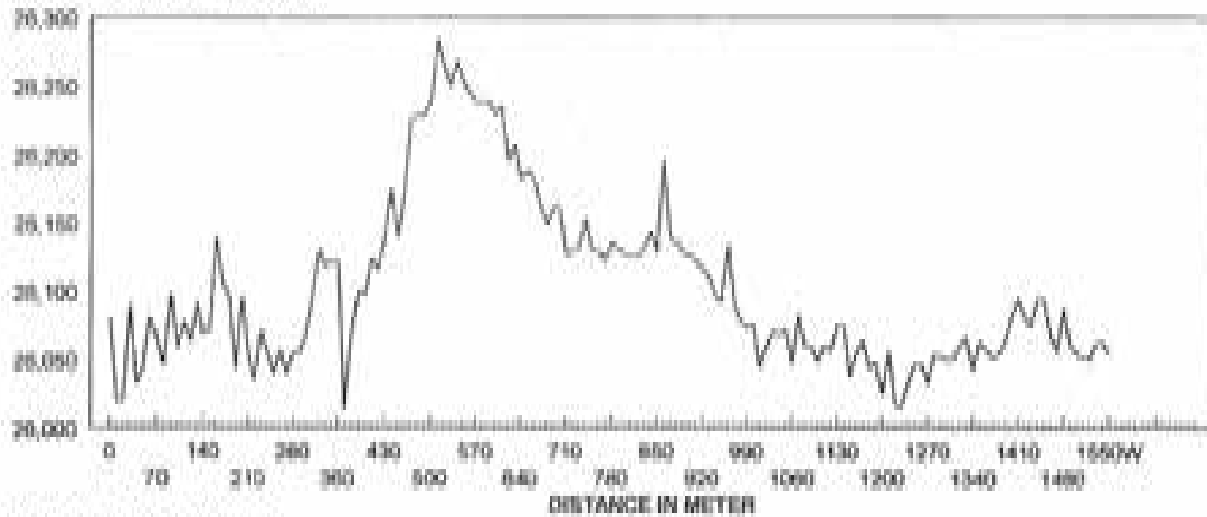


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**MAGNETIC PROFILE-01
GONDALPARA BLOCK
NORTH KARANPURA BLOCK**

Figure 3.3.3a

MAGNETIC VALUES IN GAMMA



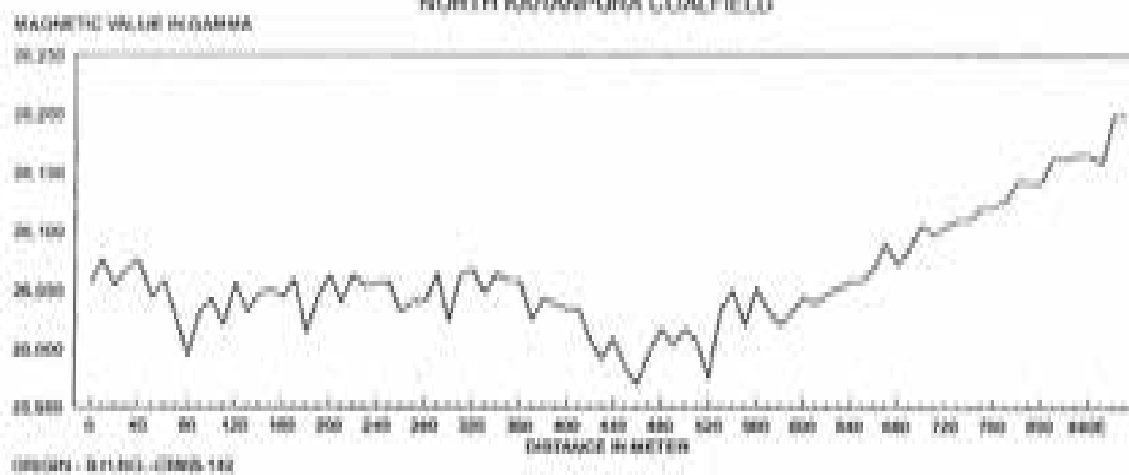
ORIGIN S.H. NO. - CMRB-142

Continued

AFTER-2
WATER RESIST
GONDALPARA COLL. PROJECT
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**MAGNETIC PROFILE-01
GONDALPARA BLOCK
NORTH KARANPURA COALFIELD**

Figure 4.2.3a

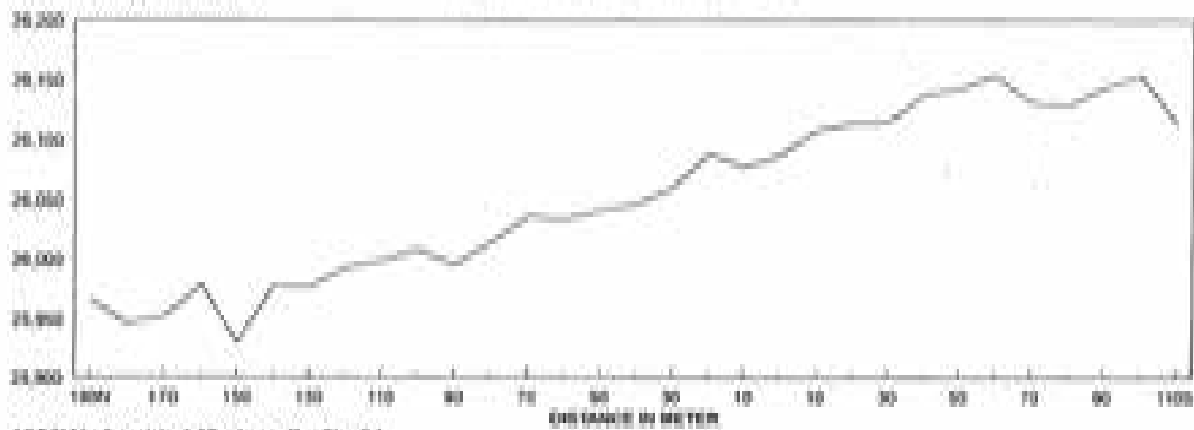


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**MAGNETIC PROFILE-02
GONDALPARA BLOCK
NORTH KARANPURA COALFIELD**

Figure 4.2.3b

MAGNETIC VALUES IN GAMMA

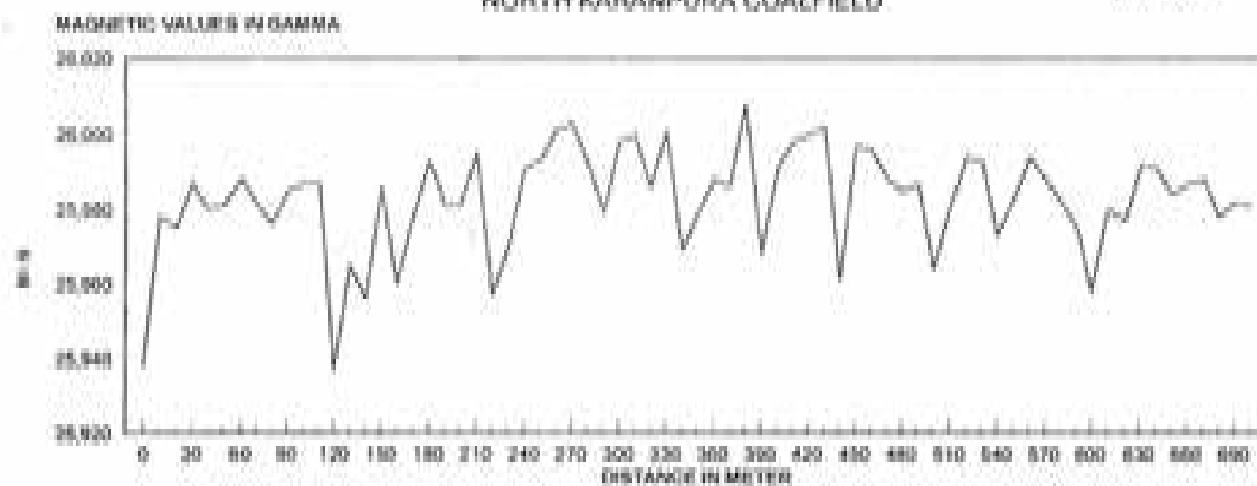


1350W of smkt-142 along Profile-01

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**MAGNETIC PROFILE-03
GONDALPARA BLOCK
NORTH KARANPURA COALFIELD**

Figure 6.2.3a



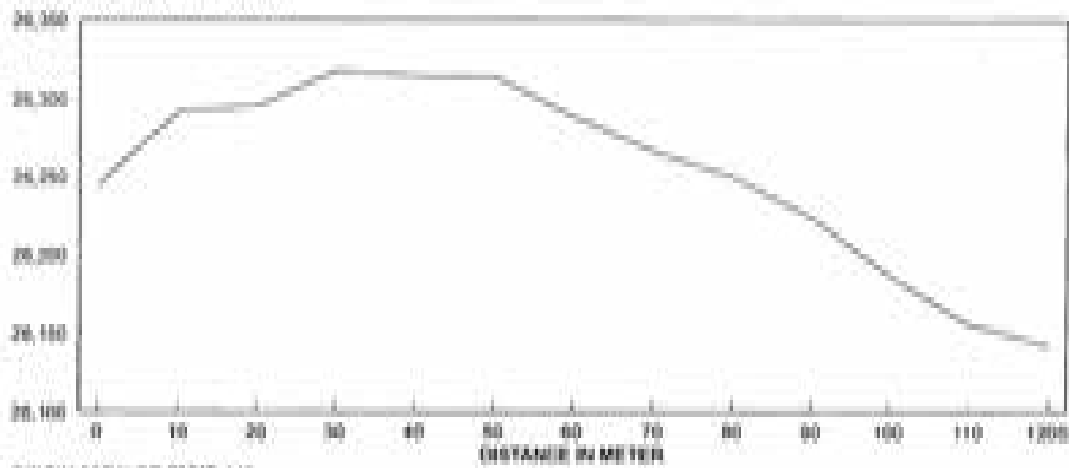
ORIGIN- 160M North of Profile-2
Along the river

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**MAGNETIC PROFILE-6
GONDALPARA BLOCK
NORTH KARANPURA COALFIELD**

Figure 4.2.3a

MAGNETIC VALUES IN GAMMA

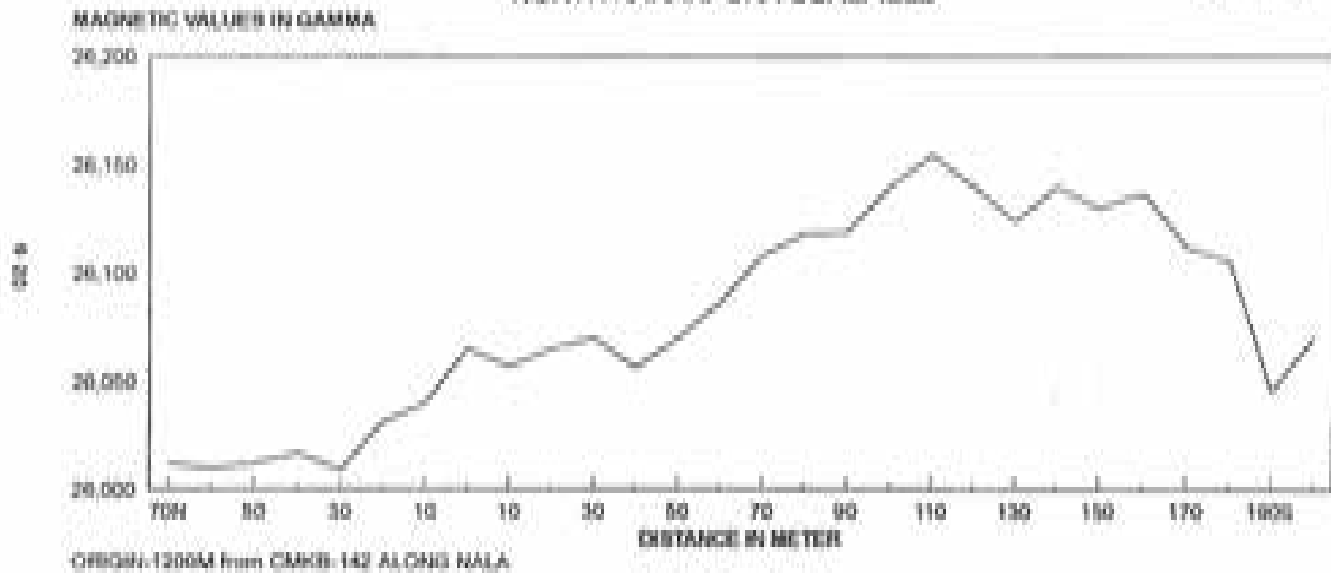


ORIGIN 500W OF GRID-143

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**MAGNETIC PROFILE-4
GONDALPARA BLOCK
NORTH KARANPURA COALFIELD**

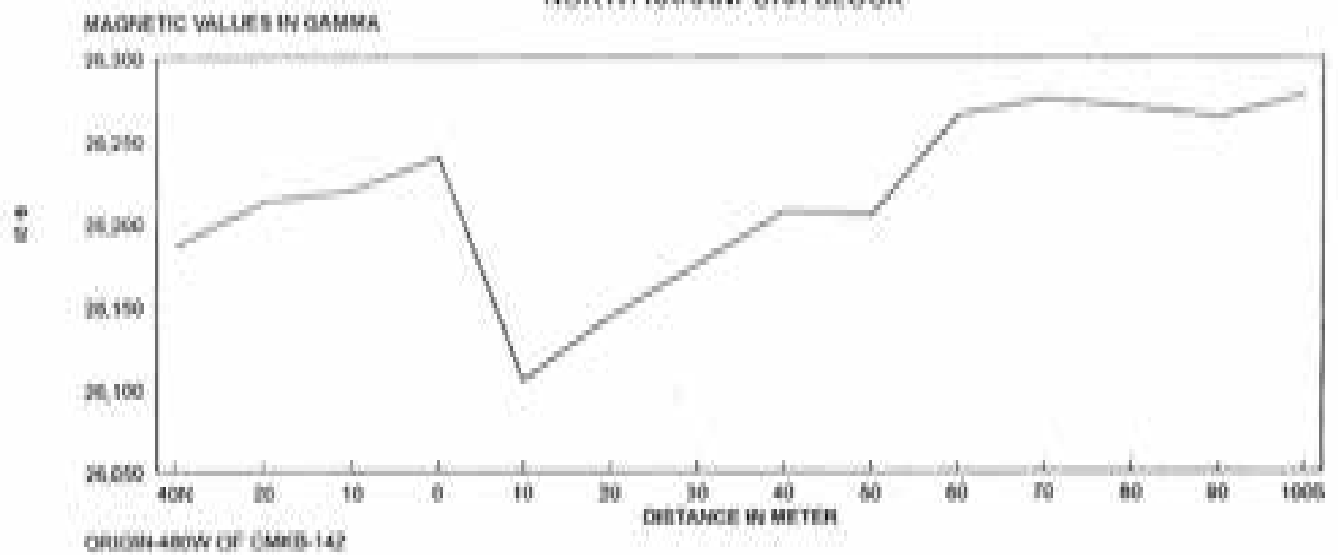
Figure-8.2.3d



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**MAGNETIC PROFILE-6
GONDALPARA BLOCK
NORTH KARANPURA BLOCK**

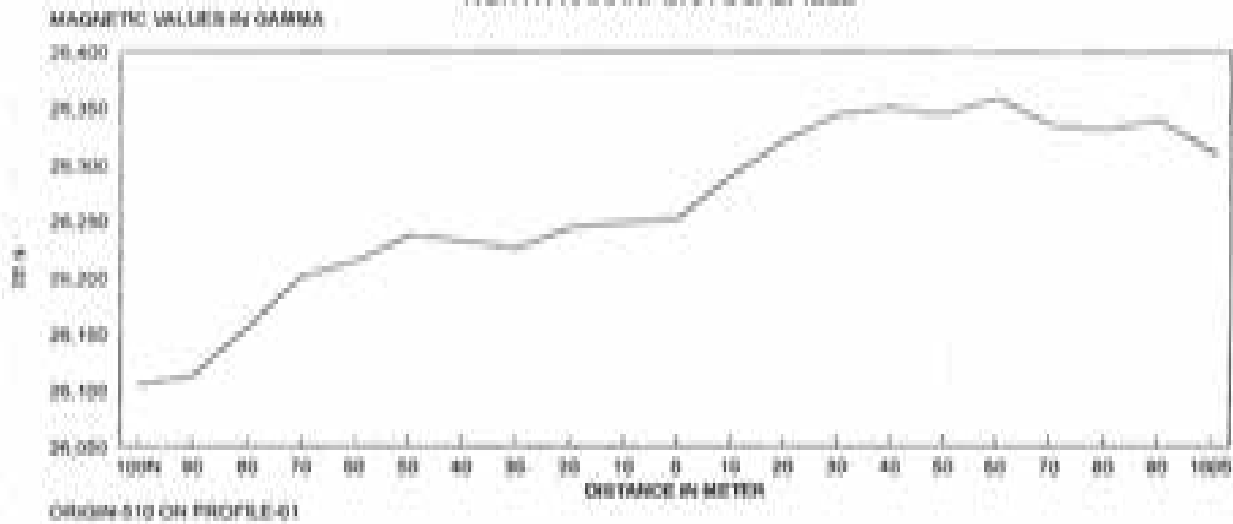
Figure A.2.3f



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**MAGNETIC PROFILE-7
GONDALPARA BLOCK
NORTH KARANPURA COALFIELD**

Figure 4.2.3a



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CHAPTER- 7

CONCLUSION AND RECOMMENDATION

CONCLUSION

Gondalpara block having an area of 4.00 Sq. Km. is located in north eastern part of North Karanpura Coalfield and falls in the Hazaribagh District of the Bihar State. The block is surrounded by Moitra Block towards north, Badam Block towards west and Babupara Block towards south. The virgin lower Barakar strata marks the eastern boundary of the block. The block is connected by fair weather road with Barkagaon village which in turn is connected to Hazaribagh by Tandwa-Hazaribagh tar road. The Hazaribagh town is at about 35 Km. from the block. The block becomes cut-off during rainy season due to non-existence of bridge on Badmahi river.

The topography of Gondalpara block is undulating marked by hilly terrain towards east and south the plain land towards north and west. The Badmahi river, the perennial source of water flows through northern and western boundaries of the block. Maximum elevation being 498 m. on hills and minimum 417 m. on the river bank.

Fifty-nine number of boreholes have been drilled within the block of which 55 boreholes were drilled by CMPDI and 4 boreholes by other agencies. Altogether, 9867.00 m. of drilling has been carried out within the block. The boreholes drilled by the other agency (GSI) could not be utilised in the present report due to their doubtful location.

The block contains both Barakars and Karharbaries as coal bearing formations. While 7 number of potential coal seams viz. Seam-I, II, III Bottom, III Top, IV, IVD, and V have been encountered in Barakar Formation, no potential coal seams exist in Karharbari Formation. There is indication that lower Karharbari seams merge to form good thickness in the eastern part generally beyond the eastern block boundary.

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The strike of the strata is generally north east - south west and dip 8° - 16° towards west. Seven faults with variable throw within the block have been interpreted. The throw amount varies from 5 m. to 170 m.

Out of seven number of potential seams, Seam-I, II, III Top and IVD are thick seams with 7 to 12 m. thickness. As per the earlier sporadic data, the Gondalpara Block was considered to contain high ash medium coking coal. But the present detail information on coal quality does not hold the earlier view correct for younger seams. The coal of some seams particularly, I and II appears to be semi to weakly coking in nature but again due to high ash content i.e. generally above 24 % the coals have been considered as long flame non-coking as per commercial grading. All the other seams are also taken as non-coking. The basic character of coal indicates long flame; the coal therefore, may be considered as long flame for B to D grade as per commercial classification.

Very few of the potential coal seams contain dirt bands with more than 1 m. thickness. Wherever thick dirt bands are present they are generally constituted by Carbonaceous Shale. Shale and Sandstone bands are practically absent in most of the coal seams.

Total reserve for the block is estimated at 74 million tonnes under "proved" category. Seam-I and II combinedly contributes 72 % of the total reserve. The total overburden is 105 Cu. m. The average total stripping ratio, therefore, comes to 1.42.

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RECOMMENDATION

Gondalpara block is potential quarriable property having 65 million tonnes of coal reserves. The coal particularly, Seam-I and II from the block has some coking property and can be used in stamp charging after required washing. The coal as such can be utilised for domestic coke making by coal Agglomerates process besides other uses.

The block becomes cut-off during rainy seasons due to non-existence of bridge over Badmahi rivers. The road from Badam village to the block is also required to be constructed for proper vehicle movements.

Part of the area is covered by the Badmahi river and part by burnt/heat affected area. If the river and the burnt /heat affected areas excluded from the block, the area left will be 1.62 Sq. Km. and within this area 101 million tonnes reserve is expected.

Due to non-approachability in the paddy field adjacent to the Badmahi river boreholes could not be drilled to the satisfaction in this region. Further, some provision of drilling may be kept for precise delineation of incrop in proposed box cut area, cornering of fault, and for delineation of burnt zone to the extent possible. For this, about 3000m. of additional drilling may be required which may be supported by geophysical logging

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REFERENCE

- 1 : Interim Report on the Pinderkon
Ganeshpur blocks of the North
Karanpura Coalfield, Palamau,
dist. Bihar, Indian Bureau of
Mines, March 1958.
- 2 Chakraborty S.K. : Geology and coal resources of
Bodem, Rautpara, Rohra, Rikba,
Pakri-Barwadih, Kerandari, Tandwa
Dhadhu - Mahua - milan, Piparwar
and Bundu area, North Karanpura
Coalfield, Hazaribagh and
Palamau District, Bihar, Vol-I
& II (1972) GSI, Coal Division.
- 3 N. Sen & : Geological note on quantable
V.D. Manjrekar coals in Pinderkon area, North
Karanpura Coalfield, Dist. Palamau
Bihar. January, 1973,
Division of Geology, NCDC, Ranchi.
- 4 S.K. Chakraborty, : Regional exploration for coal
Geologist (Sr.) and in Piparwar-Bhega area, North
M. Das, Geologist (Jr.) Karanpura Coalfield, Hazaribagh
Palamau and Ranchi districts
Bihar. (PART-182). GSI, Coal Wing,
October, 1979.
- 5 Singh B.B. : Resource evaluation and assess-
Manjrekar V.D. ment of potentiality of North
Kumar, P. Karanpura Coalfield, Bihar
Dutta S.K. (March, 1981), RI-8, Ranchi.
- 6 Mukherjee, G. : Regional investigation for coal
Das, M., Das A.K. & in Ursu-Manatu, Surajpura and
Ahamed, G. Ara-Devalgara sectors of Tandwa
area, North Karanpura Coalfield,
GSI Coal Wing, Sept., 1983.
- 7 Singh B.B. : Geological Report on Piparwar
Manjrekar V.D. Block, North Karanpura Coalfield,
Kumar, P. Bihar (March, 1984), RI. III, GMPDIL,
Dutta S.K. Ranchi.

REFERENCE

- 8 Singh B.B.
Mangrekar V.D
Kumar P.
Dutta S.K.
Rao, S.N. : Geological Report on Mangardaha Block, North Karanpura Coalfield, (Bihar) (March, 1986), RI.III, CMPDIL, Ranchi,
- 9 Saksena, S.K.
Narayan, V.
Dutta, S.K.
Shanker, P.
Verma, A.J. : Geological Report on Ashok Block, North Karanpura Coalfield, (Bihar), Sept. 1988.
- 10 Saksena, S.K.
Narayan, V.
Dutta, S.K.
Shanker, P.
Verma, A.J. : Geological Report on Purnadih Block, North Karanpura Coalfield, (Bihar) Sept. 1988.
- 11 Narayan, V.
Dutta, S.K.
Sinha, S.P.
Roy, D.S. : Geological Report on Magadh Block, North Karanpura Coalfield, (Bihar) March, 1989.
- 12 Narayan, V.
Dutta, S.K.
Roy, D.S. : Geological Report on Tandwa Block, North Karanpura Coalfield, (Bihar) August, 1989.
- 13 Narayan, V.
Dutta, S.K.
Sinha, S.P.
Sharma, A.
Verma, A.J. : Geological Report on Saradhu Block, North Karanpura Coalfield, (Bihar), October, 1989.
- 14 Narayan, V.
Dutta, S.K.
Sharma, A.
Sinha, S.K. : Geological Report on Manatu Block, North Karanpura Coalfield, (Bihar), August, 1990.
- 15 Narayan, V.
Dutta, S.K.
Sinha, S.P.
Sharma, A.
Verma, A.J. : Geological Report on Rohne Block, North Karanpura Coalfield, (Bihar), March, 1990.


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REFERENCE

- 16 Narayan, V.
Dutta, S.K.
Sharma, A.
Shome, D.
Sinha, S.K.
: Geological Report on Koyad Block, North Karanpura Coalfield, (Bihar), February, 1991.
- 17 Narayan, V.
Dutta, S.K.
Sharma, A.
Sinha, S.K.
: Geological Report on Kishenpur Block, North Karanpura Coalfield, (Bihar), March, 1991.
- 18 Narayan, V.
Dutta, S.K.
Sharma, A.
Sinha, S.K.
: Geological Report on Amrapali, (Kumrang) Block, North Karanpura Coalfield, (Bihar), July, 1991.
- 19 Narayan, V.
Dutta, S.K.
Sharma, A.
Sinha, S.K.
: Geological Report on Benti Block, North Karanpura Coalfield, (Bihar), March 1992.
- 20 Mukherjee, A.
Nath, S.
: Geological Report on Titariakhar Sector, Pinderkom-Ganeshpur Block, North Karanpura Coalfield, Dist Palamau (Bihar).
- 21 Narayan, V.
Dutta, S.K.
Sharma, A.
Sinha, S.K.
: Geological Report on Saradhu West Block, North Karanpura Coalfield (Bihar), February 1992.
- 22 Narayan, V.
Dutta, S.K.
Sharma, A.
Sinha, S.K.
: Geological Report on Kasiadih Block, North Karanpura Coalfield, (Bihar), March, 1993.
- 23 Sen, N.
Manjrelar, V.D.
: Geological Note on quarriable coals in Pinderkom Area, North Karanpura Coalfield, (Bihar), January, 1973.
- 24 Gupta, A.K.
Dutta, S.K.
Lahri, N.G.
: A Short Financial Report on the coals of Pinderkom and Ganeshpur Blocks, of North Karanpura Coalfield, (Bihar), Coal Survey Laboratory, Ranchi, July, 1994.

REFERENCE

25. Narayan, V.
Dutta, S.K.
Sharma, A.
Sinha, S.K. : Geological Report on Brinda Block, North Karanpura Coalfield, (Bihar) March, 1994.
26. Narayan, V.
Dutta, S.K.
Sharma, A.
Sinha, S.K. : Geological Report on Ganeshpur Block, North Karanpura Coalfield, (Bihar) August, 1993.
27. Narayan, V.
Dutta, S.K.
Nath, S.
Verma, A.J. : Geological Report on Pachra Block, North Karanpura Coalfield, (Bihar) February, 1995.
28. Narayan, V.
Dutta, S.K.
Nath, S.
Verma, A.J. : Geological Report on Chatti-Bariatu Block, North Karanpura Coalfield (Bihar), March, 1995.
29. Roy, A.K.
Dutta, S.K.
Nath, S.
Verma, A.J. : Geological Report on Badam Block, North Karanpura Coalfield, (Bihar) December, 1995.
30. Roy, A.K.
Dutta, S.K.
Nath, S.
Verma, A.J. : Geological Report on Dumargarh Block, North Karanpura Coalfield, (Bihar) February, 1996.
31. Roy, A.K.
Dutta, S.K.
Nath, S.
Verma, A.J. : Geological Report on Moitra Block, North Karanpura Coalfield, (Bihar) November, 1996.
32. Roy, A.K.
Dutta, S.K.
Nath, S.
Verma, A.J. : Geological Report on Pachra South Block, North Karanpura Coalfield, (Bihar) July, 1997.
33. Dutta, S.K.
Nath, S.
Shanker, P. : Geological Report on Bundu Block, North Karanpura Coalfield, (Bihar) February, 1998.

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REFERENCE

34. Dutta, S.K.
Nath, S.
Shanker, P.
Jain, K.G. : Geological Report on Karimati Block,
North Karanpura Coalfield, (Bihar)
August, 1998.
35. Dutta, S.K.
Nath, S.
Shanker, P.
Jain, K.G. : Geological Report on Chatti-Bariatu South
Block, North Karanpura Coalfield, (Bihar)
July 1999.
36. Ghosh, A.
Pal, P.K. : Report on High Resolution Shallow Seismic
Survey in Badam Block, North Karanpura
Coalfield, Bihar, July 1994.



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