NTPC LIMITED

SCOPE COMPLEX, 7 INSTITUTIONAL AREA, LODHI ROAD, NEW DELHI-110003

REVISED MINING PLAN AND MINE CLOSURE PLAN

(1st Revision)

FOR

PAKRI BARWADIH COAL BLOCK

NorthKaranapura Coalfield, Distt. - Hazaribagh, Jharkhand

Opencast – 18.00 Mtpa

Block area - 4695 Ha

January – 2016

(Incorporating clarifications to the observations of Standing Committee)

Volume-I

Text & Annexures

SANJIV KUMAR SINGH
Recognised Qualified Person
No. 340 /(15)/2009-CPAM
Ministry of Coal, Govt. of India

Prepared By:

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(RQP NO.:34011/ (15)/2009 – CPAM)

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A Maharatna Company

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OBSERVATIONS

&

COMPLIANCE TO OBSERVATIONS

SANJIV KUMAR SINGH
Recognised Qualified Person
No. 34011/(15)/2009-CPAM
Ministry of Coal, Govt. of India

Pointwise Compliance to MoC's observation issued vide letter no. 34011/05/2015/CPAM(Pt) dated 28th December 2015 on Revised Mining Plan & Mine Closure Plan – 1st Revision of Pakri Barwadih Coal Block

Sl. No	Ref Para	Observations	Compliance to the Observations
1	Sum 1(h)	ROM to be produced per year as per the mining plan should also be envisaged	ROM to be produced per year is 18 Mt and the same has been incorporated in para 1(h) of Summarised Data. ROM Quantity: • 503.38 Mt from West and East Quarry • 138.96 Mt from NW Quarry • Total = 642.34 Mt
2	Sum1 (l) & 1 (m)	It appears from the annexure XIV that the lease has been acquired under CBA. while at Summary item 1 (l) under the heading period for which mining lease has been granted it is indicated as not applicable, this needs to be reconciled.	Mining Lease is not applicable since mining area land is being acquired by NTPC under CBA Act.
3	Sum 1 (l)	No Expiry has been indicated against the date of expiry of earlier mining lease, while at para 2(d) date of expiry of the lease has been indicated as 2033. this needs to be reconciled.	Mining Lease is not applicable since mining area land is being acquired by NTPC under CBA Act. The same has been reconciled at para 2(d) of Summarised Data.
4	Sum 2 (f)	As per the calendar plan of the approved mining plan proposed year of start of production appears to be 2008-09. while at para 2(f) of	The proposed year of start of the production as per present Revised Mining Plan (1st Revision) is 2016-17.

<table>
<tr><th>Sl. No</th><th>Ref Para</th><th>Observations</th><th>Compliance to the Observations</th></tr>
<tr><td></td><td></td><td>summary item it is indicated as Mar 2017. This needs to be reconciled</td><td></td></tr>
<tr><td>5</td><td>Sum 2 (m)</td><td>Reason for delay in starting of the project should be envisaged in the item under reference.</td><td>Reasons for delay in starting of the project as per Approved Mining Plan are as under:
a) Delay in issuance of NoC on jungle jhari land by Distt Admininstration due to which Forest Clearance was delayed.
b) Revision of evacuation corridor on advice of FAC, MoEF
c) Delay in land acquisition: There was delay in physical verification & Certification of land records, disbursement of land compensation by Hazaribagh Distt. Administration took more time due to old / non availability of land records, inadequate State manpower at Distt/Block level, law & order problem etc.
d) Non-performance by the earlier MDO. NTPC finally terminated the MDO contract wef 22.06.2014.
The same has been now incorporated at para 2(m) of Summrised Data.</td></tr>
<tr><td>6</td><td>Sum 2(o)</td><td>The reason for increase in Land area from 384 to 485 Ha and reduction in land area outside block from 299 Ha to 267 Ha should be elaborated in the reference para and chapter IX of the mining plan.</td><td>There is a net increase in block area from 4626 Ha to 4695 Ha in comparison to the Approved Mining Plan as mentioned in the Table below. (reference para considered is 2 (p))
Reasons for change Area is given below:
<table>
<tr><th>Particulars</th><th>Approved Mining Plan</th><th>Revised Mining Plan</th><th>+/- (Ha)</th><th>Reason</th></tr>
<tr><td>Block Area excluding Area 'A'</td><td>3943</td><td>3943</td><td></td><td>No Change</td></tr>
<tr><td>Area 'A'</td><td>384</td><td>485</td><td>101</td><td>Detailed survey of Area 'A' at the time of detailed exploration has indicated total area as 485</td></tr>
</table></td></tr>
</table>

Sl. No	Ref Para	Observations	Compliance to the Observations

				ha Same has been notified under Section 7(i) of CBA.
Outside Block area (For OB Dumps and infrastructure)	299	267	-32	Decrease in area as per direction of restrictions of MoEF.
Total	4626	4695	69	Difference of 69 Ha is due to above two reasons.

The difference of 69 ha between the areas shown in the Approved Mining Plan and present Revised Mining Plan and Mine Closure Plan(1st Revision) is attributed due to increase of 101 ha in Area 'A' after demarcation & measurement, and reduction by 32 ha of the area taken for external dumping and infrastructure.

- The revised area of PB-NW (Sector 'A') has been certified by CMPDI (enclosed as Annexure –XIX).
- The above details have been now incorporated in the reference para and Chapter IX (Land Requirement) of the Revised Mining Plan and Mine Closure Plan(1st Revision).

7	Sum 3 (f)	Reason for deviation from lease boundary / required boundary from the boundary demarcated by CMPDIL/ SCCL/ NLC needs to be clarified.	The block boundary considered for mining is the same as provided by the CMPDI. However additional land has been envisaged and acquired for external dump and infrastructure such as Cross Country Conveyor, Railway Siding etc. outside the block boundary.
8	Sum 4(l) & 4(m)	The Grade of Coal indicated at Para 4.4.2 at Table 4.12/4.13 and other relevant pages area on obsolete system of grading of Coal. The GCV based grading of coal	GCV is calculated based on following formula: Gross Calorific Value = (UHV + 3645 -75.4*M)/1.466 Accordingly GCV based garading is now provided at Table 4.12/4.13 and incorporated at all relevant pages of the Revised Mining Plan and Mine Closure Plan (1st Revision).

Sl. No.	Ref Para	Observations	Compliance to the Observations
		should be provided at all the relevant pages.	
9	Sum - 4(o) & Chapter - 5	Seamwise Geological, Minable, blocked and corresponding extractable reserve should be indicated in the para under reference	Geological Reserves are given in following table and incorporated in Table-1.6 of Chapter-1. ***million tonnes***

Sl. No.	Reserves*	PB-West & East	PB-NW	Total
1	Net Geological	1436	137.6	1573.6
2	Amenable for Open Cast	707	121.03	828.03
3	Amenable for Underground	729	0	729
4	Mineable	503.39	138.98**	642.34

** Reserves up to 300m depth have been considered for opencast mining.*

***33.18 Mt of coal shall be mined as Barrier& Batter Coal between PBW & PB-NW.*

Seam wise Geological, Minable, blocked and corresponding extractable is now indicated in the reference para 4 (o) of summarized data and elaborated in **Chapter 5**.

Net reserves and extractable reserves and losses

(in Mt.)

Sl. No	Ref Para	Observations	Compliance to the Observations

Seam	Net Reserve	Barrier Loss	Batter Loss	Mineable Reserves	Mining Loss	Extractable Reserve	% Extraction
V Top	22.29	0.72	1 57	19 99	0.59	19 40	87.06
V Bottom	15 56	0.51	1 10	13 96	0.41	13 55	87.06
V Combined	11 57	0.21	0.49	10.87	0.44	10.43	90 16
Seam - V	**49.42**	**1.44**	**3.16**	**44.82**	**1.44**	**43.38**	**87.78**
IV Top	19.82	0.64	2 23	16 95	0.50	16 46	83.01
IV Bottom	9 92	0.32	1 12	8 48	0.25	8 23	83.01
IV Combined	92.32	3.15	10 68	78.49	2.43	76.06	82 39
Seam - IV	**122.06**	**4.10**	**14.03**	**103.93**	**3.18**	**100.75**	**82.54**
III Top	27 45	1.21	2 04	24 20	0 70	23 49	85.59
III Bottom	9.83	0.43	0 73	8 66	0 25	8 41	85.59
III Combined	4.80	0.21	0.36	4 23	0 12	4 11	85.59
Seam - III	**42.08**	**1.85**	**3.13**	**37.10**	**1.08**	**36.02**	**85.59**
II Top	59 98	4.66	6 21	49.11	1 89	47.22	78 72
II Middle	139.75	11 83	11 24	116.68	3.83	112.86	80 75
II TM	76.09	7.28	5.63	63.18	1 77	61 40	80 70
II Bottom	116 05	10 76	9 90	95.39	2 89	92 50	79 71
II MB	17 90	1.71	1 32	14 86	0 42	14 44	80 70
II Combined	7.35	0.70	0 54	6 11	0.17	5 94	80 70

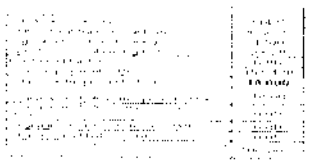
Sl. No	Ref Para	Observations	Compliance to the Observations

Seam- II	**417.13**	**36.95**	**34.85**	**345.33**	**10.97**	**334.36**	**80.16**
I Top	36.93	2.72	9.39	24.81	0.77	24.05	65.11
I Middle	72.97	5.27	18.20	49.49	1.66	47.84	65.56
I TM	2.51	0.23	0.79	1.49	0.04	1.45	57.80
I Bottom	35.60	2.52	8.69	24.39	0.52	23.87	67.06
I MB	14.85	1.35	4.67	8.83	0.24	8.58	57.80
I Combined	3.58	0.33	1.13	2.13	0.06	2.07	57.80
Seam- I	**166.44**	**12.42**	**42.88**	**111.14**	**3.28**	**107.86**	**64.81**
LL	2.60	0.10	0.35	2.15	0.11	2.04	78.62
K5	0.13	0.01	0.06	0.06	0.01	0.05	36.32
K4	4.21	0.13	1.11	2.97	0.11	2.86	67.83
K3	3.34	0.22	0.86	2.26	0.06	2.20	65.95
K2	5.38	0.27	1.14	3.97	0.07	3.90	72.40
K1	15.24	1.25	4.65	9.34	0.41	8.93	58.62
Seam-Local	**30.90**	**1.98**	**8.17**	**20.75**	**0.77**	**19.98**	**64.66**
Total	**828.03**	**58.74**	**106.22**	**663.07**	**20.72**	**642.35**	**77.58**

**Additional 20Mt of proved reserve had not been considered in the above table as the same is considered to be mined by u/g.*

10	Sum 4(t)	*The percentage of extraction needs to be checked.*	Percentage of extraction is 78% and the same has been now incorporated at para 4(t) of Summarised Data and Table-5.6 of Chapter-5.

<table>
<tr><th>Sl. No</th><th>Ref Para</th><th>Observations</th><th>Compliance to the Observations</th></tr>
<tr><td>11</td><td>Summary 5 (a)</td><td>The Schedule of starting of proposed underground mining at Para 1.6.2 is 20 year of start of mining operation, while at para 5.7 it is 10th year of start of mining operation,, while for assessment of amount to be deposited into escrow account has been envisaged from 9th year of mining operation. this needs to be reconciled</td><td>Schedule of start of underground mining operations has been envisaged from 10th year of mining operations (P10). Schedule of UG Operation is as follows.
Schedule of Commencement PB (UG)
<table><tr><th>Sl No.</th><th>Activity</th><th>Time schedule</th></tr><tr><td>1</td><td>Detailed exploration of the underground area</td><td>4 years</td></tr><tr><td>2</td><td>Preparation of G R.</td><td>1 year</td></tr><tr><td>3</td><td>Various Studies and Clearances</td><td>3 year</td></tr><tr><td>4</td><td>Preparation and approval of Mining Plan from MOC</td><td>1 year</td></tr><tr><td>3</td><td>Commencement of mining operations</td><td>1 years</td></tr><tr><td></td><td>Total time</td><td>10 years</td></tr></table>Accordingly it has been now reconciled at para 1.6.2 and para 5.4 and Table 5.22 of Chapter-5.</td></tr>
<tr><td>12</td><td>Sum 5(d) & 5(e)</td><td>Quantum of coal to be produced indicated at para 5(d) is 616.20 Mte. and extractble reserve indicated at para 4 (s) is 625.13</td><td>Total revised Quantum of coal to be produced from the block is 642.34 Mt and the same has been reconciled at para 5(d). extractable reserves and at para 4 (s).</td></tr>
</table>

Sl. No	Ref Para	Observations	Compliance to the Observations
		Mte. while production plan for only 609.19 mte has been envisaged. This needs to be reconciled.	
13	Sum 6(a)	Calculation for Coal requirement for the company and % of coal likely to be met from this project needs to be envisaged in the following table: 	Calculation for Coal requirement for the company and % of coal likely to be met from this project is given below:

Sl. No.	Parameter	Unit	Value
1	Thermal Power (Coal-Commercial) Capacity as on 06.01.2016	MW	34425.00
2	Heat Rate	kCal/kWh	2386.00
3	Average GCV of blended coal (Domestic + Imported)	kcal/kg	3367.80
4	Sp. Coal Consp. blended coal (Domestic+Imported)	kg/kWh	0.71
5	PLF	%	0.80
6	Coal Consp. (Domestic+Imported)	Million Tonnes	171.41
7	Coal Requirement (Domestic Coal) for 92% PLF	Million Tonnes	207.81
8	Coal availability from Pakri barwadih	MTPA	18.00
9	Other Blocks of NTPC	MTPA	0.00
10	Percentage of end use requirement to be met from Pakri Barwadih mine	%	9%

The same is also incorporated in Table-1.7 of **Chapter-1**.

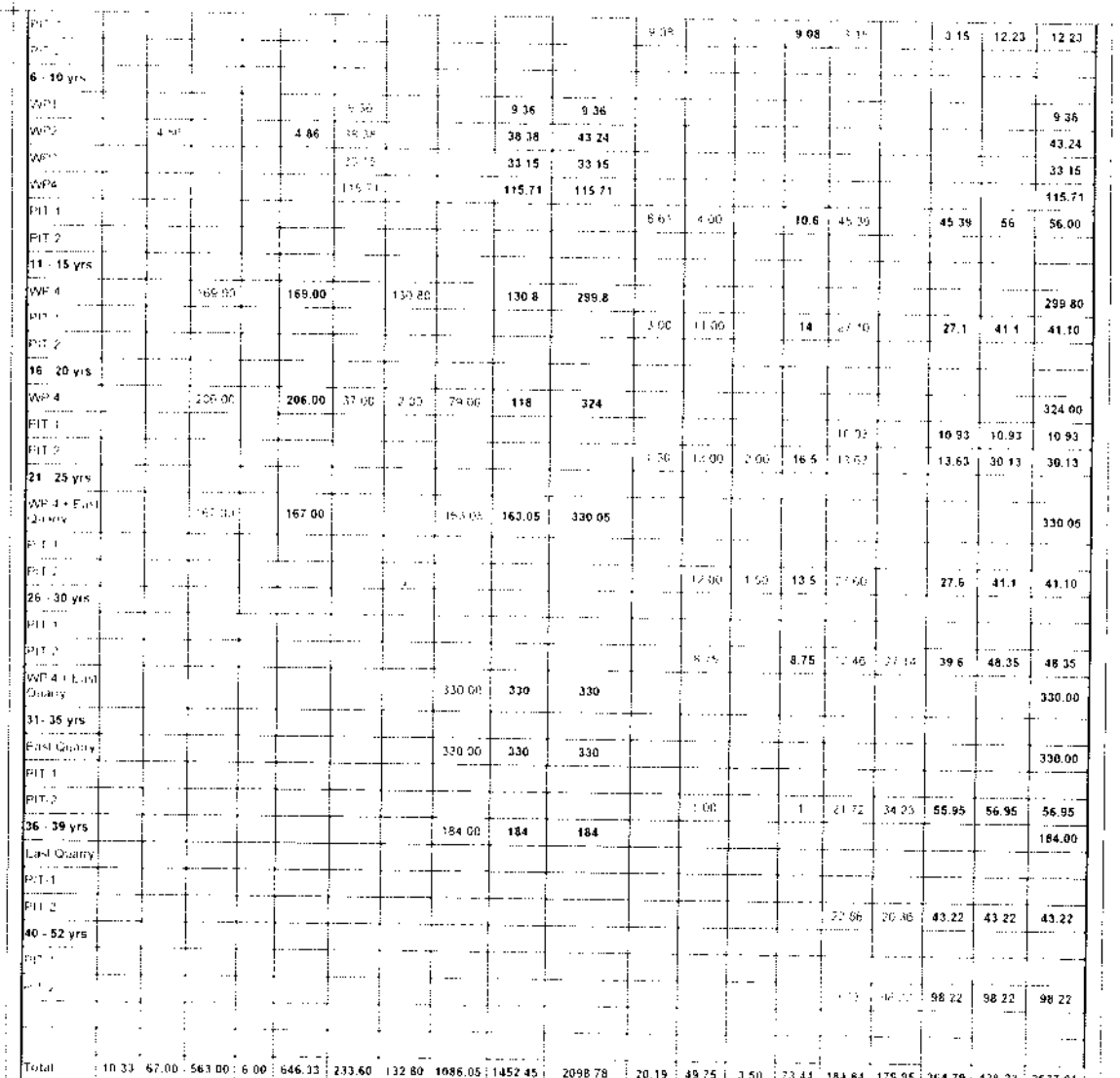
Sl. No	Ref Para	Observations	Compliance to the Observations
14	Chapter - V	There is some incoherency in coal production programme mentioned at table 5.36 & 5.37 This needs to be reconciled	Production Programme has been revised after considering the barrier & batter coal between North West quarry and West Quarry. The integrated calendar plan has now been incorporated in Table 5.16. Calendar Program of Pakri Barwadih is given in following page.

Production Years	Coal Production (Mt)					OB Removal (Mm3)					Strip Ratio (m3/t)		
	West Quarry	East Quarry	PB West & East	NW Quarry	Total from PB	West Quarry	East Quarry	PB West & East	NW Quarry	Total PB Mm3)	West & East Quarry	NW Quarry	PB
1	2.34	0.8	3.14		3.14	5.94	2.95	8.89		8.89	2.83		2.83
2	5.17	1.1	6.27		6.27	15.27	3.05	18.32		18.32	2.92		2.92
3	8.48		8.48		8.48	21.12		21.12		21.12	2.49		2.49
4	9.5		9.5	0.5	10	26.11		26.11	4.1	30.21	2.75	8.20	3.02
5	10		10	1	11	25.03		25.03	8.2	33.23	2.50	8.20	3.02
6	10		10	2	12	35.51		35.51	11.7	47.21	3.55	5.85	3.93
7	10		10	3	13	41.44		41.44	12	53.44	4.14	4.00	4.11
8	10		10	3	13	41.52		41.52	12	53.52	4.15	4.00	4.12
9	10		10	3	13	41.5		41.5	12	53.5	4.15	4.00	4.12
10	10		10	3	13	41.5		41.5	8.2	49.7	4.15	2.73	3.82
11	12		12	3	15	44		44	8.2	52.2	3.67	2.73	3.48
12	15		15	3	18	44		44	8.2	52.2	2.93	2.73	2.90
13	15		15	3	18	52.76		52.76	8.2	60.96	3.52	2.73	3.39
14	15		15	3	18	66.04		66.04	8.2	74.24	4.40	2.73	4.12
15	15		15	3	18	66		66	8.2	74.2	4.40	2.73	4.12
16	15		15	3	18	66		66	8.2	74.2	4.40	2.73	4.12
17	15		15	3	18	66		66	8.2	74.2	4.40	2.73	4.12
18	15		15	3	18	66.01		66.01	8.2	74.21	4.40	2.73	4.12
19	15		15	3	18	66.01		66.01	8.2	74.21	4.40	2.73	4.12
20	15		15	3	18	66.01		66.01	8.2	74.21	4.40	2.73	4.12
21	15		15	3	18	66.01		66.01	8.2	74.21	4.40	2.73	4.12
22	15		15	3	18	66.01		66.01	8.2	74.21	4.40	2.73	4.12

Sl. No	Ref Para	Observations	Compliance to the Observations

23	15		15	3	18	66		66	8 2	74 2	4 40	2 73	4 12
24	15		15	3	18	66		66	8 2	74 2	4 40	2 73	4 12
25	11	4	15	3	18	31 2	31 85	63 05	8 2	71 25	4 20	2 73	3 96
26	7	8	15	3	18	26	36 95	62 95	8 2	71 15	4 20	2 73	3 95
27	1 21	13 79	15	3	18	19 5	46 5	66	8 2	74 2	4 40	2 73	4 12
28		15	15	3	18		66	66	9 2	75 2	4 40	3 07	4 18
29		15	15	3	18		66	66	11 4	77 4	4 40	3 80	4 30
30		15	15	3	18		66	66	11 4	77 4	4 40	3 80	4 30
31		15	15	3	18		66	66	11 4	77 4	4 40	3 80	4 30
32		15	15	3	18		66	66	11 4	77.4	4 40	3 80	4.30
33		15	15	3	18		66	66	11 4	77 4	4 40	3 80	4 30
34		15	15	3	18		66	66	11 4	77 4	4 40	3 80	4 30
35		15	15	3	18		66	66	11 4	77 4	4 40	3 80	4 30
36		15	15	3	18		66	66	11 4	77 4	4 40	3 80	4 30
37		15	15	3	18		66	66	11 4	77 4	4 40	3 80	4 30
38		10	10	3	13		66	66	10 3	76 3	6 60	3 43	5 87
39		3 99	3 99	3	6 99		12 99	12 99	10 04	23 03	3 26	3 35	3 29
40				3	3				9 00	9		3 00	3 00
41				3	3				9 00	9		3 00	3 00
42				3	3				9 00	9		3 00	3 00
43				3	3				9 00	9		3 00	3 00
44				3	3				9 00	9		3 00	3 00
45				3	3				9 00	9		3 00	3 00
46				3	3				9 00	9		3 00	3 00
47				3	3				9 00	9		3.00	3 00
48				3	3				8 50	8 5		2 83	2 83
49				3	3				7 00	7		2.33	2 33
50				3	3				5 75	5 75		1 92	1 92
51				2	2				3 50	3 5		1 75	1 75
52				1 46	1 46				1 48	1 48		1 01	1 01
Total	**311.70**	**191.68**	**503.38**	**138.96**	**642.34**	**1238.49**	**860.29**	**2098.78**	**437.97**	**2536.75**	**4.17**	**3.15**	**3.95**

Sl. No.	Ref Para	Observations	Compliance to the Observations



PIT 1											9.08		3.15	12.23	12.23	
PIT 2																
6 - 10 yrs																
WP1							9.36	9.36								9.36
WP2	4.86		4.86				38.38	43.24								43.24
WP3							33.15	33.15								33.15
WP4							115.71	115.71								115.71
PIT 1									8.61	4.00	10.6	45.39	45.39	56	56.00	
PIT 2																
11 - 15 yrs																
WP 4	169.80		169.00		130.80		130.8	299.8								299.80
PIT 1									3.00	11.00	14	27.10	27.1	41.1	41.10	
PIT 2																
16 - 20 yrs																
WP 4	206.00		206.00	37.00	2.00	79.00	118	324								324.00
PIT 1												10.93	10.93	10.93	10.93	
PIT 2									5.50	14.00	2.00	16.5	13.63	30.13	30.13	
21 - 25 yrs																
WP 4 + East Quarry	167.00		167.00		163.05		163.05	330.05								330.05
PIT 1																
PIT 2									12.00	1.50	13.5	27.60	27.6	41.1	41.10	
26 - 30 yrs																
PIT 1																
PIT 2									8.75		8.75	39.6	39.6	48.35	48.35	
WP 4 + East Quarry					330.00		330	330								330.00
31 - 35 yrs																
East Quarry					330.00		330	330								330.00
PIT 1																
PIT 2									1.00		1	21.72	34.23	55.95	56.95	56.95
36 - 39 yrs					184.00		184	184								184.00
East Quarry																
PIT-1																
PIT 2												22.56	20.46	43.22	43.22	43.22
40 - 52 yrs																
PIT 1																
PIT 2														98.22	98.22	98.22
Total	10.33	67.00	563.00	6.00	646.33	233.60	132.80	1086.05	1452.45	2098.78	20.19	49.75	3.50	73.44	184.64	179.95	364.79	438.23	2537.01

Sl. No	Ref Para	Observations	Compliance to the Observations
20	Sum 7 (b) and Chapter XI Para 11 20	The Land use pattern pre-mining, during mining, post mining and post closure should be furnished in a tabular form. Justification for Proposed area, UG entry etc should be envisaged. The quantum of land likely to be damaged due to mining needs to be envisaged. Further post mining land likely to be restored and their future use needs to be elaborated.	Pre mining land use, land use during mining, post mining land use and post closure land use pattern are presented in the following tables. Post mining land likely to be restored and their future use is elaborated in Chapter-9.

Pre Mining Land Use "Ha"			Land Use "Ha"								
					Post Closure						
Type		Ha	Type	During Mining	End of Life	Agricultural/ Grazing	Plantation	Water Body	Public Use	Forest Land (Returned)	Undisturbed	Total
Forest	Agricultural	2638.00	Excavation Area	1382.00								
	Township		Backfilled Area	1294.00	1294.00	713.00	581.00					1294.00
	Grazing		Excavated void	688.00	688.00			688.00				688.00
	Water Bodies		Top So. Dump	47*								
	Road		External Dump	885.00	885.00		885.00					885.00
	Community		Safety Zone	10.00	10.00		10.00					10.00
	Unhabited		Coal Road between quarries									
	Barren		Road Diversion	18.00	18.00				18.00			18.00
	Agricultural	170.00	Diversion/Below River/Nalla	58.00	58.00				58.00			58.00
	Township		Settling Pond	12.00	12.00			12.00				12.00
Govt. Non Forest	Grazing		Road & Infrastructure Area	291.00	291.00		258.00		33.00			291.00
	Barren		Rationalization Area									
Forest		1787.00	Garland Drains	20.00								
			Embankment	20.00	20.00		20.00					20.00
			Screen Belt	18.00	18.00		18.00					18.00
			Water Reservoir Near Pit									
			UG Entry	18.00	18.00						18.00	18.00
			Undisturbed/Mining right for UG	1383.00	1383.00						1383.00	1383.00
			Resettlement									
Private land			Agricultural land									
Total		4595.00		4695.00	4695.00	713.00	1772.00	700.00	109.00		1401.00	4695.00

Sl. No	Ref Para	Observations	Compliance to the Observations

Cumulative area(Ha)

Stage	Excavation	Backfilling	Void	Topsoil dump	Ext. dump	Others	Total	Cumulative Plantation area(Ha) Backfill	Dump	Green area	Infrastructure	Agriculture/ Grazing land	Total
Y1	57.18	0.00	57.18	26.25	84.30	4527.27	4695.00	0.00	0.00				0.00
Y3	142.98	0.00	142.98	36.00	193.23	4322.79	4695.00	0.00	19.00				19.00
Y5	292.69	0.00	292.69	47.12	261.67	4093.52	4695.00	0.00	83.00	10.00			83.00
Y10	750.14	289.76	460.38	25.18	336.61	3605.07	4695.00	0.00	260.00	10.00			260.00
Y20	1025.34	512.34	513.00	25.18	911.03	2733.41	4695.00	67.00	456.00	15.00			523.00
Y30	1541.81	608.39	933.42	0.00	913.54	2239.05	4695.00	311.00	669.00	20.00			980.00
Y40	1935.00	1192.00	743.00	0.00	885.00	1875.00	4695.00	524.00	885.00	38.00	124.00	665.00	2174.00
Y52	1982.00	1294.00	688.00	0.00	885.00	1828.00	4695.00	581.00	885.00	48.00	258.00	713.00	2485.00

Backfill Percentage = 65.28%

Plantation Area = 1772 ha

21	Chapter - X	The Balance life of the mine is 41 years, while for assessment of amount to be deposited in Escrow account life of 43 years has been considered. This needs to be corrected.	In view of mining of coal locked in barrier and batter between North West Quarry and West Quarry Life of the mine is now increased from 41 years to 52 years. The mine closure cost and its deposition in the Escrow Account is accordingly revised and indicated in Table-11.18 of Chapter-XI of Mine Closure Plan

Sl. No	Ref Para	Observations	Compliance to the Observations

Year wise Closure Cost for Pakri Barwadih Mine

Closure Cost of PB Coal Block

Year	Average cost per annum on current cost (In Crores)			Year wise Expenditure with 5 % escalation(In Crores)			Cummulative amount deposited in the Escrow account excluding interest (Rs Crore)	Maximum amount excluding interest to be released w.r.t. expenditure incurred (Rs Crore)
	Opencast	Underground	Total	Opencast	Underground	Total		
P1	5.67	0.00	5.67	5.67	0.00	5.67	5.67	
P2	5.67	0.00	5.67	5.96	0.00	5.96	11.63	
P3	5.67	0.00	5.67	6.25	0.00	6.25	17.89	
P4	5.67	0.00	5.67	6.57	0.00	6.57	24.45	
P5	5.67	0.00	5.67	6.90	0.00	6.90	31.35	
P6	5.67	0.00	5.67	7.24	0.00	7.24	38.59	25.08
P7	5.67	0.00	5.67	7.60	0.00	7.60	46.19	
P8	5.67	0.00	5.67	7.98	0.00	7.98	54.18	
P9	5.67	0.00	5.67	8.38	0.00	8.38	62.56	
P10	5.67	0.78	6.46	8.80	0.78	9.59	72.14	
P11	5.67	0.78	6.46	9.24	0.82	10.07	82.21	32.64
P12	5.67	0.78	6.46	9.70	0.86	10.57	92.78	
P13	5.67	0.78	6.46	10.19	0.91	11.10	103.87	
P14	5.67	0.78	6.46	10.70	0.95	11.65	115.53	
P15	5.67	0.78	6.46	11.23	1.00	12.23	127.76	
P16	5.67	0.78	6.46	11.79	1.05	12.85	140.61	44.49
P17	5.67	0.78	6.46	12.38	1.10	13.49	154.09	
P18	5.67	0.78	6.46	13.00	1.16	14.16	168.26	
P19	5.67	0.78	6.46	13.65	1.22	14.87	183.13	

Sl. No	Ref Para	Observations	Compliance to the Observations

P20	5 67	0 78	6 46	14 34	1 28	15 61	198 74		
P21	5 67	0 78	6 46	15 05	1 34	16 39	215 14	56 78	
P22	5.67	0 78	6 46	15 81	1 41	17 21	232 35		
P23	5 67	0 78	6 46	16 60	1 48	18 08	250 43		
P24	5 67	0 78	6 46	17 43	1 55	18 98	269 40		
P25	5 67	0 78	6 46	18 30	1 63	19 93	289 33		
P26	5 67	0.78	6 46	19 21	1 71	20 92	310 26	72 47	
P27	5.67	0 78	6 46	20 17	1 80	21 97	332 23		
P28	5.67	0 78	6 46	21 18	1 89	23 07	355 30		
P29	5 67	0 78	6 46	22 24	1 98	24 22	379.52		
P30	5 67	0 78	6 46	23 35	2 08	25 43	404 95		
P31	5 67	0 78	6.46	24 52	2 19	26 71	431 66	92 50	
P32	5 67	0 78	6 46	25 75	2 29	28 04	459 70		
P33	5 67	0 78	6 46	27 03	2 41	29 44	489.14		
P34	5 67	0 78	6 46	28 39	2 53	30 91	520 06		
P35	5 67	0 78	6 46	29 80	2 66	32.46	552.52		
P36	5 67	0 78	6 46	31 29	2 79	34 08	586.60	118 05	
P37	5.67	0 78	6 46	32.86	2 93	35 79	622.39		
P38	5 67	0 78	6 46	34 50	3 08	37 58	659.97		
P39	5 67	0 78	6 46	36 23	3 23	39 46	699.42		
P40	5 67	0 00	5 67	38 04		38.04	737 46		
P41	5 67	0 00	5 67	39 94		39 94	777 40	147 96	
P42	5 67	0 00	5 67	41 94		41 94	819 34		
P43	5 67	0 00	5 67	44 03		44 03	863 37		
P44	5 67	0 00	5 67	46 24		46 24	909 61		
P45	5 67	0 00	5 67	48 55		48 55	958.16		
P46	5 67	0 00	5 67	50 98		50 98	1009 13	176 56	
P47	5 67	0 00	5 67	53 52		53.52	1062 66		
P48	5 67	0 00	5 67	56 20		56 20	1118 86		
P49	5 67	0 00	5 67	59 01		59 01	1177 87		

Sl. No	Ref Para	Observations	Compliance to the Observations

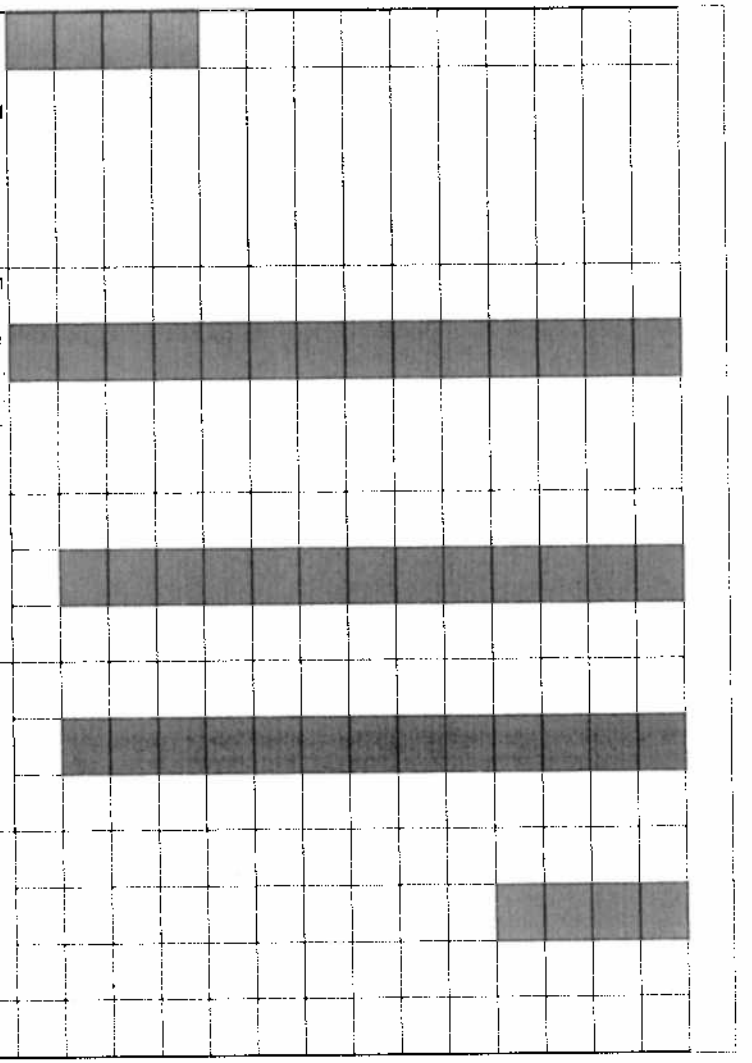
P50	5.67	0.00	5.67	61.96		61.96	1239.83	
P51	5.67	0.00	5.67	65.06		65.06	1304.89	225.34
P52	5.67	0.00	5.67	68.31		68.31	1373.20	
End of Mine Closure								381.34
Total Cost	**295.02**	**23.53**	**318.55**	**1321.09**	**52.12**	**1373.20**		**1373.20**

Note:

- *The above estimated closure cost is based on WPI for "All commodities" as on November '2015. The WPI value for "All Commodities" as downloaded from website of "Office of Economic Advisor" is enclosed as* ***Annexure XX****.*
- *Escrow Account has already been opened for area of 4626 ha corresponding mine closure cost is Rs. 799.19 Crores. (Copy of Approval of Mine Closure Plan (MoC) is enclosed at Annexure-XIII and the copy of Approved Mine Closure Plan (Report) is enclosed at Annexure XIIIA.*

22	Chapter XI Para 11.4	Against 1907.73 Ha of agricultural land only 466 Ha of agricultural land has been proposed to be restored post mining, which is significantly low. The possibility of optimisation for the same should be explored.	In the present Revised Mining Plan and Mine Closure Plan (1st Revision), an effort has been made for the restoration of agricultural land to the maximum considering the practical difficulties at the time of Mine Closure. However, the possibility of enhancing the agricultural land shall be explored after availability of dump area and quantum of restoration/reclamation. All efforts shall be made to enhance it during the Final Mine Closure Operations.
23	Chapter XI Para 11.20	Bar Chart indicating Action Plan & manpower requirement for closure activities should be indicated for the life of the project plus 3 years.	Bar Chart for additional 3 years beyond 52 years of mine life is placed at Table 11.21 of Chapter-XI. **Manpower Requirement for Closure Activities**

Sl. No.	Activities to be undertaken	Manpower of NTPC	P-6	P-11	P-16	P-21	P-26	P-31	P-36	P-41	P-46	P-51	P-52	P-53	P-54	P-55
1	**Mined Area & Waste Management**															

Sl. No	Ref Para	Observations	Compliance to the Observations		
1.1			Plantation along the block boundary, embankment, approach road, CHP Cross country conveyor, Railway siding etc and around the mine infrastructure area	Outsourced (under the	
1.2			Physical reclamation of internal and external dump (Leveling, Spreading of top soil, toe wall formation, drain etc)	supervision of NTPC) Environmental Engr-1, Surveyor-2 Chainman-4	
1.3			Physical reclamation of land of batter and haul road		
1.4			Bio reclamation of above items		
1.5			Making safe approach up to the water lagoon for future uses		

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Pointwise Compliance to MoC's observation issued vide letter no. 34011/05/2015/CPAM(Pt) dated 28th December 2015 on Revised Mining Plan & Mine Closure Plan – 1st Revision of Pakri Barwadih Coal Block

Sl. No.	Ref Para	Observations	Compliance to the Observations		
			1.6	Barbed wire fencing as per requirement	
			2	**Environmental Management (Air, Water, Waste, Noise etc.)**	
			2.1	Thorough inspection of external and stabilized internal dumps to find state of its stabilization & Bio- reclamation.	Supervisors-2 in each shift. Environmental Engineer-1 in each shift
			2.2	Action to stabilize & vegetate uncovered patches, if any	Job Outsourced
			2.3	Inspection of garland drains & bunds around external dumps to prevent leachatte water from entering natural water courses directly	Supervisors-2 in each shift. Mining Engineer-1 in each shift
			2.4	Inspection of embankment to prevent entry of uncontrolled water to mine	Supervisors-2 in each shift. Engineer-1 in each shift

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Sl. No	Ref Para	Observations	Compliance to the Observations		
				Making 2 meter high pucca wall around the external OB Dump	
	4.6			Closing with walling and gates in the haul road, to prevent advertant entry into water lagoon.	Supervisor-1 in each shift
	4.7			Filling the haul road up to ground level from surface up to sealing gate	
	4.8			Survey of the total project area for updating mine plans Under Coal Mine Regulation.	Supervisors-2 in each shift, Mining Engineer-1 in each shift
	5		Social & Economic Aspects		
	5.1			C.S.R activities	Engineer-1, HR executive/ staff-2
	6		Execution & Supervisor		
	6.1				

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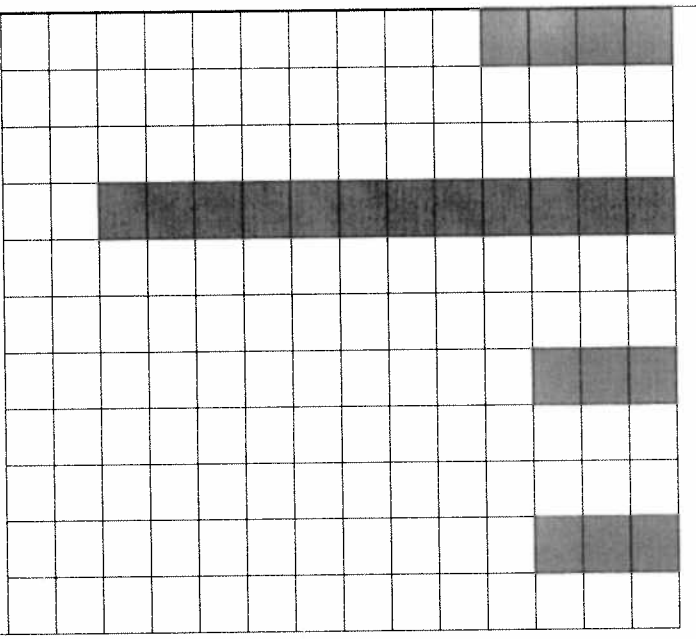
Sl. No.	Ref Para	Observations	Compliance to the Observations
			8.3 Withdrawal of machinery etc 8.4 Subsidence Management 8.5 Post closure Subsidence Monitoring 8.6 Miscellaneous charges including power cost, supervision etc. 
24	Chapter XI Para 11.21	As per the Calendar plan of the project the balance life of the mine is 41 Year for OC working, while in the assessment of escrow account balance life of 43 years has been considered. This needs to be reconciled. Further the WPI as on base date should be taken for	Refer submission at Para 21 of this reply. WPI for the month of November '2015 has been considered for the calculation of amount to be deposited in escrow account against Mine Closure. WPI as on August'09 — 129.60 WPI as on base date " November'15" — 177.60

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Sl. No	Ref Para	Observations	Compliance to the Observations
		escalation of amount to be deposited in Escrow account.	

Escalation rate of Closure cost		1.37
Rate of compounding of Annual Closure Cost		5.00%
Amount to be deposited into Escrow Account after compounding @ of 5% "Rs. in Crs"		1373.200
Particulars	**UG**	**OC**
Base Rate of Closure Cost "Rs. Crs./Ha"	0.010	0.060
Closure Cost "Rs. Crs/Ha"	0.014	0.082
Lease Area	1106.96	3588.04
Amount to be deposited into Escrow Account "Rs. in Crs"	52.120	1321.090
Amount already deposited into Escrow Account "Rs. in Crs"	0.000	0.000
Net Amount to be deposited into Escrow Account "Rs. in Crs"	52.120	1321.090
Balance Life of the project "in Yrs"	30	52
Annual Closure Cost	1.737	25.406

Sl. No	Ref Para	Observations	Compliance to the Observations
25	Sum – 8 (a) & Chapter XI	***The Mine closure activities required to be taken should be in coherence with the guidelines of the Mine Closure plan and also indicative cost with the basis of calculation of the cost of mine closure activities needs to be envisaged***	The Mine closure activities are now as per the guidelines and have been accordingly elaborated Table No. 11.22 in the Chapter XI. The estimated total expenditure for Mine Closure Activities in Sum- 8 (a) has also been accordingly modified in view of the revised mine life. Tentative assessment of activitywise closure cost is given in following table. **Provision for Expenditure for Mine Closure of Pakri Barwadih Coal Mining Block** *Amount in Rs. Crores*

Sl. No.	Activities to be undertaken	P-6	P-11	P-16	P-21	P-26	P-31	P-36	P-41	P-46	P-51	P-55	Cost
1	**Mined Area & Waste Management**	14 33	10 20	8 24	12 34	8 43	12 17	12 69	24 99	25 96	51.45	48 77	**229.08**
1 1	Plantation along the block boundary embankment, approach road CHP Cross country conveyor Railway siding etc and around the mine infrastructure area	14 33	10 20	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	24 53
1 2	Physical reclamation of internal and external dump (Leveling Spreading of top soil toe wall formation drain etc)	0 00	0 00	8 24	12 34	8 43	12 17	12 69	10 00	10 39	0 00	0 00	74 26
1 3	Physical reclamation of land of batter and haul road	0 00	0 00	0 00	0 00	0 00	0 00	0 00	10 00	10 39	20 58	0 00	40 96
1 4	Bio reclamation of above items	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	10 29	16 09	26 38
1 5	Making safe approach up to the water lagoon for future uses	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	10 29	16 09	26 38
1 6	Barbed wire fencing as per requirement	0 00	0 00	0 00	0 00	0 00	0 00	0 00	5 00	5 19	10 29	16 09	36 57

Sl. No.	Ref Para	Observations	Compliance to the Observations

2	**Environmental Management (Air, Water, Waste, Noise etc.)**	2 87	6 12	18 13	29 62	28 65	29 21	43 16	23 99	21 81	21 61	65 97	**291.14**
2 1	Thorough inspection of external and stabilized internal dumps to find state of its stabilization & Bio-reclamation	0 00	1 02	1 65	2 47	1 69	2 43	2 54	2 00	2 08	4 12	6 44	26 42
2 2	Action to stabilize & vegetate uncovered patches if any	0 00	2 04	3 30	4 94	3 37	4 87	5 08	4 00	4 15	8 23	12 87	52 85
2 3	Inspection of garland drains & bunds around external dumps to prevent leachatte water from entering natural water courses directly	0 00	2 04	3 30	4 94	3 37	4 87	5 08	4 00	4 15	8 23	12 87	52 85
2 4	Inspection of embankment to prevent entry of uncontrolled water to mine	0 00	0 00	0 00	7 41	5 06	7 30	7 62	6 00	0 00	0 00	0 00	33 38
2 5	Strengthening of embankment	0 00	0 00	0 00	7 41	5 06	7 30	7 62	6 00	0 00	0 00	0 00	33 38
2 6	Quarterly sampling of water to know its quality status	0 00	0 00	8 24	0 00	8 43	0 00	12 69	0 00	10 39	0 00	32 18	71 93
2 7	Record keeping, monitoring and reporting	2 87	1 02	1 65	2 47	1 69	2 43	2 54	2 00	1 04	1 03	1 61	20 34
3	**Management of Infrastructure & Mining Machineries**	0.00	10 20	0.00	0.00	16 85	24.34	25.39	39.99	41 54	41 16	64.36	**263.83**
3 1	Decommissioning of structurals & semi- permanent constructions	0 00	0 00	0 00	0.00	0 00	0 00	0 00	0 00	20 77	41 16	64 36	126 29
3 2	Renovation of Mine/Project office Canteen Training Centre Rest shelter etc	0 00	5 10	0 00	0 00	8 43	0 00	0 00	10 00	0 00	0 00	0 00	23 52

Sl. No	Ref Para	Observations	Compliance to the Observations

3 3	Cleaning of land for vegetation over the area	0 00	5 10	0 00	0 00	8 45	0 00	0 00	10 00	0 00	0 00	0 00	23 55
3 4	Dismantling of machineries	0 00	0 00	0 00	0 00	0 00	24 34	25 39	19 99	20 77	0 00	0 00	90 50
4	**Actions for safety & security of local community due to abandonment of the mine or part of the mine**	0 72	1 02	9 89	14 81	10 11	14.61	15 23	21 99	38 43	34 98	35 40	**197.19**
4 1	Regular inspection of the mined out area O B dumps for assessing the closure job	0 00	0 51	0 82	1 23	0 84	1 22	1 27	1 00	1 04	2 06	3 22	13 21
4 2	Action if required for making safe the drainage areas fire areas etc	0 00	0 00	0 00	12 34	0 00	0 00	12 69	0 00	10 39	0 00	0 00	35 42
4 3	Making 2 metre high pucca wall on the slope of internal dumps along the estimated water level	0 00	0 00	8 24	0 00	8 43	0 00	0 00	10 00	0 00	20 58	0 00	47 24
4 4	Making 2 meter high pucca wall around the top edge of the mined out area where immediate void exists at the quarry edge	0 00	0 00	0 00	0 00	0 00	12 17	0 00	0 00	10 39	0 00	0 00	22 56
4 5	Making 2 meter high pucca wall around the external OB Dump	0 00	0 00	0 00	0 00	0 00	0 00	0 00	10 00	10 39	0 00	0 00	20 38
4 6	Closing with walling and gates in the haul road to prevent inadvertant entry into water lagoon	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	5 19	0 00	16 09	21 28
4 7	Filling the haul road up to ground level from surface up to sealing gate	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	10 29	16 09	26 38

Sl. No	Ref Para	Observations	Compliance to the Observations

4.8	Survey of the total project area for updating mine plans Under Coal Mine Regulation	0.72	0.51	0.82	1.23	0.84	1.22	1.27	1.00	1.04	2.06	0.00	10.71
5	**Social & Economic Aspects**	7.17	5.10	8.24	0.00	8.43	0.00	12.69	10.00	10.39	0.00	0.00	**62.01**
5.1	C S R activities	7.17	5.10	8.24	0.00	8.43	0.00	12.69	10.00	10.39	0.00	0.00	62.01
6	**Execution & Supervisor**	0.00	0.00	0.00	0.00	0.00	12.17	0.00	15.00	15.58	30.87	16.09	**89.70**
6.1	Purchasing/Hiring of equipment for closure activities etc	0.00	0.00	0.00	0.00	0.00	12.17	0.00	10.00	10.39	20.58	0.00	53.13
6.2	Execution & Supervision of the activities by mining personal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.19	10.29	16.09	36.57
7	**Miscellaneous Charges**	0.00	0.00	0.00	0.00	0.00	0.00	2.54	2.00	2.08	4.12	6.44	**17.167**
7.1	Miscellaneous charges including power cost deployment of security personal 3 years post closure environmental monitoring supervision power cost etc	0.00	0.00	0.00	0.00	0.00	0.00	2.54	2.00	2.08	4.12	6.44	17.17
8	**Underground Mining**	**0**	**0**	**0**	**0**	**0**	**0**	**6.3468**	**9.9973**	**20.772**	**41.158**	**144.81**	**223.09**
8.1	Sealing of Mine entries for UG mine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	96.54	96.54
8.2	Isolation stopping, if required	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.19	10.29	0.00	15.48
8.3	Withdrawal of machinery etc	0.00	0.00	0.00	0.00	0.00	0.00	6.35	5.00	5.19	10.29	0.00	26.83
8.4	Subsidence Management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.19	10.29	0.00	15.48

Sl. No	Ref Para	Observations	Compliance to the Observations
			8.5 Post closure Subsidence Monitoring: 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 32.18 | 32.18
			8.6 Miscellaneous charges including power cost supervision etc: 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.00 | 5.19 | 10.29 | 16.09 | 36.57
			Total estimated expenditure incurred (In Rs Crore): **25.08 | 32.64 | 44.49 | 56.78 | 72.47 | 92.50 | 118.05 | 147.96 | 176.56 | 225.34 | 381.34 | 1373.21**
26	Sum 9 (a)	The base date of the mining plan should be considered for assessment of balance life, balance reserve and WPI as on that date should be considered for assessment of balance life to be deposited annually in the Escrow Account. while in this case the base date is August 2015 and WPI as on June 2015 has been considered for assessment of amount to be deposited in escrow account. This needs to be corrected.	The WPI is issued one month prior to the current month on the website of office of Economic Advisor. GoI Accordingly, the base date considered in this Revised Mining Plan and Mine Closure Plan(1st Revision) for Monthly Wholesale Price Index for "All Commodities" is November '2015 while the base date of the this Revised Mining Plan and Mine Closure Plan(1st Revision) has been considered as January '2016. Available WPI figures are placed at Annexure-XX of Mining Plan.
27	Chapter - XI	The Mine Closure plan should be in line with the Guideline for the formulation of MCP uploaded in MoC website Some of the parameter namely Para – 6 to Para	Mine Closure plan Chapter – XI. has been prepared in line with guidelines issued by MoC and all the parameters have been considered including para 6 to 8 namely Financial Assurance, Responsibility of the Mine owners and Provision for Mine Closure. The same is now elaborated in the Chapter-XI.

Pointwise Compliance to MoC's observation issued vide letter no. 34011/05/2015/CPAM(Pt) dated 28th December 2015 on Revised Mining Plan & Mine Closure Plan – 1st Revision of Pakri Barwadih Coal Block

Sl. No	Ref Para	Observations	Compliance to the Observations
		-8 needs to be incorporated in the Mining Closure portion of the mining plan	
28		Before dumping over the dip side coal bearing area of the block the opencast production potential of that area should be re-examined.	As per the available information seams occur at a depth of more than 300m in the dip side area and can be mined out by U/G method The opencast potential would however be re-examined.
29		As per the current guideline all projects of capacity more than 2.50 Mtpa should have integrated washery. This needs to be elaborated in the mining plan.	Coal washability study has not yet been carried out for Pakri Barwadih Coal. Coal quality parameters obtained from the proximate analysis of coal revealed that ash percentage in all probability is likely to remain 34% or below which does not call for commissioning of coal washery. However space provision is kept for providing a Coal Washery at mine end in future, if required.
30		Reserves locked below nala should be included in the extractable reserve and should be planned for mining.	Reserves below the nala have now been included in the mineable/extractable reserves and has been envisaged for mining. This has enhanced the mine life from 41 years to 52 years.
		Annexure	
31		Most of the Annexures attached are not legible. Ligible copies of the same should be attached.	Legible copies of Annexures are now enclosed.
32	Annexure - III	Annexure – III shown in the list of Annexure in missing in the mining plan document	Annexure – III (Copy of approved Mine Closure Plan) is now attached.

Sl. No	Ref Para	Observations	Compliance to the Observations
33		A certificate required as per the guideline, regarding confirmation from RQP that he has verified the block area with the relevant plans supplied by CMPDI/ SCCL / NLC and area covered by the mining plan does not encroach on any other coal lignite block, needs to be attached. The lining of the certificate should be in line with the guideline.	Certificate is attached at Annexure – XVI-C.
34		A certificate required as per the guideline that the mine will be developed as per the approval of the mining plan from Ministry of coal and all other approvals, as required will be obtained from relevant authorities issued by the empowered representative of / or Block allottee / applicant should be attached. The lining of the certificate should be in line with the guideline.	Certificate is attached at Annexure – XVII.
35		The lining of the Annexure – XVI C & XVI D should be exactly the same as required in the guideline for formulation of Mining plan	The lining of the Annexure – XVI C & XVI D are now as per the guideline for formulation of Mining Plan.
36		Certificate of CMPDIL that the block boundary considered in the Mining Plan is in line with the Block	Certificate is attached at Annexure – XIX.

Sl. No.	Ref Para	Observations	Compliance to the Observations
		allocated to the project proponent is to be attached.	
37		On the basis of CMPDIL certificate. a certificate of RQP is to be attached certifying that the block boundary considered in the mining plan is exactly in line with the certificate issued by CMPDIL.	Certificate of RQP is attached at Annexure – XVI-C.
		Plates	
38		Pre-Mining Land use plan should be enclosed showing distinctly Private land. Govt Land & Forest land	Pre-Mining Land use plan showing distinctly different types of land is shown as Plate No. 4.
39	Plate - 6	The plan indicates the lease boundary and block boundary. The Mine boundary in distinct colour should also be indicated in the plan	Plate No 6 is now Plate No. 7 and has been modified indicating the Lease Boundary and Block boundary with distinct colours.
40	Plate - 6	The Area to be explored prior to dumping and also for proving of reserve and also the block boundary should be demarcated in distinct colour.	Geological Plan (Plate No 6) is now Plate No. 7 has been modified indicating the Area to be explored prior to dumping and also for proving of reserve with distinct colour.
41		Cadastral plan showing total lease Area and Mine Boundary	Cadastral plan (Plate No 3) showing total lease Area and Mine Boundary superimposed over mine boundary and marked with distinct colours is attached.

Sl. No	Ref Para	Observations	Compliance to the Observations
		superimposed over it, should be attached.	
42		Conceptual plan showing infrastructure facilities including colony, boundary of mining area, mine entries, roads including road diversion, nala diversion, river diversion alignment etc. should be attached.	Infrastructure facilities including colony, boundary of mining area, mine entries, roads including road diversion, nala diversion, river diversion alignment etc. have been shown in Surface Master Plan. The modified Surface Master Plan (Conceptual Plan) is attached.
43		A plan showing top soil management should be attached	Location of Top soil dumps have been shown in respective stage plans. The detail has been explained in Chapter – V at para 5.4.9 and 5.5.10.2 regarding generation, spreading and its management.
44		Post Mining land use plan should be attached	Post Mining land use plan has been attached as Plate No 32.
45	Plate – 36	It is apparent from the plan that the final void on the NW quarry will be left as water body, while in the mining chapter it is indicated that the lower seams will be taken by Underground method of mining. Development of water body is likely to sterilise the lower un-worked seam this needs to be reconciled.	All seams of PB-NW quarry shall be mined by open cast method and no underground mining has been envisaged.

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SANJIV KUMAR SINGH
Recognised Qualified Person
No. 3/C (15)/2009-CPAM
Ministry of Coal, Govt. of India

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3.	Copy of letter for submission of Mining Plan for PB North-West (Sector-A)	Annexure –IV
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LIST OF ABBREVIATIONS

Sl. No.	Abbreviation	Full Form
1.	AMSL	Above Mean Sea Level
2.	bgl	Below ground level
3.	BH	Bore hole
4.	CBA	Coal Bearing Area
5.	CMPDIL	Central Mine Planning Design Institute Limited
6.	CSM	Continuous Surface Miner
7.	Cum/Mil. cum.	Cubic metre/ Million cubic metre
8.	DGMS	Director General Mines Safety
9.	E&M	Electrical and Mechanical
10.	EIA	Environmental Impact Assessment
11.	EMP	Environmental Management Plan
12.	FC	Fixed Carbon
13.	FE Loader	Front End Loader
14.	GCV	Gross calorific value
15.	GoI	Government of India
16.	GR	Geological Report
17.	GSI	Geological Survey of India
18.	HEMM	Heavy Earth Moving Machinery
19.	HFL	High Flood Level
20.	IB	Inter burden
21.	I.E.	Indian Electricity
22.	IMD	India Meteorological Department
23.	K. Cal/kg	Kilo Calorie per Kilogram
24.	KL/Kl	Kilo Litre
25.	L/l	Litre
26.	m/Km	Metre/Kilometre
27.	m^3/Mm^3	Cubic metre/Million cubic metre
28.	MBCM	Million Bank Cubic Metre
29.	MCP	Mine Closure Plan
30.	MECL	Mineral Exploration Corporation Limited
31.	ML	Mining Lease
32.	mld	Million litre per day
33.	MoC	Ministry of Coal
34.	MoEF	Ministry of Environment and Forests
35.	Mt	Million Tonne
36.	Mtpa	Million Tonne Per Annum
37.	OB	Overburden
38.	OC	Opencast
39.	PA	Per Annum
40.	PB	Pakri Barwadih
41.	RH	Relative Humidity
42.	RPM	Respirable Particulate Matter
43.	RQP	Recognised Qualified Person
44.	RoM	Run of Mine
45.	SC	Scheduled Caste

46.	SH	State Highway
47.	SPM	Suspended Particulate Matter
48.	ST	Scheduled Tribe
49.	T/t	Tonne
50.	TPD	Tonne Per Day
51.	TS	Topsoil
52.	UHV	Useful Heat Value
53.	UG	Underground
54.	VM	Volatile Matter

SUMMARISED DATA

SANJIV KUMAR SINGH
Recognised Qualified Person
No. 34C (15)/2009-CPAM
Ministry of Coal, Govt. of India

Summarized Data

1. General

a) Name and address of the Applicant Company	NTPC Ltd. (Govt. of India Enterprises) NTPC Bhavan,Core-7, Scope Complex, 7 Institutional Area, Lodhi Road New Delhi-110003 Tel No. 011-24387333/24387000 Fax No.011-24361018
b) Name and address of block Allottee	As above
c) Relationship between Applicant and Allottee company	Both Applicant and allottee company are one and the same.
d) Status of the Applicant Company	Public Sector Undertaking(PSU)
e) Name of the Coal Block together with name of Coalfield & State where located	Block : Pakri Barwadih Coal Block Coalfield : North Karanpura Coalfield State : Jharkhand
f) Date of allotment	Date: 11.10.2004 Letter No.: 13016/29/2003-CA-I
g) End Use of Coal as per Approval	For generation of Power. A basket Linkage exists for this Block.
h) ROM quantity proposed to be produced as per Mining Plan	ROM Quantity: 503.38 Mt from West and East Quarry 138.96 Mt from NW Quarry Total = 642.34 Mt
i) Norms adopted for calculating ROM quantity requirement in case it differs from the quantity indicated in the Allotment Order	N.A (Basket Linkage)
j) Beneficiation required: Yes/No	No
k) Requirement of Beneficiated Coal & expected availability thereof	Not Applicable
l) Period for which Mining Lease has been granted for	Since land for mining area is being acquired by NTPC under CBA Act. Mining Lease Not Applicable
m) Date of expiry of earlier Mining Lease, if any	Since land for mining area is being acquired by NTPC under CBA Act. Mining Lease Not Applicable
n) RQP who has prepared the Mining Plan Name: Address: Phone Nos :	**Mr. Sanjiv Kumar Singh** 4th Floor, Core-5, NTPC Ltd, Scope Complex,7 Institutional Area, Lodhi Road, New Delhi-110003 (+91) 011- 24387669 (O), 0120-2400372 (R)

Mobile:	(+91) 9650991396
Fax: Email ID:	(+91) 011-24367089, sanjivkumarsingh01@ntpc.co.in
Registration No of RQP: Date of grant of RQP status: Renewal of RQP Status: Validity:	34011/(15)/2009-CPAM 27.09.2010 10 years from the date of issue

2. Information regarding earlier approved Mining Plan

a) Approval Letter no. and Date	13016/29/2003-CA-I, Dated 25th August 2006 (Refer Annexure-II
b) Lease Area	4626 ha (Project Area)
c) Date of grant of Lease	Since land for mining area is being acquired by NTPC under CBA Act. Mining Lease Not Applicable
d) Date of expiry of Lease	Since land for mining area is being acquired by NTPC under CBA Act. Mining Lease Not Applicable
e) Targeted Production	15Mtpa
f) Proposed year of start of Production	-
g) Proposed year of achieving the targeted production level	12th year of Mine Operation
h) Envisaged life of mine (in years)	41 Years (Including two years of construction period)
i) Date of actual commencement of Mining Operation, if operation is already started	Production not yet started
j) Likely date of Mining Operations, if operations not yet started & reasons for non-commencement of operations	Likely date of Mining Operation-
k) Planned production and actual levels achieved in last 3 years	N/A
l) Coal:- OB	Open cast: N/A OB: N/A
m) Reasons for difference between planned and actual production levels	Reasons for delay in starting of the project are as under: a) Delay in issuance of NoC on jungle jhari land by Distt Admininstration due to which Forest Clearance was delayed. b) Revision of evacuation corridor on advice of FAC, MoEF c) Delay in land acquisition: There was delay in physical verification & Certification of land records, disbursement of land compensation by Hazaribagh Distt. Administration took more time due to old /

<table>
<tr><td></td><td>non availability of land records, inadequate State manpower at Distt/Block level, law & order problem etc.
d) Non-performance by the earlier MDO. NTPC finally terminated the MDO contract wef 22.06.2014.</td></tr>
<tr><td>n) Reason for revision of Mining Plan</td><td>MoC directed to submit Revised Mining Plan (1st Revision) including Mine Closure Plan as a whole instead of in parts, vide letter F.No.13016/29/2003-CA-1 (Part) dated 24.06.2015.</td></tr>
<tr><td>o) Details of changes in new Mining Plan compared to earlier approval</td><td>
1. Comparison between Approved and Revised plan:
<table>
<tr><td></td><td>Approved Plan</td><td>Revised Plan</td></tr>
<tr><td>Lease Area</td><td>4626 Ha</td><td>4695 Ha</td></tr>
<tr><td>Block boundary</td><td colspan="2">same</td></tr>
<tr><td>Production level</td><td>15Mtpa from 12th Year</td><td>18Mtpa from 12th Year</td></tr>
<tr><td>Reserves</td><td>West Quarry 311.71Mt

East Quarry 191.68 Mt</td><td>West Quarry 311.71 Mt

East Quarry 191.68 Mt

NW Quarry (Sector-A) 105.80 Mt</td></tr>
<tr><td>Mining Technology</td><td>Shovel Dumper combination with inclined slicing for coal and intervening parting and horizontal slicing method for top OB benches</td><td>Shovel Dumper combination with inclined slicing for coal and intervening parting and horizontal slicing method for top OB benches</td></tr>
<tr><td>Land use pattern</td><td>Forest: 1105.92 Ha</td><td>Forest: 1787.00Ha

Non-forest:</td></tr>
</table>
</td></tr>
</table>

		Non-forest: 3519.92 Ha	2908.00 Ha
	Coal Stockpile	Not provided	Stockpile which can cater to one week production of the West, East and NW Quarry is envisaged.

p. Reasons for change in Lease Area is given below:

	Approved Mining Plan	Revised Mining Plan	+/- (ha)	Reason
Block Area excluding Area 'A'	3943	3943		No Change
Area 'A'	384	485	101	Detailed survey of Area 'A' at the time of detailed exploration has indicated total area as 485 ha. Same has been notified under Section 7(i) of CBA.
Outside Block area (For OB Dumps and infrastructure)	299	267	-32	Decrease in area as per direction of restrictions of MoEF.
Total	**4626**	**4695**	**69**	

- The difference of 69 ha between the lease areas shown in the Approved Mining Plan and present Revised Mining Plan (Rev-1) is attributed to increase of 101 ha in Area 'A' after demarcation & measurement, and reduction by 32 ha of the area taken for external dumping and infrastructure.
- The revised area of PB-NW (Sector 'A') has been certified by CMPDI (enclosed as Annexure –XIX).

q. Reasons for change in Forest Area and Non-forest Area:

i) Updation/Correction of forest records and land re-classification by State Govt./forest department.
ii) Increase in the area of sector -A (North-western part of Pakri Barwadih) which consists majority of forest land.

Details of forest/non forest along with variation with respect to Approved Mining Plan area as follows:

	Approved Mining Plan	Revised Mining Plan	Increase (ha)	Decrease (ha)
Forest Land	1126	1787	661	
Agricultural & Residential Land	2675	2520		155
Govt. Non-forest Land	825	388		437
Total	**4626**	**4695**	**661**	**592**

3. Location

a) Location of the block Taluka/Village/Khasra/Plot/Block Range etc.	North-Eastern part of North Karanpura CF, bounded by longitudes 85°9'19" to 85°15' 0"E and latitude 23°51'30" to 23°55'40" Taluka- Barkagaon etc. Village- Pakri Barwadih, Nagari, Arhara, Chepakalan, Jugra etc.
b) Name of the Coalfield	North Karanpura Coalfield
c) Particulars of adjacent blocks: North, South, East, West	North- Protected Forest South- Badmahi River & Barkagaon R.F. East- BarkagaonR.F. West- Kerendari 'C' Block
d) Area of the Allotted Block (hectares)	i) Geological Block Area:4428.92 ha ii) Mining Block Area :4428.92 ha
e) Reference no. of Plan of block boundary issued by CMPDI	Drawing. No: RI/III/6/5827 plate No. II March 2004 Refer Annexure - XII.
f) Whether the lease boundary is same as demarcated by CMPDI	Yes: The block boundary considered for mining is the same as provided by the CMPDI. However additional land has been envisaged and acquired for external dump and infrastructure such as Cross Country Conveyor, Railway Siding etc. outside the block boundary.
g) Existing mining Lease Area in case of existing mines	Not Applicable
h) Applied/required Lease Area as per the Mining Plan under consideration (hectares)	Lease is not applicable however required area is given below: Total Area =4695 Ha Block Area = 4428.92 Ha Outside Block Area = 266.08 Ha
i) Whether the applied lease area falls within the allotted block	The area includes total allotted block area demarcated by CMPDI and an additional area of 266.08 Ha.
j) Area (hectares) which falls outside the block/sub-block delineated by CMPDI	266.08 Ha.
k) Details of outside area:	

- whether forms part of any other coal block - whether it contains any coal reserves -Purpose for which it is required	No No, as the detailed review of Geological Plan (vide drawing No. R-III/G/6206) of GR prepared by CMPDI reveals that the incrop of lower most seam of Barakar Formation Seam-IB is within the block boundary and no mineable coal, by opencast method, extend beyond that incrop line. Hence the area marked for dumping and infrastructure near the North-eastern side of the block is considered to be non-coal bearing area. OB Dumps and Mine Infrastructure: 193.85 Ha Evacuation corridor & siding: 72.23 Ha
l) Whether some part(s) of the allotted block has not been applied for mining lease -Total area in hectares of such part(s) -Total reserves in such part(s) -Brief reasoning for leaving such part(s)	No Not Applicable Not Applicable Not Applicable

m) Type of land involved in Hectares

Lease Area			
Sl. No	**Class of land**		**Area in ha**
1.	Forest		1787
2.	Non-Forest	Govt.	388
		Tenancy	2520
Total			**4695**

n) Broad Land use Pattern

Pre Mining Land Use					
Sl. No.	**Type**		**PB West &East**	**PB NW**	**Total of PB**
1	Tenancy	Agricultural	2731.48	176.52	2908.00
		Habitation			
		Grazing			
		Barren			
2	Govt Non Forest	Agricultural			
		Habitation			
		Grazing			
		Barren			
3	Forest	Forest	1478.52	308.48	1787.00
	Total		**4210.00**	**485.00**	**4695.00**

	Land use Post Closure Sl. No. | Type | PB West &East | PB NW | Total of PB 1 | Water body | 459.00 | 44.00 | 503.00 2 | Plantation | 2844.00 | 286.00 | 3130.00 3 | Road | 2.00 | 8.00 | 10.00 4 | Grazing | 223.00 | 24.00 | 247.00 5 | Agricultural | 524 | 76 | 600.00 6 | Public Use | 105 | 47 | 152.00 7 | Barren | 35 | 0 | 35.00 8 | For UG Mine | 18.00 | 0.00 | 18.00 Total | 4210.00 | 485.00 | 4695.00
o) Proximity of public road/ railway line/ major water body if any and approximate distance	The entire block falls in the Hazaribagh district of Jharkhand State. The Hazaribagh – Khalari – Ranchi State highway passes through the eastern part of the block touching Barkagaon and Tandwa Villages. The nearest township is Hazaribagh located at a distance of around 25 kms from Barkagaon in the northern part of the block. The nearest rail stations are Ranchi Road of SE Railway around 70- 75 kms from the block. There are a number of seasonal streams/ nullah traversing the block and the prominent ones are Dumuhan, Hardara and Khora etc. flowing roughly north to south and carry huge load during rainy seasons. None of them are perennial in nature. They discharge their load into the Badmahi River flowing further south of the block which one of the important tributaries of the mighty Damodar River is flowing west to east in southern part of the North Karanpura Coalfield.
p) Toposheet No. with Latitude and Longitude	The block is covered by the Survey of India Toposheet No. 73 E/1 (RF 1:50,000) and special sheet no. 21, 23 & 24 on R.F. 1:10000. It is bounded by longitude 85°09'19" to 85°15'00"E and latitude 23°51'30" to 23°55'40"N.

4. Geology and Exploration

a) Name of the Geological Block	Pakri-Barwadih Coal Block located in the north eastern part of North Karanpura coal field bounded by longitudes 85° 09' 19" to

and area in hectare	85°15'00" N and latitude 23° 51' 30" to 23° 55' 40" E covered by the Survey of India Toposheet no. 73E/1 (R.F 1: 50000) and special sheets no. 21, 23 & 24 on R.F. 1:10000 is located in the state of Jharkhand and is around 120-130 km from the state capital Ranchi.
b) Name of the Geological Report (GR) with year of preparation	Two Geological Reports are available namely: a. Geological Report on Coal Exploration Pakri-Barwadih Block (Non-CIL captive block) North Karanpura Coal Field, Dist. Hazaribagh, Jharkhand; prepared in March 2005. b. Geological Report on Detailed Exploration for Coal Pakri Barwadih North West (Area - A Block), North Karanpura Coal Field, Dist. Hazaribagh, Jharkhand (State) October 2012.
c) Name of the agency which conducted the exploration and prepared GR	Two agencies were involved namely: a. CMPDI for total PB Block except Area "A", North West part of Pakri Barwadih b. MECL for Area "A", North West part of Pakri Barwadih
d) Period of conducting exploration	Exploration by CMPDI was conducted in two phases: 1st Phase- 1999-01 2nd Phase- 2003-04 Exploration by MECL was conducted for PB "A" area: 2006-2012
e) Details of drilling by all agencies (Coring and Non-coring)	

Agency/ Type	Period of Drilling	Drilling	
		No. of Boreholes	Meterage
1. GSI / Regional	1961 to 1971	KB-1 to 26 (26 BHs)	8177.23
2. CMPDI a) Promotional (Semi-regional)	Dec. '1999 to April , 2001	CMKPB-1 to 38 (38 BHs)	10482.00

	b) Non-CIL (detail drilling)	Jan., 2003 to June 2004	CNPB- 1 to 135 (135 BHS)	24943.60
	Sub -Total		**199**	**43602.83**
	3. MECL for PB A	2006 to 2012	MNPB-1 to MNPB-1 (33 BHs)	4282.70
	Total (1, 2 & 3)		**232**	**47885.53**

f) No. of Boreholes drilled within the block	196 BHs in PB 33 BHs in Area A (MECL) 03 BHs in Area A(CMPDIL) Total 232 BHs
g) Overall density within the block (no. /sq. km)	10 BHs/ sq. Km in Proved Reserve Area and 1 BHs/sq. km in Indicated Reserve area
h) Area covered by detailed exploration within the block (hectares)	
i) Area covered by detailed exploration outside the block (hectares) i) No. of boreholes drilled outside the block ii) Borehole density for outside area (no./sq. Km)	N/A *5 Boreholes in the area PB- A* NA
j) Whether entire lease area is covered by 'detailed'	No

Sl. No.	Area/Type	Area in Ha.
1	PB West and East (Explored)	1774.6
2	PB NW (Explored)	485.00
3	Regionally explored	2169.32
4	Outside Block Boundary	266.08
	Total Area	**4695.00**

exploration	

k) Further Exploration with timeframe (Tentative)

A. Exploratory drilling for no coal zone proving

The infrastructure facilities and external waste dumping areas (Dump-A and B) as shown in Plate No. 4 have been selected beyond the incrop of Seam-I Bottom as indicated in the GR. CMPDIL drilled eight boreholes in this area. Karharbari seams are encountered in 7 boreholes , however these seams are erratic and impersistent in nature and lacks opencast potentiality. No attempts were made to estimate the reserves however, If required negative probing boreholes will be drilled before starting of OB Dumping.

Period	No. of Bhs.	Location	Target
Pre-construction	30 (approx.)	Infrastructure sites and external waste dumps A & B	Negative proving of workable coal seams.

B. Exploratory drilling for production support

In order to delineate the incrop of Seam-I & II and support the production requirement as per stage plan, phase-wise exploration through core drilling in different sectors of the block have been proposed below:

Period	No. of BH	Location	Estimated meterage
Development	15	Bet. F14& Seam-IBottom incrop Bet F13 & F14 Bet F8 & F9	750
Production 1st year	15	Bet F12 & F13 Bet F10 & F11 Bet F7 & F8	1500
Production 2nd year	15	Bet F12 & F13 BetF11 & F 12 Bet F9 & F10	1500
Production 3rd Year	12	Bet F8 & F10 Bet F7 & F8	1500

Production 4th year	12	Bet F5 & F6 Bet F7 & F8	2200	

C. **Exploration for area beyond 300m depth line**

The southern portion of the Pakri-Barwadih Block covering around 12 sq. km. area has also not been explored in details and only " indicated" category reserves of the order of 733.2 Mt are provisionally assessed by CMPDI. Therefore a detailed exploration programme has been proposed to convert the indicated reserve into proved category and to develop underground mine plan. This is detailed below:

i. Detailed exploration is to be carried out in this area, involving drilling of 55000-60000 m, as estimated by CMPDI.
ii. As per approved Mining Plan, 45000 m of drilling over 4 years in 12 sq. km area was indicated.
iii. Exploration in this area to be taken up in the 1st production year and completed in 4th Years.

I) i) No. of Coal horizons	Barakar : 5 persistent coaly horizons Karharbari: 5 thin coaly horizons Local : 1 coaly horizon
ii) thickness range of coal seam	The five Barakar coal seams are splitted into several sections
iii) mean thickness of total coal horizon	Maximum thickness of individual seam–28.67 m, Seam II Comb (CNPB 32). Minimum thickness of individual seam- 0.05 m, Seam K – 2 (CNPB 124).
iii) Standard Deviation of the thickness	SD of individual coal seam thicknesses ranges from 0.35 - 10.2. Mean of thicknesses of total coal seams is >35 m
Minimum and Maximum depth of intersection of roof of the coal seam	Maximum : 304.30m (Seam K - 3) Minimum : 11.50 m (Seam II Top)

m) Gross Calorific Value (GCV in K Cal/ Kg) of Coal as per GR and Useful Heat Value (UHV in K. cal/ Kg), of coal as per GR: Range Mean	GCV: Ranges from 2491 **(G-16)** to 6280 (**G-4)** Mean: 4385.5 **(G-10)** UHV: Ranges from 1368 to 5657 Mean: 3512.5
n) Quality (Grade) of coal as per GR	The range of Grade varies from B to G. The proved reserve fall mostly in D-F grade. (As per GR prepared by CMPDI).As per the average GCV, the grade of **West & East Quarry- G-10** **North West Quarry- G-8.**
o) Total Geological Reserves in the block (as per GR)	**Geological/Mineable Reserves of Pakri Barwadih**

million tonnes

Sl. No.	Reserves*	PB-West & East	PB-NW	Total
1	Net Geological	1436	137.6	1573.6
2	Amenable for Open Cast	707	121.03	828.03
3	Amenable for Underground	729	0	729
4	Mineable	503.39	138.98 **	642.34

** Reserves up to 300m depth have been considered for opencast mining.*
***33.18 Mt of coal shall be mined as Barrier& Batter Coal between PBW & PB-NW.*

Net reserves and extractable reserves and losses

(in Mt.)

Seam	Net Reserve	Barrier Loss	Batter Loss	Mineable Reserves	Mining Loss	Extractable Reserve	% Extraction
V Top	22.29	0.72	1.57	19.99	0.59	19.40	87.06
V Bottom	15.56	0.51	1.10	13.96	0.41	13.55	87.06
V Combined	11.57	0.21	0.49	10.87	0.44	10.43	90.16
Seam - V	**49.42**	**1.44**	**3.16**	**44.82**	**1.44**	**43.38**	**87.78**
IV Top	19.82	0.64	2.23	16.95	0.50	16.46	83.01

	IV Bottom	9.92	0.32	1.12	8.48	0.25	8.23	83.01
	IV Combined	92.32	3.15	10.68	78.49	2.43	76.06	82.39
	Seam - IV	**122.06**	**4.10**	**14.03**	**103.93**	**3.18**	**100.75**	**82.54**
	III Top	27.45	1.21	2.04	24.20	0.70	23.49	85.59
	III Bottom	9.83	0.43	0.73	8.66	0.25	8.41	85.59
	III Combined	4.80	0.21	0.36	4.23	0.12	4.11	85.59
	Seam - III	**42.08**	**1.85**	**3.13**	**37.10**	**1.08**	**36.02**	**85.59**
	II Top	59.98	4.66	6.21	49.11	1.89	47.22	78.72
	II Middle	139.75	11.83	11.24	116.68	3.83	112.86	80.75
	II TM	76.09	7.28	5.63	63.18	1.77	61.40	80.70
	II Bottom	116.05	10.76	9.90	95.39	2.89	92.50	79.71
	II MB	17.90	1.71	1.32	14.86	0.42	14.44	80.70
	II Combined	7.35	0.70	0.54	6.11	0.17	5.94	80.70
	Seam- II	**417.13**	**36.95**	**34.85**	**345.33**	**10.97**	**334.36**	**80.16**
	I Top	36.93	2.72	9.39	24.81	0.77	24.05	65.11
	I Middle	72.97	5.27	18.20	49.49	1.66	47.84	65.56
	I TM	2.51	0.23	0.79	1.49	0.04	1.45	57.80
	I Bottom	35.60	2.52	8.69	24.39	0.52	23.87	67.06
	I MB	14.85	1.35	4.67	8.83	0.24	8.58	57.80
	I Combined	3.58	0.33	1.13	2.13	0.06	2.07	57.80
	Seam- I	**166.44**	**12.42**	**42.88**	**111.14**	**3.28**	**107.86**	**64.81**
	LL	2.60	0.10	0.35	2.15	0.11	2.04	78.62
	K5	0.13	0.01	0.06	0.06	0.01	0.05	36.32
	K4	4.24	0.13	1.11	2.97	0.11	2.86	67.83
	K3	3.34	0.22	0.86	2.26	0.06	2.20	65.95
	K2	5.38	0.27	1.14	3.97	0.07	3.90	72.40
	K1	15.24	1.25	4.65	9.34	0.41	8.93	58.62
	Seam-Local	**30.90**	**1.98**	**8.17**	**20.75**	**0.77**	**19.98**	**64.66**
	Total	**828.03**	**58.74**	**106.22**	**663.07**	**20.72**	**642.35**	**77.58**

p) Depletion of reserves (in case of running mine)	Not applicable
q) Additional Reserves (in case of running mine)	Not applicable

r) Geological Reserves considered for mining	PB West & East: By opencast: 707.67 Mt (as per CMPDI GR).This is Net geological reserves from Seam-I to V and seam K-1 to K-5, including both proved and indicated reserves upto 300 m depth. PB North West: By opencast:137.584Mt (as per MECL GR).This is Net geological reserves from Seam-I to V, including both proved and indicated reserves upto 300 m depth.
s) Corresponding Extractable Reserve	**PB-East and West:** Open cast mineable reserve 503.38 Mt **PB-North West:** Open cast mineable reserve 138.96 Mt Total **642.34 Mt.**
t) Percentage Recovery w.r.t geological reserves	**Percentage Recovery w.r.t proved geological reserves:** Overall: 78%

5. Mining

a) Existing and Proposed method of mining Opencast Underground	Shovel dumper combination system with horizontal slicing pattern would be adopted in mining mass i.e. OB, coal and intervening parting. Bord and Pillar and Blasting gallery (which is a variation of Bord and Pillar) methods for this property.
b) The peak capacity as well in addition to targeted capacity in Mtpa when mine is fully developed and the year in which proposed to be achieved	Opencast: Targeted Capacity-18Mtpa Year of Achieving:12th
c) Life of mine Overall	- 52 Years - 27 years for West Quarry -15 years for East Quarry. -39 years overall for PB

Opencast workings :	West and East (3 year overlapping period for East and West Quarries). -52 years PB- A Quarry All workings are Opencast
d) Quantum of production and expected grade:	642.34 Mt, **G-10**

e) Conceptual Calendar Program

Opencast				ROM Coal (Mt)	Beneficiated Coal (Mt)	Washery rejects (Mt)
Yr	**Production Mt**	**OB (Mcum)**	**Stripping Ratio (Mcum/t)**			
1	3.14	8.89	2.83	3.14	Not applicable	Not applicable
2	6.27	18.32	2.92	6.27		
12	18	52.20	2.90	18		
35	18	77.44	4.30	18		
52	1.46	1.48	1.01	1.46		
Conceptual	642.34	2536.75	3.95	**642.34**		

Dump C has been planned over the area where the coal is beyond 300 m depth line and thus suitable for exploitation by underground means. As such no coal shall get sterilized due to Dump C.

Dump D has been planned for PB East on non opencastable area where quarriable potential is not indicated in the GR.

f) Whether negative proving for coal in the proposed site for OB dump/ infrastructure has been done.	The infrastructure facilities and external waste dumping area (A, B) has been selected beyond the incrop of Seam-I Bottom as indicated in GR. CMPDIL drilled eight boreholes in this area. Karharbari seams are encountered in 7 boreholes, however these seams are erratic and impersistent in nature and lacks opencast potentiality. No attempts were made to estimate the reserves however, If required negative probing boreholes will be drilled before starting of OB Dumping. Incase any quarriable patch is found, the same will be mined before starting waste dumping. If deeper seams (viz. Karharbari group seams K1 to K5) are found during the negative proving of this area, such seams will be extracted by underground mining.

<table>
<tr><td>g) Proposed configuration of HEMM for OC (Coal and OB)</td><td>PB-West & East Quarry
<table>
<tr><th rowspan="2">Equipment</th><th colspan="2">Open cast</th></tr>
<tr><th>OB</th><th>Coal/Parting</th></tr>
<tr><td>Shovel</td><td>20m^3</td><td>8.3 m3</td></tr>
<tr><td>Dumper</td><td>170/190T</td><td>100/120 T</td></tr>
<tr><td>Drill</td><td>250 mm</td><td>160mm</td></tr>
<tr><td>Dozer</td><td>410 HP</td><td>410 HP</td></tr>
</table>
PB- NW Quarry
<table>
<tr><th rowspan="2">Equipment</th><th colspan="2">Open cast</th></tr>
<tr><th>OB</th><th>Coal</th></tr>
<tr><td>Shovel</td><td>10 m^3</td><td>5.5 m3</td></tr>
<tr><td>Dumper</td><td>100T</td><td>60 T</td></tr>
<tr><td>Drill</td><td>250 mm</td><td>160mm</td></tr>
<tr><td>Dozer</td><td>410 HP</td><td>410 HP</td></tr>
</table></td></tr>
<tr><td>h) Mode of entry for Underground mines</td><td>Vertical Shaft</td></tr>
<tr><td>i) Operations that are proposed to be outsourced</td><td>As on date, an entire operation of Pakri Barwadih Coal Project will be outsourced.</td></tr>
<tr><td>j) Proposed coal evacuation facilities
Face to Surface

Surface to end-use plants</td><td>Excavator and dumper system for extracting coal and dumping the same at ROM pad and after primary crushing transporting it to Stockpile by Conveyor belts

By combination of Cross Country Conveyor and Railways for end-use plants.</td></tr>
</table>

6. End-use of Coal

a) Capacity of the	Basket linkage

approved end use plants and b) Coal required for end-use plant with grade	
c) %age of end use requirement to be met from this mine	Basket Linkage
d) If washing/beneficiation of the coal is planned to be conducted on site or adjacent to the extraction area	Coal washability study has not yet been carried out for Pakri Barwadih Coal. Coal quality parameters obtained from the proximate analysis of coal revealed that ash percentage in all probability is likely to remain 34% or below which does not call for commissioning of coal washery. However to cater for more stringent future quality stipulations, space allocation is earmarked for commissioning of Coal Washery at mine end to facilitate transport of washed coal to the power plants as per qualitative requirements.
e) Proposed use of Rejects/Middling	Not applicable

7. Environmental Management

a) Land area indicating the area likely to be degraded due to mining, dumping, roads, workshop, washery, township etc.

Type	PB West &East	PB NW	Total of PB
Mining Area	1600.00	382.00	1982.00
	0.00	0.00	0.00
Barrier zone	8.97	1.03	10.00
Proposed road on North side	12.55	1.45	14.00
Area under Nala/ River	45.00	25.00	70.00
External dump	825.76	14.45	840.21
Top soil dump	40.00	7.14	47.14
Settling pond	10.76	1.24	12.00
Infrastructure area	273.50	4.85	278.35
Rationalisation /Unutilized area	823.46	47.84	871.30
Area for UG *	570.00	0.00	570.00
Total	**4210.00**	**485.00**	**4695.00**

b) Existing land use pattern

Sl. No.	Class of land		Area in ha
1	Forest		1787
2	Non-forest	Govt.	388
		Private Land	2520
		Total	**4695**

c) Surface features over the block area — Refer to Plate No.-5

d) No. of villages/ houses to be shifted

S. No.	Name of Village	House Hold to be shifted (No's)
1	Arahara	242
2	Dadikalan	663
3	Chepakalan	460
4	Jugra	398
5	Lakura(P)	59
6	Itiz	125
7	Chirudih	10
8	Nagadi	261
9	Pakri-Barwadih	331
10	Urub	115
11	Deoria Khurd(P)	184
12	Churchu	254
13	Sonbarsa	242
14	Sinduari	228
15	Chepakhurd	278
16	Keri(P)	93
17	Langatu(P)	462
18	Barkagaon(P)	126
19	Deorikalan(P)	195
20	Sirma	17
21	Nawadih(P)	10
22	Basaria	22
23	Kandaber(P)	178
24	Jabra	8
25	Beltu(P)	6
26	Bariatu(P)	11

e) Population to be affected by the Project — 8339 Nos.

f) Year wise proposal for reclamation of land affected by mining

The table below shows the year wise proposal of reclamation of land:

Yearly Details of reclamation of land

(West Quarry , East Quarry & NW Quarry)

Year	Dump Stabilization & Vegetation (Ha)
First Year Stage	-
3rd year Stage	19
5th year Stage	64
10th year Stage	177
20th year Stage	389
30th year Stage	557
40th year Stage	617
Final Stage	334

g) Monitoring schedules for different environmental components after the commencement of mining and other related activities

The full-time environmental staff will conduct routine field monitoring and reporting to provide a close supervision on the surrounding natural environment and provide early warnings of any adverse changes that may be related to some dimension of the mining and allied operations. The schedule, duration and parameters to be monitored are shown in the following table.

Sl. No.	Description of Parameters	Schedule and Duration of Monitoring
1	Slope Failure	Bi-Weekly
2	Land Erosion	Weekly
3	Drainage	Daily
4	Blasting effect	As per mine workings and blasting
5	Re-vegetation and Green belt development	Yearly
6	Monitor Plantation Measures	Yearly
7	Surface Subsidence	Bi-Weekly

	8	Water Quality Monitoring(Ground & Surface)	
		Water quality of Surface and ground water around the site (All parameters specified by JSPCB)	Monthly
	9	Emissions and Air Quality (RPM,SO_2, NO_x ,CO)	24 hourly samples with analysis carried out monthly all-round the year.
	10	Meteorological Station	Continuous
	11	Air Quality	Continuous
	12	Noise Quality	Continuous
	11	Occupational Health	Bi-Weekly

8. Mine Closure Plan

a) Estimated total capital expenditure for Mine closure activities	Rs. 318.55 Crores(current cost)	
b) Major closure Activities with proposed Capital Expenditure	**Activities to be undertaken**	**Total (Rs.) in Cr**
	Total closure cost for opencast mine (compounding @ 5% escalation)	1321.08
	Total closure cost for underground mine (compounding @ 5% escalation)	52.12
	Total closure cost for Pakri Barwadih Mine	1373.20

9. Others

a) Base date of Mining Plan	November 2015
b) Calendar year from which the production will start from the zero date i.e. date of approval of mining plan.	2016
c) Results of any investigation carried out for scientific mining, conservation of minerals and protection of environment; future proposals	NA
d) Signature of RQP	Sanjiv Kr Singh

Date : 31/1/2016

Place : NEW DELHI

Sanjiv

CHAPTER I

INTRODUCTION

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INTRODUCTION

1.1 Overview

The Pakri Barwadih Coal Block is located in North Karanpura Coalfields in Hazaribagh district of Jharkhand state. The block has been allocated to NTPC Ltd., for captive mining for supply of coal to their super thermal power stations by Ministry of coal, Government of India vide letter no. 13016/29/2003-CA, New Delhi, dated 11th Oct 2004 & DO No.13016/29/2003-CA dated 24th August 2005 for a total area of 46.26 sq km. Copy of letter enclosed as **Annexure-I** and **Annexure-II.**

1.2 Background of NTPC Ltd.

The company was incorporated on 7th November, 1975 under the Companies Act, essentially to promote power generation in the Country. Subsequently, the name of the Company was changed to its present name NTPC Limited and a fresh certificate of incorporation was issued on October 28, 2005. The name of the Company was changed to reflect the diversification of business operations beyond thermal power generation to include, among others, generation of power from hydro, nuclear and renewable energy and undertaking coal mining and oil exploration activities.

The Company is not operating under any injunction or restraining order.

1.3 Installed Capacity of NTPC

Present installed capacity of NTPC is 45,548 MW (including 6,196 MW through JVs) comprising of 41 NTPC Stations (18 Coal based stations, 7 combined cycle gas/liquid fuel based stations, 1 Hydro based station), 7 Joint Venture stations (6 coal based and one gas based) and 8 renewable energy projects. Installed Capacity of NTPC is given in **Table 1.1**. Regional Spread of Generating Facilities is given in **Table 1.2.**

TABLE 1.1

Installed Capacity of NTPC

Sl.No.	NO. OF PLANTS	CAPACITY (MW)
NTPC Owned		
Coal	18	34,425
Gas/Liquid Fuel	7	4,017
Hydro	1	800
Renewable energy projects	8	110
Total	34	38,602
Owned By JVs		
Coal & Gas	7	6,196
Total	**41**	**45,548**

TABLE 1.2

Regional Spread of Generating Facilities

REGION	COAL	GAS/Liquid	Renewable	TOTAL
Northern	9,515	2,344	35	11,894
Western	10,840	1,313	50	12,203
Southern	4,600	360	10	4,970
Eastern	9,470	-	10	9,480
Islands	-	-	5	5
Hydro	-	-	-	800
JVs	4,229	1,967	-	6,196
Total	**37,904**	**5,984**	**110**	**45,548**

RQP No. 34011/(15)/2009-CPAM dated 27.09.10.

SL. NO	COAL BASED (Owned by JVs)	STATE	COMMISSIONED CAPACITY (MW)
1.	Durgapur	West Bengal	120
2	Rourkela	Orissa	120
3	Bhilai	Chhattisgarh	574
4	Kanti	Bihar	415
5	IGSTPP, Jhajjar	Haryana	1500
6	Vallur	Tamil Nadu	1500
	Total		4,229

1.3.2 Projects Under Implementation and Future Capacity Addition:

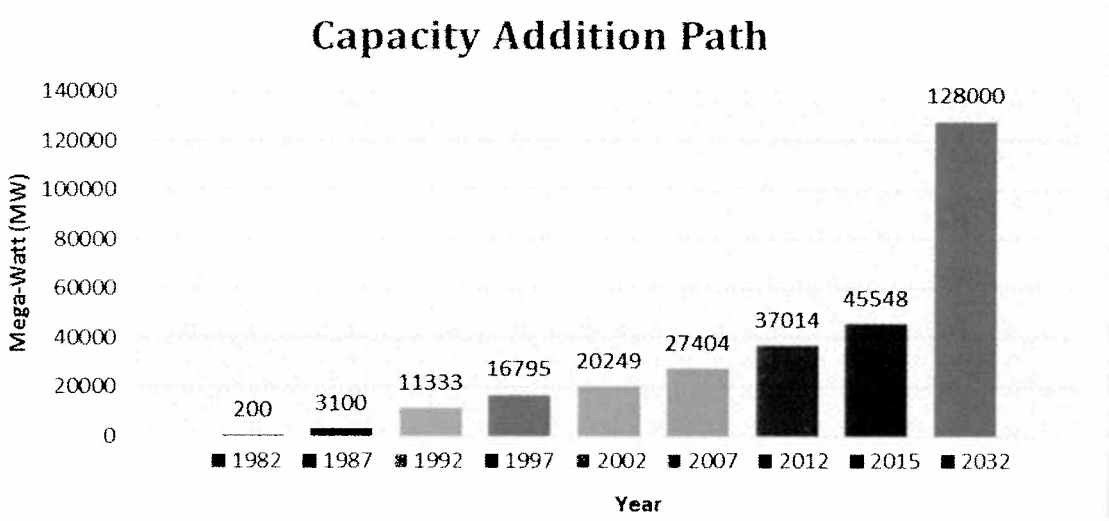
NTPC, India's largest power company, was set up in 1975. Present installed capacity is 45048 MW and additional 23504 MW(capacity is under construction. To realise the vision of becoming a world class power major, NTPC has plans to become 128000 MW company by 2032. Projects under implementation is given in **Table 1.5**. Capacity addition path is given in **Fig-1.1.**

TABLE 1.5

PROJECTS UNDER IMPLEMENTATION (Coal Based Thermal)

UNDER CONSTRUCTION	
COAL	
STAND ALONE	
BARH-I	1980
BONGAIGAON	500
VINDHYACHAL-V	500
KUDGI-I	2400
MAUDA-II	1320
SOLAPUR	1320
LARA-I	1600
GADARWARA	1600
UNCHAHAR-IV	500
DARLIPALI	1600
NORTH KARANPURA	1980
TANDA-II	1320
KHARGONE	1320
TOTAL	17940
SUBSIDIARY/JVs	
NABINAGAR (BRBCL)	1000

KANTI-II (KBUNL)	195
MEJA (MUNPL)	1320
NABINAGAR (NPGCPL)	1980
TOTAL	4495
TOTAL COAL	22435
HYDRO	
TAPOVAN VISHNUGAD	520
LATA TAPOVAN	171
RAMMAM	120
TOTAL HYDRO	811
RENEWABLE	
SINGRAULI HYDRO	8
AP SOLAR PV	250
TOTAL RE	258
GROUP TOTAL	23504



I.P. NAGPAL
Under Secretary
Ministry of Coal
Shastri Bhawan
Govt. of India
New Delhi-110001

Fig 1.1.

SANJIV KUMAR SINGH
Recognised Qualified Person
No. 34011/(15)/2009-CPAM
Ministry of Coal, Govt. of India

1.4 Coal Mining in Pakri Barwadih Block

Due to increase in plant load factor and future expansion program of NTPC, the gap between demand and supply of coal is continuously increasing. To elaborate it further, the existing power stations had been accorded with long-

As already explained at that time of preparation of Mining Plan for the Pakri Barwadih Block the present area on the north western side of the block, now referred to as "**Sector– A**" was not explored. In the Approved Mining Plan NTPC had committed to carry out a detailed exploration of the area and submit a separate Mining Plan within six (6) months of the preparation of the GR. As per the commitment, detailed exploration was carried out and "Geological report (GR) of Sector- A was submitted by MECL in October 2012.

As per the commitment given by NTPC a separate Mining Plan of North West part (Sector-A) of capacity 3 MTPA was prepared and submitted to MoC on 02.07.2013. Geological reserves are 137.584 Mt, out of which Opencast mineable reserves were envisaged to be 106.688 Mt and the underground reserves are 30.896 Mt. Copy of letter enclosed as **Annexure-IV.**

1.5.3 Mining Plan of Pakri Barwadih-East

In order to augment the coal production from Pakri Barwadih block NTPC proposed to simultaneously commence production from Eastern Part of the block. Mining Plan of East Quarry of Pakri Barwadih with production potential of 7 MTPA was prepared and submitted to MoC on 27.08.2013 for consideration of Standing Committee. Copy of letter enclosed as **Annexure-V.**

1.5.4 Revision of Mining Plan

Ministry of Coal vide its letter .No.13016/29/2003-CA-I(Part) dated 9th October'2014 advised NTPC to submit a Revised Mining Plan (1st Revision) including Mine Closure Plan as a whole instead of in parts. Copy of letter enclosed as **Annexure-VI.** NTPC vide letter no. CC: CM: ENGG: 7010: MP: 8 dated 03.04.2015 submitted Revised Mining Plan (1st Revision) to MoC for consideration. Copy of letter enclosed as **Annexure-VII.**

1.5.5 Present Revision of Mining Plan

To ward off the delay in commencement of mining operation NTPC decided to start up Eastern Quarry and run for a period of two years in the interim period till appointment of Mine Developer cum Operator (MDO) for commencement of mining operations from Western Quarry. NTPC informed its intentions to MoC vide letter No. CC:PEM:7010:MP:83 dated 22.05.2015 (Copy of letter enclosed as **Annexure-VIII).** Inter-alia acceptance of proposal MoC vide letter No1306/29/2003-CA-I (Part) dated 24.06.2015 directed NTPC to submit a

revised Mining Plan within a period of three months after incorporating the changes in sequence of operation (Copy of letter enclosed as **Annexure-IX**).

1.6 Present Revised Mining Plan

1.6.1 Compliance

In compliance to the advice of MoC an integrated Mining Plan has been prepared with a targeted capacity of **18 MTPA** after incorporating the changes in sequence of operation and is submitted herewith to MoC for consideration and approval.

1.6.2 Salient Features of Present Mining Plan

i. Present Mining Plan deals with exploitation of opencastable mineable reserves upto 300m depth only. Underground mining is envisaged from 10th years of Mining operations. A separate mining plan shall be submitted to MoC for consideration for the reserves amenable for underground mining, subsequent to completion of drilling/detailed exploration in the area proposed for underground mining.

ii. Three distinct quarries have been carved out of Pakri Barwadih coal block namely

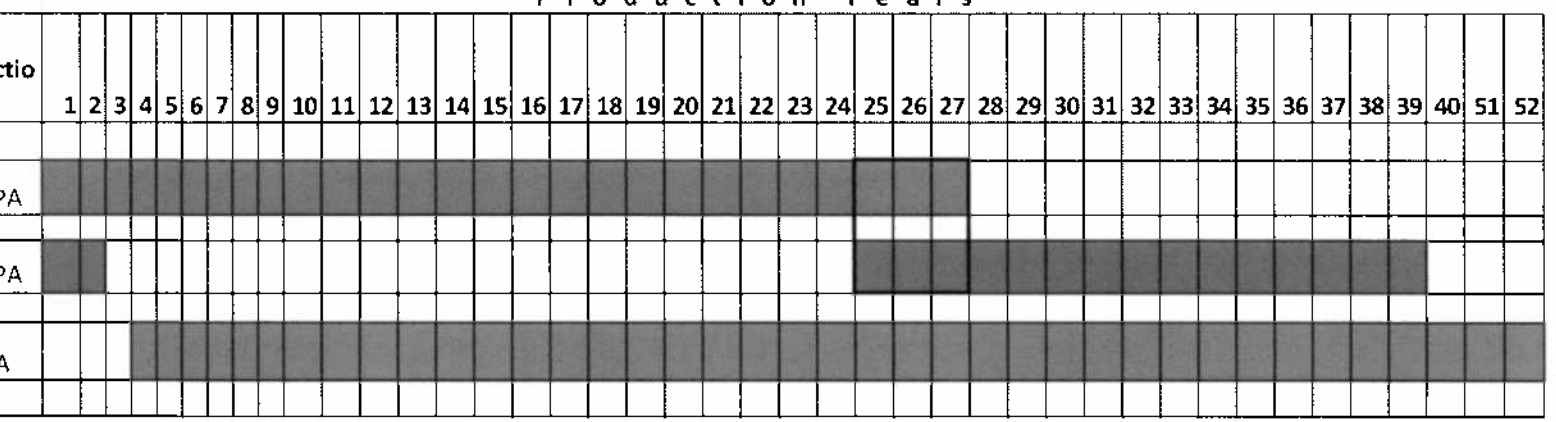
   a. Pakri Barwadih West
   b. Pakri Barwadih East
   c. Pakri Barwadih North-West (Sector-A).

PB East and PB West shall commence simultaneously. PB North West quarry (Sector-A) shall commence on 4th year. Workings of PB East shall be stopped after two years of operations. PB West quarry and PB North West Quarry shall continue to work for their designated life. PB East shall be restarted after exhaustion of reserves of PB West. Sequence of operations in different quarries is given in **Fig-2**.

Fig-2

Sequence of Operation for Pakri Barwadih Coal Mining Block (18 MTPA)

Sl. No.	Name of Quarry	Peak Production	Production Years
1	PB West	15 MTPA	
2	PB East	15 MTPA	
3	PB(NW) (Sector-A)	3 MTPA	



Note:

1. *PE West shall continue mining operatios till the end of 27 years.*
2. *PE east shall stop afer two years of mining operatios and shall restart on 25th years.*
3. *There will be overlapping period of 3 years i.e. from 25th to 27 th years*
4. *PB (NW) shall continue upto 41 years of mining operations*
5. *Total peak production from the block is 18 mtpa.*
6. *From 40 Years 52 nd year coal of Barrier and Batter locked between PB-NW & PB-West shall be exracted*

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RQP No. 34011/(15)/2009-CPAM dated 27.09.10.

iii. Three dedicated and separate Access Trenches shall be driven for operation of abovementioned three quarries. Both Coal and OB shall be produced from these three quarries through these trenches. Sequence of driving of the trenches shall correspond to the sequence of operation of quarries. PB East and PB West quarries shall produce peak capacity of 15 MTPA throughout the life either separately or in conjunction, while PB North West Quarry shall produce peak capacity 3 MTPA which together constitutes Pakri Barwadih an **18 MTPA Mine**.

iv. Infrastructure is planned for PB West quarry and PB NW quarry. Infrastructure proposed for PB West quarry such as CHP, Sub Station, Workshop, administrative buildings etc. shall be utilised progressively for eastern quarry with the rising production, but the infrastructure/facilities which could not be shared with PB West Quarry shall be constructed separately for PB East Quarry for the period of two years such as Haul roads, culverts drainage system etc. Certain facilities such as coal sampling lab, environmental cell, vocational training centre, magazine etc. shall be common for all three quarries.

v. A Megalith falls in the PB East quarry area. As per EC no mining is permitted within 500m radius of the Megalith. While complying with the requirement of EC, it transpired that approximately 20Mt of coal shall be sterilized in the zone of influence. This 20Mt is considered lost coal in the present Revised Mining Plan but the loss has been compensated by adoption of following measures.

    i. The Pakwa nala shall be re-aligned along the periphery of East Quarry.

    ii. Nala between North West quarry and west quarry shall be diverted along northern fringe of PB-NW Quarry after conducting required studies.

vi. Drilling & Blasting is proposed for preparation of coal and OB. Overburden of quarries shall be kept at designated locations. In pit dumping is proposed wherever the need arise. Top soil shall be kept at designated locations and shall be preserved. Crushing is proposed for reduction of coal from ROM to (-50) mm size. Trucks, Conveyors are proposed for transportation of coal, railway system is proposed for evacuation of coal, and provision of ancillary equipment needed for proper running of big opencast mine are kept in place.

Sanjiv

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vii. Separate set of HEMM is proposed for all three quarries. On cessation of PB West Quarry all the HEMM shall be deployed in PB East quarry except for the period of initial two years for which separate set of HEMM are proposed. Shovel dumpers are proposed for excavation, loading and in pit transportation. Primary and secondary crushers are proposed for crushing of coal to desired size. Cross country conveyor are proposed to transport the coal from mine end to Benadag siding. Coal shall be loaded in the railway wagon by Rapid Loading system from where coal shall be transported to designated power plants.

viii. Coal washability study has not yet been carried out for Pakri Barwadih Coal. Coal quality parameters obtained from the proximate analysis of coal revealed that ash percentage in all probability is likely to remain 34% or below which does not call for commissioning of coal washery. However to cater for more stringent future quality stipulations, space allocation is earmarked for commissioning of Coal Washery at mine end to facilitate transport of washed coal to the power plants as per qualitative requirements.

ix. Detailed exploration of the area earmarked for extraction by underground mining below proposed Dump-C shall be carried out, much in advance so as not to jeopardise the reserves.

x. Provision has been kept for Effluent Treatment Plant, Sewerage Treatment Plant, wet drilling, dust suppression & Fire Fighting arrangement in crushers and CHP arrangement etc. in line with stipulation of Environmental Clearances.

xi. Environment Clearance (EC) and Forest Clearance (FC) have been accorded for PB West & PB East Quarry and Coal Conveyor Corridor. In the present Mining Plan NW Quarry along with its dedicated conveyor corridor is integrated for which EC and FC is not available. It is expected the above clearances may be obtained in 3-4 years' time frame, accordingly commencement of PB NW Quarry is deferred by three years.

1.7 PROSPECTING AGENCIES

Following agencies have carried out exploration for Pakri Barwadih Coal Block:

- Geological Survey of India, Kolkata
- Central Mine Planning & Design Institute Ltd, Gondwana Place, Kanke Road, Ranchi-834008

- Mineral Exploration Corporation Limited, Dr.Babasaheb Ambedkar Bhavan, Seminary Hills, Nagpur

1.8 PERIOD OF WHICH MINING LEASE ACQUIRED

Being Public Sector Organization NTPC is acquiring land under CBA (A&D) Act, 1957 within the Coal block area and for area outside the block boundary the area is acquired under "The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013", LARR-2013/LA Act 1894, hence obtaining lease from the State Government is Not Applicable.

1.9 COAL SUPPLY FROM PAKRIBARWADIH COAL MINING PROJECT

Pakri Barwadih Coal Mine is having basket linkage and will make up for the shortfall in supply for coal in the existing and/or upcoming power projects of NTPC. Coal supply from PB block is not envisaged to replace any existing linkages. Calculation for Coal requirement for the company and % of coal likely to be met from this project is given in **Table-1.7.**

Table-1.7.
Coal Requirement and Meeting Coal Requirement

Sl. No.	Paramerer	Unit	Value
1	Thermal Power (Coal-Commercial) Capacity as on 31-Mar'15	MW	34425.00
2	Heat Rate	kCal/kWh	2386.00
3	Average GCV of blended coal (Domestic + Imported)	kcal/kg	3367.80
4	Sp. Coal Consp. blended coal (Domestic+Imported)	kg/kWh	0.71
5	PLF	%	0.80
6	Coal Consp. (Domestic+Imported)	Million Tonnes	171.41
7	Coal Requirement (Domestic Coal) for 92% PLF	Million Tonnes	207.81
8	Coal availability from Pakri barwadih	MTPA	18.00
9	Other Blocks of NTPC	MTPA	0.00
10	Percentage of end use requirement to be met from Pakri Barwadih mine	%	9%

1.10 DESPATCH OF COAL

ROM coal shall be crushed in two stages to final product size of (-50) mm. From the mine end (-50) mm shall be transported through cross country conveyor system up to the loading silos. Independent coal evacuation system by cross country coal conveyor system is envisaged for PB West quarry and PB North West Quarry. Coal produced from PB East shall be transported from the cross country conveyor envisaged for PB West quarry. NTPC shall construct Railway Siding at Banadag where the loading silos are located. From the silo, coal shall be transported though the Indian Railways network to the identified endues power stations of NTPC.Road transport is being envisaged till the completion of the proposed Cross Country Conveyor.

1.11 NAME OF APPLICANT WITH COMPLETE ADDRESS

TABLE 1.8
NAME OF APPLICANT WITH COMPLETE ADDRESS

LOCAL OFFICE	REGISTERED OFFICE
NTPC Limited Sh R.S.Rathee, ED (PB/CB/KD) Pakri Barwadih Coal Mining Project Ujjwal Complex, Pugmil Road, Hazaribagh, Jharkhand – 825301	NTPC Limited Sh Sharad Anand, Regional Executive Director, Coal Mining, 6th Floor, Core 6, NTPC Ltd, Scope Complex , Institutional Area, Lodhi Road , NewDelhi-110003
Ph:06546 - 270622, 9470575777	Ph:011-24362871
Fax:06546 – 270744	Fax : 011-24367089
Email: rsrathee@ntpc.co.in	Email : sharadanand@ntpc.co.in

1.12 BOARD OF DIRECTORS OF COMPANY

TABLE 1.9
BOARD OF DIRECTORS OF COMPANY

SL. NO.	NAME	DESIGNATION
1.	Mr. A.K.Jha	CMD cum Director (Technical)
2.	Mr. U.P.Pani	Director (HR)
3.	Mr. S C Pandey	Director (Projects)
4.	Mr. Kualmani Biswal	Director (Finance)
5.	Mr. K.K.Sharma	Director (Operations)
6.	Dr. Pradeep Kumar	Govt. Nominee

SL. NO.	NAME	DESIGNATION
7.	Mr.Prashant Mehta	Independent Director
8.	Mr. Rajesh Jain	Independent Director
9.	Dr. Gauri Trivedi	Independent Director

1.13 RECOGNISED QUALIFIED PERSON

MoC has accorded grant of recognition to Sh. Sanjiv Kumar Singh of NTPC as competent person to prepare Mining Plan for Coal Block/Lignite of NTPC only. Particulars of RQP are given in **Table-1.10**. Copy of letter enclosed as **Annexure-X.**

TABLE 1.10

RECOGNISED QUALIFIED PERSON

Name		**Mr. Sanjiv Kumar Singh**
Address (i) Office	:	4th Floor, Core 5,NTPC Bhawan, SCOPE Complex, 7 Institutional Area, Lodhi Road, New Delhi- 110 003
Fax	:	011-24377089
E-mail	:	sanjivkumarsingh01@ntpc.co.in
Registration Number	:	34011/(15)/2009-CPAM
Date of grant / renewal	:	27.09.2010
Phone	:	011-24387669, 9650991396

CHAPTER II

DETAILS OF EARLIER APPROVED MINING PLAN

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अवर सचिव/ Under Secretary
कोयला मंत्रालय/Ministry of Coal
भारी उद्योग/Govt. of India
नई दिल्ली/New Delhi-110001

SANJIV KUMAR SINGH
Recognised Qualified Person
No. 340 (15)/2009-CPAM
Ministry of Coal, Govt. of India

CHAPTER II

EARLIER APPROVED MINING PLAN

2.1. EARLIER APPROVED MINING PLAN

Mining Plan for the Pakri Barwadih Coal Project was approved by Ministry of Coal vide letter number 13016/29/2003-CA-I dated 25th August, 2006. A copy of the Approved Mining Plan along with Approval Letter is enclosed as **Annexure-III** and **Annexure-III A**.

Salient features of Approved Mining Plan is given in Table 2.1.

Table-2.1
Salient features of the Approved Mining Plan

Sl. No.	Heads	Particulars		
	Name of Project	Pakri Barwadih Coal Block		
	Location	North Karanpura Coalfield,		
		District: Hazaribagh , Jharkhand		
	Company	NTPC Ltd		
	Block Allotment Reference No.	Block allotted vide ref no 13016/29/2003-CA, New Delhi dated 11th October 2004 and DO no 13016/29/2003-CA dated 24.8.2005		
	Block Area	4626 Ha		
	Nearest Township	Hazaribagh		
	Nearest Railway Station	Ranchi Road and Chitarpur		
	Nearest Airport	Ranchi		
	No. of Workable Seam	12 workable splits in 5 seams		
	Seam Gradient	$10^0 – 20^0$		
	No. of faults	19		
	Total Geological Reserves within the block	1436 Mt		
	Proved	702.70 Mt		
	Indicated	733.20 Mt		
		Mineable Reserves (Mt)	Vol. Of OB (M cum)	Av. S. R. (cum/t)

	Reserves & Overburden	503.39	2098.78	4.16
	Target Output (Mtpa)	15		
	Quality of coal	Grade D – E (Avg. E)		
	Specific gravity of coal (Avg.)	1.68 t/cum		
	Method of Mining	Opencast (Shovel-Dumper combination)		
	Main Customer	All power plants of NTPC Ltd		
	Life of the Mine including Construction Period	39 Years		

Main Equipment	Equipment	Size	No
	Overburden		
	Electric Rope Shovel	20 Cum	7
	Electric Rope Shovel	10 Cum	5
	Electric hydraulic shovel	8.3 Cum	14
	Rear Dumper	170-190T	78
	Rear Dumper	120-150T	152
	RBH Drill	250 mm	24
	RBH Drill	160 mm	10
	Track Dozer	310 kW	30
	Coal		
	Electric hydraulic	4.5 Cum	9
	Rear Dumper	50 T	77
	RBH Drill	160 mm	15
	Track Dozer	310 kW	15
	Wagon drill	100 mm	3

Mine Parameters	**West Quarry**	**East Quarry**
Maximum Depth (m)	300	300
Maximum strike length (Km)	5.5	3.8
Maximum width (Km)	1.66	1.71

2.2. Compliance of Conditions imposed if any with approval of the mining plan

Sl. No	Compliance of Condition(s) imposed	Action
1(i)	The Mining Company shall achieve the 15 Mtpa production level from the opencast by 12th year.	The built up of production level for PB West has been kept the same as mentioned in the approved Mining Plan. PB East is planned to commence with PB West .Operations of PB East shall cease after 2 years and will restart again from 25thyear of Mining operation. NTPC shall achieve 15 Mtpa production level from the opencast by 12th year.
1(ii)	As regards of coal block that has also been allotted to ONGC for Coal Bed Methane extractions, the conditions laid down in the allotment letter shall be fully complied.	Will be complied during operation stages.
1(iii)	The approval of the Mining Plan is without prejudice to the requirement of approvals from competent/prescribed authority under the relevant rules/regulations etc.	All necessary approval under relevant rules/regulations shall be obtained without prejudice to the requirement of approvals from competent/prescribed authority.
2	Two copies of the Approved Mining Plan duly signed by the competent authority are returned herewith with the request that a copy of the Approved Mining Plan may be submitted to the concerned state government for necessary action and also a photocopy of the Approved Mining Plan may be sent to the Coal Controller for monitoring of the block.	Complied

2.3. Status of Mining Plan submitted to MoC

Detailed in Clause No. 1.5 of Chapter-I

2.4. Revision of Mining Plan

Detailed in Clause No. 1.5.4 of Chapter-I

2.5. Present Mining Plan

Detailed in Clause No. 1.6 of Chapter-I.

2.6. Reasons for revision of Mining Plan

2.6.1 To fulfill the commitment given to Government regarding start of Coal Production and also keeping in view the likely time taking process of award of MDO for PB West Quarry because of densely populated /hostile villages and densely populated /hostile villages existing within PB. West Pit as well as connecting roads, NTPC has proposed to commence Mining Operations in the PB East Quarry (Shown as EP 1 in Surface Master Plan) area adjacent to main road where land is available.

2.6.2 OB removal and Coal production has been planned from a patch of PB East Quarry (Eastern Pit 1) for two years as Interim Arrangement. The Plans showing the proposed stage of working by the end of First Year and Second Year are given in respective Stage Plan. Proposed area for mining has been mainly selected due to the availability of land for mining as well as ease of approach from the State Highway.

2.6.3 As a result of early startup of PB East Quarry there is a variation in the calendar Programme and Land Use Pattern of the mine.

2.6.4 PB NW Quarry which was unexplored at the time of approval of mining plan is now integrated with the present Revised Mining Plan (1st Revision). Resultant coal evacuation facilities from road and coal handling plant and additional volumes of OB/coal mining shall change the calendar programme and Land Use Pattern.

2.6.5 MoC vide letter No1306/29/2003-CA-I (Part) dated 24.06.2015 directed NTPC to submit a revised Mining Plan within a period of three months after incorporating the changes in sequence of operation (Copy of letter enclosed as **Annexure-IX**).

2.7. Changes in Revised Mining Plan with respect to Approved Mining Plan.

2.7.1 Change in mining sequence

The proposed quarry area is part of PB East Quarry as per approved Mining Plan and is located in its North-Eastern part and is named Eastern Pit-1 (EP-1). The proposed quarry namely EP-1 is at a distance of approximately 850 m in North-West direction from the Tandwa-Barkagaon-Hazaribagh State Highway and is accessible by road connecting to Arhara village from the State Highway. However in variance with the approved Mining Plan, Eastern Quarry

is now planned to be started in 1st year of Mining Operations instead of 25th year. In the approved Mining Plan PB East Quarry was to start in 25rd year of Mining operation.

2.7.2 External Dump Area

The land for external dumps as per approved Mining Plan Dump A, B, C is presently not available. Accordingly, to start mining operations, External Dump has been envisaged in the available land in the north side of this quarry area. This area lies partly in the area earlier identified for coal evacuation facilities. The area has been shown in Surface Master Plan). Forest diversion of this external dump area has been obtained and change of land use of this area has been taken up with MoEF.

2.7.3 Variation in Coal Transportation Arrangement

As per earlier approved Mining Plan coal is planned to be transported through belt conveyor to Banadag Railway siding which are under construction. It is proposed that coal shall be transported to Banadag Siding by Road till the construction of cross country conveyor.

CHAPTER III

LOCATION, TOPOGRAPHY AND COMMUNICATION

CHAPTER III

LOCATION, TOPOGRAPHY, DRAINAGE & COMMUNICATION

3.1. General

It is to mention that two separate Geological reports are prepared for Pakri Barwadih Block. The former is Geological Report for Pakri Barwadih and the later is Geological Report for Pakri Barwadih A. In the present Mining Plan i.e. Revised Mining Plan of Pakri Barwadih (Rev-1), reference to Pakri Barwdih Mine/Block/Project includes Pakri Barwadih-A (PB-NW), Pakri Barwdih West and Pakri Barwadih East.

3.2. Location of Block

Pakri-Barwadih coal block is located in Hazaribagh district of Jharkhand State. The block is located in the north-eastern part of North-Karanpura Coalfield, bounded by:

a. Longitudes $85^0\,09'19''E$ to $85^0 15'\,00''E$

b. Latitude $23^0 51'30''N$ to $23^0\,55'40''\,N$

It is covered by the Survey of India Toposheet no. **73E/1** (R.F 1: 50000) and special sheets no. ***21, 23 & 24*** on R.F. 1:10000.

The entire block falls in the Hazaribagh district of Jharkhand State. The Hazaribagh – Khelari metal Road passes through the eastern part of the block touching Barkagaon and Tandwa Villages. The nearest township is Hazaribagh, located at a distance of about 24 kms from Barkagaon which is in the southern part of the block.Location is given at Fig-3.1.

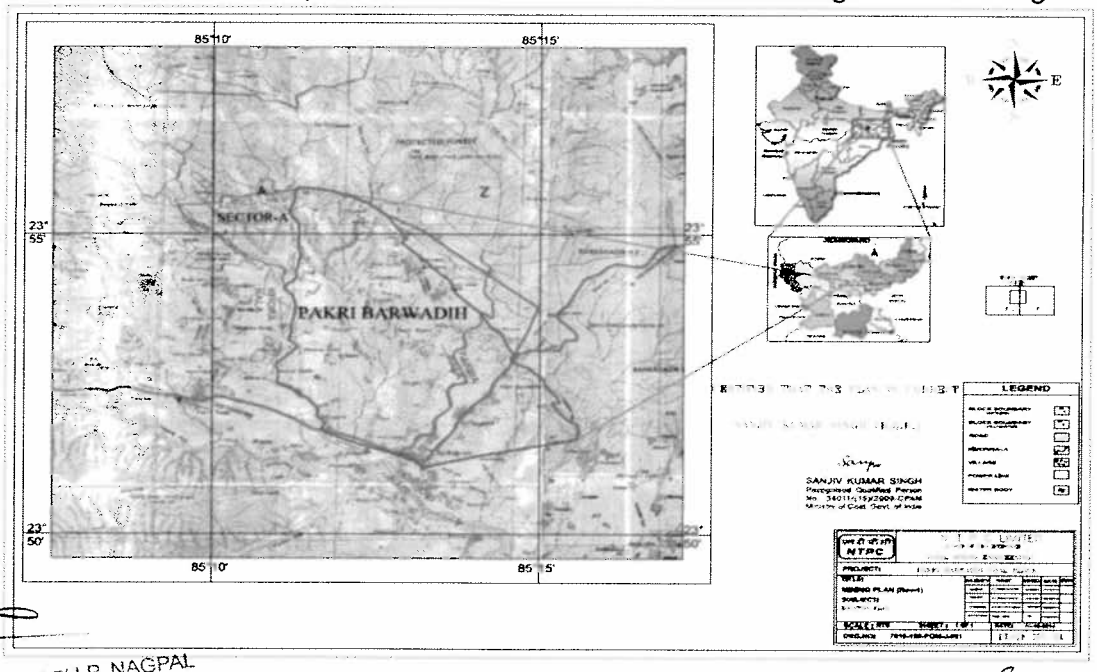

Fig-3.1.

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3.3. Communication

The block is well connected to nearest town city and state capital through all-weather road. Brief description on the accessibility of the block is given below:

i **Rail Link:** The nearest rail stations are Ranchi Road and Chitarpur on the Gomoh Barkakana – Dehri-on-Sone loop lines of SE Railway both around 70- 75 km from the block.

ii **Road Link:** The Block is well connected to the district headquarter Hazaribagh via Barkagaon at a distance of 40 km by all-weather road. The block is located at a distance of 10 km from Barkagaon Township. The Hazaribagh - Khelari State Highway passes 5 Km south of the block via Barkagaon and Tandwa village. The area is also connected to Patratu Township by all-weather road via Urimari..

a A PWD Road exists between Hazaribagh & Barkagaon, Tandwa – Khalari. Our approach will be take-off from this road and will go from eastern to western part of the property. The total approach will be about 10 km from take-off point to mine entry point.

b This PWD road passes through the east quarry of the quarriable block, which shall be shifted to other route only after exhaustion of West Quarry but before mining operation of East quarry, is started.

iii **Air Link:** Nearest Airport is at Ranchi which is about 130 km from the block.

3.4. North Karnapura Coalfields

Pakri Barwadih Coal Block falls in the North Karnapura Coalfield under CCL command area of CIL. The North Karanpura Coalfield (1230 km2) as the name implies forms the northern part of the main Karanpura basin. It is separated from the South Karanpura CF by a east west elongated metamorphic patch. However, they are interconnected near Bachra and Hindegir village by a narrow strip of Talcher formation. It is bounded by Latitude 23039' and 23060' (N) and 840 46' and 850 24' (E) longitude spreads over to Hazaribagh, Ranchi, Chatra and Palamau districts with Pakri-Barwadih block located in ,as mentioned above , Hazaribagh district.

The North-Karanpura coalfield lies close to Hazaribagh town, the head quarter of the district bearing the same name. Barkagaon, an important locality in the north-eastern part of the coalfield is also located on the southern fringe of the Pakri-Barwadih Block under review. This locality is connected from Hazaribagh by an all-weather 24 Km metalled road which has been extended along the northern & western part of the coalfield touching Kerendari and Tandwa. This can serve as a useful road link from Pakri-Barwadih to Tandwa where proposed STPS of NTPC is located. This metalled road passes through the East sector of Pakri-Barwadih and divides the sector into two parts. The

Ranchi- Chandwa – Chatra – Barhi highway passess close to the western margin of the Coalfield. Several places in the western and southern parts of the field are connected with Ranchi- Lohardaga and Ranchi – Daltanganj State Highway. The eastern Railway Branch Line from Dhanbad to Gomoh and Dehri-on-Sone runs along the southern part of the coalfield. This railway line also passes through Chandrapur, Bokaro & Patratu Thermal Power Stations. However the western, northern and eastern part of the coalfield is presently devoid of railway lines. The coalfield is likely to be connected by a new railway network under initial phases of execution from Gomoh Daltanganj railway line of SE Rly.

The location plan of the area have been shown in drg no 7010-199-POM-J-001 and area covering buffer zone of 10 km radius all around the allocated block is presented at key plan in drg no. 7010-199-POM-J-002

3.5. Block area

Total area of the Parkri Barwadih Coal Block is 46.95 Sq. Km. Subsequently to the allocation of the block NTPC has applied for acquisition of land u/s 4(i) of CBA Act (1957) for mining of above mentioned coal bearing area together with an additional area of 2.99 sq km on the north- eastern side of allocated block for accommodating infrastructure facilities. Braekup of Mine Area is given in **Table 3.1.**

Table 3.1

Breakup of Mine Area

Sl. No.	Particulars of Area	Area in (Sq. Km.)
1.	Explored (PB E & PB W)	39.43
2.	Explored (PB N W)	4.85
3.	Coal bearing area (1+2)	44.28
4.	Additional Acquisition for OB Dump	2.66
	Total (3+4)	**46.95**

3.6. Climate & Rainfall

3.6.1 Temperature:

The area experiences a subtropical climate with very hot and dry in summer and well-distributed rainfall in the southwest monsoon season. Annual mean rainfall recorded at IMD's Observatory, Hazaribagh is 1277.90 mm and maximum temperature is 43 °C in summer and minimum temperature is 3 °C in winter season. It has three distinguishable seasons:

i) The summer season starts from mid - March to mid – June. The temperatures varies from 16.5°C to 41.1°C

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ii) The rainy season starts from the mid June to September with an average annual mean rainfall of 1277.90 mm with the total number of rainy days being 67.

iii) Winter season commences from the November to February. The temperature varies from 4°C to 31°C.

3.6.2 Relative Humidity:

Since the climate is dry & hot, the relative humidity is generally moderate. The annual mean daily humidity is 61%.

3.6.3 Rainfall:

Pakri-Barwadih block being a virgin block has no rain gauging station. The nearest station is at Barkagaon Block office where daily rainfall is recorded. The records available in the block office from year 1979 to 2004 shows that the maximum annual rainfall of 2037.50 mm was recorded in the year 1994 and minimum was 656.20 mm in the year 2002. The average annual rainfall is about 1182 mm.The rainfall does not show any cyclic occurrences and shows wide and erratic variations. The average annual rainfall recorded at Barkagaon office for the year 1979 to 2004 ranged between 656.2 to 2037.50mm (Mean is 1181.5mm). The monsoon season is spread over the months from June to September. Rainfall records at IMD Hazaribagh is given at **Table 3.2**

Table 3.2

Rainfall records at IMD Hazaribagh.

Month	Monthly total (mm)	No. of rainy days	Maximum Rainfall in 24 hrs.(in mm) with date	
January	2.5	1.7	68.1	6-1945
February	16.2	1.4	63.5	23-1927
March	18.4	1.7	44.2	20-1946
April	17.0	1.4	60:5	22-1925
May	43.4	2.9	84.1	27-1887
June	177.1	9.2	249.2	24-1911
July	310.0	16.2	221.7	6-1953

August	320.1	16.2	180.1	17-1988
September	260.9	11.6	167.4	28-1963
October	80.6	4.1	149.4	24-1963
November	5.5	0.4	95.0	8-1924
December	5.2	0.4	39.4	13-1885
No of years data	29			

3.6.4 Vegetation:

At one time, the area, especially the hills and plateaus were covered with dense forest comprising mainly Sal, Mahua etc. With progressive increase of population and felling of trees, the forest areas have now reduced to isolated patches mostly occupying the upper parts of the hill. Other trees that grow in the area are Palash, Khair, Bair, Amla, Simul, Sisiu, Karanj etc.

About 50% of area of the notth west part of the block is covered by forest. The plantation of orchards of mango, mahua, kaju and other common trees are found scattered in the block. However, forest comprising mainly of Sal, Assan and Kusum trees occupies the southern, north-eastern to eastern part of the block. The important wild lives found are bear fox, Jackal, Hyena, Monkey and rabbits.

3.7. Topography

Topographically the area is rather hilly and undulating in northern and north-west part of the block. The central and eastern part of the block is characterized by more or less flat terrain with gentle undulations. The ground in general slopes towards south. In western part the maximum elevation of 501 m is noticed in northern part near borehole CNPB- 109 and minimum elevation of 402 m in southern part near borehole CMKPB –32. In the central part the maximum elevation of 459 m is noticed in the northern part near borehole CMKP –30 and the minimum elevation of 396 m near borehole CMKP-30 in south –eastern part. In eastern part the maximum elevation of 480 m is noticed in north-eastern part near borehole CNPB –55 and minimum elevation of 405 m near borehole CMKPB –12 in southern part.

The north western part of the block exhibits undulating topography with general slope towards south. Due to presence of numerous ravines in the eastern half of the block, the topography is highly rugged, rendering the area unapproachable. In general the elevation of ground varies from 430m to 460m above mean sea level.

3.8. Drainage

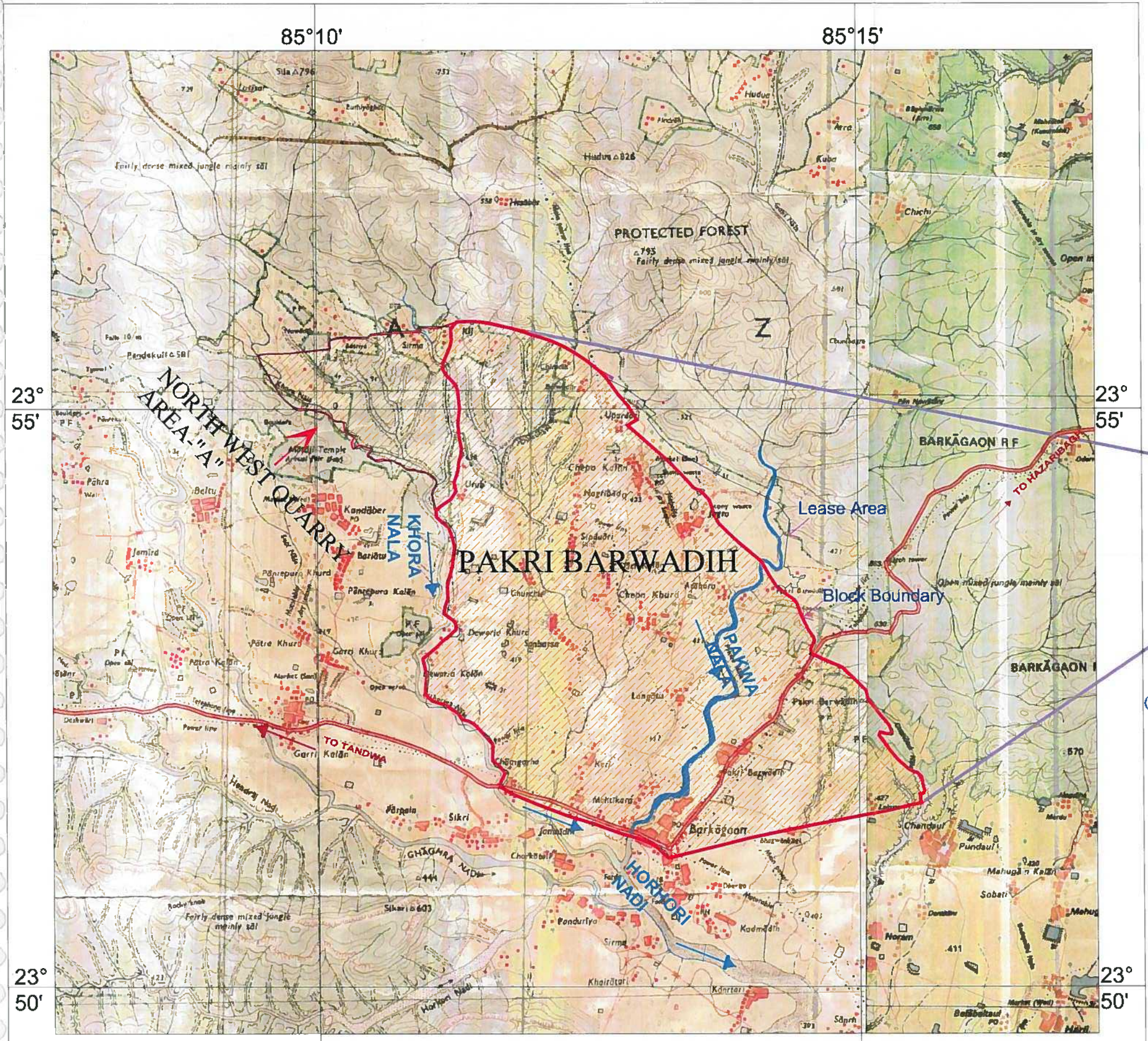
The drainage of the block is controlled by Sunrah river, which finally joins to Badmahi river, which is one of the major tributary of Damodar river flowing in south central part of coalfield. Three major nallahs flowing north to south are Khora, Dumuhani and Hardara (Pakawa). Besides these nallahs of the block, there are many small streams & stream lets, which discharge their load into these major nallahs. All the nallahs of the block are seasonal and become dry during summer.

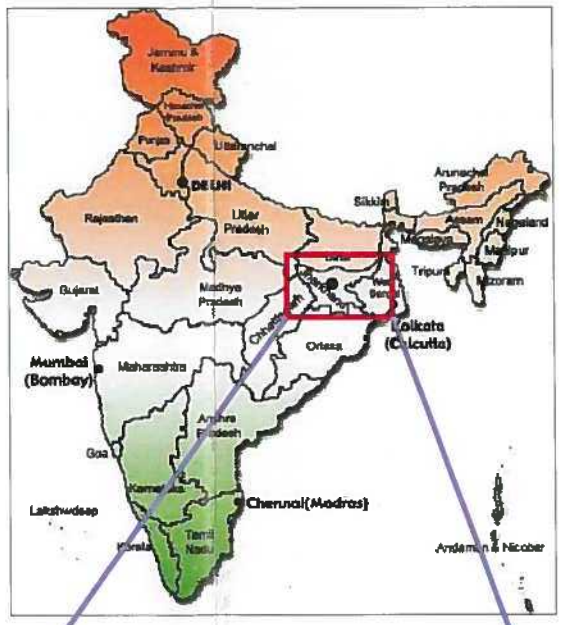
The shape of north western part of the block is triangular. On two sides, block boundary is defined by tributaries of Khora Nala, which discharges its load Lathorwa Nala. The drainage of the block is controlled by Khora Nala, which flows into Lathorwa/Khora Nala which in-turn joins to Haharo Nadi, which is one of the major tributary of Damodar River flowing in south central part of coalfield. Besides, Khora nala of the block, there are many small Streams & streamlet, which discharge their load into this major nala. All the nalas of the block are seasonal and become dry during summers. (Plate No.5).

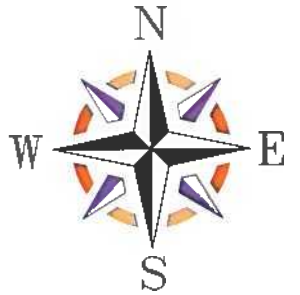
None of the nalas/tributaries were planned for diversion except straightening of Khora Nala – B at NW part of the block. During mining, adequate clearance from high bank of nala are left on the active pit side, to prevent seepage/flooding of water to mine. Embankments are also planned to prevent inrush of water during rainy season or otherwise.

3.9. Population

The entire coal-field is low to moderately populated except Barkagaon, Kerendari & Tandwa, which are the most populated villages in the northern & Western part of the coal-field.

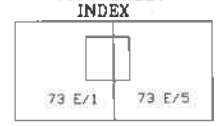






आई० पी० नागपाल/ I.P. NAGPAL
अवर सचिव/ Under Secretary
कोयला मंत्रालय/Ministry of Coal
शास्त्री भवन/Shastri Bhawan
भारत सरकार/Govt. of India
नई दिल्ली/New Delhi-110001

TOPO SHEET INDEX



CERTIFIED THAT THE PLAN IS CORRECT

SANJIV KUMAR SINGH (R.Q.P.)

Sanjiv

SANJIV KUMAR SINGH
Recognised Qualified Person
No. 34011/(15)/2009-CPAM
Ministry of Coal, Govt. of India

LEGEND

- BLOCK BOUNDARY (APPLIED)
- BLOCK BOUNDARY (ALLOCATED)
- ROAD
- RIVER/NALA
- VILLAGE
- POWER LINE
- WATER BODY

एन टी पी सी NTPC

N T P C LIMITED
(A GOVT. OF INDIA ENTERPRISE)
(COAL MINING ENGINEERING)

PROJECT: PAKRI BARWADIH COAL BLOCK

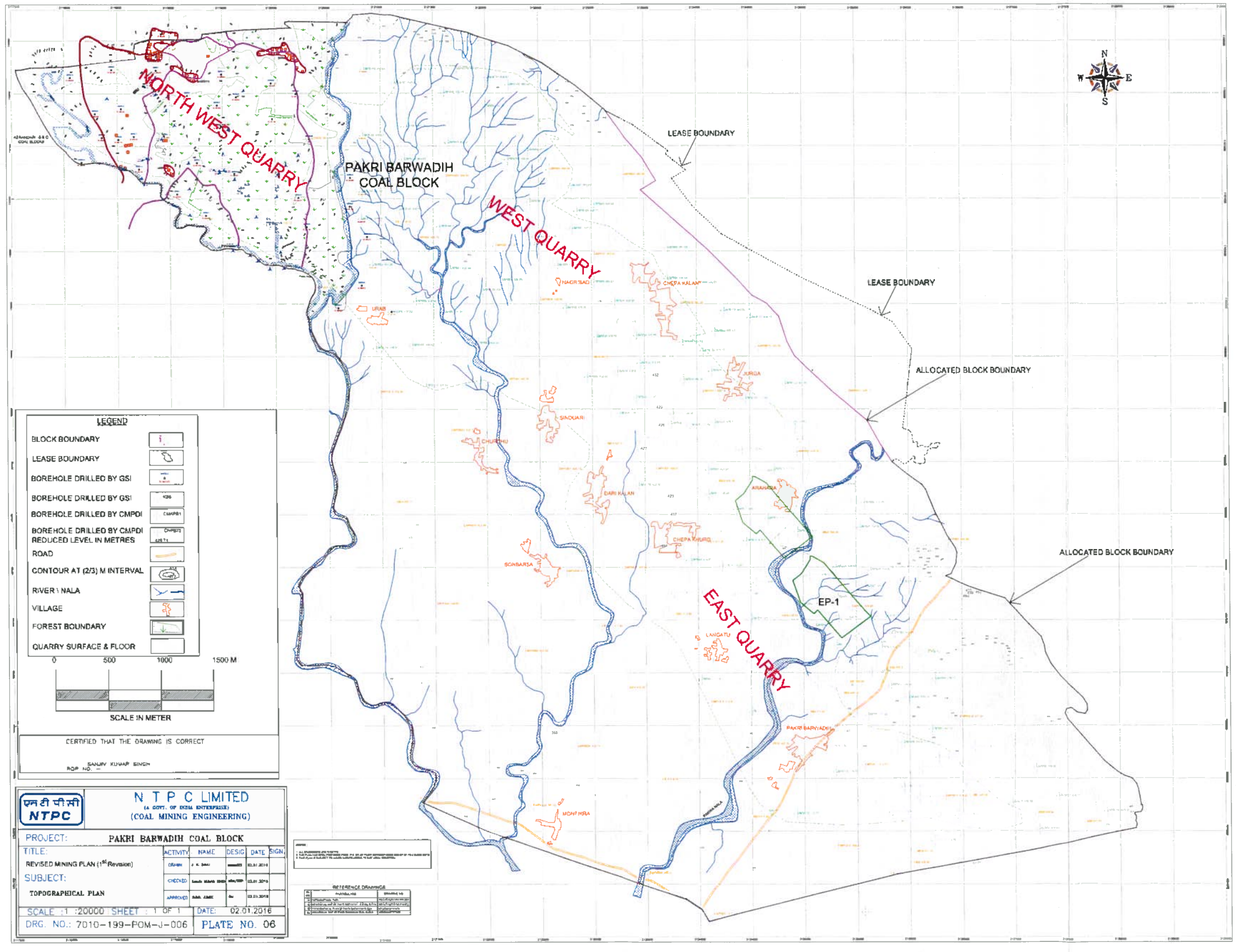
TITLE: REVISED MINING PLAN (1st Revision)

SUBJECT: LOCATION PLAN

ACTIVITY	NAME	DESIG.	DATE	SIGN.
DESIGN	Dr. J. K. GARG	MANAGER	29.12.2015	
DRAWN	S.V. RAMESH KUMAR	Sr. MGR	30.12.2015	
CHECKED	SANJIV KUMAR SINGH	AGM(GP)	29.12.2015	
APPROVED	SUNIL JUNEJA	GM	30.12.2015	

SCALE : NTS **SHEET :** 1 OF 1 **DATE:** 30-12-2015

DRG.NO: 7010-199-POM-J-001 PLATE NO. 01



आई० पी० नागपाल/ I.P. NAGPAL
अवर सचिव/ Under Secretary
कोयला मंत्रालय/Ministry of Coal
शास्त्री भवन/Shastri Bhawan
भारत सरकार/Govt. of India
नई दिल्ली/New Delhi-110001

SANJIV KUMAR SINGH
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CHAPTER IV

EXPLORATION, GEOLOGY, SEAM SEQUENCE, COAL QUALITY AND RESERVES

SANJIV KUMAR SINGH
Recognised Qualified Person
Ministry of Coal, Govt. of India

CHAPTER-IV

GEOLOGY

4.1 General

4.1.1 Pakri Barwadih (PB) coal block is located in the north eastern part of North Karanpura Coal Field bounded by Longitudes 85° 09'19" to 85° 15' 00" E and Latitude 23° 51' 30" to 23° 55' 40" N and covered by the Survey of India Topo sheet No73 E/1 (RF 1:50000) and special Sheets No 21,23 & 24 (RF 1:10000). The Block is located in the state of Jharkhand and is around 120-130 km from the state Capital Ranchi.

4.1.2 As per the Guidelines issued by MoC for preparation of Mining Plan for the coal blocks issued vide Letter No. 34011/(48)/2009-CPAM dated 15.07.2015, MoC directed to enclose additional item:

"Certificate from CMPDI that the Geological Coordinates (Longitude and Latitude) used in preparation of Mining Plan in accordance with the Vesting Order and Geological Coordinates covered by the Mining Plan do not encroach into any other/adjacent coal block"

Pakri Barwadih coal mining block was allocated to NTPC through Government Dispensation route in the year 2004. The block was retained with NTPC since Honourable Supreme Court had not de-allocated the same. Hence certificate from CMPDI is not applicable in this context. However boundary certified by CMPDI for notification under CBA Act is attached as **Annexure-XIX**.

4.2 Geological Report

Two Geological Report were prepared for this Block. NTPC has procured Geological Report (GR) of the block from CMPDIL vide letter No DG/693(A)/095-96 dated 04/05/2005 (Copy of letter enclosed as **Annexure-XI**). It pertains to the exploration of Western and Eastern part of the block. In compliance to the commitment to MoC, Geological Report of PB North West (Sector-A) was prepared by NTPC through MECL, which pertains to the exploration of North Western part of the block. The brief is as following:

A Memorandum of Understanding (MoU) was signed between Mineral Exploration Corporation Limited (MECL) and NTPC Ltd, on 12.06.2006 for conducting detailed exploration for coal in Pakri Barwadih North West

(Sector-A) Coal Block. The exploration work was awarded to MECL as per Letter of Award (LOA) No.CS-7010-708-9CY-LOA dated 14.07.2006.

MECL has carried out a detailed exploration for coal and allied geological activities including sampling and chemical analysis etc. in the said block based on the relevant standards.

Exploratory work carried out by MECL intermittently rather than continuous due to local problems. Villagers nearby hindered the work which contributed delay in completion of exploration work. Geological report was submitted to NTPC on 30.10.2012. (Copy of letter enclosed as **Annexure-XIA**)

The above two Geological Reports have been considered for preparation of present Mining Plan "Revised Mining Plan (1st Revision) Pakri Barwadih Coal Block".

4.2.1. Connection with National Grid

Pakri Barwadih Coal Block is connected with the national grid.

4.2.2. Payments of Exploration Cost vis a vis cost of Geological Report

NTPC has paid full amount for the cost of the above mentioned Exploration/Geological Report raised by GSI, CMPDIL and MECL.

MoC vide letter No. 13016/29/2003/CA-I (Part) dated 18.08.2015 confirmed that no additional amount is due with NTPC. (Copy of letters enclosed as **Annexure-XII**)

4.3 Details of exploration

4.3.1 Core / Non-Core drilling

Drilling activity is carried out in two different phases for Pakri Barwadih west, east and Pakri Barwadih North West (Sector-A) block. A total of 196 boreholes have been drilled by GSI & CMPDI in Pakri Barwadih Block whereas in Pakri Barwadih North West MECL has drilled 33 boreholes and CMPDIL has drilled 3 borehole. In total 232 boreholes have been drilled in the whole block. The boreholes drilled during different phases in Pakri Barwadih Block as per break up given in **Table 4.1**. The seam wise borehole intersections and density is given in **Table 4.2**. The Location Plan of these boreholes have been shown **Plate No.7.**

Table 4.1

Phase wise Agency wise exploration status

Agency/ Type	Period of Drilling	Drilling	
		No. of Boreholes	Meterage
1. GSI / Regional	1961 to 1971	KB-1 to 26 (26 BHs)	8177.23
2. CMPDI a) Promotional (Semi-regional)	Dec. '1999 to April , 2001	*CMKPB-1 to 38 (38 BHs)	10482.00
b) Non-CIL (detail drilling)	Jan., 2003 to June 2004	CNPB- 1 to 135 (135 BHS)	24943.60
Sub-Total (1 & 2)		**199**	43602.83
3. MECL for PB North West (Sector-A)	2006 to 2012	MNPB-1 to MNPB-1 (33 BHs)	4282.70
Total (1, 2 & 3)		**232**	**47885.53**

**CMKPB 24,25 & 38 are falling in PB (NW) quarry*

4.3.2 Seam wise borehole intersections and density

Table-4.2
Seam wise borehole intersections and density

Seam/Parting	No. of Boreholes considered	Seam/Parting	No. of Boreholes considered
Seam-V Top	55	Seam-II MB	12
Seam-V Bottom	58	Seam-II Comb.	3+1
Seam-V Comb.	29	Seam-I Top	100
Seam-IV A	47	Seam-I Middle	97
Seam-IV Top	26	Seam-I TM	6
Seam-IV Bottom	26	Seam-I Bottom	72
Seam-IV Comb.	63	Seam-I MB	20
Seam-III Top	56	Seam-I Comb.	3+10

Seam-III Bottom	56	Local	90
Seam-III Comb.	31	Seam-K5	57+1
Seam-II Top	70	Seam-K4	58+1
Seam-II Middle	62	Seam-K3	56
Seam-II TM	46+10	Seam-K2	60
Seam-II Bottom	96+11	Seam-K1	75

4.3.3 Requirement of Further Exploration with time frame

4.3.3.1. Exploratory drilling for no coal zone proving

The infrastructure facilities and external waste dumping areas Dump-A, B and D) as shown in **Surface Master Plan (Plate No-5)** have been selected beyond the incrop of Seam-I Bottom. However, there is no specific mention of no-coal zone in the area. Therefore, before start of OB Dumping if required or insisted by Standing Committee the drilling for negative proving shall be carried out.

Period	No. of BH (Tentative)	Location	Estimated meterage	Target
Pre-construction (before start of OB dumping if required)	30	Infrastructure sites and external waste dump A & B	3000	Negative proving of workable coal seams
Pre-construction	10	Infrastructure sites and external waste dump D	1000	Negative proving of workable coal seams

4.3.3.2. Exploratory drilling for production support

In order to delineate the in-crop of seam I & II and to support the production requirement as per stage plan, phase-wise exploration through core drilling in different sectors of the bock have been proposed **Table 4.3**

Table 4.3
Production support boreholes

Period	of BH	Location	timated meterage	Target
Pre-construction (2 years)	15	Bet. F14 & Seam IB incrop Bet. F13 & F14 Bet F8 & F9	750	To delineate incrop of seam IB & IIB To support 1st & 2nd year production
1st year	15	Bet. F12 & F13 Bet. F10 & F11 Bet F7 & F8	500	To support 2nd & 3rd year production
2nd year	15	Bet. F12 & F13 Bet. F11 & F12 Bet F9 & F10	500	To support 3rd & 4th year production
3rd year	12	Bet. F8 & F10 Bet. F7 & F8	500	To support 4th & 5th year production
4th year	12	Bet. F5 & F6 Bet. F7 & F8	200	To support 5th to 6th year production

4.3.3.3. Exploration for area beyond 300m depth line

The southern portion of the Pakri Barwadih Block covering around 12 sq. km. area has also not been explored in details and only " indicated" category reserves of the order of 733.199 Mt are provisionally assessed by CMPDI. Therefore a phase wise exploration programme has been proposed to convert the indicated reserved into proved category and to develop underground mine plan.Phasewise exploration program is given in **Table 4.3 A**.

Table-4.3 A
Phase wise exploration program

Period	No. of BH	Location	Estimated meterage	Target
1st year	25	**Area beyond 300 m depth line**	14000	**To convert the indicated reserves into proved category and to develop underground mine plan**
2th year	25		14000	
3th year	25		14500	
4th year	25		14500	
Total			**55000-60000**	

4.4 Regional Geological set up of the area

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 east west elongated metamorphic patch. However, they are interconnected near Bachra and Hindegir village by a narrow tongue of Talcher outcrops. On the eastern side, North Karanpura Coalfield is separated from the West Bokaro Coalfield by a narrow stretch of metamorphic rocks having several outliers of Talcher formation. In the west, it is separated by a stretch of about 20 Km wide metamorphic belt from Auranga Coalfield.

The generalized Stratigraphic Sequence of North Karanpura is given at **Table 4.4**.

Table 4.4
Geological Succession of North Karanpura Coalfield

Period	Group	Sub-group	Formation	Lithology
Recent	-	-	Alluvium	Detrital and alluvial soil and sub soil
Jurassic	-	Equivalent to Rajmahal Trap	Igneous Intrusive	Dolerite and Mica Peridotite
Triassic	Upper Gondwana		Mahadeva	Massive coarse to conglomeratic feldspathic ferruginous sandstone with shale intercalation
Upper Permian to Lower	Lower Gondwana		Panchet	Yellowish to white coarse grained sandstone, red, chocolate colour clastic clays.

Triassic				In the upper part, yellowish friable sandstone whereas lower part is greenish yellow
Upper Permian		Damuda	Raniganj	Fine to medium grained quartzo-feldspathic and quartzitic sandstone often micaceous and matured, interbanded shale and sandstone, carbonaceous shale and thin coal seam.
			Barren Measures	Dark Shale, sandy micaceous shale with sideritic interbanded shale and sandstones
			Barakar	Conglomerrate, sandstone, shale, intercalation siltstone and shale, carbonaceous shale, fireclay, coal seams.
			Karharbari	Dark mottled sandstone occasional shale bands, fireclay, chocolate coloured clays and coal seams
Permo-Carboniferous			Talchir	Rikba plants beds, boulders, conglomerate, varvites, sandstone, tilloids and tillites.
----------Unconformity----------				
Pre-Cambrian	-	-	Metamorphics	Granite, gneiss, pegmatite, phylittes, micashist and limestone, chromite bearing rocks, amphibolites and quartzite.

Out of 1230 sq. Km area of North Karanpura coalfield the coal bearing formations viz; Karharbari, Barakar and Raniganj crop-out over an area of about 500 sq. Km. The Karharbari formation is well developed in south-central and eastern part of the coalfield. It contains only one coal seam which occurs often in two to three sections. It comprises of very coarse grained gritty sandstone and at times has silicified sandstone, hard strata difficult to negotiate during drilling operation. The Barakar formation contains a number of coal seams and contributes the major bulk of reserves in this coalfield. Five persistent coal seams have been established in the coalfield. The total coal column is more or less around 30 to 40 meter in the major part of coalfield. Raniganj formation contains three or four impersistent coal seams which are generally shaly in nature.

4.4.1 Local Geology

a. PB Block (East and West):

The Pakri-Barwadih block comprises of Talchir, Karharbari, Barakar, Barren Measures and Raniganj Formations belonging to Damudas, a Sub-Group of Lower Gondwana.Talchir Formation rest directly over the Pre-Cambrains. The Karharbaris and Barkars are the main coal bearing formations in the block. Stratigraphic succession of the formations in the block is given in **Table 4.5.**

Table 4.5
Stratigraphic Sequence of Pakri-Barwadih Block

Period	Group	Sub-group	Formation	Thickness Range	Lithology
Recent	Lower Gondwana	Damuda	Alluvium	3.50 – 25.85	Detrital and Alluvial soil & subsoil
Upper Permian			Raniganj	1.50 – 324.50	Fine to medium grained micaceous sandstone, interbanded shale and sandstone,

					Carbonaceous shale & thin uneconomic Coal seams.
Upper Permian			Barren Measures	5.14 – 353.00	Dark shale, sandy shale & interbanded shale & sandstone.
			Barakar	12.50 - 268.85	Fine to coarse grained sandstone, Shale, Conglomerate, Carbonaceous shale & Coal seams.
			Karharbari	10.00 – 81.60	Medium to coarse grained sandstone, Shale, silicified quartzite rock & thin coal seams.
Permo Carbonitero us	--	--	Talcher	0.80 – 13.50	Green coloured shale, Boulder & Congolomerate
----------Unconformity----------					
Pre-Cambrian	--	--	Metamorphics	--	Granite, Gneisses & Quartizites

There are a few small outliers of Barakar/ Kaharbari/ Talchir Formations occurring over the Pre-Cambrian Basements immediately north of the Pakri-Barwadih Block.

b. PB Block (North West):

However, in PB North West (sector-A) area small exposures of sand stone and coal seam are found near the bank of Khora Nala in the western margin of the block. At places Karharbari Formation also rest directly over metamorphic. The geological

succession established in the PB North West area (sector-A) of the block from sub-surface exploration data is given in **Table 4.6**.

TABLE 4.6
STRATIGRAPHIC SUCCESSION OF PB NW (SECTOR-A) AREA OF COAL BLOCK

Period	Group	Sub-Group	Formation (Thickness)	Lithology
Recent & Sub-Recent			Alluvium (3.00 to 23.00m)	Soil & Sub-soil
----------Unconformity----------				
Middle Permian			Barren Measure (44.00 – 138.70m)	Predominantly shale with intercalation of sandstone and shale and arenaceous shale
Lower Permian	Lower Gondwana	amuda	Barakar (19.07m – 137.10m) Karharbari (5.14m to 91.52m)	Fine to coarse grained sand-stones, shale, carbonaceous shale and coal seams. Fine to coarse grained sandstone with bands of shale and coal seams
Permo - Carboniferous			Talchir 0.65m to 4.64m)	Green coloured shale, boulders and conglomerates
----------Unconformity----------				
Precambrian			Metamorphics (2.80-11.00m)	Gniesses, granites and quartzites

4.4.2 Structure

a. Structure of PB (East and West)

Structurally the North Karanpura coalfield is a major broad syncline with its axis trending east to west and plunging towards east. The Pakri-Barwadih is Located in the NE part of northern limb. The northern boundary of the block

appears to have normal contacts with Talcher and basement metamorphics. The southern boundary of the Eastern sector is marked by a major fault of about 250m throw towards south. This has resulted in bringing the Barakar formations including coal seams in juxtaposition with Raniganj formation.

The block is generally traversed by NW-SE/SE-EW trending faults with northerly throw causing step like configuration. The strike of the strata is generally NW-SE and the dip of the strata varies from 10^0 to 20^0 (1 in 3 to 1 in 5.5) but generally 10^0 to 15^0 towards south-west.

Nineteen faults with throw ranging up to 170m have been deciphered based on exploration carried out in the block. The throw of most of the faults ranges from 10-40m.

It may be mentioned here that the geological structure of the block is primarily based on CMPDI GR in general and in particular in the north and north central part of West Quarry i.e. north of fault F10 –F10, giving due cognizance to the long field association of CMPDI during exploration.

The fault F5 which is of distinctive nature has been considered as the boundary for division of the block into West & East Quarry. The details of faults are given in **Table 4.7**.

Table 4.7

Fault Details of PB West & East Block

Fault	Trend	Dip	Throw	Remarks
F1 -F1	East- West	Northerly	20-60m	Omission of (i)Seam-II in KB-16 (ii) Seam-II Top to Seam-IV in CMKPB 29 (iii) Reduction in parting between Seam-II MT & Middle in CMKPB-12

F2 -F2	NW-SE	North-easterly	10-100m	Omission of (i) Seam-I in CMKPB 10 (ii) Seam-II Bottom & V in CMKPB 35 (iii) Seam-III Top & Bottom in CMKPB-12
F3 –F3	NW-SE& Curvilinear fault trending NW-SE and gradually swerving to N-S	Northerly	80–170 m	Intersected in (i) CNPB – 107 (Omission of Seam-I Bottom to Seam-V Top). (ii) Based on Stratum Contours.
F4 –F4	NW-SE dies out near borehole CNPB- 52	North–East	0 –20m	Omission of (i) Seam-I Bottom to Seam-II Bottom in CNPB – 49, (ii) Seam-IVA & IV in CNPB- 15 (iii) Seam-II Top & (iv) Seam-III in CNPB-21& Seam-IV in CNPB –64.
F5 -F5	NW-SE to swerving to E-W	North-Easterly/ Northerly	40–140 m	Omission of (i) Seam-I & II in CNPB-92, (ii) Seam-III Bottom in CNPB-93, (iii) Seam-III in CNPB-95, (iv) Seam-III Bottom to V top in KB-11 (v) Seam –II to V top in CNPB-16 (vi) Based on Stratum contour.
F6 -F6	NW-SE abuts against fault F5-F5 near BHs CNPB-93.	North Easterly	10 – 40 m	(i) CNPB-39 Omission of Seam-II Top, Middle & Bottom), (ii) CNPB- 29 Omission of Seam-I Top to I Bottom (iii) Based on Stratum contour.
F7 -F7	Almost E-W Abuts against fault F6-F6 near BH CNPB-28	Northerly	20-80 m	(i) Omission of Seam-III in boreholes CNPB-28, 20& 68. (ii) CNPB – 61 Omission of Seam-II Top to Seam-I Bottom (iii) CNPB-25 Omission of seam floor of Seam-II MB to Seam-I Bottom (iv) CNPB – 29 Omission of Seam-I Top to Seam-I Bottom.
F8 –F8	NW-SE	North Easterly	10-20m	(i) Reduction in parting between Seam II Top & III in CNPB–

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				94&KB- 17. (ii) Omission of Seam-IVA &Seam-IV in CNPB – 40, (iii) Seam –III Top to Seam-IV A in CNPB – 38 (iv) Seam- III Bottom in CNPB-32 &(v) Seam-II in CMKPB-11.
F9 - F9	E–W, Abuts against fault F-8 near BH CNPB -30	Northerly	20 – 40m	Based on stratum contour plan
F10 – F10	NW – SE curvilinear fault trending almost E-W	Northerly	20 – 60m	Omission of (i) Seam-II Bottom to IVA in CNPB-78 (ii) Based on stratum contour.
F11– F11	Curvilinear fault Trending almost E-W	Northerly	20 – 60m	(i) Based on Stratum Contour plan (ii) Omission of Seam-I in boreholes CNPB – 83 & CNPB – 135.
F12– F12	Curvilinear fault Trending almost E-W	Northerly	20m	(i) Intersected in Borehole CNPB – 80 where Seam- I Top & Middle is faulted (ii) Based on Stratum Contour Plan
F13- F13	E – W	Northerly	20 - 40 m	(i) Roof of Seam – II Top & Middle Combined is faulted in borehole CMKPB- 5. (ii) Based on Stratum Contour Plan.
F14- F14	E-W	Northerly	40-60m	(i) Roof of Seam II Top & Middle combined is faulted in borehole CMKPB-5. (ii) Based on stratum contour plan.
F15– F15	Limits the southern boundary of Eastern Sector of the block Major fault trending almost E-W.	Southerly	More than 200 m throw	Raniganj and Barren Measure formations are in juxtaposition with Barakar
NEW FAULTS				

FN-16	WNW-ESE	NEN	20M	1) Redelineation of incrop of seam 1 2)Cross Section 3. Revision of Floor contours of seam I
FN-17	NW-SE tion in the East Sector within the quarriable zone.	NE	5M	1 &2 same as above 3. Revision of Floor Continuer plan 4. Geological Cross Section additional.
FN-18	NW-SE Location in the Central sector	NE	Amount of throw could not be establis hed	Geological Cross Section
FN –19	WNW-ESE	NNE		Geological Cross Section

b. Structure of PB (North West)

Pakri Barwadih North West (Sector-A) area of the Block, the general strike of the formation in the block is almost east-west. The local swing in the strike at places is due to rolling dip. The strata are dipping at 10° to 12° southerly.

The block is traversed by 8 numbers of faults. Among these, 3 faults are varying from 0 m to 50 m. Fault F1 is the major fault varying in through from 160m to 180m. This fault runs approximately along southern to western boundary of the block. The trend of the fault is NW-SE and except faults F7 & F8, all are extending in metamorphic terrain. The description of faults is presented in the **Table 4.8**.

Table 4.8

DESCRIPTION OF FAULTS INTERPRETED IN PB NW (Sector-A)

FAULT NO.	LOCATION	NATURE	TREND & THROW (m)	BH. NO.	DEPTH (m.)	EVIDENCES
F_1 – F_1	Located near southern to western boundary	Oblique fault	NW-SE & 160 – 180m	MNPB - 25	274.50	• Seam K-1 to K-5 & Local -L faulted in borehole MNPB-25 • Interpreted based on level difference of seam on either side of fault • Metamorphics has come in juxtaposition of Gondwana in north western part of the block • Equivalent to fault F_3 of western section of Pakri-Barwadih block
F_2 – F_2	Located in Central part of the block	Oblique fault	NW-SE & 0 – 40	MNPB-4	170.00	• Seam K-1 & K-2 faulted in MNPB-4 • Interpreted based on level difference of seam on either side of fault
F_3 – F_3	Located in Central part of the block	Oblique fault	NW-SE & 30 – 55	MNPB-7 MNPB-26	29.00 316.60	• Seam K2 faulted in MNPB-7 • Seam K-1 and contact of Karharbari and metamorphic faulted in borehole MNPB-26 • Interpreted based on level difference of seam on either side of fault • Equivalent to F_5

FAULT NO.	LOCATION	NATURE	TREND & THROW (m)	BH. NO.	DEPTH (m.)	EVIDENCES
						of western sector of Pakri-Barwadih
F_4 – F_4	Located in north-eastern part of the block	Oblique fault	NW-SE& 10 – 50	MNPB-11	87.00	• Seam K-1 to K-4 faulted in Borehole MNPB-11 • Interpreted based on • level difference of seam • on either side of fault • Equivalent to F_{10} of western sector of Pakri Barwadih
F_5 – F_5	Located in north - eastern corner of the block	Oblique fault	NW-SE & 10	-	-	Extending from western sector of Pakri-Barwadih (equivalent to fault F_{14})
F_7 – F_7	Located in the eastern part of the block	Oblique fault	NW-SE & 0 – 10	MNPB-24	205	Seam K-3 faulted in borehole MNPB-24 equivalent to fault F_8 of Pakri-Barwadih Block
F_8 - F_8	Located in the eastern part of the block	Oblique fault	NW-SE & 0 – 5	MNPB-5 MNPB-10	100 28	• Seam K-2 faulted • Seam K-5 faulted

4.4.3 Stratigraphic Sequences

Stratigraphic Sequences of PB West & East

The Barakar formation contains five persistent coal seams numbered Seam-I to Seam-V in ascending order. Out of these, Seam-I & Seam-II have spitted into 3 sections, whereas Seam-III, Seam-IV and Seam-V spitted in two sections each. The split sections are designated as top, middle & bottom. The split sections of the seams merge to form composite seams designated for example as II TM for II Top & Middle combined and MB for Middle and Bottom combined.

The Karharbari formations underlies the Barakar formation and contain 5 thin non-workable coal seams namely Seam-K1 to Seam-K5. The average thickness of these coal seams is less than 1 m.

The summarized sequence and details of coal seams in the block are given in **Table 4.9** and seams have been shown in geological plan **(Plate No. 7)**

Table 4.9
Sequence & details of coal seams

Seam/Parting	Thickness range (m)		General thickness (m)	No of BH considered
	Minimum	Maximum		
Seam-V Top	0.39 (CNPB – 34)	3.91 (CMKPB 13)	1.50	55
Parting	0.80 (CNPB – 32)	12.41 (CMKPB 13)		
Seam -V Bottom	0.18 (CNPB –113)	2.20 (CMKPB 29)	1.00	58
Seam-V Comb	0.73 (CMKPB 37)	6.00 (CMKPB 11)	1.50	19
Parting	2.16 (CNPB– 95)	29.11 (CNPB – 64)		
Seam-IV A	0.20 (CNPB – 95)	3.13 (CNPB –105)	1.25	47
Parting	0.64	12.37		

Seam/Parting	Thickness range (m)		General	No of BH
	(CMKPB –4)	(CMKPB – 30)		
Seam-IV Top	0.90 (CNPB – 26)	7.88 (CNPB – 68)	3.00	26
Parting	0.90 (CNPB – 105)	17.59 (CNPB – 53)		
Seam-IV Bottom	0.65 (CNPB – 86)	7.64 (CNPB –134)	2.50	26
Seam-IV Comb	2.10 (CNPB – 131)	14.61 (CNPB – 144)	8.00	53
Parting	0.98 (MNPB – 25)	44.31 (CMKPB 37)		
Seam-III Top	0.46 (CMKPB 12)	3.75 (CMKPB 10)	1.50	56
Parting	0.94 (CMKPB 15)	28.88 (CMKPB 10)		
Seam-III Bottom	0.16 (CNPB – 85)	3.10 (CNPB – 22)	1.25	56
Seam-III Comb	0.46 (CNPB – 7)	3.74 (CNPB – 37)	1.50	31
Parting	1.97 (CNPB – 48)	45.97 (CNPB-91)		
Seam-II Top	0.25 (CMKPB –4)	15.46 (CMKPB 10)	8.00	60
Parting	Nil	31.93 (CNPB-31)		
Seam-II Middle	2.98 (CMKPB 30)	20.04 (CNPB – 34)	8.00	56
Seam-II TM	10.28	20.26	12.00	39

Seam/Parting	Thickness range (m)		General	No of BH
	(CNPB– 17)	(MNPB-22)		
Parting	0.77 (CNPB –131)	10.75 (CNPB-72)		
Seam-II Bottom	1.40 (CNPB – 38)	14.56 (CMKPB 10)	7.00	80
Seam-II MB	13.85 (CMKPB 29)	22.51 (CNPB-30)	16.00	12
Seam-II Comb	17.70 (CMKPB–8)	28.67 (CNPB-32)		3
Seam-I Top	0.21 (CMKPB 12)	11.36 (CNPB-124)	2.50	81
Parting	1.00 (CNPB –110)	18.77 (CNPB-91)		
Seam-I Middle	0.42 (CNPB – 106)	10.13 (CNPB-110)	2.50	90
Seam-I TM	3.85 (CNPB – 90)	11.95 (CNPB-125)		6
Parting	0.85 (CNPB – 44)	23.62 (CNPB-72)		
Seam-I Bottom	0.20 (CNPB –108)	8.10 (CNPB-134)	2.00	64
Seam-I MB	4.70 (MNPB –11)	11.88 (CMKPB-25)		6
Seam-I Comb	7.96 (CNPB – 78)	13.76 (CMKPB-35)		3
Parting	1.80 (CNPB – 72)	35.75 (CNPB-73)		
Local	0.06	5.56	1.50	72

Seam/Parting	Thickness range (m)		General	No of BH
	(MNPB – 38)	(CMKPB-5)		
Parting	4.72 (CNPB – 69)	78.89 (CNPB-88)		
Seam-K5	0.08 (MNPB –38)	2.22 (CNPB-79)	0.75	39
Parting	2.27 (CNPB – 80)	81.25 (CNPB-124)		
Seam-K4	0.09 (CNPB –124)	3.04 (CNPB-90)	0.75	34
Parting	1.20 (CNPB –106)	29.75 (CMKPB-36)		
Seam-K3	0.08 (CNPB – 90)	2.46 (CNPB-116)	1.25	33
Parting	0.50 (CNPB –110)	33.40 (CMKPB-20)		
Seam-K2	0.05 (CNPB –124)	4.80 (CNPB-123)	1.25	36
Parting	1.04 (CNPB –101)	48.00 (CNPB-128)		
Seam –K1	0.10 (CNPB – 52)	6.45 (CNPB-105)	1.50	50

Note: (i) TM stands for Top & Middle Merged.
(ii) MB stands for Middle & Bottom Merged.

The details of the thickness of different coal seams, partings and OB is given in **Table 4.10 & Table 4.11**.

Table 4.10

Thickness of Coal Seams & Partings in PB (West East)

Particulars	West Quarry		East Quarry	
	Max	Min	Max	Min
Over Burden	251.55	10.39	266.81	6
Seam-V Top	3.24	0.36	3.91	0.84
Parting	7.19	0.8	4.89	0.82
Seam-V Bottom	3	0.29	2.04	0.21
Parting	24.97	2.16	19.95	5.88
Seam-IV Top	7.88	0.9	6.57	2.34
Parting	6.76	0.9	17.59	16.38
Seam-IV Bottom	7.64	0.65	6.56	0.87
Parting	44.31	5.1	22.93	5.31
Seam-III Top	3.75	0.23	3.22	0.49
Parting	24.75	1.1	16.94	0.94
Seam-III Bottom	3.1	0.16	2.41	0.21
Parting	45.97	3.39	33.72	1.97
Seam-II Top	12.7	0.74	11.22	0.25
Parting	31.93	1.2	28.12	1.34
Seam-II Middle	20.04	1.75	10.98	3.5
Parting	6.28	0	5.8	0.97
Seam-II Bottom	11.4	1.4	14.02	1.99
Parting	30.43	6.21	27.94	4.74
Seam-I Top	11.36	0.45	4.95	0.42
Parting	18.77	1	14.73	1.6
Seam-I Middle	10.13	0.42	6.71	0.87
Parting	16.35	0.95	18.7	0.85
Seam-I Bottom	8.1	0.2	4.8	0.25

Table 4.11

Thickness of Coal Seams & Partings in PB (North West)

Sl. No.	Seam /Parting	Min.	Max.
1	V COMB	3.24	5.9
2	Parting	3.72	27.16
3	IV COMB	5.15	10.04
4	Parting	0.98	30.55

Sl. No.	Seam /Parting	Min.	Max.
5	II TOP	6.96	10.61
6	Parting	1.09	5.12
7	II MID	7.17	11.68
8	Parting	0	0
9	II T+M	15.97	20.26
10	Parting	1.4	24.22
11	II BOT	2.85	6.3
12	Parting	5.89	15
13	I TOP	0.42	3.79
14	Parting	0.52	4.51
15	I MID	1.15	8.73
16	Parting	0.17	4.19
17	I BOT	1.01	4.17
18	Parting	0	0
19	I M+B	4.7	11.88
20	Parting	16.8	27.68
21	LOCAL(L)	0.06	2.35
22	Parting	16.39	29.67
23	K-5	0.08	1.32
24	Parting	4.74	12.65
25	K-4	0.28	1.74
26	Parting	4.4	9.85
27	K-3	0.45	1.96
28	Parting	8.45	19.58
29	K-2	0.06	2.99
30	Parting	1.95	13.84
31	K-1	1.19	4.68

4.4.3.1 General characteristics of Lithological units (coal seams/ parting/ overburden)

(i) The Seam-II and its splits are the most potential seams in the block both from resource and grade of coal but seam II Top & Middle is found as coalesced seam in the eastern part of the block i.e. PB North-West(sector-A) area.

(ii) Seam-I is highly discontinuous and occur mostly in patches. Seam I Bottom and I Middle is found as combined seam in the eastern part of the block.

(iii) In Pakri Barwadih block all Barakar seams of the block are highly inter banded and inferior in nature except Kraharbari seams. Where as Karaharbari formation are well developed in the PB North West (sector-A) area except in few small patches. The Barakar coal seams (seam I to V) are medium to high ash, non-coking bituminous type. The moisture and ash of these coals normally ranges between 3% to 5% and 25% to 45% respectively on inclusion of all dirt bands less than 1m in thickness.

(iv) Overall proximate analysis on 60% RH and 40^{0}C has been carried out for selected boreholes to determine Moisture, Ash and Volatile Matter (VM) on samples excluding carbonaceous shale & all other dirt bands (BCS) and including dirt bands up to 30 cm (I_{30}) and including dirt bands up to 1m (I_{100}) thickness. However all non-combustibles dirt bands such as Grey Shale, Arenaceous Shale, Sandstone samples more than 5 cm have been excluded for estimations of quality and reserves in all cases.

(v) In the boreholes where seam overall proximate analysis has not been determined, Ash & Moisture have been calculated by weighted average method from band by band data. Useful Heat Value (UHV) of coal has been calculated by using the formula 8900-138 x (A%+M %) for determination of grade as per present standard of commercial coal grading system.

(vi) The other special test such as Ultimate Analysis, Ash Analysis, Ash Fusion Range, Petrographic Analysis, Mineralogical Study and Selective Reactivity test have been carried out to ascertain different industrial properties of coal in case of selected seams/sample.

(vii) The Partings of the coal seams are comprises of sandstone, alternate shale & sandstone, shale, carbonaceous shale, etc. The bulk of the OB rocks comprise of sandstones and shale and their intermediate varieties. The soil and weathered rock varies 6 to 24 m thick but generally varies from 6 - 18m.

4.5 Seam wise Quality Parameters of PB Block

The generalized range of quality of coal including dirt bands is given in **Table-4.12.**

Table 4.12
Range of Quality details of Coal seams, PB (West East)

Seam	M%	ASH%	VM%	UHV (K.Cal/Kg.)	Grade (Based on UHV)	CV (K.Cal/ Kg.)	Grade (Based on GCV)	CV (Dmmf) (K.Cal/ Kg.)
Seam-V Top	3.5-6.8	22.4-52.2	17.8-22.3	1144-4880	D-G (E-F)	3040-5466	G7-G15	6932-7765
Seam - V Bottom	3.9-7.3	15.7-48.7	20.1-21.9	1648-6015	B-G (E-F)	3409-6321	G4-G13	7012-8361
Seam-V Comb	3.4-7.1	17.9-51.8	18.5-24.70	1236-5472	C-Ungr (E-F)	3136-5858	G5-G14	7054-7794
Seam-IV A	3.4-5.2	25.2-49.9	18.5-19.6	1510-4750	D-G (E-F)	3329-5475	G7-G14	7167-7830
Seam-IV Top	3.1-5.8	31.3-43.6	20.4-23.7	2255-3969	E-G (E-F)	3788-4999	G8-G12	7306-7778
Seam-IV Bottom	3.7-5.3	21.6-50.2	18.2-23.8	1626-5225	C-G (D-F)	3438-6070	G5-G13	7307-8191
Seam-IV Comb	2.6-6.7	31.2-48.2	17.9-27.1	1641-3863	E-G (E-F)	3000-4832	G9-G15	5714-7825

Seam	M%	ASH%	VM%	UHV (K.Cal/Kg.)	Grade (Based on UHV)	CV (K.Cal/ Kg.)	Grade (Based on GCV)	CV (Dmmf) (K.Cal/ Kg.)
Seam-III Top	2.6-5.5	17.2-51.2	18.7-25.7	1365-5767	B-G (C-E)	3200-6136	G4-G14	7048-8672
Seam-III Bottom	2.8-5.7	16.6-50.0	22.7-27.1	1616-5818	B-G (D-E)	3447-6160	G4-G13	7299-7924
Seam-III Comb	3.4-5.8	25.9-37.9	-	3021-5055	D-F (E)	4037-5529	G6-G11	7264-7919
Seam-II Top	2.7-6.7	23.3-52.7	18.0-25.3	1158-5059	C-G (D-F)	3130-5724	G6-G14	7129-7931
Seam-II Middle	2.0-6.9	23.1-43.2	20.7-28.5	2621-5132	C-F (D-F)	4520-5789	G6-G10	7635-8107
Seam-II TM	2.6-5.8	27.2-45.9	21.9-26.2	2206-4650	D-E	3854-5550	G6-G12	7485-8809
Seam-II Bottom	1.6-5.6	26.9-47.2	21.2-26.3	2082-5183	C-G(D-F)	3736-5578	G6-G12	7223-8142
Seam-II MB	2.3-4.0	29.7-35.3	23.3-24.0	3711-4178	D-E	4820-5214	G7-G9	7652-7661

Seam	M%	ASH%	VM%	UHV (K.Cal/Kg.)	Grade (Based on UHV)	CV (K.Cal/ Kg.)	Grade (Based on GCV)	CV (Dmmf) (K.Cal/ Kg.)
Seam-II Comb	3.8-4.6	28.9-36.6	22.9-23.0	3324-4398	D-F (E-F)	4620-5292	G7-G9	7751-8057
Seam-I Top	1.5-5.7	18.7-51.1	20.8-29.6	1368-5657	B-G (D-F)	3525-6280	G4-G13	7435-8209
Seam-I Middle	1.8-5.3	18.6-50.8	18.0-27.7	1599-5602	C-G (D-F)	3400-5459	G7-G13	7365-7977
Seam-I TM	2.9-4.3	27.2-46.0	20.5	2151-4544	D-G (E-F)	3903-5363	G7-G12	7440-7836
Seam-I Bottom	1.5-4.1	20.1-53.9	18.3-27.6	1172-5208	C-Ungr (E-F)	2491-6071	G5-G17	7217-8006
Seam-I MB	2.8-5.2	33.5-43.8	-	2459-3642	E-F	4016-4716	G9-G11	7531-7727
Seam-I Comb	2.9-3.6	30.9-49.4	20.1	1682-4128	E-G (F-G)	3484-5114	G8-G13	7303-7818
Local	2.3-5.7	15.7-52.8	17.6-26.5	1213-5984	B-G (E-G)	2867-6286	G4-G15	6945-7970
Seam-K5	2.5-5.8	8.0-49.9	-	1677-7603	A-G (C-E)	3502-6753	G2-G13	7301-8090

Seam	M%	ASH%	VM%	UHV (K.Cal/Kg.)	Grade (Based on UHV)	CV (K.Cal/ Kg.)	Grade (Based on GCV)	CV (Dmmf) (K.Cal/ Kg.)
Seam-K4	2.8-6.2	6.4 - 45.9	-	2116-7492	A-G (B-D)	3761-6963	G2-G12	7397-8117
Seam-K3	2.3-6.1	7.1-48.7	15.1-31.40	1820-7244	A-G (B-D)	3400-7145	G1-G13	6981-8154
Seam-K2	2.3-5.6	6.5-47.4	22.4	1996-7299	A-G (B-D)	3712-7056	G1-G12	7428-8128
Seam-K1	1.0-5.1	8.4-49.8	19.3-28.7	1773-7230	A-G (B-D)	3603-7213	G1-G13	7515-8254

Note: *(i) TM Stands for Top & Middle Merged.*
(ii) MB stands for Middle & Bottom Merged.

An exercise has been carried out to assess the coal reserves under D&E grade which together may give an overall ash of nearly 34% and that of F grade & inferior coals with higher ash content. It will be observed that the grade of coal seams generally range between D to G with average of E grade. The reserves in grade D & E constitute over 85% and grade F to G coal accounts for the balance 15% of the total quarriable reserves up to 100 m depth. The corresponding data for total reserves in grade D and E are nearly 70% in the depth range 100 to 300m. From the quality details as available, the reserves available in the block are suitable for power generation.

4.6 RESERVE ESTIMATION:

4.6.1 Reserve Estimation for Pakri Barwadih (West & East)

4.6.1.1 Methodology of Reserve Estimation

Reserves for all the potential coal seams of Barakar formation i.e. Seams I bottom – Seam V top except IV-A & Local Seams have been estimated by utilizing isochore of individual coal seams. In this isochore method, the areas between successive isochores were determined with the help of digital planimeter which has been multiplied with the average thickness of successive isochores to arrive at volume of chore. The specific gravity of 1.28 + 1% of ash% has been considered for estimation of tonnage of different coal seams.

4.6.1.2 Seam-wise Grade-wise Geological Reserve:

Grade-wise reserves were also computed by measuring area between iso-grad (UHV contours).

4.6.1.3 Category wise Net geological reserves

The reserves so estimated have been categorized as Proved and Indicated reserves based on density of boreholes. The reserves of Southern and South-Western part of the block have been placed under Indicated category, whereas the entire reserve of north – eastern part of the block is placed under Proved category. Further these reserves are also classified under UNFC guidelines considering the economic, feasibility and geological axis.

Summarized details of coal reserves are furnished in **Table 4.13** and Summary of Coal Reserve in Million tonnes is given in **Table 4.14**

Table 4.13
Seam-wise Grade-wise Geological Reserve

Seam Name	Area Sq. Km.	Grades							
		B	C	D	E	F	G	Ungr.	Total
PROVED RESERVES									
Area less than 100m Depth									
EASTERN SECTOR									
Seam-V Top	0.128	0.128				0.004	0.328		
Seam-V Bot	0.214	0.214				0.465			
Seam-	0.841	0.841				4.883	2.386	0.077	

Seam Name	Area Sq. Km.	Grades							
		B	C	D	E	F	G	Ungr.	Total
IV Comb									
Seam-III Top	0.438	0.438			0.874	0.423	0.052		
Seam-III Comb	0.067	0.067				0.192			
Seam-II Top	1.644	1.644			0.549	2.340	3.468		
Seam-II Mid	1.580	1.580			9.877	6.295			
Seam-II Bot	1.642	1.642			0.388	10.443	1.603		
Seam-II MB	0.063	0.063				1.415			
Seam-I Top	1.771	1.771		2.253	1.400	0.019			
Seam-I Mid	2.551	2.551				1.502	2.964	5.290	
Seam-I Bot	0.782	0.782			0.613	1.227	0.877	1.380	
Total				**2.253**	**13.701**	**29.208**	**11.678**	**6.747**	
Area Between 100m & 300m Depth									
Seam-V Top	1.575			0.044	0.047	5.304	0.206		5.601
Seam-V Bot	1.497				2.534	0.746			3.280
Seam-V Comb	0.170				0.579				0.579
Seam-IV Comb	1.590				6.095	6.332	0.276		12.703
Seam-III Top	1.687		1.091	3.632	0.529	0.131			5.383
Seam-IIIBot	0.171					0.312			0.312
Seam-III Comb	0.097				0.419				0.419
Seam-II Top	1.256		0.337	0.588	1.801	3.408	0.143		6.277

Seam Name	Area Sq. Km.	Grades							
		B	C	D	E	F	G	Ungr.	Total
Seam-II Mid	1.642			16.659	3.020				19.679
Seam-II Bot	1.558			0.392	11.643	0.080			12.115
Seam-II MB	0.015				0.336				0.336
Seam-I Top	1.465	0.103	0.595	1.773	0.537	0.079			3.087
Seam-I Mid	1.726					2.732	3.927		6.659
Seam-I Bot	1.130					1.151	2.067		3.218
Total		**0.103**	**2.023**	**23.088**	**27.540**	**20.275**	**6.619**		**79.648**
Total for EASTERN SECTOR		**0.103**	**4.276**	**36.789**	**56.748**	**31.953**	**13.366**		**143.235**
CENTRAL SECTOR									
Area less than 100m Depth									
Seam-V Top	0.013					0.038	0.012		0.050
Seam-IV Top	0.172					0.776			0.776
Seam-IV Bot	0.178			0.234	0.270				0.504
Seam-IV Comb	0.069				0.565				0.565
Seam-III Top	0.382			0.080	0.376	0.236			0.692
Seam-III Bot	0.441			0.592	0.502				1.094
Seam-II Top	0.860			1.720	1.529				3.249
Seam-II Mid	0.900			2.249	10.939				13.188
Seam-IITM	0.761			5.227	5.379				10.606
Seam-II Bot	1.615			0.487	6.953	3.094	0.159		10.693
Seam-II MB	0.240				5.738				5.738

Seam Name	Area Sq. Km.	Grades							
		B	C	D	E	F	G	Ungr.	Total
Seam-II MB	0.240				5.738				5.738
Seam-I Top	1.053			0.339	0.776	0.588	0.691		2.394
Seam-I Mid	1.746			0.013	0.320	1.200	4.010		5.543
Seam-I TM	0.149					0.287	2.154		2.441
Seam-I Bot	0.552			0.071	0.267	0.611	0.373		1.322
Seam-I Comb	0.024						0.038		0.038
Total				**11.012**	**33.614**	**6.830**	**7.437**		**58.893**
Area Between 100m & 300m Depth									
Seam-V Top	2.056			0.443	1.023	3.187	1.939		6.592
Seam-V Bot	2.092			0.074	0.153	3.036	1.664		4.927
Seam-V Comb	0.995		0.209	0.271	0.605	0.783	0.591		2.459
Seam-IV Top	0.639				0.706	1.914	0.154		2.774
Seam-IV Bot	0.784			0.254	0.334	0.538	0.334		1.460
Seam-IV Comb	3.199				1.233	26.630	1.723		29.586
Seam-III Top	3.090		0.350	2.127	2.859	0.190			5.526
Seam-III Bot	1.180		0.550	1.070	0.869				2.489
Seam-III Comb	0.240			0.168		0.675			0.843
Seam-II Top	3.070		0.071	2.574	4.221	1.203	0.292		8.361
Seam-II Mid	3.927		1.475	43.298	6.393				51.166
Seam-IITM	0.941			12.451	5.465				17.916
Seam-II	3.592			1.210	21.87	6.638	0.164		29.885

Seam Name	Area Sq. Km.	Grades							
		B	C	D	E	F	G	Ungr.	Total
Bot					3				
Seam-II MB	0.487				11.580				11.580
Seam-II Comb	0.199				5.551				5.551
Seam-I Top	2.649			0.595	1.350	2.236	1.174		5.355
Seam-I Mid	3.378				0.095	3.796	3.726		7.617
Seam-I TM	0.004						0.066		0.066
Seam-I Bot	1.157					1.436	2.108		3.544
Seam-I Comb	0.231						2.675		2.675
Total			**2.655**	**64.535**	**64.310**	**52.262**	**16.610**		**200.372**
Area beyond 300m Depth									
Seam-V Top	0.519					1.483	0.608		2.091
Seam-V Bot	0.648				0.125	2.085			2.210
Seam-V Comb	0.445		0.221	0.266	0.285	0.275			1.047
Seam-IV Top	0.222					0.580			0.580
Seam-IV Bot	0.222					0.623			0.623
Seam-IV Comb	1.587					16.216	0.594		16.810
Seam-III Top	1.053			0.149	1.357	0.271	0.137		1.914
Seam-III Bot	0.051			0.081	0.018				0.099
Seam-II Top	1.485			0.592	1.836	1.229	1.151	0.254	5.062
Seam-II Mid	1.490			10.994	9.362				20.356
Seam-II Bot	1.482			0.216	4.545	5.434			10.195

Seam-II Comb	0.045				1.256				1.256
Seam-I Top	0.688			0.022	0.079	0.843	0.634		1.578
Seam-I Mid	0.808					1.339	0.862		2.201
Seam-I Bot	0.572					0.893	0.428		1.321
Total			**0.221**	**12.320**	**18.863**	**31.271**	**4.414**	**0.254**	**67.343**
Total For CENTRAL SECTOR			**3.876**	**88.867**	**117.787**	**91.363**	**29.461**	**1.254**	**327.608**

WESTERN SECTOR									
Area less than 100m Depth									
Seam-III Top	0.507						1.068		1.068
Seam-III Bot	0.377				0.574	0.189			0.763
Seam-IITM	1.470			6.063	17.010				23.073
Seam-II Bot	1.661			0.374	4.048	3.912			8.334
Seam-I Top	1.710	0.485	1.192	1.023	1.775	0.669			5.144
Seam-I Mid	2.217		2.511	3.804	2.744	0.394			9.453
Seam-I Bot	1.242			0.714	2.235	1.965			4.914
Seam-I MB	1.018				7.782				7.782
Total		**0.485**	**3.703**	**11.978**	**36.168**	**7.129**	**1.068**		**60.531**
Area Between 100m & 300m Depth									
Seam-V Top	0.902				0.139	1.145	1.868		3.152
Seam-V Bot	0.387					0.939			0.939
Seam-V Comb	0.469				0.722	0.896			1.618
Seam-IV Top	1.195				0.685	7.551			8.236

Seam-IV Bot	1.192			0.570	2.516	0.968	0.348		4.402
Seam-IV Comb	1.061				0.643	12.158	0.219		13.020
Seam-III Top	1.107		0.524	0.759	0.632	0.563	0.412		2.890
Seam-III Bot	0.188				0.409				0.409
Seam-III Comb	0.502			0.605	0.964				1.569
Seam-II Top	0.583			1.791	0.909				2.700
Seam-II Mid	0.901		0.224	8.190	2.801				11.215
Seam-IITM	1.906			4.047	25.424				29.471
Seam-II Bot	2.421			4.350	12.278	3.185	0.078		19.891
Seam-II Comb	0.098			2.285					2.285
Seam-I Top	2.034			0.970	1.881	2.226	0.428		5.505
Seam-I Mid	2.563			0.399	3.546	6.382			10.327
Seam-I Bot	1.802				0.666	3.732	0.903		5.301
Seam-I MB	0.623					7.076			7.076
Seam-I Comb	0.069					0.871			0.871
Total			**0.748**	**23.966**	**54.215**	**47.692**	**4.256**		**130.877**
Area beyond 300m Depth									
Seam-V Top	0.334			0.409	0.348	0.397			1.154
Seam-V Bot	0.229					0.465			0.465
Seam-V Comb	0.121				0.432				0.432
Seam-IV Top	0.465					3.392			3.392
Seam-IV Bot	0.465				0.967	0.815	0.216		1.998

Seam-IV Comb	0.472				0.326	3.567			3.893
Seam-III Top	1.016		0.359	0.632	1.224	1.077	0.197		3.489
Seam-III Comb	0.581			1.281	0.275				1.556
Seam-II Top	0.030			0.138					0.138
Seam-II Mid	0.540			0.464	0.770				1.234
Seam-IITM	0.565			11.388	0.972				12.360
Seam-II Bot	0.474			0.660	3.429	0.299			4.388
Seam-I Top	0.436			0.025	0.416	0.828	0.214		1.483
Seam-I Mid	0.559				0.926	1.896			2.822
Seam-ITM	0.081				1.277				1.277
Seam I Bot	0.457					1.158	0.210		1.368
Total			**0.359**	**14.588**	**11.014**	**13.497**	**0.837**		**41.449**
Total for WESTERN SECTOR		**0.485**	**4.810**	**50.532**	**101.397**	**68.318**	**6.161**		**232.857**

INDICATED SECTOR									
EASTERN SECTOR									
Area Between 100m & 300m Depth									
Seam-V Top	0.704					2.661			2.661
Seam-V Bot	0.679			0.193	0.980	1.672			2.845
Seam-IV Top	0.240.				1.913				1.913
Seam-IV Bot	0.300		1.682						1.682
Seam-IV Comb	0.748				5.183	2.638			7.776
Seam-III Top	0.752			0.972	0.551	0.079			1.602
Seam-III Bot	0.073					0.161			0.161

Seam-III Comb	0.118				0.499				0.499
Seam-II Top	1.116			0.554	4.438	0.103			5.095
Seam-II Bot	1.270				10.347	0.484			10.831
Seam-I Top	0.527		0.095	0.708	0.314				1.117
Seam-I Mid	0.727				0.118	2.252	0.408		2.778
Seam-I Bot	0.610					1.600	0.166		1.766
Total			**1.777**	**2.427**	**24.298**	**11.650**	**0.574**		**40.726**
Area beyond 300m Depth									
Seam-V Top	1.888					2.863	2.868		5.731
Seam-V Bot	2.213			0.716	2.126	2.254			5.096
Seam-IV Top	1.060				8.448				8.448
Seam-IV Bot	2.060		8.857						8.857
Seam-IV Comb	0.339				0.825	2.385			3.210
Seam-III Top	1.546			0.052	2.511	0.842			3.405
Seam-III Bot	0.823					2.080			2.080
Seam-II Top	3.694				10.653				10.653
Seam-II Mid	2.681			18.973	1.387				20.360
Seam-II Bot	2.685				15.257				15.257
Seam-I Top	1.387	0.221	1.363	1.281					2.865
Seam-I Mid	1.781					2.547	4.327		6.874
Seam-I Bot	1.290			0.013	0.116	1.751			1.880
Total		**0.221**	**10.220**	**21.035**	**41.323**	**14.722**	**7.195**		**94.716**
Total for EASTERN SECTOR		**0.221**	**11.997**	**23.462**	**65.621**	**26.372**	**7.769**		**135.442**
CENTRAL SECTOR									
Area Between 100m & 300m Depth									

Seam-V Top	0.258					0.575	0.167		0.742
Seam-V Bot	0.541					0.769	0.467		1.236
Seam-IV Top	0.317					2.605			2.605
Seam-IV Bot	0.317			0.084	0.568				0.652
IV Comb	1.495				9.410	6.147			15.557
III Top	0.326		0.105	0.172	0.461				0.738
Seam-III Bot	0.763				1.593				1.593
Seam-II Top	1.189				6.136	0.521	0.588		7.245
Seam-II Mid	0.632			7.401	0.670	0.075			8.146
Seam-II Bot	0.740			0.608	0.914	4.448			5.970
Seam-I Top	1.163			0.249	0.105	1.103	1.202		2.659
Seam-I Mid	1.462				0.834	1.899	0.360		3.093
Seam-I Bot	1.126						1.723	0.881	2.604
Total			**0.105**	**8.514**	**20.691**	**18.142**	**4.507**	**0.881**	**52.840**
Area beyond 300m Depth									
Seam-V Top	4.240					1.895	12.577	0.716	15.188
Seam-V Bot	4.670				3.262	5.778	0.196		9.236
Seam-IV Top	1.814				4.235	10.657			14.892
Seam-IV Bot	1.814			0.560	1.269	4.376			6.205
Seam-IV Comb	2.488				1.887	8.281			10.168
Seam-III Top	2.985		0.090	0.935	3.767	1.574			6.276
Seam-III Bot	1.991			0.746	2.502	0.948			4.196
Seam-II Top	3.876			3.266	19.307	0.757	0.540		23.870
Seam-II Mid	4.230			10.874	12.771	0.243			23.888
Seam-II Bot	4.212			0.196	31.639	1.695			33.530

SEAM/DEPTH	0 - 50	50 - 100	100 - 150	150 - 200	200 - 250	250 - 300	TOTAL
II BOT	695	5011	2630	2639	1117	6	**12098**
I TOP	1081	2927	1355	1240	496	0	**7099**
I MID	1485	1670	1039	216	2	2	**4414**
I BOT	862	629	276	104	1	1	**1873**
I M+B	2366	6632	3407	4115	1537	5	**18062**
TOTAL	**7191**	**39083**	**26681**	**24307**	**9374**	**52**	**106688**

Table 4.21

SEAM WISE AND DEPTH WISE UNDERGROUND RESERVES PB (NW)

(in '000 Tonnes)

SEAM/DEPTH	<300	>300	TOTAL
LOCAL	0	2597	**2597**
K - 5	128	0	**128**
K – 4	4209	2	**4211**
K – 3	3334	9	**3343**
K – 2	5355	20	**5375**
K – 1	15023	219	**15242**
TOTAL	**28049**	**2847**	**30896**

4.7 Total Reserves

Total reserves of Pakri Barwadih Coal Block is given in **Table 4.22**.

Table No 4.22

Total Reserve in Pakri Barwadih Block

Sl. No.	Reserve Category	PB West & East	PB NW	Total(Reserve in Million Tones)
1	Proved	703	134.470	837.470
2	Indicated	733	3.114	736.114
	Total	1436	137.584	1573.584

CHAPTER V

MINING

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No. 340 (15)/2009-CPAM
Ministry of Coal, Govt. of India

CHAPTER V
MINING

5.1. GENERAL

5.1.1. Pakri Barwadih coal mining block covers an area of 46.95 Sq km and located in North Karanpura Coalfield. Present Mining Plan covers entire area of the block including an area of 2.66 sq km falling outside block between Barakar seams and metamorphic on the rise side for OB dumps, proposed mine infrastructure, evacuation corridor and railway siding. Underground Mining is also proposed for which separate mining plan shall be submitted on 9th year from the commencement of Opencast Mining operations. Details of area is given in **Table 5.1**.

Table 5.1
Area of the Block

Sl. No.	Particulars	Area in Sq. Km
1	Pakri Barwadih West and East	39.43
2	Pakri Barwadih North West	4.85
3	Additional area for OB dump, Infra, Evacuation	2.66
	Total	**46.95**

5.1.2. Total 27 number of villages are located in the coal block. Villages namely Itiz, Chirudih, Nagadi, Dadi Kalan, Chepa Kalan, Arahara, Pakri Barwadih, Sinduari, Sonbersa, Churchu, Jugra, Chepa Khurd, Keri, Langatu, Deoria Khurd, Urub, Barkagaon, Bariatu ,Beltu, Kandaber, Nawadih, Sirma, Basariya and Jabra. Sirma, Basariya and Nawadih are located in the northern part of the block. Jabra village is towards Southwest of the block.

Cumulative population of approximately 8339 Project Affected Persons (PAPs) were estimated for the block. These PAPs shall be relocated at Rehabilitation and Resettlement Colony which shall be constructed near Denga Village on the South Eastern part of the Block.

5.2. MINE DESIGN STRATEGY

5.2.1. Out of 44.28 sq Km block area of Pakri Barwadih Block, 29.28 Sq Km is fully explored and rest 15 sq km is regionally explored. 266.08 Ha of land falls outside of the block boundary. Two nos. of Geological Reports have been prepared, the first GR which was prepared by CMPDI covered West and East part of the block while the other GR prepared by MECL covered North West sector. Total area of the block is 46.95 Sq. Km. Estimated coal reserves are

1573 million tonnes. Data from both the GRs have been used for preparation of Present Mining Plan.

5.2.2. Pakri Barwadih Block is designed to produce 18 MTPA (Peak Capacity) of coal for captive usage of NTPC Power Plants located at different parts of country. As block area is virgin/Greenfield and no coal evacuation infrastructure is available at present, requisite infrastructure is also planned.

5.2.3. In the present Mining Plan, coal from Pakri Barwadih blocks is envisaged for extraction of coal by Open Cast method of mining.. Coal shall be extracted up to 300 meter depth line only by mixed slicing method through deployment of Shovel-Dumper combination. Horizontal slicing method shall be adopted to extract coal from PB North West and East quarry while combination of inclined and horizontal slicing method shall be adopted to extract coal from PB West quarry.

Underground Mining is proposed for which separate mining plan shall be submitted on 9th year from the commencement of opencast mining operations.

5.2.4. Initially two box cuts namely Box cut-West & Box cut – East shall be simultaneously driven for Pakri Barwadih West, Pakri Barwadih East respectively. PB East quarry shall be worked for two years initially. On 4th year to facilitate augmentation of coal extraction one more box cut in the quarry PB North West shall be driven. During 25th year when the PB-West quarry ceases to operate, previously driven (Box Cut-East) shall be restarted and continued for extraction of coal from PB East quarry in the remaining life of PB East mine.

5.2.5. Mining Operations shall be carried out in three quarries namely PB West, PB East and PB North West. PB West quarry shall commence production on 1st operating year shall produce peak production of 15 MTPA in 12th operating year. PB East quarry shall also commence on the 1st operating year and shall produce peak production 1.1 MTPA for initial two years only. However, while PB West Quarry shall still be operational PB East quarry shall be restarted after 25th year. Throughout the period of 37 operational years PB West Quarry and PB East together shall be producing 15 MTPA of Peak production.

PB North West quarry shall commence production on 4th operating year and produce peak production of 3 MTPA up to 50th year.

The combined peak production of Pakri Barwadih shall be 18 MTPA from 12th to 37th operational year. Total life of Pakri barwadih coal mine is 52 years.

5.2.6. For optimisation of internal dumping in PB West quarry, 4 pits shall be created namely WP-1, WP-2 WP-3 and WP-4 to progressively all these pits shall be worked and filled by in pit dumping in succession. For operation of PB East only one pit shall be created. PB North West quarry shall be worked by making two pits namely PIT-1, PIT-2 and in later years PIT-1 shall be filled by in pit dumping.

5.2.7. Scrapping of Top soil, face preparation, marking of holes, drilling, charging of holes blasting, loading through excavators, transportation of OB & coal to the destination, observance of safety requirements, dust suppression, deployment of statutory personnel, haul roads preparation, grading, environment management, wildlife preservation etc. shall be routine operations observed during extraction of mineral.

5.2.8. Useful Top soil shall be scrapped and stacked separately before preparation of OB for reclamation purposes. Drilling and Blasting shall be performed by deployment of large diameter drilling machines and SMS/emulsion explosives. Excavated OB shall be loaded by High capacity Excavators in High capacity Dumpers. This OB shall be dumped either in allocated external dumps or designated in pit dumps.

5.2.9. In initial years OB shall have to be exclusively dumped in the external dump. Dump A, B & C are earmarked to dump Overburden produced from PB West quarry. Dump D is earmarked to dump Overburden produced from PB East quarry for two years only. During the course of mining in the Western Quarry, in pit dumping shall also be carried out when sufficient de-coaled area is available. In the later years i.e after 25 years entire Overburden of PB East quarry shall be dumped in the void created by workings of PB West quarry. Here also intermittent in pit dumping shall be performed. Therefore no re-handling of OB shall take place for PB-West and PB East quarry. It is not proposed to re handle external dumps created by PB West & PB East Quarry.

5.2.10. For PB-NW quarry three external dumping location have been identified name A, B and C. External dump A shall be re-handled to facilitate extraction from PIT-2. Dump-C shall be re-handled and filled in the void of PB-West quarry to facilitate extraction of coal locked beneath it. Dump heights varying from 60m-90m shall be maintained.

5.2.11. Nallahs namely Khora, Dumuha, Pakwa Nalla, Hardara are traversing through the block.

It is proposed to construct a catchment canal from the northern periphery of the block as per the diversion study report prepared by CWPRS, Pune. The above drain shall also serve the purpose of catchment canal for rainwater and runoff from northern hills.

Lathorva nalla which flows from western side of PB NW quarry shall not be diverted but realigned/straightened if necessary emboldened to carry additional load of diverted Khora Nalla.

Before restart of exploitation of East Quarry reserves Hardara Nalla shall be diverted in the periphery of PB East Quarry which shall meet its own course further downstream within the block boundary.

General slope for diverted channel shall be kept as 1 in 500-1000, side slopes shall be kept limited to 2H to 1V and free board shall be maintained to 1.5m.

It is amply clear from the above that all nallas flowing through the blocks and interfering with the production regime shall be diverted preferably to the northern fringe of the block to free up the locked reserves so as to ensure minimum or no sterilization of coal.

5.2.12. There shall not be any barrier between PB NW, PB West, PB East quarries hence no coal shall be sterlilized. Reserves are blocked only in the barrier left against the adjacent mines and batters which shall be governed by prevailing design standards.

5.2.13. Detailed exploration of regionally explored area below planned Dump-C where underground mining is proposed shall be carried out and finished before commencement of actual dumping operations in such a manner not to jeopardise the underground mining operations.

5.2.14. ROM coal transportation shall be effected by dumper brought up to receiving hopper of primary Crusher. Coal shall be reduced up to (-) 50mm size by the deployment of Primary and Secondary crushing units. Crushed coal from West and East Quarry shall be fed by mine end conveyor system either to stock yard having stacking & reclaiming system or directly to 14 km Cross Country conveyor transporting coal from mine to Silo at Bandag railway siding.. Within mining lease (-) 50 mm coal shall be transported from PB NW to stacking and reclaiming system by trucks.

5.2.15. Loading silos of concrete construction, shall load the coal in the Railway 60T/other specification wagons through Rapid Loading System, weighment arrangement of coal at conveyors and in motion weigh bridges shall be provided

pre & post loading points. Through Indian Railway system coal shall be transported to its destination.

5.2.16. Coal washability study has not yet been carried out for Pakri Barwadih Coal. Coal quality parameters obtained from the proximate analysis of coal revealed that ash percentage in all probability is likely to remain 34% or below which does not call for commissioning of coal washery. However to cater for more stringent future quality stipulations, space allocation is earmarked for commissioning of Coal Washery at mine end to facilitate transport of washed coal to the power plants as per qualitative requirements.

5.2.17. Permanent source of electrical power is identified as Patratu Thermal Power station transmission lines shall be drawn at 220KV. The 220/33/11KV main receiving station is being envisaged by NTPC for providing power for mining operations. Two nos. of 33KV independent feeders are provided from 33KV switchgear for each quarry i.e for PB West, PB East and PB North West quarry. Further power distribution to infrastructure and other facilities for both the quarries shall through 33KV transmission Lines. High capacity DG sets have been envisaged for backup power.

5.2.18. Hazaribagh-Tandwa Road which passes through eastern part of the block is identified as approach road to connect the mine from Sate Highway. Nearly 10 km road upto Mine entry shall be constructed/strengthened for transportation of HEMM during commissioning. Existing Hazaribagh- Tandwa Road shall be diverted at the periphery of PB East quarry during 18th year of mining operation to facilitate extraction coal from East quarry.

5.2.19. Requisite infrastructure is planned for PB West & East quarry and NW quarry. Infrastructure proposed for PB West such as CHP, Sub Station, Workshop, administrative buildings etc. shall be utilised also for PB East quarry., Some infrastructure/facilities such as haul roads, culverts drainage system etc. shall be made separately for eastern quarry. Certain facilities such as coal sampling lab, environmental cell, vocational training centre, magazine etc. shall be common for both the quarries.

5.2.20. Environment clearance, forest clearance, nalla diversion study, SES study have been completed for PB West and PB East quarry. However, Environment clearance, Forest clearance, Nalla diversion study, SES study shall be carried out separately for PB NW quarry. Slope stability and wash ability study (if required) shall be carried out for entire block.

5.2.21. During mine closure there shall be two voids. The first in the order shall be in the North West side while the second shall be on the eastern side of the block. Re-handling of internal & external dump overburden for reduction of void is not

envisaged in the present mining plan. The voids so left shall serve for the purpose of water storage reservoir for use society and shall also facilitate groundwater recharge. Overburden dumps shall be planted, as far as possible the other area shall be levelled and planted and handed over the state government. Dangerous infrastructures shall be dismantled, manpower shall be shifted to other operating mine of NTPC. Roads and buildings shall be handed over to the state government for public use.

5.3. MINING

As already explained extraction of reserves shall be carried out from three distinct quarries of Pakri Barwadih Coal Block. The mining system is explained under following different heads.

i) Characteristics of Deposit
ii) Quarry boundary
iii) Opening up of Deposit
iv) Quarry Design Strategy
v) Mineable Reserves and Stripping Ratio
vi) Mining Method and Choice of Technology
vii) System Parameters
viii) Drilling and Blasting
ix) Disposal of Waste
x) Projected Production Plan/Calendar Program
xi) Equipment Requirement
xii) Annual Capacity and Life of Quarry
xiii) Quarry Drainage

5.3.1. Characteristics of Deposit

PB West & East

The geological & mining characteristics of the PB West & East depicts total 12 workable splits contained in 5 seams i.e. Seam-I to V is considered for open cast mining. Seam I occurrence is not reported in most of the boreholes, as a result mining shall be carried out in patches. In general, the coal seams are dipping at 1 in 3 to 1 in 5 towards south. As per Geological Report prepared by CMPDI, the Karharbari formations containfive thin non workable seams namely K1 – K5. The average thicknes of these seams are less than 1m. GR indicated four coal seams (Seam-II to V with 9 distinct splits) amenable for opencast mining. On critical analysis taking mineral conservation as top priority, patches of seam I is also considered in the planning. Advance drilling shall be carried out to prove the extent of Seam-I for opencast mining. The seam can be taken with the same Haul Road in pockets.

PB (North West)

The geological & mining characteristics of PB North West depicts a basinal structure particularly in the, area north and west which are Precambrian inlier.

The older formations are exposed along the periphery of the coalfield while the youngest Mahadevas occur in the axial region. The axis of syncline runs almost east-west. The general strike of the formation is almost east-west. The local swing in the strike at places is due to rolling dip. The strata are dipping at 10° to 12° southerly.

The block is traversed by 8 numbers of faults. Among these, 3 faults are varying from 0 m to 50 m. Fault F1 is the major fault varying in through from 160m to 180m. This fault runs approximately along southern to western boundary of the block. The trend of the fault is NW-SE and except faults F7 & F8, all are extending in metamorphic terrain.

There are total 10 nos. of coal seams, 5 each coal bearing horizons belonging to Barakar & Karharbari formation respectively. In ascending order these are seam K-1,K-2,K-3,K-4,K-5 in Karharbari Formation and Local(L), I, II, IV & V in Barakar Formation. Seam I splits into 3 sections viz. I Top, I Middle & I Bottom. At places Seam I Bottom and I Middle combined and form single seam namely I Bottom + Middle. Similarly, Seam II also splits into 3 sections viz. II Top, II Middle and II Bottom. Seam II Top and II Middle coalesce to form single seam as II Top + II Middle in eastern part. Seam V & IV occur as a combined seam.

In the proposed Mining Plan, the entire property is envisaged to be mined by opencast method from the view of conservation of coal.

The mining & geological characteristics of the PB West East quarriable block for OCP are given in **Table 5.2A. The mining & geological characteristics of the PB West East** quarriable block for OCP are given in **Table 5.2B.**

Table 5.2A

Mining and Geological Characteristics of PB West & East Quarriable Block

Sl No	Particulars	Unit	WEST QUARRY				EAST QUARRY
			WP-1	WP-2	WP-3	WP-4	
I	Seams/ Splits		Thickness range of Coal Seam				
	1. 1B	m	3.27-6.03	0.20 – 6.69	0.25 – 5.44	0.22 – 8.1	0.25 – 4.8
	2. 1M	m	2.2 – 10.13	1.7 - 5.5	1 – 4.95	0.42 – 5.9	0.87-6.71
	3. 1T	m	2.65 – 5.98	0.45 – 3.23	0.93 -11.36	0.6 – 5.35	0.42 – 4.95
	4. IIB	m		2.84- 8.82	2.68-11.26	1.4 – 11.4	1.99 – 14.02
	5. IIM	m		1.75 – 8.82	5.14 – 11.25	5.9 – 20.04	3.5 – 10.98
	6. IIT	m		0.74 – 8.49	0.98 – 5.2	1.54 – 12.7	0.23 – 2.85
	7. IIIB	m		0.23 – 2.85	0.28 – 3.1	0.16 – 2.30	0.21 – 2.41
	8. IIIT	m		1.3 – 2.01	0.67 – 2.53	0.23 – 3.75	0.49 – 3.22
	9. IVB	m			0.86- 3.59	0.65 – 7.64	0.87 – 6.56
	10. IVT	m			0.9 – 4.26	1.8 – 7.88	2.34 – 6.57
	11. VB	m			0.29 – 3.0	0.37 – 3.0	0.21 – 2.04
	12. VT	m			0.3 – 3.0	0.36 – 3.24	0.84-3.91
			Average thickness overburden				
II	Top OB (Avg.)	m	22.96	26.72	27.37	91.16	74.57
III	Partings		Thickness range of Parting				

	Part bet IB & IM	m	2.29 – 3.62	0.95 – 10.56	1.13 – 16.35	0.95 – 11.96	0.85- 18.7
	Part bet IM & IT	m	1.0 – 2.60	1.66- 3.71	1.01 – 15.8	1.02 – 18.77	1.6 – 14.73
	Part bet IT & IIB	m		7.43 – 25.5	11.21 – 30.05	6.21 – 30.43	4.74 – 27.94
	Part bet IIB & IIM	m		1.6 – 6.28	0 – 2.85	0.85 – 4.65	0.97 – 5.8
	Part bet IIM & IIT	m		10.46 – 10.46	19.04 – 29.42	1.2 – 31.93	1.34 – 28.12
	Part bet IIT & IIIB	m		10.16-20.39	10.24 – 33.87	3.39 – 45.97	1.97 – 33.72
	Part bet IIIB & IIIT	m		4.38-24.75	2.48 – 17.29	1.1 – 20.2	0.94 – 16.94
	Part bet IIIT & IVB	m			8.58 – 29.23	5.1 – 44.31	5.31 – 22.93
	Part bet IVB & IVT	m			1.23 – 6.54	0.9 – 6.76	16.38 – 17.59
	Part bet IVT & VB	m			23.08	2.16 – 24.97	5.88 – 19.95
	Part bet VB & VT	m				0.8 – 7.19	0.82 – 4.89
IV	Quarry parameters						
	Dip of Seams		1 in 4 to 1 in 5	1 in 4 to 1 in 5.5	1 in 4	1 in 4	1 in 3
	Surface Strike Length	m	1800	2200	1600	5500	3800
	Surface width	m	400	800	400	1800	1400
	Maximum depth	m	100	150	125	300	300
	Area of excavation *	Ha	59.98	140.7	113.6	605.29	662.85

Table 5.2 B

Mining and Geological Characteristics of PB NW Quarriable Block

Sl.no	Particulars	Units	PIT 1	PIT 2
°	**Seam /Parting**			
1	V COMB	m	3.24-5.9	3.24-5.9
2	IV COMB	m	5.15-10.04	5.15-10.04
3	II TOP	m	6.96-10.61	6.96-10.61
4	II MID	m	7.17-11.68	7.17-11.68
5	II T+M	m	15.97-20.26	15.97-20.26
6	II BOT	m	2.85-6.3	2.85-6.3
7	I TOP	m	0.42-3.79	0.42-3.79
8	I MID	m	1.15-8.73	1.15-8.73
9	I BOT	m	1.01-4.17	1.01-4.17
10	I M+B	m	4.7-11.88	4.7-11.88
11	LOCAL(L)	m	0.06-2.35	0.06-2.35
12	K-5	m	0.08-1.32	0.08-1.32
13	K-4	m	0.28-1.74	0.28-1.74
14	K-3	m	0.45-1.96	0.45-1.96
15	K-2	m	0.06-2.99	0.06-2.99
16	K-1	m	1.19-4.68	1.19-4.68
	Top OB (Avg.)	Average thickness overburden		
		m	25	45

	Parting			
1	Par bet V COMB & IV COMB	m	3.72	27.16
2	Par bet IV COMB & II TOP	m	0.98	30.55
3	Par bet II TOP & II MID	m	1.09	5.12
4	Par bet II MID & II T+M	m	0	0
5	Par bet II T+M & II BOT	m	1.4	24.22
6	Par bet II BOT & I TOP	m	5.89	15
7	Par bet I TOP & I MID	m	0.52	4.51
8	Par bet I MID & I BOT	m	0.17	4.19
9	Par bet I BOT & I M+B	m	0	0
10	Par bet I M+B & LOCAL(L)	m	16.8	27.68
11	Par bet LOCAL(L) & K-5	m	16.39	29.67
12	Par bet K-5 & K-4	m	4.74	12.65
13	Par bet K-4 & K-3	m	4.4	9.85
14	Par bet K-3 & K-2	m	8.45	19.58
15	Par bet K-2 & K-1	m	1.95	13.84
	Quarry parameters			
1	Quarry floor area	ha	167	158
2	Quarry surface area	ha	267	175
3	No. of seams	no	14	14
4	Life in years	no	24	28
5	Gradient		10° to 12°	10° to 12°
6	Strike length (along floor)			
	a) Maximum	m	1180	1060
	b) Minimum	m	565	270
7	Strike length (along surface)			
	a) Maximum	m	1410	1050
	b) Minimum	m	1060	290
	Depth		280	280

Note:
**Total quarriable area for all the pits=1982 ha (919.2 (West quarry) + 662.85 (East quarry) = 1582 ha. Out of 1562ha, 42 ha is common because of excavation to be done in phases. Hence net quarriable area for West & East quarries is 1540 ha).*

5.3.2. Mine/Quarry boundary

The boundaries of PB West and PB East Quarry are delineated and given in **Table-5.3**.

Table 5.3
Boundaries up to 300 m depth line

Particulars	WEST QUARRY				EAST QUARRY	NORTH WEST QUARRY	
	WP -1	WP -2	WP -3	WP -4		PIT-1	PIT-2
North-West Boundary	Incrop of seam I	F_{14} and Incrop of seam I	Incrop of seam I	Incrop of seam I	Incrop of seam I	in-crop of K -1 seam Quarry surface has been projected at 45° on the surface with respect to the quarry floor	in-crop of K -1 seam Quarry surface has been projected at 45° on the surface with respect to the quarry floor.
West Boundary	Khora nala and Incrop of seam I	Khora nala and incrop of seam I	Arbitrary line	Khora nala	F_5 F_5	20 m from the Khora – B Nala.	20 m from the Khora – B Nala
East Boundary	F_{14} & Incrop of seam I	F_{10} - F_{11}	F_5	F_5	F_3 F_3/F_2 F_2	60 m from the Khora - A Nala	60 m from the Khora A Nala
South-East Boundary	F_{13}	F_{10} & F_{11}	F_5 and FRL of 300 Seam-II	300 m depth line/ FRL of 120 m Seam II	300 m depth & FRL of 120 m of Seam II	Quarry surface has been projected at 45° on the surface as well as on the confluence of Khora Nala - A & B	Quarry surface has been projected at 45° on the surface as well as on the confluence of Khora Nala - A & B.

Note: 7.5m space width is left from the outer boundary of PB NW quarry

5.3.3. Opening up of Deposit

Advance action activities would be implemented before starting Box-Cut operation in WP–1, WP–2 and WP–3 and EP in 1st year of quarry operation. These activities include

i) Land acquisition and possession.

ii) Construction of canal on the rise side of the proposed West Quarry to control inflow of surface water of the area on the rise side. This canal joins Hardara (Pakwa) nala in the east and Khora nala in turn Lathorva Nalla in the west.

iii) Bringing power line to the project and construction of electrical sub-station.

iv) Construction of the workshop for commissioning of HEMM and other necessary civil constructions.

v) Construction of essential Residential Buildings.

vi) Railway siding and coal loading arrangement for coal dispatch.

Details are shown in Surface Master Plan (SMP).

NW-Pit 1 shall be opened first by opening a box cut near the borehole MNPB - 7 in the incrop of Seam K - 1 at a gradient of 6% to touch the seam floor. The bottom seams are workable in this area. Initially the quarry shall be advanced towards southern block boundary in south and **NW-Pit 2** commences from an arbitrary line adjoining Pit - 1 in north. During later years the mine shall be advanced towards south in the dip side. Coal production shall start in P–4. During P – 6 of mining operations shall be shifted further west ward to accommodate the overburden in-pit dumping and the earlier mine opening

shall cease to operate. At the P–28, OB and Coal shall be transported to and from Pit – 2 through western most corner of the block. Temporary pit workshop shall cease to operate and permanent workshop shall be used for various purposes.

5.3.4. Quarry Design Strategy

PB-West and PB East

i) The rated capacity shall be achieved at the end of 12th year by increasing the production in gradual manner in order to create the space for internal dumping.

ii) A total of 9 workable splits contained in four seams i.e. Seam –II to V is considered for open cast mining excluding three distinct splits of Seam – I which is having three distinct splits has also been considered for mining in patches. Wherever required, advance drilling (if required) shall be carried out to prove the extent seam 1.

iii) It has been envisaged that quarry operation shall be started by creating three separate pits viz WP-1, WP-2 & WP-3 simultaneously in west quarry area to create the internal dump space along the area bounded by up throw faults.

iv) Due to the small size of pits, in the initial period, mine production shall be limited and gradually start producing 10 Mt by 5th year of production after about 3 km strike length in pit WP-4 gets developed.

v) The mine production shall again start increasing from 11th year of operation gradually when the WP-2, WP – 3 and WP – 4 shall merge leading to longer strike length of more than 5 km.

vi) The western quarry shall achieve a rated capacity of 15 Mt/yr from 12th year of operation and shall continue till 24th year (Stage Plans are enclosed). Further capacity enhancement is not possible due to the following reasons:

- Property is intervened by 19 Nos. of strike faults resulting into reduced strike length as well as dislocation of Seam II.
- Steep gradient of coal seams needs adoption of modified inclined slicing method of working in mining mass.
- Problem of internal dump stability at the floor gradient of 1 in 3 to 1 in 5.
- Large volume of overburden handling (Avg. SR 1: 4.16)
- Limited dump space available outside the mining mass where maximum dump height of 90 m has been considered.
- Most of the coal seams are thin with thickness ranging between 1 m to 4 m except seam II B & II M which are 6 to 9 m.
- Highly splitted seams with variable parting.

- Congestion of mining equipment at overburden benches. As the maximum possible per day dumping just matches with the dumping requirement at 15 MTPA.
- Considerably high rate of face advancement of the order of 60 m and 103 m in West and East quarry respectively in down dip direction to achieve 15 MTPA.

The above is depicted in Final Stage Quarry Plan.

vii) The magnitude of OB dumping can be judged from the fact that about 2098.78 million cubic meter of OB shall have to be excavated and dumped suitably for mining 503.40 Mt of coal from the total mine block upto a depth of 300 m.

viii) The total dumping outside the quarry shall be accommodated in dumps A and B on the northern side in non-forest area Dump C on southern side of the open-cast limit line and Dump D on northern side of PB East limit line. The ratio of external dumping on the surface as compared to total quantity shall be about 31% for the whole opencastable mine block.

ix) Attempt has been made to reduce external dumping by raising the height of back-filled dumps in WP-1, WP-2 & WP-3 and merging these with surface dumps A & B on the northern side so as to maximise total dump capacity. Details are shown in Final Stage Dump Plan.

x) The PB West quarry has been planned to achieve a rated capacity of 15 MTPA from 12th year onwards. The production from PB West quarry shall taper from 25th year and opencastable reserves of West quarry shall be completely exhausted by the end of 27th year. The production from PB North West quarry shall commence from 4th year onwards of production plan of Pakri Barwadih Block. PB East Quarry shall restart producing from 25th year with an overlap of 3 years so as to reach the full capacity before the exhaustion of PB West Quarry and maintain the rated capacity of 15 Mt/yr till its exhaustion. The de-coaled space of West quarry shall be utilised to accommodate remaining quantity of OB/waste to be generated in PB East quarry internally.

xi) The quarriable block for West and East Part of Pakri Barwadih have total 12 workable splits contained in 5 seams i.e Seam – I to V is considered for open cast mining. Seam I occurrence is not reported in most of the boreholes, as a result mining shall be carried out in patches. In general, the coal seams are dipping at 1 in 3 to 1 in 5 towards south.

xii) Before restart of PB East quarry, Hardara (Pakwa) nallah on the eastern side shall be diverted towards dump filled area. The main road linking Hazaribagh and Barkagaon shall also be diverted along the diverted course of above mentioned nallah (South-eastern boundary of block). This shall enable release of blocked coal underneath the Hardara (Pakwa) nallah & the existing road.

xiii) A canal has been planned along the north-eastern boundary of the block to catch the rain water & small streamlets ahead of the quarriable area for smooth operation of mine during rainy season.

- **PB-North West**

i) Availability of numerous seams/splits (14nos.) at amenable depth (280m) and also reasonable coal overburden ratio (3.15 m3/t) presents a favourable situation to develop a mechanised opencast mine in the coal block under reference.

ii) The entire property is envisaged to mine by opencast method from the view of conservation of and exploitation of high grade coal.

iii) To the east of PB North West quarry adjoins PB Western Quarry which has an important bearing on design of PB North West Quarry mine. Road passing through northern fringe of the PB shall serve as approach road for PB North west. This road shall meet with Hazaribagh - Tandwa State Highway.

iv) Khora nala defines two sides of block boundary. Meandering part of Lathorva Nala – B at the western side of the block approximately 1 km in length is planned for straightening. Khora Nallah shall be diverted along the northern fringe of PB-NW part which shall discharge its load on Lathorva Nalla. Study of such diversion shall be carried out before commencement of PB-NW quarry. An embankment suitably sloped on both sides shall be constructed to prevent in-rush during rainy season and flash flood. A road of 5m wide shall run all alongside the embankment.

v) . Initial Mine entry shall be made near borehole No. MNID – 13. Floor of seam K - 1 shall be mine floor. Entire coal of the block in envisaged for extraction. Due to paucity of land for OB dumping the mine is divided into two Pits namely Pit - 1 & Pit - 2. Fault F5 – F5 (throw 150m), shall serves as a natural arbitrary line of division of two pits. Pit – 2 is planned as an extension of Pit–1 in 28th year of mining operation.

vi) As land outside the block is unavailable all generated waste shall be dumped inside the coal block boundary in three locations namely Dump - A, Dump - B & Dump - C. Dump - A shall not be re-handled while Dump B and Dump C shall be temporary and progressively re-handled at later years of mine life. Rehandling shall facilitate release of additional area for excavation of coal from Pit–2 and from Barrier between PB-NW and PB-West (Total 33.18 Mt, 10.95Mt of PB West & 22.23Mt of PB North west), Plate No.4.

vii) Coal from the mine shall be brought to the surface by 60T coal body dumpers. ROM coal shall be reduced through primary and secondary crushing to (-) 50mm size. Crushed coal shall be transported by road upto a coal stock pile near TP–1 from where it shall be brought to NTPC's

Benadag Yard by conveyors and shall be loaded on railway wagons by fast loading silo and dispatched to end use plants through Indian Railway.

viii) Taking into account the extraction of coal in the barrier between PB-NW and PB-West envisaged life of PB-NW quarry is 52 years including 3 years of construction period.

ix) Environmental clearance (EC) has already been obtained for PB block (West & East Quarries) vide MoEF letter no.J-11015/692/2007-IA. II(M) dated 19.05.2009 for rated production of 15Mtpa. At present, base line data generated previously are used to address environment management chapter. However, fresh EIA/EMP shall be carried out for this block and MoEF clearance shall be obtained.

x) The area is sparsely populated as revealed during site visit, approximately 150 PAP's have been considered for preparation of Mining Plan. Site is conducting SES study based on which Rehabilitation and Resettlement Plan shall be drawn for PAPs as per NPRR and other relevant policies.

5.3.5. Mineable Reserves, OB and Stripping Ratio

The total mineable reserve of **PB West and East Quarry** is estimated as 503.39 Mts up to the 300m depth line i.e. FRL of 120 m of seam II bottom and mineable coal reserves of seam I, which is found suitable for mining by the open cast method, especially in the western part of PB West Quarry and PB East Quarry. The corresponding OB removal estimated as 2098.78 Mm3 at an average stripping ratio of 4.16 m3/t. Percentage extraction with respect to net geological reserves for seam II to V is also given in the same table. Due to the discontinuous nature of Seam I it has been planned that mining shall be done in patches.

Total geological coal reserve of **PB NW Quarry** as per GR is estimated to be about 137.584 Mt. It is estimated that 105.78 Mt of mineable coal would be available against overburden of 348.24 Mm^3 within the mine boundaries However additional reserves of barrier 33.18 Mt. and additional OB of 90 Mm3 shall also be excavated is kept at present in Pit-2 account. The average stripping ratio works out to 3.30m^3/t. Extractable reserves of PB West & East is given in **Table-5.4**. The detailed break-up of quarry wise and sub-quarry wise mineable reserves is given in **Table 5.5**.

Table 5.4
Extractable Reserves

Total geological reserve up to 300 m depth line		
Sl No.	**Description**	**Reserves (Mt)**
1	Seam I to V Net geological reserves as per (CMPDI GR):	707.67
2	Seam I to V Net geological reserves as per geological model based on Bore Hole data	696.78
3	Difference	1.5 %
As per GR, seam I has not been considered opencastable		
4	Net geological reserves Seam II to Seam V (upto 300 m depth line) amenable to opencast mining	540 *
5	Additional coal reserves available beyond 300m depth line on high wall side as considered in Mining plan	15.45
6	Total reserves arrived for proposed quarry upto pit depth(4+5)	555.45
7	Less : Reserves transferred to UG property due to (a) Enclosed between Nallah and fault F-3 (b) Coal falling South of fault F-5	48.05
8	Less :Coal Reserves in crushed zones between faults F1 & F2 having very steep gradient, narrow patch and cannot be worked hence kept outside pit boundary	16.50
9	**Net opencastable Reserves Seam II to seam V (9 -10-11)**	**490.90**
10	To be extracted from Eastern & Western Quarry	437.01
11	Barrier against Khora Nallah to be opencasted later along with North-West patch "A".	10.95
12	**Net Extractable reserve (seam II to seam V)**	**447.96**
13	**Percentage extraction (seam II to seam V)**	**91.25 %**
Reserve balance of seam I , a part of which has been considered for opencast mining in the present mining plan		
14	**As per GR, Total reserve of seam I up to 300 m depth line**	135
15	Reserves transferred to UG property	17.24
16	Coal Reserves in crushed zones between fault F1 & F2	2
17	**Net opencastable Reserves of Seam I (14 -15-16)**	**115.76**
18	To be extracted from Eastern & Western Quarry as per calendar plan	66.39
19	Barrier against Khora Nallah to be opencasted later along with North-West patch "A".	5
20	Net extractable reserve of seam I as per mining plan (18+19)	71.39
21	Balance reserve(Part of which may be extracted later after proving by production support drilling)	39.37
22	**Total extractable reserve for West & East Quarries**	**503.37**
23	**Total Extractable reserve for NW Quarry**	**138.96**
23	**Total extractable reserve for PB Block (22+23)**	**642.35**

* As per table 5.4.1(pg. 169) of GR indicating sectorwise and depthwise volume of total excavation recasted at table 04.09 of mining plan the assessed volume of coal up to 300 m depth line of seam II.

bottom is 329 Mm3 which compares favorably with volume estimates through geological model i.e. 327.27 Mm^3 (equivalent to 540 Mt considering average sp. gravity of 1.65)

Table 5.5
Mineable Coal Reserves, Volume of OBR, Stripping ratio

Quarry	Extractable reserves in Mt	OB including Access trench in Mm3	Strip ratio cum/t
WEST QUARRY(Seam I-V)			
WP -I	6.65	25.9	3.89
WP -II	28.47	82.57	3.01
WP -III	18.51	62.57	3.38
WP -IV	258.09	1067.44	4.14
Subtotal (West Quarry)	311.71	1238.49	3.97
EAST QUARRY (EP-1)(Seam I-V)	191.68	860.29	4.49
Subtotal (East Quarry)	191.68	860.29	4.49
***Subtotal (West and East Quarry)**	503.39	2098.78	4.17
NORTH WEST QUARRY (All Seam)			
PIT 1	68.6	201	2.94
PIT 2	70.36	237.24	3.96
****Subtotal (NW Quarry)**	138.96	438.24	3.15
TOTAL (block)	642.34	2537.02	3.95

Remarks:

**Up to 300 m depth line, OB estimated as per GR = 1441 Mm^3. In the GR, the OB estimation is based on considering vertical wall along 300 m depth line.*

- ***i*** *In the Mining-Plan, the final stage-working plan envisages. Inclined pit slope due to benching and for stability. Hence the total OB in quarriable area works out to 2098 Mm^3 considering pit slope for both Western & Eastern quarries combined and extraction of Seam-I in certain patches.*
- ***ii*** *In the Mining-Plan certain patches of Seam-I is planned to be extracted by opencast. For this additional overburden, parting between Seam-I top to FRL of Seam-II B is required to be evacuated for extracting Seam-I. Total quantity 186 Million m^3 – II to I.*
- ***iii*** *Additional excavation done along high wall to provide for inclined pit-slope providing stability to the high wall as well as for batter roads 471 Million m^3 (This 471 Million m^3 constitutes 22.45 % of total excavation i.e. 2098 Million m^3)*

Hence additional excavation required to be done on account of above two reasons is 186 Million m^3 + 471 Million m^3 = 657 Million m^3.

Thus total OBR removal/ excavation required to be done = 1441 Million m^3 + 657 Million m^3 / = 2098 Million m^3

***The Geological Report indicated that the coal reserves down upto Seam - I are 106.688 Mt with an OB: Coal ratio of 1.649.*
In the present Mining Plan, the lower seams also have been considered for OC mining due to two reasons :first Good quality of coal in Karharabari seams and the second he stripping ratio for the workable area (>1m) of these seams comes around 3.5-4 m3/t for all the seams combined together.

i. *The equipment selection and operating methods have been designed considering the volume and nature of overburden and disposition of coal seams.*

ii. *Additional reserves of 33.18 Mt. from barrier & batter. and additional OB of 90 mm3 shall also be excavated is kept at present in Pit-2 account*

Extractable Reserves:

Net opencastable reserves of Pakri Barwadih is 808.23 Mt, barrier loass and batter loss worked out as 58.74 Mt and 106.22 Mt. Taking into account of mining losses of 20.72 Mt extractable reserves worked out as 642.35 Mt. Percentage of extraction by opencast mine is 78%. Net reserves and extractable reserves alongwith losses are given in **Table -5.6.**

Table -5.6
Net reserves and extractable reserves and losses

(in Mt.)

Seam	Net Reserve	Barrier Loss	Batter Loss	Mineable Reserves	Mining Loss	Extractable Reserve	% Extraction
V Top	22.29	0.72	1.57	19.99	0.59	19.40	87.06
V Bottom	15.56	0.51	1.10	13.96	0.41	13.55	87.06
V Combined	11.57	0.21	0.49	10.87	0.44	10.43	90.16
Seam - V	**49.42**	**1.44**	**3.16**	**44.82**	**1.44**	**43.38**	**87.78**
IV Top	19.82	0.64	2.23	16.95	0.50	16.46	83.01
IV Bottom	9.92	0.32	1.12	8.48	0.25	8.23	83.01
IV Combined	92.32	3.15	10.68	78.49	2.43	76.06	82.39
Seam - IV	**122.06**	**4.10**	**14.03**	**103.93**	**3.18**	**100.75**	**82.54**
III Top	27.45	1.21	2.04	24.20	0.70	23.49	85.59
III Bottom	9.83	0.43	0.73	8.66	0.25	8.41	85.59
III Combined	4.80	0.21	0.36	4.23	0.12	4.11	85.59
Seam - III	**42.08**	**1.85**	**3.13**	**37.10**	**1.08**	**36.02**	**85.59**
II Top	59.98	4.66	6.21	49.11	1.89	47.22	78.72
II Middle	139.75	11.83	11.24	116.68	3.83	112.86	80.75
II TM	76.09	7.28	5.63	63.18	1.77	61.40	80.70
II Bottom	116.05	10.76	9.90	95.39	2.89	92.50	79.71
II MB	17.90	1.71	1.32	14.86	0.42	14.44	80.70
II Combined	7.35	0.70	0.54	6.11	0.17	5.94	80.70
Seam- II	**417.13**	**36.95**	**34.85**	**345.33**	**10.97**	**334.36**	**80.16**
I Top	36.93	2.72	9.39	24.81	0.77	24.05	65.11
I Middle	72.97	5.27	18.20	49.49	1.66	47.84	65.56
I TM	2.51	0.23	0.79	1.49	0.04	1.45	57.80
I Bottom	35.60	2.52	8.69	24.39	0.52	23.87	67.06
I MB	14.85	1.35	4.67	8.83	0.24	8.58	57.80

(a) Bucket Wheel Excavator

Bucket Wheel Excavator (BWE) alternative has not been considered due to following reasons

i. The strata below the upper most weathered mantle are hard and strong requiring blasting hence bucket wheel is not viable.

ii. Presence of large number of seams and interburden layers of mostly of small thickness, which shall be uneconomic in this alternative.

iii. Requirement of precision selective mining which shall not be possible by bucket wheels especially for thin seams and partings.

In view of the above this option is not recommended.

(b) Dragline

Dragline has not been recommended due to following reasons:

i. Steep gradient of seams

ii. Multiplicity of seams and that the lower most seam is thin and the OB parting lying over is also thin due to which neither the advantage of long reach can be taken nor adequate OB material shall be available from the overlying OB layer for direct casting.

In view of the above this option is not recommended.

(c) Continuous Surface Miner (CSM)

CSM has not been recommended due to following reasons:

i. Depth of mine is 300m depth (approx.) and seams are dipping at 1 in 3 to 1 in 5, these machines cannot be deployed exclusively due to limitation of mobility /flexibility.

ii. These machines also require wider benches which shall require comparatively higher volumes of OB to be removed in the initial stages leading to higher cost of production and imbalance in equipment utilization due to subsequently decreasing OB: coal ratio.

iii. Over and above, marginal grade improvement shall be of much use in this specific case.

In view of the above this option is not recommended.

(d) Shovel & Dumper

Shovel & dumper combination is recommended due to following reasons:

i. In view of multiple seams and equal nos. of inter burden layers to be tackled, an equipment system which is capable of dealing many layers

	OB Bench	70^0	70^0
	Coal Bench		70^0
	Dump bench	37^0	37^0
	Overall (Ultimate) pit slope	**37^0** (300 m depth)	43^0 (155m depth)

5.3.8. Drilling and Blasting

For PB West and East Quarry Drilling & Blasting shall be required both in OB and Coal benches before excavation by shovels. Top OB benches shall be developed in horizontal/inclined slicing method. 20 m3 rope shovel along with 170-190 T class of dumpers shall be deployed. A part workload of Top OB shall also be handled by 8.3 cum Hydraulic shovels with 120-150T class of dumpers

Partings and coal seams shall also be worked in horizontal slices using a combination of hydraulic front end and backhoes machines to minimise intermixing of waste with coal with intermediate benches of 5m.

Thin seams (Seam V T and V B, Seam III T and III B, thin partings between Seam V T and V B, between IV T and IV B, II M and II B shall be ripped, dozed and piled by 850 hp/510kW dozers. The piled material shall be taken by 5 cum wheel loaders, loading onto 120-150T trucks.

Based on the workload of the above sections, it is expected that about 5% of the OB workload and about 10% of the coal workload shall be ripped. The balance material shall have to be blasted.

For PB NW Quarry Drilling & Blasting shall be required both in OB and Coal benches before excavation by shovels. Top OB benches shall be developed in horizontal slicing method. 10 m3 shovel along with 100 T class of dumpers shall be deployed. A part workload of Top OB shall also be handled by 5.5 cum Hydraulic shovels with 60 T class of dumpers

Partings and coal seams shall also be worked in horizontal slices using a combination of hydraulic front end and backhoes machines to minimise intermixing of waste with coal with intermediate benches of 5m.

Thin seams (Seam V T and V B , Seam III T and III B, thin partings between Seam V T and V B, between IV T and IV B, II M and II B shall be ripped, dozed and piled by 410 hp dozers. The piled material shall be taken by 8-10 cum wheel loaders, loading onto 100 T trucks.

Based on the workload of the above sections, it is expected that about 5% of the OB workload and about 10% of the coal workload shall be ripped. The balance material shall have to be blasted.

5.3.8.1. Drilling & Blasting in Overburden

For PB West and East Quarry top O.B benches shall be of 15 m height where 250 mm Blast hole drill shall be used for drilling blast holes. For thin partings & thick wedges, 160 mm Blast hole drill shall be used.

Blasting pattern depends upon the nature and hardness of rock and varies from mine to mine. Expert agency shall be engaged to design and optimize the blast patterns after field trials.

For PB NW Quarry Top O.B benches shall be of 15 m height where 250 mm Blast hole drill shall be used for drilling blast holes. For thin partings & thick wedges, 160 mm Blast hole drill shall be used.

Blasting pattern depends upon the nature and hardness of rock and varies from mine to mine. Expert agency shall be engaged to design and optimize the blast patterns after field trials.

Suggested pattern is given below in **Table-5.8**

Table-5.8

Pattern of Drilling in Overburden

Sl. No.	Particular	1MTY	3 MTY	10 MTY	15 MTY
1	Average Annual OB including top and parting (mm^3)	6	18	40	66
2	Weekly OB Removal (000 mm^3)	120	350	700	1270
3	Weekly Explosive Required (tonnes)	50	150	300	500
4	Blast Hole Spacing (meters)	8 to 10	8 to 10	8 to 10	8 to 10
5	Blast Hole Burden (meters)	7 to 8	7 to 8	7 to 8	7 to 8
6	Powder Factor assumed (m^3/Kg of explosives)	2.5	2.5	2.5	2.5
7	Type of Explosives	Bulk Explosives slurry/emulsion			

Blast holes shall be suitably drilled to provide sufficient OB to each shovel unit for one week's work load.

5.3.8.2. Drilling & Blasting in Coal

For PB West and East Quarry Coal benches planned are of 10m or less in height. 160 mm drill shall be used for drilling blast holes in Coal benches. Blasting shall be done once in 3 days in Coal benches. Field trials shall be required by expert agency for designing best suited pattern in coal.

For PB NW Quarry Coal benches are planned for 10 m or to the thickness of seams, whichever is less. 160 mm drill shall be used for drilling blast holes in Coal benches.. Field trials shall be required by expert agency for designing best suited pattern in coal.

Suggested pattern for blasting in coal is given below in **Table-5.9**

Pattern of Drilling in Coal

Table-5.9

Sl. No.	Particular	1MTY	3 MTY	10 MTY	15 MTY
1	Annual Coal Production (Mt)	1	3	10	15
2	Three days Coal Production considering 330 days a year (000 T)	10	30	100	150
3	Explosives required for 3 days coal production (tones)	1.7	6	17	25
4	Blast Hole Spacing (meters)	6	6	6	6
5	Blast Hole Burden (meters)	5	5	5	5
6	Powder Factor assumed (m^3/Kg of explosives)	6t/kg of explosive	6t/kg of explosive	6t/kg of explosive	6t/kg of explosive
7	Type of Explosives	Bulk Explosives slurry/emulsion			

Effort shall be made to suitably distribute drilling in all coal benches to provide 3 days work load to each shovel.

Powder factor of 0.3 kg/cum for OB and 0.2 kg/cum for coal has been assumed for Explosive consumption.

5.3.8.3. Control of ground vibrations due to blasting

Ground vibration due to blasting shall be controlled by following:

- Reducing the explosive charged per delay
- Reducing the spacing and burden per blast

- Reducing the amount of explosive charged per blast
- Proper controlled rock movement during blast by using suitable initiating sequence and delay.

5.3.8.4. Storage of explosive

It is envisaged that the blasting operation shall be carried out by Emulsion/SMS (Site Mix Slurry) and shall be transported to the mine site by the explosive agency located centrally for the North Karanpura coalfield.

For PB-West & East Quarry A cluster of 3T magazines, 3 in nos. (total capacity 9T) is provided for storing detonating fuses, detonators etc. and other explosives for secondary blasting if necessary.

For PB-NW Quarry A 3T magazines, 1 in nos. (Total capacity 3T) is provided for storing detonating fuses, detonators etc. and other explosives for secondary blasting if necessary.

Magazines shall be located as shown in the Surface Master Plan at place generally not interfered with public or employees.

If required additional Magazines capacity shall be provide to improve operational efficiency

5.3.9. Disposal of Waste

5.3.9.1. Overburden Management

For PB West and East Quarry Proposed quarries namely PB West and East are to be opened in Barakar formations, which consist of alluvium soil, sandstone and shale. The thickness of soil/weathered mantle generally varies from 6-18 m. It is commonly dirty-white to reddish-brown in colour and carbonaceous shale generally constitutes bulk of inseam burden.

The overburden / Waste stripping operation shall start first with top soil removal which shall be stacked separately for reclamation purposes from both the quarries. The top soil dump has been planned over the non-coal bearing areas of eastern quarry. The external dumps "A", "B" for PB West Quarry and external dump "D" for PB East have been planned on non-opencastable coal area where quarriable potential is not indicated in the GR.

The OB from WP-1, WP-2 & WP-3 would be dumped externally up to 5th year of quarry operation in external dumps A & B. Whereas the OB from EP1 would

be dumped externally up to 2nd year of quarry operation in external dump D. The assessed OBR (solid) **capacities are 10.3 Mm^3 (Dump A), 67 Mm^3 (Dump B) and 6 Mm^3 (Dump D) respectively which corresponds to loose capacities of 12 Mm^3, 80 Mm^3 and 7.2 Mm^3 respectively for dump A, B & D. About 21 Mm^3 of OB shall be transported to the area earmarked for dump 'C' in the 4th year of operation.** The WP-1, after de-coaling in 7th year, shall accommodate internal dumping. Subsequently, WP-2 and WP-3 shall also be ready to accommodate internal dumping after its de-coaling i.e. 8th year and 10th year respectively. After two years of mining operation in PB (East) quarry no dumping shall be resorted to external dump D.

From 7th to 11th year, OB shall be accommodated in the de-coaled area of WP-1, WP-2 and WP-3. As soon as de-coaled area is created in the floor of Seam-II within WP-4, internal dump shall be formed after leaving a safety distance of 100-150m from advancing lower most coal bench of high wall side of the OCP. This safety distance shall be reduced if step up fault is met while advancing. The high wall face, because of step up fault, shall act as a retaining wall for holding the slope of dump. However, a scientific study shall be undertaken before going for implementation. In addition to it, a safety distance of 100-150 m shall be kept against the haul road to accommodate conveyor system for transporting coal also.

After accommodating OB in the floor of WP-4 (Internal Dumping), balance OB from 12th year onwards shall be accommodated in Dump 'C'. Afterwards the OB shall be accommodated in maximum possible space available within WP-4 but major share of OB shall still have to be accommodated in dump 'C'. The capacity of dump 'C' has been assessed as 563 Mm3. Dump C has been planned over the area where the coal is beyond 300m depth line and thus suitable for exploitation by underground means only for which tentative scheme for mining has been envisaged and included in the Approved Mining Plan. Reserves beyond 300 m depth line are under "Indicated" category and shall be subjected to detailed exploration. As such no coal shall thus get sterilized due to dump 'C'.

ONGC/IOC programme of CBM exploration/exploitation shall be taken care of while dumping in dump "C". A corridor of about 40-50m width shall be marked from WP-4 upto the dump 'C' location in consultation with ONGC/IOC and a haul road shall be developed to connect with dump C.

After exhaustion of WP-4 quarry, East Quarry shall be restarted. Entire remaining OB of East Quarry shall be dumped into voids of West Quarry.

Final stage dump plan, as well as other stage plans also show the location of external/internal dumps in respective stage plans including height as well as volume of dump.

The total non-forest land available in south side of the quarriable block is 15 sq. km in which 7.7 sq. km is available for Dump "C", balance 7.3 Sq.km covers, safety distance of 300m against the high wall side of the OCP, two different locations of pair shafts for approaching coal seams lying at depth, two villages which are densely populated and area kept for further advancing of high wall side of the OCP in future, if need arises. This shall be decided at a later date for extending the quarry beyond 300 m depth line if feasible.

Small area of non-forest land falling on north side of the quarriable block has been proposed to be utilized for infrastructure of the OCP, leaving forest area in which only a magazine is proposed to be located. Most of the forest area is having hilly terrain hence dump formation over the hilly terrain is not feasible.

PB North West quarry is dotted with hillocks on its north , on the west & south side, the block is surrounded by Kerandari 'C' coal block. Above constraints restricts the availability of land outside the block. No space outside the block is envisaged for dumping of overburden. Entire overburden generated during the life of the mine shall be dumped inside the block boundary.

OB generated shall be dumped at the three locations viz. Dump 'A', Dump 'B' and Dump 'C'.

External Dump A'

It is located on the north western side on non-coal bearing area. From 1st to 3rd year of mining operation, OB shall be dumped in 3 benches of 30m each. The OB shall be rehandled at the closing stages of the mine life for reclamation purposes. Total volume accommodated in this dump is 11.00Mm^3 and the area of the dump is 16.23 Ha.

External Dump B':

It is located on the western side of coal bearing zone i.e. Pit – 2.From 6th to 28th year of mining operation, OB shall be dumped in two benches of 30m each. This OB shall be rehandled from 28th year onwards and dumped in the void of Pit-1 and void created by PB west pit. This arrangement shall facilitate release of coal progressively for simultaneous excavation. Entire OB shall be

rehandled for concurrent reclamation. Total volume accommodated at peak in this dump is 49.75Mm^3 and the area of the dump is 123 Ha.

External Dump C':

It is located on the south side of the coal bearing zone at the confluence of Khora Nala A & B. From 16th to 19th year of mining operation i.e. for 4 years, OB shall be dumped in three benches of 30m, 20m, and 10m height respectively. The OB shall be re-handled during 40th year to free up the blocked reserves beneath it. Coal below this dump shall be taken alongwith the locked coal of barrier between PB West and this quarry. Total volume accommodated at peak in this dump is 3.50Mm^3 and the area of the dump is 10 Ha.

In Pit Dumping:

Above three dumps together accommodate 73.44 Mm^3 out of 438 Mm^3 generated during the life of the mine. About 9.19Mm^3 of OB is utilized for creation of embankment along nala which is accounted in Dump A and remaining 364.79 Mm^3 of OB shall be accommodate in in-pit dumping during different stages of mine.

OB removal and its phasing from Pakri Barwadih is given in **Table- 5.10 & Table 5.11** respectively. Percentage dumping of overburden in internal and External dumps are given in **Table 5.12**.

Table 5.10

Year wise proposed OB Removal from PB (Mm^3)

Prod. Year	OBR (West Quarry)	Cum OBR (West Quarry)	OBR (East Quarry)	Cum OBR (West Quarry)	Total OBR (West & East)	OBR (NW Quarry)	Cum OBR (NW Quarry)	Total OBR (PB Block)
1	5.94	5.94	2.95	2.95	8.89		0	8.89
2	15.27	21.21	3.05	6	18.32		0	18.32
3	21.12	42.33		6	21.12		0	21.12
4	26.11	68.44		6	26.11	4.08	4.08	30.19
5	25.03	93.47		6	25.03	8.15	12.23	33.18
6	35.51	128.98		6	35.51	11.69	23.92	47.2
7	41.44	170.42		6	41.44	12.03	35.95	53.47
8	41.52	211.94		6	41.52	12.03	47.98	53.55
9	41.5	253.44		6	41.5	12.03	60.01	53.53
10	41.5	294.94		6	41.5	8.22	68.23	49.72

Prod. Year	OBR (West Quarry)	Cum OBR (West Quarry)	OBR (East Quarry)	Cum OBR (West Quarry)	Total OBR (West & East)	OBR (NW Quarry)	Cum OBR (NW Quarry)	Total OBR (PB Block)
11	44	338.94		6	44	8.22	76.45	52.22
12	44	382.94		6	44	8.22	84.67	52.22
13	52.76	435.7		6	52.76	8.22	92.89	60.98
14	66.04	501.74		6	66.04	8.22	101.11	74.26
15	66	567.74		6	66	8.22	109.33	74.22
16	66	633.74		6	66	8.22	117.55	74.22
17	66	699.74		6	66	8.21	125.76	74.21
18	66.01	765.75		6	66.01	8.21	133.97	74.22
19	66.01	831.76		6	66.01	8.21	142.18	74.22
20	66.01	897.77		6	66.01	8.21	150.39	74.22
21	66.01	963.78		6	66.01	8.21	158.6	74.22
22	66.01	1029.79		6	66.01	8.21	166.81	74.22
23	66	1095.79		6	66	8.22	175.03	74.22
24	66	1161.79		6	66	8.23	183.26	74.23
25	31.2	1192.99	31.85	37.85	63.05	8.23	191.49	71.28
26	26	1218.99	36.95	74.8	62.95	8.23	199.72	71.18
27	19.5	1238.49	46.5	121.3	66	8.23	207.95	74.23
28		1238.49	66	187.3	66	9.17	217.12	75.17
29		1238.49	66	253.3	66	11.36	228.48	77.36
30		1238.49	66	319.3	66	11.36	239.84	77.36
31		1238.49	66	385.3	66	11.36	251.2	77.36
32		1238.49	66	451.3	66	11.36	262.56	77.36
33		1238.49	66	517.3	66	11.37	273.93	77.37
34		1238.49	66	583.3	66	11.43	285.36	77.43
35		1238.49	66	649.3	66	11.43	296.79	77.43
36		1238.49	66	715.3	66	11.43	308.22	77.43
37		1238.49	66	781.3	66	11.43	319.65	77.43
38		1238.49	66	847.3	66	10.32	329.97	76.32
39		1238.49	12.99	860.29	12.99	10.04	340.01	23.03
40						9.00	349.01	9
41						9.00	358.01	9
42						9.00	367.01	9
43						9.00	376.01	9
44						9.00	385.01	9
45						9.00	394.01	9
46						9.00	403.01	9
47						9.00	412.01	9
48						8.50	420.51	8.5
49						7.00	427.51	7

Prod. Year	OBR (West Quarry)	Cum OBR (West Quarry)	OBR (East Quarry)	Cum OBR (West Quarry)	Total OBR (West & East)	OBR (NW Quarry)	Cum OBR (NW Quarry)	Total OBR (PB Block)
50						5.75	433.26	5.75
51						3.50	436.76	3.5
52						1.48	438.24	1.48
Total	**1238.49**		**860.29**		**2098.78**	**438.24**		**2537.02**

Table 5.11
Phased overburden dumping /waste disposal and capacity of dumps

(in Mm^3)

Particulars	PB WEST AND EAST										PB NW								PB GRAND TOTAL
	External Dump (Solid)					Internal Dump (Solid)					External				Internal				
	A	B	C	D	SUB TOTAL	A (Extn.)	B (Extn.)	WP-4	SUB TOTAL	Total (West&East)	DUMP 'A'	DUMP 'B'	DUMP 'C'	Sub Total	DUMP 'A' Extn.	WP-4	Sub Total	TOTAL (NW)	(Solid)
1- 5 yrs																			
WP1	10.33	6.55			**16.88**					**16.88**									**16.88**
WP2		40.00			**40.00**					**40**									**40.00**
WP3		8.23	21.00		**29.23**					**29.23**									**29.23**
WP4		7.36			**7.36**					**7.36**									**7.36**
EP1				6.00	**6.00**					**6**									**6.00**
PIT-1											9.08			**9.08**	3.15		**3.15**	**12.23**	**12.23**
PIT-2																			
6 - 10 yrs																			
WP1						9.36			**9.36**	**9.36**									**9.36**
WP2		4.86			**4.86**	38.38			**38.38**	**43.24**									**43.24**
WP3						33.15			**33.15**	**33.15**									**33.15**
WP4						115.71			**115.71**	**115.71**									**115.71**
PIT-1											6.61	4.00		**10.6**	45.39		**45.39**	**56**	**56.00**
PIT-2																			

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(in Mm^3)

Particulars	PB WEST AND EAST										PB NW								PB GRAND TOTAL (Solid)
	External Dump (Solid)					Internal Dump (Solid)					External				Internal				
	A	B	C	D	SUB TOTAL	A (Extn.)	B (Extn.)	WP-4	SUB TOTAL	Total (West&East)	DUMP 'A'	DUMP 'B'	DUMP 'C'	Sub Total	DUMP 'A' Extn.	WP-4	Sub Total	TOTAL (NW)	
11 - 15 yrs																			299.80
WP 4			169.00		169.00		130.80		130.8	299.8									
PIT-1											3.00	11.00		14	27.10		27.1	41.1	41.10
PIT-2																			
16 - 20 yrs																			324.00
WP 4			206.00		206.00	37.00	2.00	79.00	118	324					10.93		10.93	10.93	10.93
PIT-1											1.50	13.00	2.00	16.5	13.63		13.63	30.13	30.13
PIT-2																			
21 - 25 yrs																			330.05
WP 4 + East Quarry			167.00		167.00			163.05	163.05	330.05									
PIT-1												12.00	1.50	13.5	27.60		27.6	41.1	41.10
PIT-2																			
26 - 30 yrs																			
PIT-1												8.75		8.75	12.46	27.14	39.6	48.35	48.35
PIT-2																			

(in Mm^3)

Particulars	PB WEST AND EAST										PB NW								PB GRAND TOTAL
	External Dump (Solid)					Internal Dump (Solid)					External				Internal				
	A	B	C	D	SUB TOTAL	A (Extn.)	B (Extn.)	WP-4	SUB TOTAL	Total (West&East)	DUMP 'A'	DUMP 'B'	DUMP 'C'	Sub Total	DUMP 'A' Extn.	WP-4	Sub Total	TOTAL (NW)	(Solid)
WP 4 + East Quarry								330.00	330	330									330.00
31- 35 yrs																			
East Quarry								330.00	330	330									330.00
PIT-1																			
PIT-2																			
36 - 39 yrs												1.00		1	21.72	34.23	55.95	56.95	56.95
East Quarry								184.00	184	184									184.00
PIT-1																			
PIT-2																			
40 - 52 yrs															22.86	20.36	43.22	43.22	43.22
PIT-1																			
PIT-2																			
															0.00	98.22	98.22	98.22	98.22
Total	10.33	67.00	563.00	6.00	646.33	233.60	132.80	1086.05	1452.45	2098.78	20.19	49.75	3.50	73.44	184.84	179.95	364.79	438.23	2537.01

RQP No. 34011/(15)/2009-CPAM dated 27.09.10.

Table 5.12
Percentage Overburden Dumping

	PB West & East (Mm3)	PB NW(Mm^3)	PB (Mm^3)	PB West an East (%)	PB NW (%)	PB (%)
External Dump	619.00	73.44	692.44	29.49%	16.76%	27.29%
Internal Dump	1479.83	364.79	1844.62	70.51%	83.24%	72.71%
Total	2098.83	438.23	2537.06	100.00%	100.00%	100.00%

5.3.9.2.Top Soil Management

For PB-WEST & EAST Quarry during Operating life of mine 5.81 Mm^3 of top soil shall be generated. This figure is arrived at by considering 1 m (approx.) thickness of top soil, as because unlike PB-NW Quarry considerable deposition has not taken place in the block.

For the initial 5 years of Mining operation, top soil shall be stacked at a designated location over coal bearing area, as shown in **Surface Master Plan**. Estimated land requirement for stacking is 1 Ha. The requirement of land shall cease to operate from 10th year onwards as because scrapped top soil shall be spread over the dump for land reclamation.

Stacking of top soil shall be achieved in two tiers. The bottom tier shall be of 3m in height while top tier shall be of 2m or shall below height not exceeding the limit as per prescribed norms.

Stack of top soil shall be grassed to retain fertility if required. Besides this, top soil stack them shall be made use of concurrent filling without bringing the scrapped top soil to the stack.

For PB-NW Quarry during Operating life of mine 5.81 Mm^3 of top soil shall be generated. This figure is arrived at by considering 1.5m (approx.) thickness of top soil, as because presence of ravines and surrounding nalas considerable deposition has taken place in the block.

For the initial 5 years of Mining operation, top soil shall be stacked at a designated location over Pit – 2, as shown in **Plate No.5**. Estimated land requirement for stacking is 1 Ha. The requirement of land shall cease to operate from 10th year onwards as because scrapped top soil shall be spread over the dump for land reclamation.

Stacking of top soil shall be achieved in two tiers. The bottom tier shall be of 3m in height while top tier shall be of 2m or shall below height not exceeding the limit as per prescribed norms.

Top soil scrapping: Scrappers shall be deployed to scrap the top soil off the surface. With the help of front end loader, top soil shall be loaded on the tripper of 10T capacity and transported to top soil stock yard. In the event of non-stacking system, top soil shall be transported directly to the desired location.

Top soil spreading: Front end loader shall load on to the trippers and transported to desired location and spread with the help of dozer/graders.

Stack of top soil shall be grassed to retain fertility if required. Besides this, top soil stack them shall be made use of concurrent filling without bringing the scrapped top soil to the stack. Year wise quantity schedule of management of top soil excavated and spread is given in **Table 5.13** and Summerised data for Top Soil Management is given in **Table 5.14.**

Table 5.13

Management of top soil

	PB West and East				PB-NW			
Year	Area of TS removal (Ha)	Prog. Top Soil (Mm^3)	Prog. Spread (Ha)	prog. Spread (Mm^3)	Area of TS removal (Ha)	Prog. Top Soil (Mm^3)	Prog. Spread (Ha)	Prog. Spread (Mm^3)
P-1	70.88	0.57	0.00	0.00	0.00	0.00	0.00	0.00
P-2	88.60	0.71	0.00	0.00	0.00	0.00	0.00	0.00
P-3	106.32	0.85	0.00	0.00	0.00	0.00	0.00	0.00
P-4	124.04	0.99	0.00	0.00	15.48	0.23	0.00	0.00
P-5	141.76	1.13	0.00	0.00	19.35	0.29	0.00	0.00
P-6	159.48	1.28	5.32	0.07	23.22	0.35	0.00	0.00
P-7	177.20	1.42	5.32	0.07	27.09	0.41	0.00	0.00
P-8	35.44	0.28	5.32	0.07	30.96	0.46	0.00	0.00
P-9	35.44	0.28	5.32	0.07	34.83	0.52	1.00	0.03
P-10	35.44	0.28	5.32	0.07	38.70	0.58	1.00	0.03

	PB West and East				PB-NW			
Year	Area of TS removal (Ha)	Prog. Top Soil (Mm^3)	Prog. Spread (Ha)	prog. Spread (Mm^3)	Area of TS removal (Ha)	Prog. Top Soil (Mm^3)	Prog. Spread (Ha)	Prog. Spread (Mm^3)
P-11	35.44	0.28	5.32	0.07	7.74	0.12	1.00	0.03
P-12	35.44	0.28	10.63	0.14	7.74	0.12	1.00	0.03
P-13	35.44	0.28	10.63	0.14	7.74	0.12	1.00	0.03
P-14	35.44	0.28	10.63	0.14	7.74	0.12	1.00	0.03
P-15	35.44	0.28	10.63	0.14	7.74	0.12	1.00	0.03
P-16	35.44	0.28	10.63	0.14	7.74	0.12	1.00	0.03
P-17	35.44	0.28	15.95	0.21	7.74	0.12	1.00	0.03
P-18	35.44	0.28	15.95	0.21	7.74	0.12	2.00	0.06
P-19	35.44	0.28	15.95	0.21	7.74	0.12	2.00	0.06
P-20	35.44	0.28	15.95	0.21	7.74	0.12	3.00	0.09
P-21	35.44	0.28	15.95	0.21	7.74	0.12	3.00	0.09
P-22	35.44	0.28	15.95	0.21	7.74	0.12	3.00	0.09
P-23	35.44	0.28	15.95	0.21	7.74	0.12	3.00	0.09
P-24	35.44	0.28	21.26	0.28	7.74	0.12	3.00	0.09
P-25	35.44	0.28	21.26	0.28	7.74	0.12	3.00	0.09
P-26	35.44	0.28	31.90	0.43	7.74	0.12	3.00	0.09
P-27	26.58	0.21	31.90	0.43	7.74	0.12	4.00	0.12
P-28	26.58	0.21	31.90	0.43	7.74	0.12	4.00	0.12
P-29	26.58	0.21	31.90	0.43	7.74	0.12	4.00	0.12
P-30	26.58	0.21	31.90	0.43	5.81	0.09	4.00	0.12
P-31	26.58	0.21	31.90	0.43	5.81	0.09	4.00	0.12
P-32	17.72	0.14	53.16	0.71	5.81	0.09	4.00	0.12
P-33	17.72	0.14	53.16	0.71	5.81	0.09	4.00	0.12
P-34	17.72	0.14	53.16	0.71	5.81	0.09	4.00	0.12
P-35	8.86	0.07	74.42	0.99	3.87	0.06	4.00	0.12
P-36	8.86	0.07	74.42	0.99	3.87	0.06	4.00	0.12
P-37	8.86	0.07	74.42	0.99	3.87	0.06	4.00	0.12
P-38	8.86	0.07	74.42	0.99	1.94	0.03	6.00	0.17
P-39	8.86	0.07	74.42	0.99	1.94	0.03	6.00	0.17
P-40	0.00	0.00	53.16	0.71	1.94	0.03	6.00	0.17
P-41	0.00	0.00	21.26	0.28	1.94	0.03	6.00	0.17
P-42	0.00	0.00	26.58	0.35	1.94	0.03	6.00	0.17
P-43	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.17
P-44	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.17

Year	PB West and East				PB-NW			
	Area of TS removal (Ha)	Prog. Top Soil (Mm^3)	Prog. Spread (Ha)	prog. Spread (Mm^3)	Area of TS removal (Ha)	Prog. Top Soil (Mm^3)	Prog. Spread (Ha)	Prog. Spread (Mm^3)
P-45	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.17
P-46	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.23
P-47	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.23
P-48	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.23
P-49	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.29
P-50	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.29
P-51	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.29
P-52	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.23
P-53	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.23
P-54	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.06
P-55	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.06
TOTAL	1772	14.176	1063.2	14.176	387.02	5.8053	200	5.81

Table 5.14
Summerised data for Top Soil Management is given in

Sl. No.	Particular	PB West & East	PB -NW
1	Total Area disturbed (Ha)	1772	387.02
2	Thickness of Top Soil Cover (m)	0.8	1.5
3	Volume of Top Soil (Mm3)	14.176	5.8053
4	Commencement of T/Soil Removal	P-1	P-4
5	Storage period in Years	5	5
6	Reclaimed area through Spread (Ha)	1063.2	200
7	Thickness of Top Soil in Reclaimed Area (m)	1.33	2.90

5.3.10. Projected Production Plan/Calendar Program

The Pit-Wise planned production programme from PB West quarry, PB East Quarry and PB North-West, is given in **Table 5.15**. Calander Programme is given in **Table-5.16**

Table 5.15
Pit-Wise production programme (Coal in Mt)

Year	PB West Quarry					PB East Quarry		PB NW			Total
	WP-1	WP-2	WP-3	WP-4	Sub Total PB-West	EP1	Sub Total PB-East	PIT-1	PIT-2	Sub Total PB-NW	
1st Yr	0.4	1.2	0.74		**2.34**	0.8	**0.8**				**3.14**
2nd Yr	0.8	2.4	1.97		**5.17**	1.1	**1.1**				**6.27**
3rd Yr	1.2	3.6	2.98	0.7	**8.48**		**0**				**8.48**
4th Yr	1.2	3.6	3.5	1.2	**9.5**		**0**	0.5		0.5	**10**
5th Yr	1.2	3.6	2.5	2.7	**10**		**0**	1		1	**11**
6th Yr	1	4.8	1.5	2.7	**10**		**0**	2		2	**12**
7th Yr	0.85	4.79	1.5	2.86	**10**		**0**	3		3	**13**
8th Yr		4.48	1.5	4.03	**10.01**		**0**	3		3	**13.01**
9th Yr			1.5	8.5	**10**		**0**	3		3	**13**
10th Yr			0.82	8.18	**9**		**0**	3		3	**12**
11th Yr				12	**12**		**0**	3		3	**15**
12th Yr to 24th Yr.				15	**15**		**0**	3		3	**18**
25th Yr				11	**11**	4	**4**	3		3	**18**
26th Yr				7	**7**	8	**8**	3		3	**18**
27th Yr				1.21	**1.21**	13.79	**13.79**	3		3	**18**
28th Yr						15	**15**	2.1	0.9	3	**18**
29th Yr to 37th Yr						15	**15**		3	3	**18**
38th Yr						10	**10**		3	3	**13**
39th Yr						3.99	**3.99**		3	3	**6.99**
40th Yr to 50th Yr							**0**		3	3	**3**
51st Yr									2	1.28	**1.28**
52nd Yr									1.46	1.28	**1.28**

Table 5.16
Calendar Program of Pakri Barwadih

Production Years	Coal Production (Mt)					OB Removal (Mm3)					Strip Ratio (m3/t)		
	West Quarry	East Quarry	PB West & East	NW Quarry	Total from PB	West Quarry	East Quarry	PB West & East	NW Quarry	Total PB Mm3)	West & East Quarry	NW Quarry	PB
1	2.34	0.8	3.14		3.14	5.94	2.95	8.89		8.89	2.83		2.83
2	5.17	1.1	6.27		6.27	15.27	3.05	18.32		18.32	2.92		2.92
3	8.48		8.48		8.48	21.12		21.12		21.12	2.49		2.49
4	9.5		9.5	0.5	10	26.11		26.11	4.1	30.21	2.75	8.20	3.02
5	10		10	1	11	25.03		25.03	8.2	33.23	2.50	8.20	3.02
6	10		10	2	12	35.51		35.51	11.7	47.21	3.55	5.85	3.93
7	10		10	3	13	41.44		41.44	12	53.44	4.14	4.00	4.11
8	10		10	3	13	41.52		41.52	12	53.52	4:15	4.00	4.12
9	10		10	3	13	41.5		41.5	12	53.5	4.15	4.00	4.12
10	10		10	3	13	41.5		41.5	8.2	49.7	4.15	2.73	3.82
11	12		12	3	15	44		44	8.2	52.2	3.67	2.73	3.48
12	15		15	3	18	44		44	8.2	52.2	2.93	2.73	2.90
13	15		15	3	18	52.76		52.76	8.2	60.96	3.52	2.73	3.39
14	15		15	3	18	66.04		66.04	8.2	74.24	4.40	2.73	4.12
15	15		15	3	18	66		66	8.2	74.2	4.40	2.73	4.12
16	15		15	3	18	66		66	8.2	74.2	4.40	2.73	4.12
17	15		15	3	18	66		66	8.2	74.2	4.40	2.73	4.12
18	15		15	3	18	66.01		66.01	8.2	74.21	4.40	2.73	4.12
19	15		15	3	18	66.01		66.01	8.2	74.21	4.40	2.73	4.12
20	15		15	3	18	66.01		66.01	8.2	74.21	4.40	2.73	4.12
21	15		15	3	18	66.01		66.01	8.2	74.21	4.40	2.73	4.12
22	15		15	3	18	66.01		66.01	8.2	74.21	4.40	2.73	4.12
23	15		15	3	18	66		66	8.2	74.2	4.40	2.73	4.12
24	15		15	3	18	66		66	8.2	74.2	4.40	2.73	4.12

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Production Years	Coal Production (Mt)					OB Removal (Mm3)					Strip Ratio (m3/t)		
	West Quarry	East Quarry	PB West & East	NW Quarry	Total from PB	West Quarry	East Quarry	PB West & East	NW Quarry	Total PB Mm3)	West & East Quarry	NW Quarry	PB
51				2	2				3.50	3.5		1.75	1.75
52				1.46	1.46				1.48	1.48		1.01	1.01
Total	**311.70**	**191.68**	**503.38**	**138.96**	**642.34**	**1238.49**	**860.29**	**2098.78**	**437.97**	**2536.75**	**4.17**	**3.15**	**3.95**

Sl. No.	Description	Productivity (Mm3)
2	10m3 Hydraulic shovel with 100T rear dumper	2.6
3	20 m3 rope shovel + RD 170 T	4.015
4	10 m3 rope shovel + RD 120 T	2.08
5	8.3 m3 hyd shovel + RD 120 T	2.18
B	COAL	
1	8.3 m3 hyd. shovel + RD 120 T	2.2
2	4.5 m3 hyd. shovel + RD 50 T	1.18
3	5.5m3 Hydraulic shovel with 60T rear dumper	1.65

Table-5.19

Productivity of dumpers for Lead

Different Combination	1 Km	1.5 Km	2 Km	2.5 Km	3 Km	3.5 Km	4 Km	4.5 Km
RD 170 T + 20 m3 shovel	0.7584	0.6398	0.5671	0.5181	0.4696	0.4322	0.4252	0.3852
RD 120+ 10m3 rope shovel	.5018	.4288	.3835	.3524	.3214	.2972	.275	.262
RD 120 T+ 8.3 m3 hyd. shovel	.566	.4845	.433	.398	.363	.336	.311	.296
RD 50 T + 4.5 m3 shovel	0.2128	0.1801	0.1603	0.1471	0.1335	0.1232	0.120	0.112
5.5m3 Hydraulic shovel with 60T rear dumper	0.2312	0.1971	0.1762	0.1623	0.1477	0.1365	0.143	
10m3 Hydraulic shovel with 100T rear dumper	0.4456	0.3758	0.3341	0.3062	0.2777	0.2559	0.2386	

The requirement of dumpers has been worked based on the annual workload, deployment of equipment, lead assessed from the stage plan of pit operations for 1st to 5th yr, 10th yr, , 20th yr, 30th yr, 40th yr and final stage along with dumping plan

It is suggested that the dumpers deployed in coal and OB to a have suitable dump bodies for optimum utilisation of the dumper payload.

5.3.11.4 Equipment selection for PB West and PB East Quarries.

The geo-mining conditions warrant that the equipment deployed in partings and coal to alternate between the coal seam and partings. Thus, in the

process of selection of mining equipment, two major equipment combinations have been proposed. One for Top OB and the other for the coal seams and the partings.

20 cum Electric Rope Shovels operating with 170T-190T class of dumpers shall be deployed in Top OB and 10 cum Electric/Diesel Hydraulic shovel/ backhoe operating with 100-120T class of dumpers in partings and Coal. The size has been decided to meet the twin objective of effective deployment, optimal utilization of the equipment and at the same time keeping the fleet size to manageable levels. This equipment size shall also offer a choice from a variety of vendors during the procurement and facilitate better inventory management.

In the initial years, the mine shall be opened by 10 cum hydraulic shovel/backhoe working with 100-120 T rear dumpers. This is proposed, as this combination shall have much smaller lead time for deployment. Deployment of 20 cum Electric rope shovels shall start as soon as the load for top OB increases.

A part of the Top OB workload is also proposed to be handled by 10 cum hydraulic shovel/backhoe operating with 100-120T rear dumpers. This has been done in years where there isn't enough consistent workload for a deployment of a new 20 cum rope shovel. This gives flexibility to the operations and also ensures better equipment utilization.

It is also proposed to work out the thin seams/partings with the help of high capacity ripper dozers (510hp).

5.3.11.5 Equipment selection for PB NW Quarries.

The geo-mining conditions warrant that the equipment deployed in partings and coal to alternate between the coal seam and partings. Thus, in the process of selection of mining equipment, two major equipment combinations have been proposed. One for Top OB and the other for the coal seams and the partings.

10 cum Electric Rope Shovels operating with 100T class of dumpers shall be deployed in Top OB and 5.5 cum Electric/Diesel Hydraulic shovel/ backhoe operating with 60 T class of dumpers in partings and Coal. The size has been decided to meet the twin objective of effective deployment, optimal utilization of the equipment and at the same time keeping the fleet size to manageable levels. This equipment size shall also offer a choice from a variety of vendors during the procurement and facilitate better inventory management.

In the initial years, the mine shall be opened by 5.5 cum hydraulic shovel/backhoe working with 60 T rear dumpers. This is proposed, as this

combination shall have much smaller lead time for deployment. Deployment of 10 cum Electric rope shovels shall start as soon as the load for top OB increases.

A part of the Top OB workload is also proposed to be handled by 5.5 cum hydraulic shovel/backhoe operating with 60T rear dumpers. This has been done in years where there isn't enough consistent workload for a deployment of a new 10 cum hydraulic shovel. This gives flexibility to the operations and also ensures better equipment utilization.

It is also proposed to work out the thin seams/partings with the help of high capacity ripper dozers (410hp). These machines shall rip the material, doze to form a heap to be handled by 10 cum front end loaders with 100 T class dumpers.Proposed.

5.3.11.6 Proposed HEMM

Size of HEMM are minimum and may vary in size as per requirement of site conditions. Proposed list of HEMM is given in **Table 5.20.**

Table 5.20
Proposed list of HEMM FOR PB WEST AND PB EAST

PB WEST AND EAST				PB-NW			
Sl. No.	Equipment	Size /capacity	Nos.	Sl. No.	Equipment	Size /capacity	Nos.
COAL							
1	Elec. Hydraulic shovel	4.5 m^3	9	1	Diesel Hydraulic Shovel with Backhoe attachment	5.5 m^3	2
2	Rear Dumper	40-60 T	77	2	Rear Dumper	60 T	18
3	RBH Drill	160 mm	15	3	RBH Drill (Electric)	160 mm	2
4	Track Dozer	310 kW	15	4	Dozer with Ripper attachments	410 HP	2
5	Back hoe hyd shovel	2.8m^3	6	5	Wheel Dozer	410 HP	1
6	Wagon drill	100mm	3	6	Coal Tippers (Coal Body)	20T	25
TOP OB/PATING/INTERBURDEN							
1	Elec. Rope Shovel	20 m^3	7	1	Hydraulic Shovel	5.5 m^3	3
2	Elec. Rope Shovel	10 m^3	5	2	Hydraulic Shovel	10.0 m^3	3
3	Elec. Hydraulic shovel	8.3 m^3	14	3	Rear Dumper	60 T	20

PB WEST AND EAST				PB-NW			
Sl. No.	Equipment	Size /capacity	Nos.	Sl. No.	Equipment	Size /capacity	Nos.
5	Rear Dumper	170-190 T	78	4	Rear Dumper	100 T	18
6	Rear Dumper	120-150 T	152	5	RBH Drill (Electric)	250 mm	3
7	RBH Drill	250 mm	24	6	Dozer with ripper attachments	410 HP	4
8	RBH Drill	160mm	10	7	Dozer with ripper attachments	850HP	4
9	Track Dozer	310 kw	30				
COMMON /AUXILIARY EQUIPMENT							
1	Dozer with Ripper	510 kW	5	1	Water Sprinkler (wide spray system)	70 KL	3
2	Motor Grader	205 kW	14	2	Truck Mounted DTH Drill	100-120mm	1
3	Wheel Loader	5 m^3	4	3	Mobile Rough Terrain Crane	70T	1
4	Diesel crane	75 T	2	4	R. T. Crane	30T	1
5	Hyd. Rough terrain crane	30 T	5	5	R. T. Crane	8T	
6	Hyd. Rough terrain crane	12 T	6	6	F.E.Loader	10 Cum	1
7	Diesel Hyd. Pickup Crane	8 T	8	7	Hydraulic shovel with Backhoe (Diesel)	1.2-2.2 m^3	1
8	Wheel Dozer	280 kW	6	8	Wagon drill	100-120mm	1
9	Water Sprinkler	28 kL	14	9	Diesel Browser	16KL	1
10	Tyre Handler		4	10	Rock Breaker		1
				11	Fire Tender		1
				12	Cable Handler		1
				13	Tyre Handler		1
				14	Tipping trucks	10 T	6
				15	Maintenance Van		1
				16	Heavy Duty Toeing truck		1
Haul Road Equipment							
				1	Grader	280 HP	2
				2	Vibratory Compactor	30TH	1
				3	Wheel Dozer	460 HP	1
Reclamation							
				1	F E Loader	10 m^3	1
				2	Water Sprinkler (wide spray system)	28 KL	2

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PB WEST AND EAST				PB-NW			
Sl. No.	Equipment	Size /capacity	Nos.	Sl. No.	Equipment	Size /capacity	Nos.
				3	Rear Dumper	60T	3
				4	Dozer (With ripper Attachment)	410 HP	1
				5	Farm Track/tractor with trolley		1

In the initial two years of mining operation of PB East quarry, separate set of smaller equipment are proposed. After completion of the said period these equipment shall be disposed of suitably. The proposed list of major equipment are mentioned in **Table 5.21**.

Proposed list of HEMM FOR PB EAST FOR INITIAL TWO YEARS

Table 5.21

Sl No	Equipment Type	Size/Cap	Population
1	Shovel	4.5 Cum	3
2	Dumper	35 T	30
3	Dozer	320 Hp	3
4	Drill Machine	160 mm	3
5	Grader	145 Hp	1
6	Water sprinkler	28 Kl	1

The size and the equipment indicated above may vary depending upon their market availability and technology upgaradtion.

5.3.12. Annual Capacity and Life of Quarry

The life of the PB OCP is estimated as 52 years. No construction period is considered. PB-NW quarry shall commence mining operation on 4th year. After 39 year peak capacity of mine shall be 3 MTPA and shall be limited to extraction of coal of barrier.

Annual peak capcity and life quarrywise and for PB mine is given in **Table 5.22**.

Table 5.22
Annual Capacity and Life of Quarry

Sl. No.	Quarry	From	To	Life	Capacity (MTPA)
1	PB-West	P-1	P-27	27	15
2	PB-East initial	P-1	P-2	2	1

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3	PB-East Later	P-25	P-39	15	15
4	PB-NW	P-4	P52	48	3
	PB Mine	**P-1**	**P-52**	**52**	**18**

5.3.13. Quarry Drainage

5.3.13.1 Quarry Dewatering

Sufficient numbers of inpit sumps as required PB West and East Quarry and all necessary in pit drainage channels to facilitate pit dewatering to comply with the Water Management Plan. A suitable number of large mining pumps (some mounted on pontoons) shall ensure adequate capacity to pump water from the mine during and after the "monsoon" season. The mine shall be so designed that it allows all water falling on the working areas to be directed to major sumps located strategically at the bottom of each pit. During very high rainfall periods production focus shall be on the drier upper benches.

Sufficient temporary and permanent inpit and expit pipework and drainage channels shall be provided for to ensure adequate dewatering can take place both during and after the monsoon period. Annual planning shall ensure that mining from lower benches is minimised during the monsoon so that disruptions to production due to flooded lower areas of the pit can be minimised also. Time to dewater the lower areas of the pit during and after the monsoon season is allowed for in the mine plan. Lower areas of the mine shall be mined during the dryer months.

5.3.13.2 Water Management Plan

The main areas of water management in the Quarry shall be:-

- Surface water flow around the mine through Garland Drains
- In pit accumulation caused by intense rainfall during the monsoon season and plans for managing this rainfall by utilising sumps, diversion ditches and pumps.
- Groundwater flow into the pit and the construction, maintenance and operation of mine dewatering plant to handle this groundwater.
- Non potable water required for construction and mining services around the mine site including fire protection.
- Potable water required for drinking purposes at both the mine site and the colony.
- Discharge of decanted water into the seasonal streams which traverse the mining lease.

5.3.13.3 Surface Water Flow

NTPC had appointed Central Water and Power Research Station (CWPRS), Pune for conducting an area-drainage study. As recommended by CWPRS, the central nallah flowing across PB block, shall be tapped at the northern boundary of the block to transfer the flow to the eastern and western nallas through diversion canals.

Water flow from this canal is directed towards both the Lathorva Nallah and Hardara (Pakwa) Nallah. Additionally collector and diversion drains shall be constructed around the outside of the pit, predominantly along the base of the waste dumps to intercept over land flow and water shed from the waste dumps. This captured water shall be diverted via the drains and sediment ponds to existing nallahs to take the water away from the mine. All collection and diversion drains shall be bunded to increase drain capacity. The alignment of the proposed canal and layout of these drains and sediment ponds are shown in the "Surface Master Plan".

Garland drains all around the periphery of the excavation zone shall be dug with the help of low capacity backhoe. This garland drain shall be connected to nearest natural nala. Such garland drains and their inter-connection shall be ever shifting and unlined. Preferably, 2m wide and 1m deep cross section is presumed to carry rain water to the nearest natural drainage.

Adequate sump capacity to cater to the ground water seepage and direct rainfall water during rainy season shall be created at all point of time in the mine life. Additional water shall be dewatered with the help of pump installed near sump at elevated location. Pipe ranges shall discharge water to the settling tank on the surface. In the settling tank/pond clear water shall be pumped to nearest natural nala.

For keeping the working face and benches during monsoon season, benches shall be mildly sloped toward sump side/dip side to allow water to percolate at the bottom most coal benches and finally lead to sump. Diesel operate face sump and slurry pumps shall be installed for occasional running for drying up faces.

Pump out water from the mine shall be brought to the settling pond located by the north of Khora/Lathorva Nala (A). Furrows suitable to arrest the siltation if any before finally pumping the clean water to nala. Settling pond shall be 2m (approx.) deep and around which bund shall be erected. Settling pond measuring approx 1 Ha shall be sloped southward to facilitate natural flow of water.

Drained mine water as explained above shall be carried to Lathorwa nala which finally meets Ghagra river on south side of the block.

5.3.13.4 In pit Storm water from Monsoon rainfall

In pit storm water runoff shall be intercepted at various levels within the pits to minimise the amount of water reaching the base of the pit. This shall involve the following system:

- Bund walls at specified levels within the pit to create a multilevel series of small holding dams
- Corresponding bench drains for interception of surface and ground water flow and its subsequent diversion to holding dams
- High volume discharge pumps at each holding dam level to discharge collected storm water. These shall be on an automatic start float system.

5.3.13.5 Groundwater Flows

Groundwater shall be controlled by the installation of dewatering wells along the perimeter of the pit which shall intercept groundwater flow and reduce the risk of excessive flows into the pit. The dewatering system shall be progressive and shall be brought on in stages as the mine develops. The system shall utilise 100 mm diameter submersible pumps in 150 mm diameter PVC well screens and casing and the wells shall be at approximately 150 m centres.

The details of the groundwater dewatering system shall be refined on the basis of data collected from specialised pump tests to be conducted along the northern pit limit of the West Quarry (between the proposed canal and the pit limit). In addition, groundwater monitoring boreholes shall be established at 500 m centres to collect data on a continuous basis, which shall be used along with geotechnical monitoring systems to assess slope stability parameters on a continual basis.

5.3.13.6 Non Potable Water Requirements

Water from the dewatering wells shall be piped to a water storage facility. From here the water shall be piped to various locations around the mine site for use in construction, dust suppression at the mine and coal handling plant, sewerage system at the mine infrastructure and Colony, green belt irrigation, fire protection and for miscellaneous washing purposes.

5.3.13.7 Potable Water Requirements

Water from the storage facility shall be piped to a water treatment plant to produce potable water. This water shall then be piped around the mine site infrastructure and to the Colony. Borewell shall also be drilled to meet

requirement of drinking water and water requirement during construction stage.

5.3.13.8 Discharged Water

Excess water from the mine shall be discharged into the existing nallahs via Sediment Ponds. The ponds shall be 300m x 300m with a depth of 1.5 to 2.0 metres and internal bunding to control flow movement.

5.3.13.9 Pumping of Mine Water

The pumping system has been planned separately for each pit considering simultaneous working. Mine has been planned in such a way that working faces and haul road shall remain dry as far as possible. Layout of quarry provides suitable gradient along quarry floor and benches to facilitate self-drainage of water to lowest level of quarry.

Proper drains shall be dug along both sides of haul road to keep the haul roads dry. Main sump at the lowest-point of quarry shall have sufficient capacity to accommodate entire make of water.

Water accumulated in the sump shall be pumped out of the mine at suitable point so that it drains away to canal and to Main River. Suitable sedimentation tank shall be made where quarry water shall be discharged and then after proper sedimentation, water shall flow to the nallahs. Pumping requirement has been assessed on the basis of,

(i) Meteorological data from nearby area concerning maximum rainfall.

(ii) Catchment area and depth of quarry.

Assuming 20 hours of pumping and six days to pump out the total water, the required pumping rate shall be 7726 cum/hr. selecting 540m3/hr pumps, the requirement is as given below. Initially 60 m head pumps shall be used for pumping out water from main Sump. As the quarries advance on dip side lower head pumps shall be replaced by higher head pumps.

a) Main Pumps [160 lps x 60 to 300 m head]: Complete with 6.6 KV 365KW electricals and starters.4% Pump sets with electricals to be kept as standby for emergency.

b) Diesel operating Pumps:

- 80 lps X 60 m head
- 35 lps X 60 m head

c) Face pumps 11 lps X 30 m head

d) Pipes: Sufficient length of pipes of dia. 406 mm, 300 mm, 219 mm and 100 mm have been envisaged for above pumps depending upon capacityofpumps.

5.4. CONCEPTUAL UNDERGROUND MINING

5.4.1 Pakri-Barwadih (PB) Block has been divided into two portions, one for opencast upto a depth of 300 meters for deepest Seam, Seam-I and the other for underground mining. No underground mining shall be carried out in the PB-NW and PB-East as all the seams are extracted by opencast working. Thickness of mining block between floors of bottom most seam to roof of top most seam varies from about 120 m to about 170 m, average being about 140 m. The maximum depth of the Pakri-Barwadih block is about 600 m. Thus, the mining depth of proposed underground mining shall vary from about 160 m to 600 m. Such a property is ideally approached by an incline for coal raising and two shafts for ventilation and man and material transport. However, an incline through quarry bottom is not possible as this shall prevent or at least greatly limit back filling of over-burden in the worked out quarry and hence underground mines shall be developed through shafts only.

As per Geological data available, the underground area of the Pakri-Barwadih block contains about 728 millions tones (Mt) of coal reserves out of which only 109 Mt are 'Proved' and balance are 'indicated'. This calls for detailed exploration and formulation of geological report before action oriented Project is prepared. The detailed exploration programme for this area has already been discussed elsewhere in the document. Deailed exploration shall be completed before start of actual dumping operations over underground area. The time frame for exploration and exploitation of underground area and submission of mining plan for the same is given below.

Zero date of Commencement of exploration work for the area - from the commencement of opencast mining operations. Commencement of mining operations shall be reckoned from commencement of shaft sinking. Schedule of commencement is given in **Table 5.23.**

Table 5.23
Schedule of Commencement PB (UG)

Sl No.	Activity	Time schedule
1	Detailed exploration of the underground area	4 years
2	Preparation of G.R.	1 year
3	Various Studies and Clearances	3 year
4	Preparation and approval of Mining Plan from MOC	1 year
3	Commencement of mining operations	1 years

	Total time	**10 years**

This chapter, therefore, deals with only a conceptual approach for exploitation of the deposit through underground mining. It may, however, be mentioned here that exploration and detailed mine planning activity are so timed and executed that it should be possible to start underground mine development activity at the earliest. This is necessary because underground mine development work, namely shaft sinking pit-bottom, winding arrangements, pump house and sump, horizon development and finally development of production panels take a long time.

5.4.2 Tentative Calendar Program:

Considering the production from area beyond 300 m depth line i.e. reserve amenable to underground mining a projected production plan is summarised in **Table 5.24.**

Table 5.24
Projected production plan

Year	UG mining (Projected)	Cumulative
	(Mt)	(Mt)
-	-	-
-	-	-
10th Yr	0.5	0.5
11th Yr	1	1.5
13th Yr	3.6	5.1
14th Yr	3.6	8.7
15th Yr	3.6	12.3
20th Yr	3.6	30.3
25th Yr	3.6	48.3
30th Yr	3.6	66.3
35th Yr	3.6	84.3
40th Yr	3.6	102.3
45th Yr	3.6	120.3
50th Yr	3.6	138.3
51st Yr	3.6	141.9
52nd Yr	3.6	145.5
-	-	-
-	-	-

5.4.3 Mine development

The underground mining area shall be developed through two pairs of shafts, one pair for the Western sector and the other for the Central sector of the Block (there being practically no area in the Eastern sector for coal of depth of more than 300 Mining from surface for development of a separate underground mine). These shafts shall be at least 400 m away from overburden dumps to ensure that infrastructure created near the shaft is not affected by any accidental slide of dumps. Shafts shall be sunk up-to a depth of about 430 m with landing arrangements at about 400 meter from surface.

From each shaft, two level cross-measure roadways (in fact marginally rising for drainage of water to shaft) shall be driven to touch initially the top-most seam but later on to all seams as need arises. There shall thus be two main intakes and two main returns. Thereafter, all development shall be in coal. At shaft bottom, the following facilities shall be developed in stone and shall serve all the seams throughout the life of the mine:

1. Pump house and Sump
2. Sub-station both at downcast (DC) shaft
3. Skip loading arrangements at upcast (UC) shaft.
4. 150-200 t coal surge bunker before skip loading arrangements.

The upcast shaft shall be suitably covered to prevent short-circuiting of air. This shaft shall be connected to main mine exhaust fans (two in number-one working, one stand-by) through a fan-drift.

The upcast shaft shall be equipped with 15-tonne skip winding system with automatic loading of coal at shaft-bottom and automatic unloading of coal at shaft-top. The winding cycle shall be of about two minutes capable of giving 30 cycles per hour. Arrangements shall be made for man-winding in skip shaft in case of emergency.

The downcast shall be equipped with cages for man and material winding.

Both winding systems shall be operated through ground mounted Koepe winders. Shafts shall be equipped with rigid guides for smooth winding of skips and cages. Both shafts shall be of 6.5 m dia. finished and shall be about 60 m apart.

For initial development both shafts shall have temporary headgears and winders equipped with cage and mine car systems. Once facilities in rock are developed, permanent-winding facilities shall be installed as mentioned above.

Up-cast and down-cast shafts shall be connected only through one gallery in stone to restrict short circuiting of mine air. Development faces shall mainly be ventilated by auxiliary fans and tubing.

For stone work, compressed air shall be supplied from compressors installed on surface supplying compressed air to working forces through pipes and houses. Side discharge loaders of about 2 m3 bucket capacity, shall be used for loading blasted rock in mine cars. On surface, these cars shall be taken to a tippler from where a conveyor shall take the muck or the mined rock to a bunker for loading dump trucks, for dumping the mined rock in overburden dump of the opencast mine.

All workings in rock shall be rock-bolted and gunited. Arches or wall-girder support shall be provided only where found necessary.

No underground working shall be permitted within 60 m of worked out opencast mine, thus maintaining minimum 60 m solid barrier between underground and opencast as this is necessary on safety consideration.

5.4.4 Development in coal

Once the four cross-measure roadways of 400 m horizon touch a coal seam, rest of the mine development shall be in coal. Seams shall be developed and extracted top downwards. Two main intakes and two main return air roadways shall be developed on both sides of cross-measure roadways. Thus, there shall be a set of four main roadways for each seam or each group of seams. From these roadways, panels shall be developed on rise and dip-side. Scheme of development is shown in fig. 1& 2. Solid barrier shall be left between a panel and main trunk roadways. Return and intake roadways shall be connected at as few places as possible to reduce the number of stoppings and to prevent leakage. Development shall be done with the help of side- discharge loaders and conveyors, which shall initially load mine cars but later on skip loading conveyor. 2.5 t capacity mine cars shall be used for development before all conveyor system is established.

Main trunk roadways shall be 4.8 m wide, roof-bolted. Centre to centre distance between roadways shall 48 m. Panel development emanating from these trunk roadways shall be according to the final method of coal extraction. Height of trunk roadways shall be equal to seam thickness or a maximum of 3 m. There shall be only one set of trunk roadways for each group of seams. If any seam has top, middle and bottom sections, trunk roadways for them shall only be one set in located a suitable horizon. Similarly if any two seams have less than 9 m parting between them, trunk roadways shall only be in one of them only.

Main trunk return air and intake air roadways shall have as few connections as possible. When not in use, these inter-connections shall be cut off by stoppings. One intake-airway shall be used for conveyors and travelling the other for material supply rail track equipped with endless haulage.

Each seam shall have its own small sump and pumping station which shall pump water to main sump of the mine.

5.4.5 Mine development includes:

1. Working in stone as shown in the area bound by dotted line.
2. Shafts 4 nos. of cross-measure drifts, sub-station, Pump house, sump, skip drift, bunker, skip loading arrangements are in stone and for all seams. All other development is in coal seam.
3. Seams are extracted top downwards.
4. Coal transport is through belt in intake except from main intake to skip loading station which is in return.
5. Seams are touched by cross-measure drifts 4 nos. – 2 intake 2 returns.
6. Initial development shall be through cages, mine-cars and haulages.

5.4.6 Method of coal extraction

There are basically three methods of underground coal extractions:-

1. Board and pillar,
2. Room and Pillar, and
3. Longwall.

Normally for such deep mines as in this case Powered support Longwall is the appropriate method of coal extraction provided the deposit is near uniform and roof is not hard to cave. If the seam thickness varies considerably, more them one set of powered support are needed to cover the entire property. Even for one panel, double telescopic powered supports may be required to cover the entire seam thickness variation. Such supports are very costly. The geological data available indicated that each seam has considerable thickness variation.

Coming to geological structure in the underground area, the same is yet to be confirmed by detailed exploration as the area mostly contains "Indicated reserves". There are a large number of faults in the opencast area and if similar structure is considered for dip-side underground area, formation of long panels (an essential requirement of powered support longwall) for 150 to 200 m long face shall not be possible.

Further, geological information has revealed that roof rocks are very hard in nature and to cave them properly heavy duty and costly supports shall be needed and yet caving may not be proper and regular without blasting in goaf.

For the reasons mentioned above longwall – Technology is ruled out for coal extraction.

Coming to Room and Pillar system of mining seam gradient is a bottle neck here. Gradient of seams is indicated as 1 in 3 to 1 in 5 (100 to 150). This rules out use of shuttle cars with continuous miners. Use of continuous haulage with continuous miner is a possibility but this technology has not yet been tried in India and is not widely practiced even in those countries, which extensively use Room and Pillar system of mining. Further this system cannot effectively extract coal from seams that are more than 4.5m thick. As per geological information available out of over (12) twelve mineable coal seams and twenty (20) coal sections these (including top, middle, bottom top and middle, middle and bottom, and total combined sections etc.), as many as 15 have coal thickness more than 5 m in different areas. Such a deposit cannot be efficiently worked by Room and Pillar technology.

We thus have no alternative but to adopt Board and Pillar and Gallery Blasting (which is a variation of Board and Pillar) methods for this property. However deep properties like the area in question, require high output and high productivity. This can be achieved by using higher capacity side discharge loaders, universal drilling machines (both for roof bolting and to obtain longer pull per blast by long hole drilling and by mechanization of support system in pillar extraction.

Sequence of extraction shall be as follows:-

a) If two seams have a parting of less than 3m between them the thicker seams shall be worked and the thinner shall be left in-site unused.

b) If parting between two seams is 3 to 6 m both seams shall be developed and extracted simultaneously.

c) If parting between two seams is more than 6 m upper seams shall first be extracted.

All seams shall be extracted by caving.

Thickness less than 1.5m shall not be worked.

Seams of thickness 1.5 to 4.0 shall be extracted by Slice and Rib (SR) method and of thickness more than 4 m by Blasting Gallery (BG) method.

5.4.7 Panel Size

Since the depth of opencast mine shall be 300m from surface for the lower most seams, in the underground mine the upper-seams in some area shall have depth less than 300m depth. For area of depth less then 240m panels shall have 9 level galleries and 8 pillars of size 30.5 x30.5m centre to centre with 4.2m wide galleries. Panel shall as long as possible. For long panels system of sub-panelling shall be adopted, if required. For during extraction stage.

For depths between 240 and 360 m a panel shall be of 7 level and 6 pillars of size of 39.5 x 39.5 centre to centre.

For depths beyond 360 m a panel shall have 6 level and 5 pillars of size 45m x 45m m centre to centre.

The above is as per requirements of Coal Mines Regulation, 99. However it is proposed to approach Directorate General of Mines Safety to permit pillars of Factor of safety 2.5 as it has been scientifically established that pillar of Factor of safety 2 and more have long term stability. If the proposal is accepted by DGMS, pillar size can be much smaller than presently required under Law. With smaller pillars there shall be more number of faces and depillaring shall also be facilitated.

Each panel shall be equipped with 3 side-discharge loaders (SDLs) 2m^3 bucket capacity, 3 universal drilling Machines (UDMs) and at least 3 face conveyors, 2 gathering conveyors and one gate conveyor.

In order to improve percentage of extraction and to reduce number of stopping, this solid barrier shall be left between panels. Thickness of such barrier shall be scientifically determined.

5.4.8 Mine Output

On an average a panel with 3 SDLs (2m^3 bucket capacity) shall give a production of 600 tonnes per day. Such ten panels shall be worked at a time, six in upper seams and 4 in the lower seams. Where BG method shall be worked, SDLs shall have remote controlled facility. The projected mine output is thus 6000 tonnes per day.

5.4.9 Total Output

With working of two underground mines, each producing 6000 tonnes per day the total annual output works out to 3.6 million tonnes a year considering 300 working days in a year.

5.4.10 Coal Disposal

Initially, skips of a mine shall unload coal to a small bunker which shall load a conveyor. This conveyor shall carry coal to 200 T capacity overhead bunkers for truck transport of coal to railway siding of the opencast mine. Later on, a conveyor shall be installed on surface to take coal from 200 T bunker to a 1000 T bunker at a point central to both underground mines. Similar facilities shall be created for the second underground mine. From two close by 1000 T bunkers a conveyor, which shall be laid on the leveled of over-bunker of western sector opencast mine, shall carry coal to main bunker of opencast mine for rail movement of coal.

5.4.11 Environment protection

In a multi –seam mining situation two factors need special attention. They are

1. Risk of underground fire, and

2. Heavy subsidence on surface.

These problems shall be tackled in following manner.

A. Underground Fire

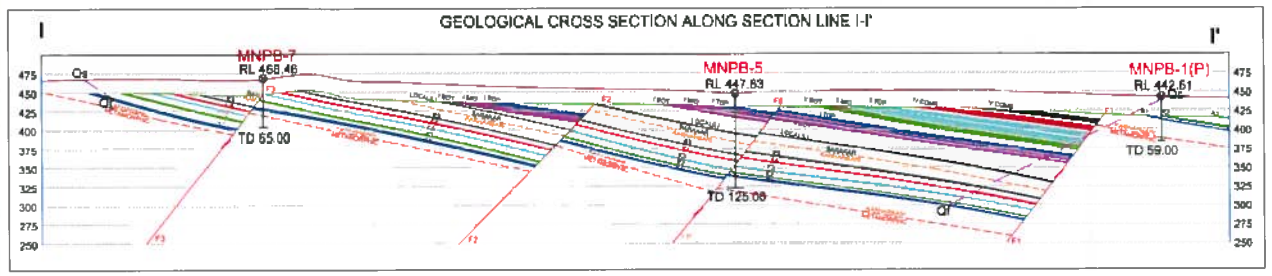
Solid coal barriers shall be left between panels so that problem of one panel is contained within the same. Wherever required (due to incubation period considerations) sub-paneling shall be done.

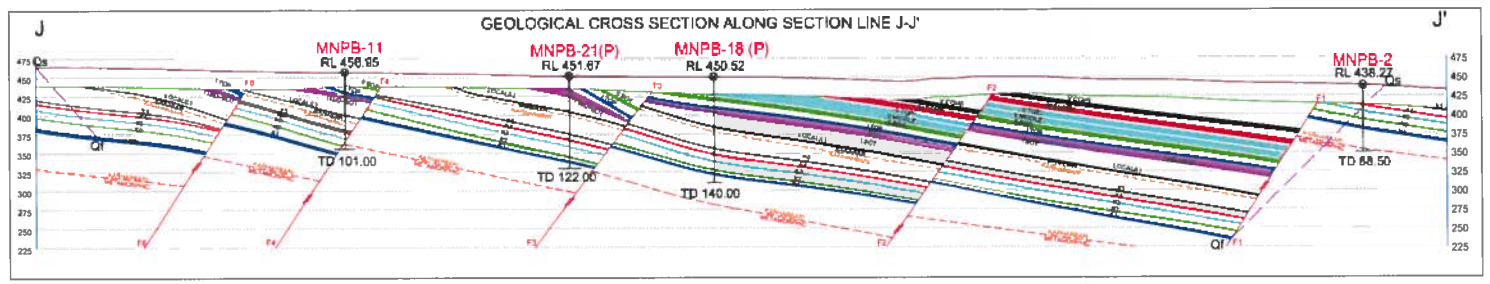
Working panels shall have minimum connections with trunk roadways so that they can be isolated quickly in case of fire.

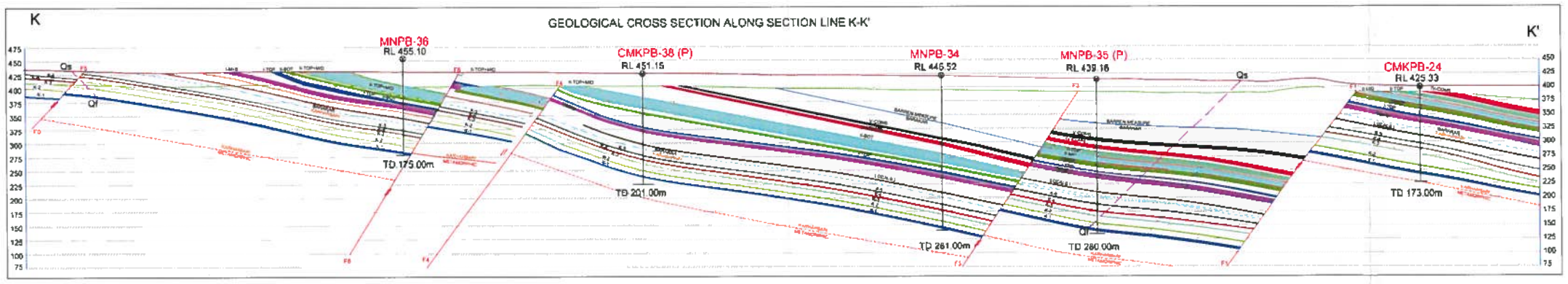
Automatic monitoring system shall be installed at strategic points underground to give audio-visual alarm in control room on surface for abnormal rise in values of CO, CH4 and temperature

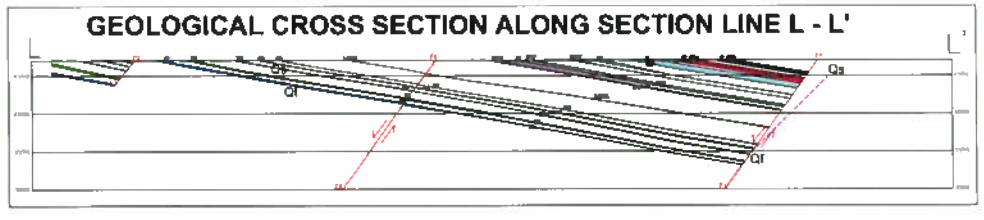
B. Damage to surface

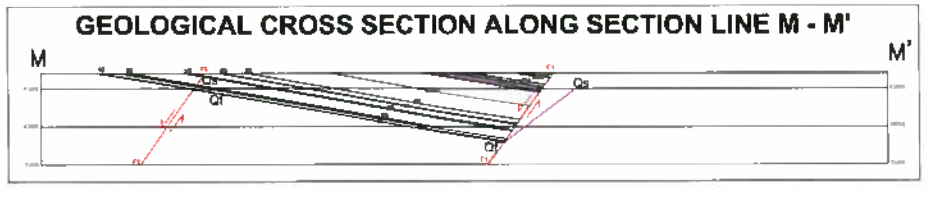
Since the underground mine area is yet to be covered by detailed exploration, panel layouts, exact thickness of coal extraction and subsidence due to such extraction cannot be projected at this stage.











LEGEND		SEAM LEGEND			
MNPB-36	BOREHOLE DRILLED BY MECL	V COMB		I M+B	
RL 455.10	REDUCED LEVEL IN METRES	IV COMB		LOCAL(L)	
F6	FAULT WITH NUMBER	II-TOP		K-5	
F8		II-MID		K-4	
TD 201.00m	TOTAL DEPTH DRILLED IN METRES	II T+M		K-3	
	BLOCK BOUNDARY	II-BOT		K-2	
Qs	QUARRY SURFACE	I-TOP		K-1	
Qf	QUARRY FLOOR				
	SURFACE				

NOTES :

1. ALL DIMENSIONS ARE IN METRE
2. THIS SECTION IS SUBJECT TO MINOR MODIFICATIONS TO SUIT LOCAL CONDITION

Certified that the plan is correct

SANJIV KUMAR SINGH (R.Q.P.)

एन टी पी सी NTPC

N T P C LIMITED
(A GOVT. OF INDIA ENTERPRISE)
COAL MINING ENGINEERING

PROJECT:	PAKRI BARWADIH COAL BLOCK				
TITLE:		ACTIVITY	NAME	DESIG	DATE / SIGN
REVISED MINING PLAN (1st Revision)					
SUBJECT:					
CROSS-SECTIONS ALONG II', JJ', KK, LL' & MM' (WITH QUARRY SLOPE)					
SCALE : 1 : 5000	SHEET : 1 OF 1	DATE: 28.12.2015			
DRG. NO.: 7010-199-POM-J-10	PLATE NO. 10				

आई० पी० नागपाल/ I.P. NAGPAL
अवर सचिव/ Under Secretary
कोयला मंत्रालय/Ministry of Coal
शास्त्री भवन/Shastri Bhawan
भारत सरकार/Govt. of India
नई दिल्ली/New Delhi-110001

SANJIV KUMAR SINGH
Recognised Qualified Person
No. 34011/(15)/2009-CPAM
Ministry of Coal, Govt. of India

NORTH WEST QUARRY

NW PIT-1

WEST QUARRY

EAST QUARRY

WP-1

WP-2

WP-3

WP-4

DUMP A

DUMP B

DUMP C

DUMP D

EP-1

TO BANADAG YARD

FB 'A' CONVEYOR ALIGNMENT

PART-1 (FB-WSE) CONVEYOR ALIGNMENT

LEGEND

DESCRIPTION	SYMBOL
BLOCK BOUNDARY	
LEASE BOUNDARY	
SURFACE CONTOUR	
QUARRY SURFACE	
QUARRY FLOOR	
FLOOR CONTOUR	
FAULTS WITH THROW (m)	
OB DUMP	
RIVER/NALA	
REALIGNMENT OF NALA	
ROADS	
DIVERTED ROAD	
EMBANKMENT	
EMBANKMENT WITH ROAD	
HAUL ROAD	
RESIDENTIAL AREA OF PB	
TOP SOIL STORAGE	
VILLAGE	
MINE ENTRY	
EP-1	
POWER LINE CORRIDOR	
CONVEYOR WITHIN MINE	
CROSS COUNTRY CONVEYOR	
BOREHOLE WITH R L (m)	
ROAD-M	
SUB STATION	
TRANSMISSION LINE	
CRUSHER	
RAVINE	

NOTES :

1. ALL DIMENSIONS ARE in METRE
2. THIS PLAN IS SUBJECT TO MINOR MODIFICATIONS TO SUIT LOCAL CONDITION
3. EARTHEMBANKING WORK IS PLANNED IN THE INDICATED RESERVED SHALL BE DEVELOPED AFTER WITH YEARS
4. PROPOSED REALTE OF DIVERTED NALA IS INDICATIVE ONLY MAY CHANGE AS PER ACTUAL SITE CONDITION

REFERENCE DRAWINGS

SL NO	PARTICULARS	DRAWING NO
01	Land use Plan	
02		
03		
04		
05		
06		

HAZARIBAGH TANDWA ROAD

APPROACH ROAD TO COLONY

RESIDENTIAL COLONY

APPROACH ROAD TO R&R COLONY

REHABILITATION AND RESETTLEMENT COLONY

UPCAST SHAFT

DOWNCAST SHAFT

MAGAZINE (COMMON)

N T P C LIMITED

COAL MINING ENGINEERING

PAKRI BARWADIH COAL BLOCK

REVISED MINING PLAN (1st Revision)

SURFACE MASTER PLAN

आई० पी० नागपाल/ I.P. NAGPAL
अवर सचिव/ Under Secretary
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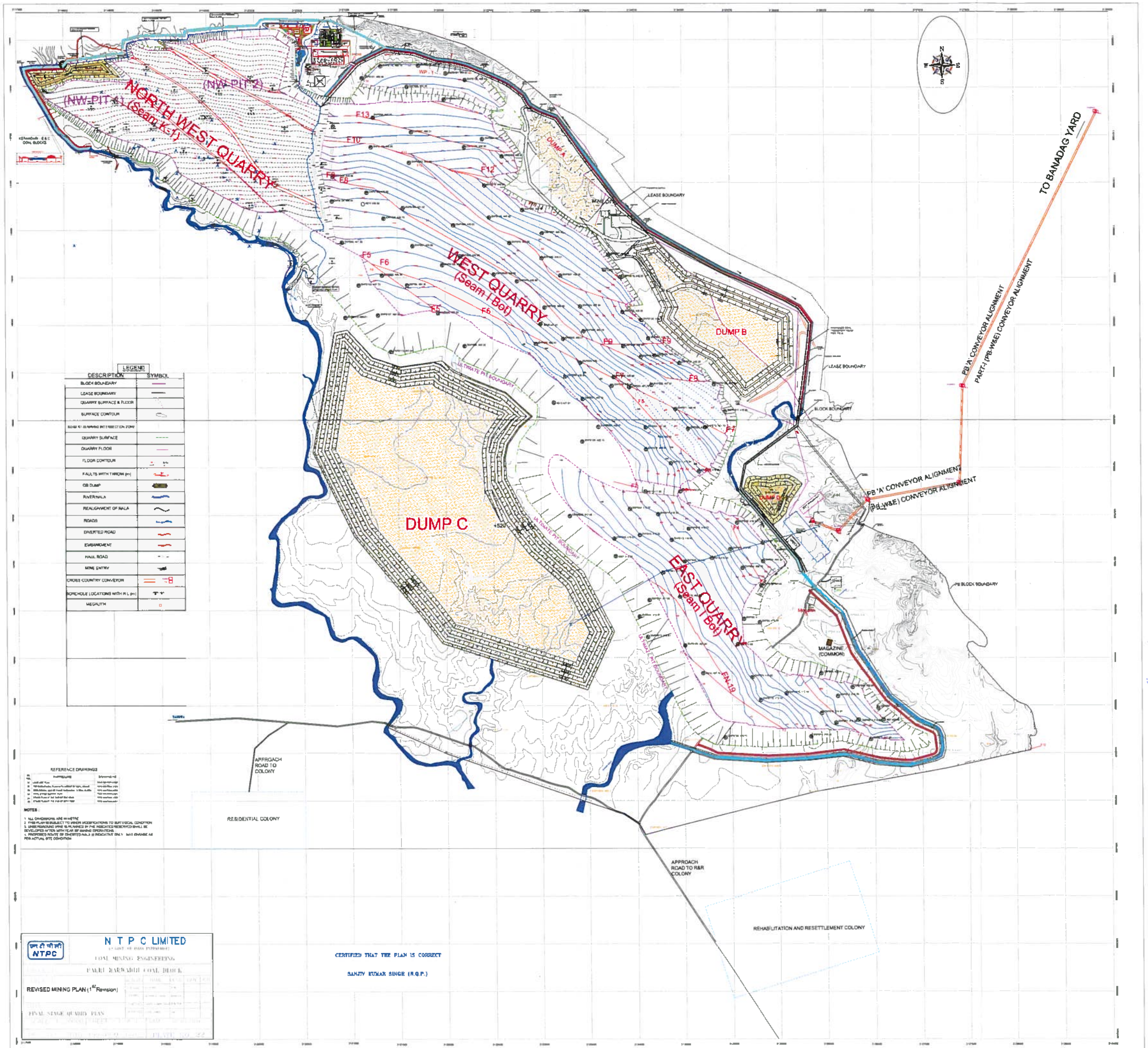

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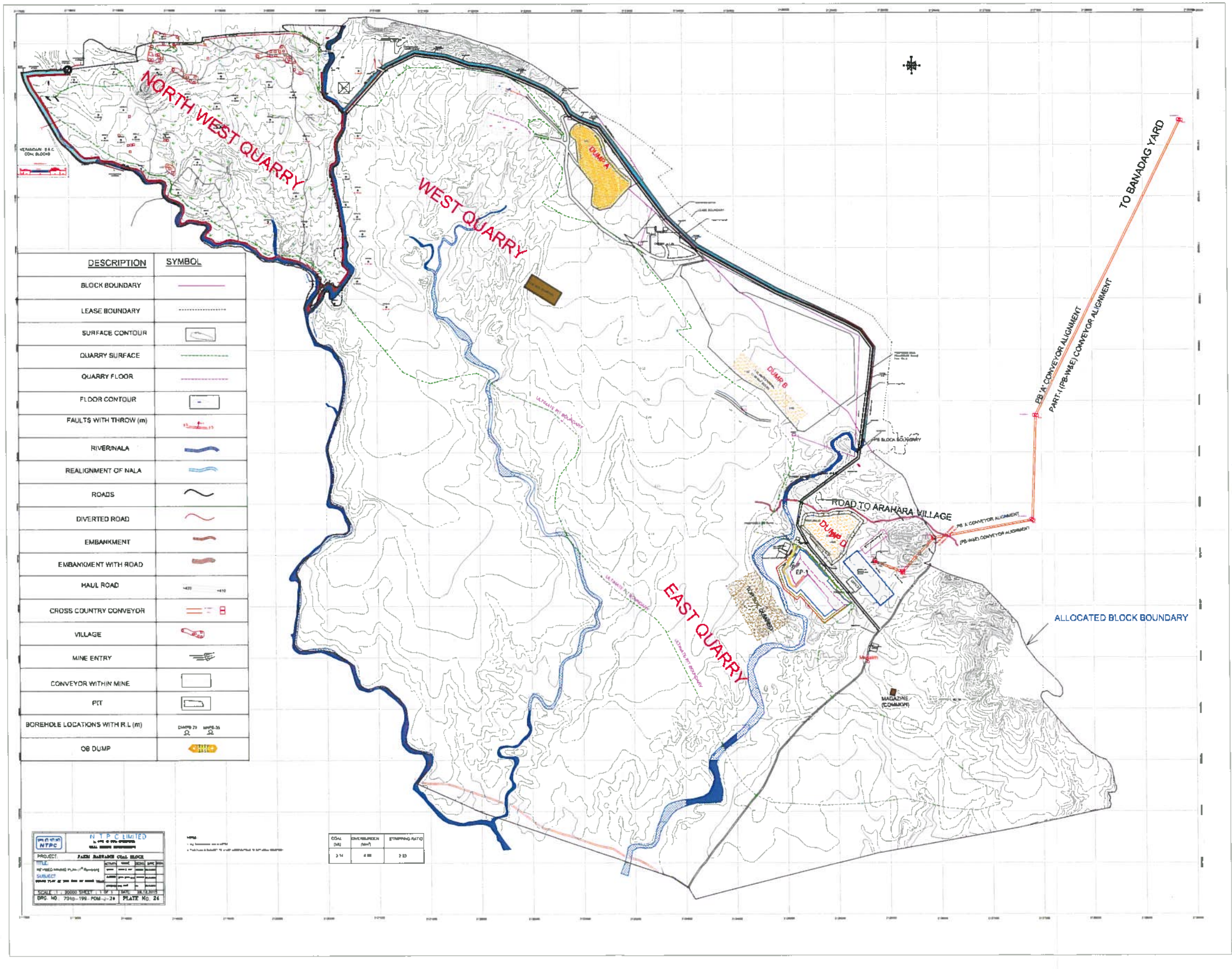

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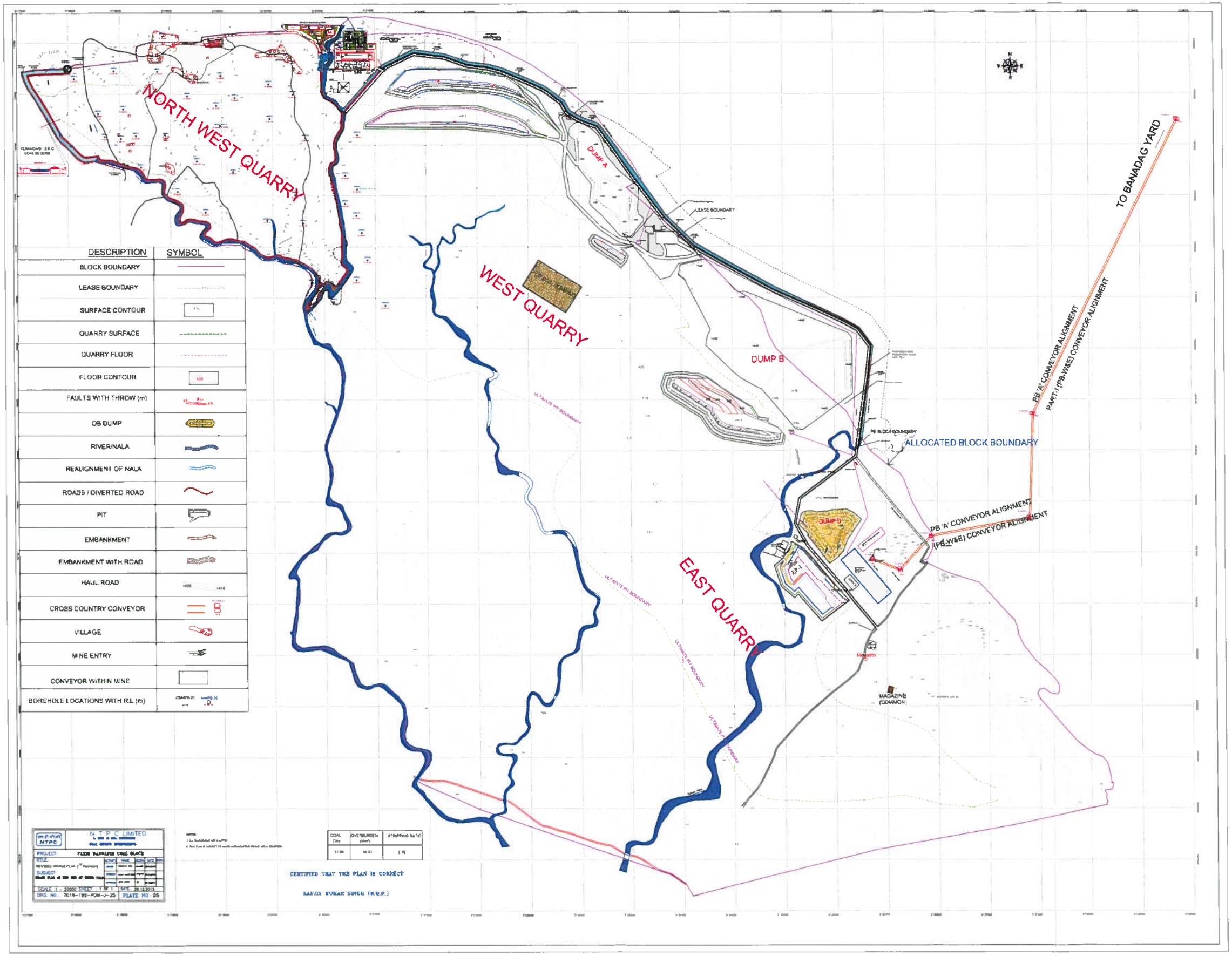

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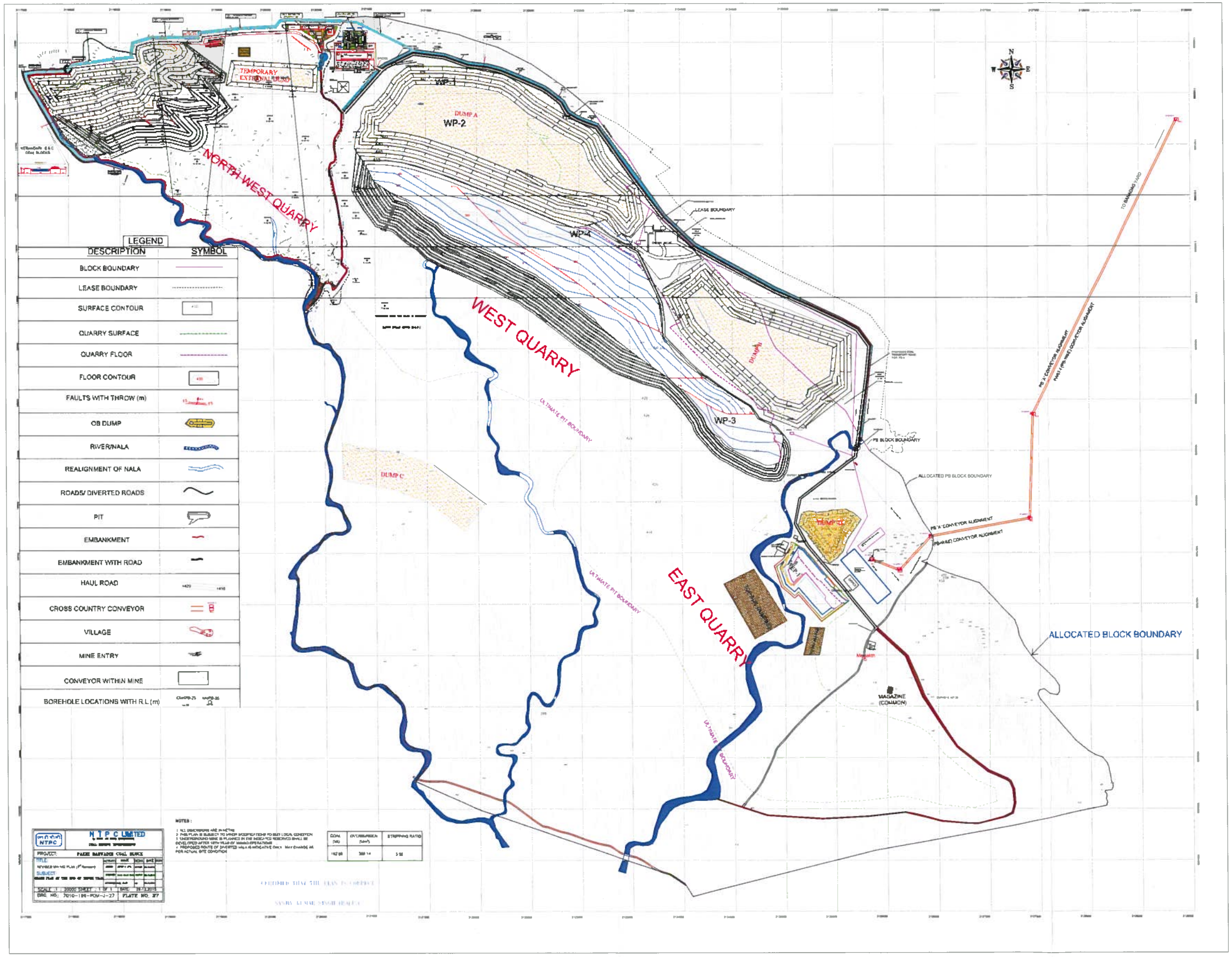

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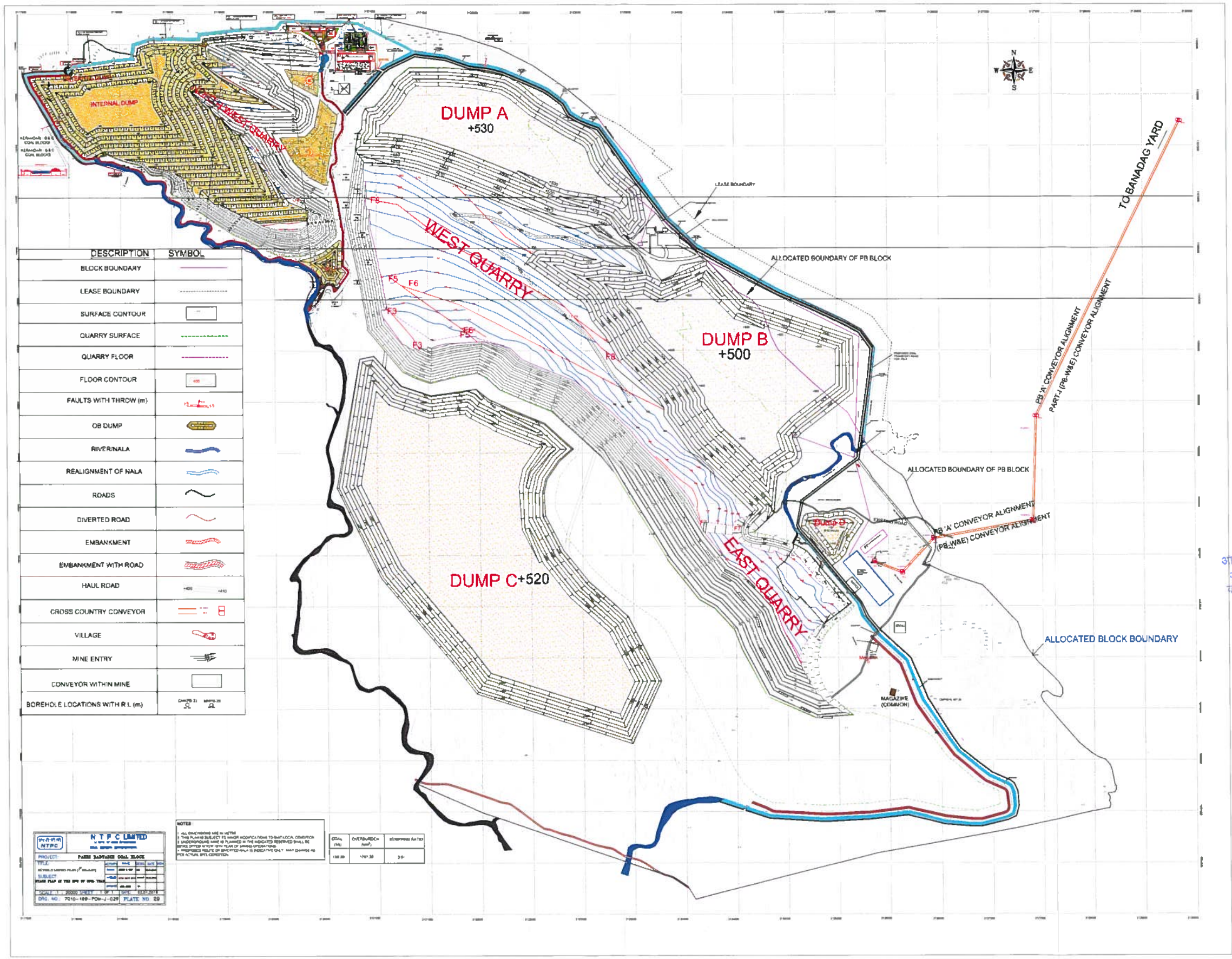

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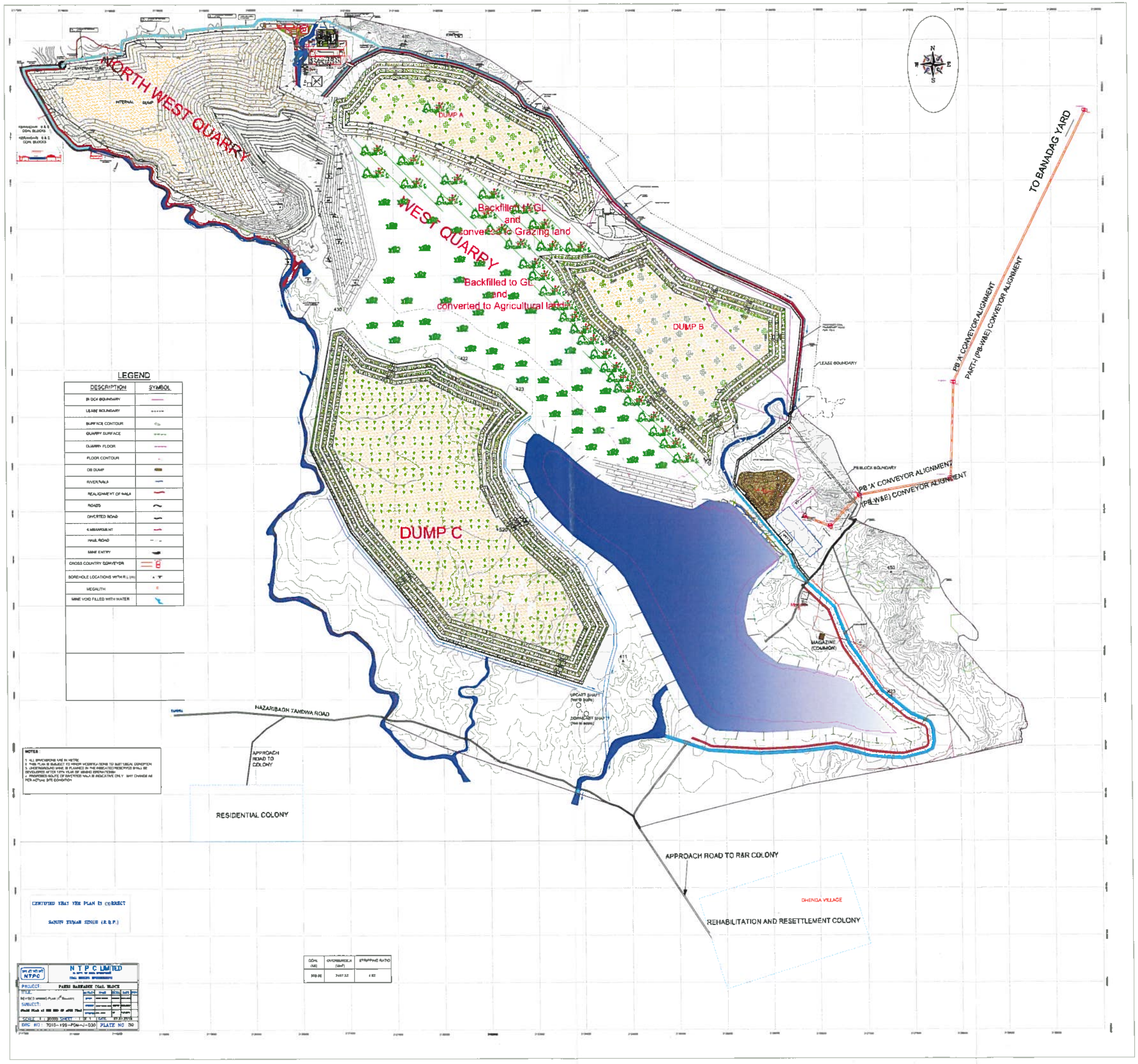

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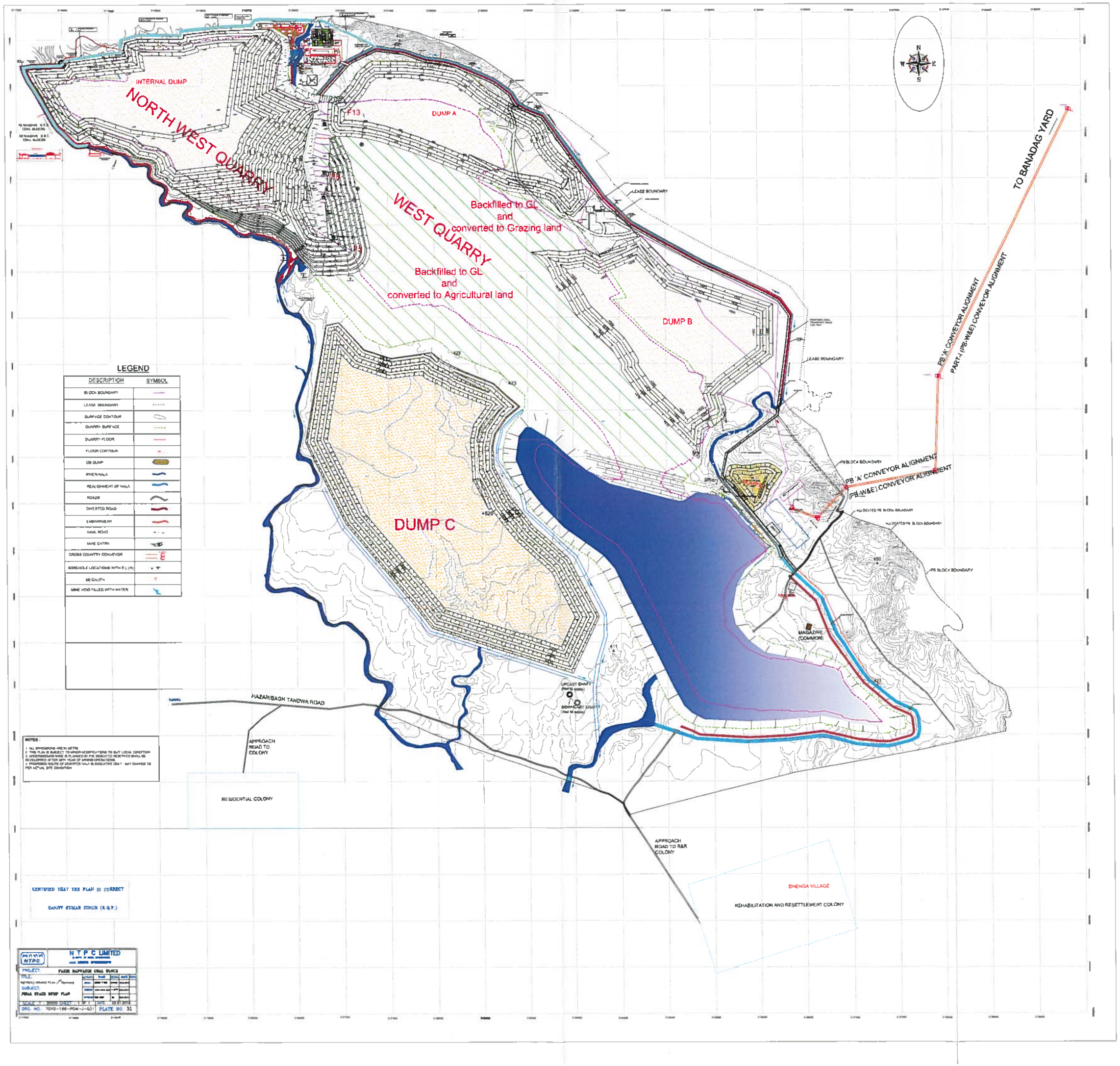

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CHAPTER VI

MANPOWER, SAFETY AND SUPERVISION

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MANPOWER, SAFETY AND SUPERVISION

6.1 INTRODUCTION

6.1.1 Life of the mine shall be approximately 52 years as per the calendar programme. Besides maintaining large fleet of HEMM and ancillary equipment, there is need to employ sufficient manpower to improve overall availability/utilization of the mining equipment , extraction transportation & despatch of coal, administration & welfare of the personnel employed, for safe and economic exploitation of mineral. The manpower has been provided to achieve the above objective.

6.1.2 Requisite manpower is provided for PB West and PB NW quarry. Manpower proposed for PB North West quarry shall be utilized for managing the affairs of PB North West quarry exclusively. As already explained in Chapter-5 PB East quarry shall be operated in two distinct phases the first phase shall last for initial two years while the second phase shall commence from 25th year till end of life of quarry.

In the second phase of PB East Quarry manpower proposed for PB West Quarry shall be utilized for managing the affairs of PB East Quarry progressively, commensurate with the fall & rise of production from West Quarry and East Quarry respectively. In the first phase of PB East Quarry separate set of manpower is propposed for managing the affairs of PB East Quarry. At the conclusion of first phase of PB East Quarry the proposed manpower shall be suitably deployed by NTPC in its establishments.

For the common Infrastructure and ancillary facilities (Explained in Chapter-VIIII) separate fleet of manpower shall be provided which shall serve the purpose of managing common affairs of quarries.

6.1.3 Manpower planning and scheduling has been done in compliance with Mine Act 1952, Mine Rules 1955, Coal Mine Regulation 1957, Mine Vocational Training Rules 1966 and all other rules and regulations applied to Indian Coal Mines, apart from compliance to the directives/circulars issued by DGMS (Directorate General of Mine Safety) issued time to time.

6.1.4 Abiding by the aforementioned statutes organisation chart for the mine shall be drawn. The positions of statutory manpower such as Mine Manager Assistant Mine Manager, Safety Officer, Labour Officer, Welfare Officer, V.T. Manager, mine officials, workman inspectors, Supervisors, set of competent persons etc., have been clearly identified and shall be deployed in consultation with DGMS. Qualifying requirement shall be drawn up and

TABLE 6.1
Statutory Persons

Head	Category	Statutory (DGMS)
Management	General Manager	*Agent*
Management	Manager - Mine Operation	*Mine Manager*
Management	Manager - Maintenance	*Colliery Engineer*
Operations	Deputy Manager - Safety	*Safety Officer*
HR & Admin	IR Officer	*Welfare Officer*
HR & Admin	Training and Development Manager	*Training Officer*
Fixed Plant	Fixed Plant Manager -CHP	*Colliery Engineer CHP*

6.2 Requirement of Man Power

6.2.1 Requirement of Departmental Manpower is given in Table-6.2

TABLE 6.2
MAN POWER REQUIREMENT FOR PAKRI BARWADIH PROJECT

Sl.No	Category	PB West & East Quarry	PB NW	Total
1	**OB Direct**	**345**	**267**	**612**
2	**Coal**			
	Coal Direct	479	211	690
	CHP	136	42	178
	Loading & Despatch	12	4	16
		627	**257**	**884**
3	**Common Services**			
	Excv Supervision	108	13	121
	E&M Supervision	42	13	55
	Excv P&M maintenance	242	220	462
	E&M Maintenance	91	20	111
	Support Equipment/Other Operations	114	45	159
	Safety, Production &Quality Control	72	17	89
	CGM Office / Project Office cum Planning Division	51	10	61

TABLE 6.3
MAN POWER REQUIREMENT FOR PB EAST PROJECT

Sl.No	Category	Number
1	**OB Direct**	**120**
2	**Coal**	
	Coal Direct	65
	CHP	27
	Loading & Despatch	4
		96
3	**Common Services**	
	Excv Supervision	22
	E&M Supervision	9
	Excv P&M maintenance	49
	E&M Maintenance	19
	Support Equipment/Other Operations	23
	Safety, Production &Quality Control	15
	Training Centre	
	Finance & Accounts	3
	Survey	3
	Transport	4
	Sub-Total	**147**
5	**Reclamation & Env. Mgmt.**	**4**
	Total	**367**

6.3 SAFETY ASPECTS

6.3.1 GENERAL

6.3.1.1. Designated Owner in person by name of the mine has to be notified by the Board Secretary on advice of the Board of Directors of company. The designated Owner shall notify Agent of the mine. The Agent shall notify employment of the Manager of the mine. Company will appoint Under Manager, Asst. Manager, Safety Officer, V.T Officer, Welfare Officer, Surveyor, all excavation and E & M Engineers including Chief Excavation Engineer and Chief E & M Engineer, Overmen, Mining Sirdars, attendance Clerks, electrical supervisors and mechanical foremen. The Mine will be inspected daily, as far as practicable, and also in odd hours by the Manager and the Agent and deficiencies in safety noted during inspection are to be rectified on priority basis. Under the above broad administrative setup, the

arrangements shall be discussed with DGMS and modification suggested by DGMS, if any, shall be incorporated.

6.3.1.2. Under the above set-up, all safety precautions during the mining operation, posting of sufficient number of officials and persons, maintenance of all records/registers as per statute, disaster management framing of bye-laws and code of practices shall be undertaken. Manager shall have the authority to order withdrawal of persons/ suspension of operation in case of any emergency like fire/inundation and he shall issue such order, if found fit, in consultation with the Agent and it is subject to the provision of CMR, 1957. Mining is a hazardous industry and hence, necessary measures shall be taken to prevent accident due to following anticipated hazardous/risk prone activities.

- Slope failure
- Handling of explosives
- Fly-rocks during heavy blasting
- Movement of HEMM
- Inundation due to surface water
- Dust hazards
- Fire hazards due to spontaneous heating of coal
- Hazards associated with use of electricity
- Flooding of lower benches

6.3.2 STATUTORY RULES

6.3.2.1. Deployment of HEMM in any mine for excavation of coal/ OB needs planning of various activities in conformation with the prevailing statutory provisions, as per Mines Act 1952, CMR 1957, various DGMS circulars & bye-laws.

6.3.2.2. All applicable statutory rules, regulations, bye-laws etc and statutory requirement related to Govt. licenses, workers compensation, insurance, etc, including Minimum Wage Act for workers employed by the outside agency shall have to be adhered to. Any other rule imposed by local/State/Central authorities shall also be complied with by user of HEMM/equipment and then shall have to supply various protective equipment viz. helmets, shoes, safety gear for welding, working at height, electrical apparatus handling, etc. to the workmen at their cost.

6.3.2.3. It is recommended that code of practice as parted out in Cl.6.2.1.2 to be prepared by Company will be based on following.

1. ILO code of Safety and Health and in opencast Mines (1991)
2. Coal Mines Regulation 1957
3. Mines Act 1952
4. Mines Rules 1966
5. Vocational Training Rules 1966
6. Indian Electricity Rules 1956
7. DGMS circulars from 1948 upto date
8. Factories Act 1948 (as applicable to mines)
9. Conditions attached to statutory permissions and exemptions granted by DGMS.
10. Recommendations of National Safety Conferences, Tripartite Safety Review Committees.
11. Special guide lines issued by DGMS following accident enquiries etc.
12. Any prevailing directive of Central or State government in their region.

6.3.3 SAFETY FOR HEMM/EQUIPMENT AND WORKERS

6.3.3.1. Special precaution shall be taken while deploying the HEMM and workers in the mine. Some of the major safety aspects before deploying of workers & HEMM to the mine are enumerated as follows:

(A) For workers

- No worker shall be deployed unless he is skilled enough to take up the designated assignment and trained at VTC.
- Records in Form- B and Form- D shall be maintained.
- Records of Vocational training Certificate and driving license of operators shall be kept by owner.
- No persons shall be employed unless person holds VTC certificate. A record of it shall be maintained.
- Adequate supervision shall be maintained by qualified competent persons.
- Safety guidelines and safety instruction will be followed.
- All drivers shall obey traffic rules prepared by the management.
- Before deploying workers, they must be trained and briefed about safety aspects in opencast mine.

However during course of execution of the work, if any accident occurs, whether major or minor, the matter shall have to be immediately informed to the mine management i.e. Colliery Manager/Agent/GM of Area so that Notices of accidents in a accordance with (Reg.9 of CMR 1957) and Section

23 of Mines Act 1952 may be given and other necessary steps may be taken in accordance with the Mines Act 1952.

(B) For machineries as recommended by DGMS Cir. (Tech.) 1 of 1999:

- All machineries to be deployed in mines shall be checked before deployment by the relevant Chief Engineer (mine) of the MDO.
- Regular checking of machines deployed by outside agency shall be done. No unfit machine shall be deployed before the defect is rectified.
- A proper record of repair and maintenance along with inspection done by manager and defect pointed out shall be maintained and signed by authorized person.
- The HEMM shall be provided with Audio visual alarms, proper light for use at night and during period when natural light is not sufficient. Also audio-visual alarms for reversing of HEMM shall be provided.
- RTO certificate photo copies of all vehicles shall be submitted to manager.
- Regular inspection of HEMM shall be done by the agency's mechanic as directed by the manager.
- Machine manufacturers shall be asked to give risk analysis details in respect machines deployed.
- Suitable fire extinguishers shall be provided in every machine.
- Risk Management Plan of HEMM shall be made and implemented.
- Transport system will be deployed in such a way so as to minimize pollution in the mine and keep the environmental status as recommended under the approved EMP.

6.3.4 STABILITY OF BENCHES, QUARRY HIGH WALLS AND SPOIL DUMPS

6.3.4.1. During quarry operations, it is necessary to adopt suggested mining parameters for the stability of benches, high-walls and spoil dumps. It is also mandatory to examine systematically the fencing of mine working, land slides and cracks between benches. It is required to maintain well graded and wide roads on benches keeping the width of working areas sufficient for spreading of blasted rock and movement of the mining and transport equipment.

6.3.4.2. During actual mining operation, systematic observations and regular monitoring of the condition of benches, high-wall slopes and spoil dumps shall be carried out and the dimensions shall be modified if necessary, to suit the local conditions. Recommended bench geometry for different HEMM has been found suitable in existing opencast mines in the country.

6.3.4.3. Following slopes have been recommended in this report considering the practices in the other mines.

Overall (Ultimate) pit slope	-	37^0
OB Bench	-	70^0
Coal Bench	-	70^0
Dump bench	-	37^0

6.3.4.4. Company should get studies of physico-mechanical properties of rocks done at IITs/ISM/CMRI/CMPDI or other institutes so that further stability study can be performed by expert.

6.3.5 PRECAUTIONS AGAINST DANGER OF INUNDATION FROM SURFACE WATER

6.3.5.1. A careful assessment is to be made against the danger from surface water before the onset of rainy season. The necessary precautions shall be clearly laid down and implemented. A garland drain needs to be provided to drain away the surface rain water from coming into the mine. Garland drain shall be provided around OB dumps and working mines to course the rain water to main streams.

6.3.5.2. Inspections for any accumulation of rain water, obstruction in normal drainage

6.3.5.3. Standing order for withdrawal of working persons in case of apprehended danger.

6.3.5.4. During heavy rain inspection of vulnerable points is essential. In case of any danger persons are to be withdrawn to safer places.

6.3.5.5. The nearest nala is Khora nala A & B and already discussed are flowing either side of the Block. There may be possibility of inrush of rain water from flooding of nalas into the opencast mine pit. However any such possibility is eliminated as all the nalas are planned to be straightened systematically.

6.3.5.6. Any excavation under such circumstances would inundate the mine if nala is not straightened. Hence, straightening of nala has been proposed before 3rd year of mining operation. So there is no risk of flooding from these water streams.

6.3.5.7. Moreover in order to control the in-rush of water into the quarry in rainy season from the surface or through seepage from the strata, sufficient garland drains will be made around the opencast excavation as proposed. Besides, pumps of required capacity and HP will be installed to pump out the seepage and rain-water continuously. A stand by diesel generator will be provided for un-interrupted supply of power to the pumps in the event of failure of power.

6.3.6 PREVENTION OF FLOODING OF EQUIPMENT DEPLOYED AT BOTTOM HORIZONS

6.3.6.1. During the heavy monsoon period, the mining operation in the lower-most benches may have to be stopped. Adequate pumping capacity on the basis of historical data of maximum rainfall and distribution of rainfall has been designed. But in case of unprecedented rainfall, machineries may have to be withdrawn from lower benches temporarily and redeployed after dewatering in the lower benches again. Meanwhile they will be gainfully employed in the upper benches.

6.3.6.2. For ensuring safety of the equipment while working out bottom horizons with no access to surface profile, the following measures shall be taken:

1. Drivage of initial trenches and coal cutting on bottom benches shall be done during the dry season of the year.
2. Ramps shall be made for quick shifting of equipment from bottom horizons, liable to be flooded during monsoon period to the top horizons.

6.3.7 PREVENTION OF ELECTRIC SHOCKS

6.3.7.1. During mining operations, all the statutory provisions of the Indian Electricity Rules 1956, and Indian Standards for installation and maintenance of electrical equipment etc. shall be observed.

- For protection from electric shocks to persons, from electrical equipment with voltage up to 1000V Earth Leakage Relay shall be provided which will automatically disconnect electrical circuits.
- Closed mobile substations and switchgears shall be mechanically interlocked which exclude the possibility of opening the door when oil switch and air circuit breakers are in operation.
- All metal parts of electrical equipment shall be properly earthed to avoid failure of insulation.

- All H.T. lines and cables located within the blasting zones shall be disconnected during blasting operations.

6.3.8 DUST SUPPRESSION & DILUTION OF EXHAUST FUMES

6.3.8.1. The following measures shall be adopted for dust suppression at all quarry working places, dump, haul roads, CHP and near other auxiliary mining operations.

- Water sprinklers shall be deployed in haul road. Additionally, chemical additives are recommended to form consolidated crust. This can be first tried on certain length and then extended for the entire length, if found suitable.
- Spraying with water on all working faces by special spraying machines.
- While drilling holes, it is necessary to use dust extraction devices.
- Installation of local dust suppression and air conditioning devices in cabins of excavators and drilling rigs will be considered.
- Levelling of spoil dump surface.
- Separate dust suppression arrangement shall be provided for CHP.
- To prevent collection of harmful mixtures in the atmosphere, from the different sections of quarry working, it is recommended.
- Maintaining the engine and exhaust conditioners properly, so as to keep emission gasses within limits and regular checking of exhaust and recording the same.

6.3.9 FIRE FIGHTING AND FIRE PREVENTION

6.3.9.1. In addition to statutory provisions, the measures for fire fighting and prevention of fires are as follows:

- Efforts are to be made not to lose any coal in O.B benches, and specially ledges of coal in inclined slicing system.
- Organization of special cell for systematic observation to examine and prevent fire.
- Removal of spillage of coal on benches and cleaning of coal horizons to prevent cases of coal heating.
- Storage of lubricants and cotton waste in enclosed fire proof containers in working places
- Provision of fire extinguishers and fire tenders.

- Delivery range of pump should have nozzles, strategically located, to tap water in case of emergency. Emergency organization shall be formed to deal with emergency during fire. The organization shall have names of responsible person along with their telephone numbers. Their duties shall be clearly specified and the persons shall be properly trained. Mock – rehearsals shall be held. A disaster management plan shall be prepared by the management and a CMG (Crisis Management Group) consisting of highly skilled & decision making persons shall be identified within the organization to tackle with such extreme situations.

6.3.10 MEASURES DURING DRILLING AND BLASTING

6.3.10.1. Following measures shall be taken while drilling and blasting operations in the quarry:

1) Drilling and Blasting in quarry shall be done in accordance with the provisions of Mines Act, rules and regulations.

2) Adequate safety measures have to be taken during blasting operations in the quarry so that men/machines are not affected.

3) Ground vibration due to blasting will be controlled by following:

   - Reducing the explosive charge per delay. 2-5 millisecond of delay interval per meter of burden has been recommended.
   - Spacing and burden are to be optimized by the blasting engineer.
   - Reducing the amount of explosive charged per blast
   - Proper controlled rock movement during blast by using suitable initiating sequence and delay.
   - Pit blasting engineer will optimize powder factor, watch out for quantity of oversize and secondary blasting, improve utilization of Shovel and reduce damage of bucket teeth.

4) Sub-drill depth may be 0.2 times the distance between adjacent holes stemming depth will be 0.7 to 1.0 times the burden. It should be recommended that if burden is less, there will be venting of explosive gases with loss of efficiency and generation of fly rock. More burden results in back break and poor fragmentation. Too close spacing causes crushing and crater forming between holes, boulder in burden area and excessive toes. Too wide spacing results in inadequate fracturing between hole accompanied by bumps on the face and toe problem between the holes.

6.4 RISK ASSESSMENT

6.4.1 INTRODUCTION

6.4.1.1. Mining activities are associated with several potential hazards both to the employees and the public at large. A worker in a mine should be able to work under conditions that are adequately safe and healthy. At the same time the environmental conditions should be such as not to impair his working efficiency. The various safeguards will be taken to ensure the safety of the mine and that of employees are provided in the Mines Act, 1952.

6.4.2 IDENTIFICATION OF HAZARDS

6.4.2.1. There are various factors, which can cause disaster in the mines. These hazards are as follows:

i. Drilling
ii. Blasting
iii. Overburden handling
iv. Heavy Machinery and
v. Explosives storage.

6.4.3 DRILLING AND BLASTING

6.4.3.1. Most of the accidents from blasting occur due to the projectiles, as they may some times go even beyond the danger zone, mainly due to over charging of the shot holes as a result of certain special features of the local ground. Flying rocks are encountered during initial and final blasting operations. Vibrations also lead to displacement of adjoining areas. Dust and noise are also problems commonly encountered during blasting operations.

6.4.4 OVERBURDEN HANDLING

6.4.4.1. The overburden dumps may cause landslides. High overburden dumps created at the quarry edge may cause sliding of the overburden dump or may cause failure of the pit slope due to excessive loading, thereby causing loss of life and property. Siltation of surface water may also cause run-off from overburden dumps.

6.4.5 HEAVY MACHINERY

6.4.5.1. Most of the accidents during transport of dumpers, trucks, poclains, ripper dozers and other heavy vehicles are often attributable to mechanical failures and human errors.

6.4.6 EXPLOSIVE STORAGE

6.4.6.1. Most of the accidents occur during, transportation, storage, handling and use. Accidents often attributed to failure of workman to observe safety rules and regulations.

6.5 DISASTER MANAGEMENT

6.5.1 MEASURES SUGGESTED TO AVOID ACCIDENTS DUE TO BLASTING HAZARDS

- Shots shall not be fired except during the hours of day light or until adequate provision is made for artificial lighting and the holes charged on a particular day shall be fired on the same day;
- Shots, if fired after hours of daylight, should be muffled so that the flying fragments from the blasting material do not project beyond a distance of 10 m from the place of blasting;
- Adequate shelters or other protective structures shall be provided to the workers at all times;
- The shot fired shall give sufficient warning by effective signal over the entire area falling within a radius of 500m.
- Where any permanent building or structure is damaged within the danger zone, the aggregate maximum change in all the holes fired at any particular time shall not exceed 2 kg.
- If a single shot exploder is used or if blasting is done with ordinary detonator, the shot-firer shall not fire more than fifty shots in one shift, but if multi-shot exploder is used, the number can go up to eighty;
- During the approach and progress of an electrical storm, adequate precaution shall be taken;
- No shot hole shall be drilled in the overburden above the underground galleries.

6.5.2 MEASURES TO PREVENT THE DANGER OF OVERBURDEN

- A stone wall should be built around the toe of each active dump at a distance of about 50m from the toe;
- To prevent the failure of overburden slopes, especially during the rainy

season, the following precautions shall be taken:

- Proper terracing of the dump slopes, with a maximum dump height of 10 m should be maintained;
- In flat areas where the dumping operations have come to an end, the slope angle should be flattened by about 5° lower than the angle of repose, which varies from site to site but not less than 25°;
- Planting vegetation as early as possible over the overburden dump slopes;
- Provide drainage channels along the overburden dump toe for additional protection, in such a way that a distance of 15m should be maintained left between the overburden dump and the bench; and
- If a mine is abandoned, the bench and overburden dump should be separated from each other by digging a trench of 6 to 10 m width.

6.5.3 MEASURES TO PREVENT ACCIDENTS DUE TO TRUCKS AND DUMPERS

- All transportation within the main working area should be carried out under the direct supervision and control of the management;
- The vehicles must be maintained in good repairs and checked thoroughly at least once a week by a competent person authorized for this purpose by the management;
- Broad signs should be provided at each and every turning point, specially for the guidance of the drivers at night;
- To avoid dangers while reversing the trackless vehicles, especially at the embankment and tripping points, all areas for reversing of lorries should, as far as possible, be made man free, and there should be a light and sound device to indicate reversing of trucks; and
- A statutory provision of the fence, constant education, training etc will go a long way in reducing the incidence of such accidents.

6.5.4 STORAGE OF FUELS AND EXPLOSIVE MATERIALS

- The explosives will be stored in a magazine of 4T capacity.
- Based on the study of accidents in chemical industry in India over a few decades, a specific legislation was enacted and enforced by the Government of India (GOI) in 1989 in conjunction with Environment

Protection Act, 1986, referred to as "GOI rules 1989". These rules are for the purpose of identifying major hazardous installations applying certain criteria on toxic, flammable and explosive properties of chemicals.

- Besides, the criteria list of hazardous substances with their threshold quantities is provided in part II of schedule I of the rules.
- Schedule-II of the rules sets out the threshold quantities for isolated storage units.
- Schedule-III gives a list of hazardous chemicals with their threshold quantities. In this schedule different chemicals are classified into different sub group viz. Group 1 - Toxic substances, Group 2 - Toxic substances, Group 3 - Highly reactive substances, Group 4 - Explosive substances and Group 5 - Flammable substances.
- Schedule-IV of the rules indicates various operations, which are hazardous during production, processing or treatment of organic and inorganic chemicals.
- The of storage of flammable and explosive materials used in mines to determine the Threshold quantities as notified GoI Rules 1989 and the applicable rules are identified. The results are summarized in **Table 6.4.** The major hazardous materials stored and used in the mines are Diesel, Ammonium nitrate and Nitroglycerine.

TABLE 6.4
APPLICABILITY OF GOI RULES TO HAZARDOUS MATERIALS STORAGE

Sl. No.	Chemical	Annual Requirement/storage	Listed in Schedule No.	Threshold Qty as per GOI Rules (application of rules)
1	Diesel	40 KL (10 KL storage)	1(2)	*(5, 7-9, 13 - 15 10 - 12)* 25 MT 200 MT
2	Ammonium Nitrate	540 T (25 T Magazine)	1(2)	*(4,5 7-9 10 - 15)* 350 T 2500 T

Since the storages of all hazardous materials in Pakri Barwadih - A Mines are much less, when compared with threshold storage quantities, the mine management advised to follow the Indian Explosive Act and Rules 1983 for handling of explosives.

6.6 RECOMMENDATIONS

i. It is recommended to carry out slope stability study before/during mining operation warranting storage of Overburden dump and stability of benches.

ii. It is recommended the Blasting Pattern shall be designed in consultation with CMPDI or a contemporary agency before conducting any blasting for the purpose of winning coal.

iii. Prevailing statute at the time of commencement of mining operation shall be observed regarding storage of hazardous material within the mining lease area.

iv. Area Drainage Study/Nalla Diversion Study for PB North West (Sector A) had not been carried out. Straightening of nalla for a distance of 1km is proposed in this mining plan. However in the favour of safety it is recommended to carry out study and its approval before commencement of mining operations to prevent potential inundation hazard.

v. In the present Mining Plan diversion/alignment of Khora Nala–A is envisaged to be explored during 25th year of mining operation over the back filled area of PB west to enable extraction of additional 33.18 Mt (10.95 of PB West & 22.23 of PB North West) coal blocked under barrier between the two quarries (PB & PB NW) & coal blocked under Dump C after 38th year of mining operation. It is recommended to carryout separate study for said diversion at appropriate time.

vi. Forest clearance of PB North West (Sector A) had not been obtained. As approximately 65% of land of this sector falls in forest land category it is recommended to obtain clearance from MoEF&CC before commencement of mining operations.

vii. EIA/EMP clearance PB North West (Sector-A) had not been obtained. As more than 65% of land of this sector is forest land approximately it is recommended to carry out EIA/EMP study and obtain its approval from MoEF &CC before commencement of mining operations.

CHAPTER VII

COAL HANDLING, WASHING & MODE OF DISPATCH

CHAPTER VII

COAL HANDLING, WASHING & DISPATCH OF COAL

7.1. Use of Mineral

Pakri Barwadih block has been allocated to NTPC to undertake coal mining for exclusive use of coal for its power plants. Coal linkages already in place shall not be disturbed and NTPC shall continue to honour its commitments towards long-term linkages from nationalised companies to its thermal power plants.

All coal mined from the block, shall be used in NTPC power plants and no coal shall be disposed of in any other manner, whatsoever, without prior permission, in writing, of the Govt. of India.

NTPC has presently planned Open Cast, Underground mining shall also be planned to extract the reserves below 300 meters at later date. This project is planned for produce 18 million tonnes of coal out of which 15 million tonnes shall be produced by PB West & East Quarry while 3 million tonnes shall be produced by PB NW Quarry. The produced ROM coal shall be D-E grade/ (G-8) from PB North West while D-F grade / (G-8) from PB West & East. Coal produced from all the three quarries shall be power grade coal.

7.2. Mineral Processing

NTPC power plants have been designed to accept F grade coal. The entire coal production from the mine has been basket linked to different power houses. Rom coal directly received from the mine is expected to have 1000-1200 mm size, ROM coal shall be screened and oversize coal shall be reduced to -50mm. The ROM coal shall be crushed in two stages, at initial stage (Primary Crushing) size shall be reduced from 1000-1200 mm to 200-250 mm and in the subsequent stage (Secondary Crushing), size shall be reduced from 200-250 mm to (-) 50mm. If necessary suitable de-shaling/dry de-shaling arrangement will be provided, as may be required from time to time.

The above processing arrangement shall be installed at the pit head of the mine. Further processing if necessary shall take place at the power plant end.

7.3. Surface Transport of Coal

ROM Coal shall be transported from active faces of all three quarries namely PB West, PB East and PB NW, in coal body dumpers (60T) to their respective pit head Coal Handling Plant (CHP) hoppers. CHP of PB West shall be dismantled at the exhaustion of coal from the same. Each of CHP hoppers are designed to cater to the requirement of volume of production of respective quarries and provided with enough space for unloading of two dumpers.

The processed coal shall be fed to the Cross country conveyors which in turn convey the coal to Benadag Yard being constructed by NTPC. Benadag Yard is located at approx. 14 km from the project boundary.

Indian Railway wagons shall be loaded by rapid loading system provided in loading silos. Onward transportation of coal shall be through Indian Railway to identified power plants of NTPC.

Cross Country Conveyor System from the mine to Benadag Siding is presently under construction. Till the completion of the conveyor system coal shall be transported to the nearest Railway siding (Benadag) by road.

7.4. Coal Handling Plant for Western & Eastern Quarry

As per this Mining Plan built up period for western quarry is 12 years, CHP shall be commissioned phase wise to handle 15 million tonnes of coal initially for western quarry. During period of full production this CHP shall be handling entire coal production from western quarry. During the overlapping period of 3 years separate CHP shall be installed to handle the coal from Eastern quarry. As coal production from western quarry diminishes, and coal production from PB East quarry surges the CHP of Western quarry shall be dismantled and simultaneously installed for Eastern quarry in phases. Brief of working philosophy of CHP of PB West and PB East is described below:

7.4.1. GENERAL

The coal handling plant has been designed to crush the ROM (-) 1000-1200mm feed from different pits to produce (–) 50 mm sized coal. The major process facilities of proposed CHP will comprise of the following:

a. In-pit Skid mounted crusher/ Crusher equipped with apron feeder and hopper
b. Long distance belt conveyor
c. Secondary crushing
d. Product stockpiling & reclaiming
e. Cross country conveyor from Reclaimer to Railway Loading point.
f. Loading & dispatch

The coal from different benches will be transported by dumpers and will be fed to the in-pit crushers / Crushers through apron feeders, placed at suitable locations in different pits to generate (-) 250 mm product. The crushed coal will be brought to long distance belt conveyor through conveyors. The long distance belt conveyor running along the north-eastern periphery of the pits will transport the crushed coal to secondary crushers/ Crushers to further reduce the product size to (-) 50 mm. The sized coal will be further conveyed to product stockpile, where it will be stacked and reclaimed through stacker reclaimer unit, or will be directly discharged into the cross country conveyor. The cross country conveyor shall transport the sized coal and directly load into the railway wagon through silos. The CHP has been planned to handle ultimate total capacity of 15 Mty of coal. Initially, all the 3 skid mounted primary Crushers will be installed along with one circuit of long distance belt conveyor, 1 set of stacker reclaimer, 2 circuits of cross country conveyor and 1 no. silo has been envisaged to be commissioned in the first phase. Subsequently, the 2nd circuit of LDBC will be ready by 4th year of production, second set of stacker reclaimer, cross country conveyor and second silo will be commissioned by 10/11th year to meet the rated capacity of 15 Mty.

7.4.2. DESIGN PARAMETERS

a. BASIC DATA

- Production capacity in MTY - 15.0
- No. of working days / annum - 330
- No. of working shifts / day - 3
- Duration of each shift (hours) - 8
- Feed size of R.O.M coal (mm) - (-) 1000-1200
- Product size in mm - (-) 50

b. CHP WORKING SCHEDULE

Crushing, storage and loading will be done in three shifts per day and seven days a week.

c. SYSTEM CAPACITY

The handling capacity of the CHP has been decided to match with the production capacity of the mine. In order to meet the fluctuations of coal output from the mine due to irregularities of despatch / transport system

and seasonal fluctuations, the design capacity of the CHP has been fixed accordingly.

7.4.3. SALIENT FEATURES

The proposed CHP consist of the following units:

- Three no. of Skid mounted Crushing station equipped with apron feeder and receiving hopper. Apron feeders will feed coal into primary Crusher.
- 3 nos. of Crushers (Primary) of 1600 TPH at receiving hopper to crush coal from 1200 mm to 250 mm size.
- Two streams of 1800mm wide Conveyor systems upto the secondary crushing station.
- 4 nos. of Crushers (Secondary) of 1200 TPH each with vibro feeders at Secondary crushing house to crush coal from 250 mm to 50 mm size.
- Conveyor systems of 1800 mm width and 2200 tph from secondary crushing station upto the stockyard.
- Two numbers of Stacker Reclaimer of 2500 tonnes per hour capacity each.
- Three circuits of 1800mm wide belt conveyors of 2500 TPH each capacity upto loading point.
- Two nos. of 4000 te capacity Silo each containing 2sets of 5500 TPH capacity Rapid loading system with 2x72te capacity pre-weigh hoppers.
- One numbers of magnetic separators in each flow.
- One numbers of metal detectors in each flow.
- One numbers of belt weighers to weigh the coal in each flow after secondary crushing.
- Miscellaneous facilities like dust control system, firefighting and ventilation system. Plant cleaning and Infrastructure for preventive maintenance are also envisaged. Necessary Electrical, interlocking, signalling and communication facilities.

7.4.4. IN-PIT SKID MOUNTED SEMI - MOBILE CRUSHING STATION

Coal receiving unit will be of 200 te capacity, semi-mobile, skid mounted consisting of Apron/Chain feeder of 1600 TPH capacity with matching suitable electric drive motor. Adequate height skirt plates will be installed on the apron/ chain feeder in

such a way that the assembly acts as a receiving hopper to receive coal from tipping trucks. The apron/ chain feeder will be of robust construction, heavy duty type and suitable for round the clock continuous operation. It will be suitable for use in adverse environmental conditions and dusty surroundings. The feeder will be capable of absorbing the impact of falling lumps of maximum lump size. It must be capable of receiving the direct impact of coal from tippers.

The R.O.M. coal brought from the quarry by tippers will discharge into the said sizing plant. The unit will be complete in all respect, could be easily dismantled, shifted and installed at new location. Major components of the unit are as under.

Low height roll Crusher (preferably double roll) has been envisaged to size the coal to (-) 250 mm size with matching suitable electric motor drive. The sizing roll will be fitted with replaceable sizing teeth which shall slide over the slots provided in the shaft with picks (heavy duty). The Crusher design will be such that it be able to have round the clock continuous operation. It will be suitable for dusty condition. It will be able to start at full load conditions and robust enough.

Suitable lifting devices will be provided for ease in installation, dismantling and taking out components for maintenance. The components/ parts will also be provided with lifting lugs.

Unit will be designed to provide suitable maintenance platform for inspection, maintenance etc. It will also have an operator's cabin installed at a suitable location for the operator of the machine. Operator should be able to view the crushing operation.

Suitable dust suppression system will be provided to suppress dust particles during discharge of coal by tipping trucks etc and also at transfer points. Portable type fire extinguishers of different type will be provided in the Crushing unit to prevent fire hazards.

The electrical system of the semi-mobile sizing units consist of the A.C drives and (related Motor Control Centre for Apron / Chain feeder, Crushers etc. Along with this the power supply arrangement should also cater for dust suppression system, electrical hoists, illumination (Plant & Peripheral) and other sub system. Power at 3.3/6.6 kV will be made available up to the sizing units

7.4.5. SPECIFICATION OF SECONDARY CRUSHER

• Nos. :	04 (Four)
• Material to be handled:	Coal
• Feed size of ROM. coal (in mm):	(-) 250
• Product size (in mm):	(-) 50
• Average HGI of coal:	45 (max.)
• Bulk density of coal:	1000 kg/m3
• Crushing capacity:	Rated-1600tph
• Designed:	1850 tph
• Moisture content:	upto 10%
• Ambient temperature:	50 deg C
• Duty:	Continuous,
Hrs/day:	20
Per Year:	350
• Power Supply:	3.3kV, 3phase, 50Hz,

7.4.6. CRUSHER LOCATION

Considering the gradual increase of production from 2.34 Mt to 10 Mt in the first 5 years, the required nos. of Crushers will be added at different pits starting from the second year of construction period as indicated in the table showing phasing of CHP. These Crushers will be located at the mouth of the different pits viz WP-1, WP-2, WP-3 & WP-4 in the initial period. Further enhancement of capacity from 10 Mt to 15 Mt. will start in the 11th year of production from WP-IV pit. Two no. of Crushers from pit WP-I, WP-2 and WP-3 will be shifted to pit WP-4 in the 8th year and 10th year respectively.

On advancement of faces at WP-4 pit, the Crushers will be shifted and located at suitable places to keep the dumper lead minimum.

7.4.7. CONVEYING ARRANGEMENTS

The sized coal will be discharged to collecting-cum-elevating conveyor which in turn will discharge it to the long distance belt conveyor having length of about 5 km. The entire product will be conveyed to the secondary crushing station where coal will be crushed to (-) 50mm. Finally coal will be reclaimed through 2 no. of 1800mm wide belt conveyors and conveyed to the product stockpile. Two circuits of long

distance belt conveyor (LDBC) with each having 2500 TPH capacity has been envisaged up to the product stockpile. Stacker & Reclaimers have been proposed for stacking the coal on the ground and loading on the cross country conveyors. Stacker and Reclaimer shall be installed at the terminal point of the long distance belt conveyor and starting point of cross country conveyor for carrying coal to Silo for fast loading into the rakes. These (-)50 mm coal will be transported to the Silos located at loading point through two circuits of cross country belt conveyors having a length of about 14 km of above mentioned specification.

7.4.8. Product Stockpile

Open air product stockpile of 800m x 400m dimension has been proposed with facility of stacking and reclaiming through rail mounted Stackers & Reclaimers with capacity of 2500 tph each. There will be a bypass arrangement at product stock pile wherein the sized coal can be directly fed to the cross country conveyor, without stacking, for loading into the wagons through silos. The product stockpile can accommodate 4 lakh tons of coal ie. about 10 day production of the mine at rated capacity.

7.4.9. BROAD TECHNICAL PARAMETERS OF STACKER-RECLAIMER

The main characteristics of the Stacker-Reclaimer shall be as follows.

- Type: Rail mounted, self-propelled, luffable, slewable, Boom type Stacker cum Bucket wheel Reclaimer.
- Nos. : 02 (Two)
- Material to be handled: Coal
- Duty: Continuous, 20 hrs. /day, 350 days a year.
- Capacity, tph: Stacking
  Rated: 2500, Designed: 2875
  Reclaiming
  Rated: 2500, Designed: 2875
- Power Supply:
  3.3kV, 3phase, 50Hz, through Flexible Cables and Cable Reeling Drums.
- Boom length, m: To suit the stock-pile width
- Track centres: 6.0 m
- Length of travel: 750m

- Travel speed: Forward 0-20 m/ min stepless
- Hoisting speed: 2 m/min (approx.)
  /Luffing Range to suit the stock-pile width/ length
  (With respect to discharge pulley)
- Cross section of the stock file: Triangular
- Bottom width of stock pile: 25 m
- Height of stock: 10-15 m Pile w.r.t. to rail level.

7.4.10. WAGON LOADING SYSTEM

Fast loading Silo having 4000 T capacity suitable for flood loading of Indian Railway Rakes 58 Box 'N' or long 116 Box 'N' has been proposed. Silo shall be of RCC construction each fitted with two nos. pre-weigh bins and telescopic swing chutes suitable for loading at the rate of 5000 TPH.

The brief specification of silos is as follows.

i) Capacity selected	4000 T
ii) Diameter (apprx.)	20 m
iii) Height (apprx.)	55 – 60 m

7.5. Coal Handling Plant for PB North-West (NW) Quarry

7.5.1. Introduction

The rated coal production of 3.0 Crusher from PB North West (Sector-A) Coal Block is required to be fully processed through separate Coal Handling Plant (CHP) to ensure consistent size and continuous supply of coal to thermal power station (TPS).

Coal from the Quarry NW shall be transported upto the receiving hopper, in the CHP ROM coal shall be reduced to -50mm size and stored in the truck loading hoppers. 20-40 tonner trucks shall be loaded through truck loading system and transported upto surge bunker located near PB East & West surge bunker. Reclaim conveyor shall load the coal in the cross country conveyor. Through a separate stream of conveyor, coal shall be conveyed upto loading silo located at Benadag Yard. Rapid loading system installed in the Loading Silo shall load the coal in the Railway wagons from where the coal shall be despatched to the identified power plant of NTPC.

However, detail feasibility study is recommended to finalise the following:

a. Coal evacuation system for PB (NW) Quarry adjacent to cross country conveyor of PB(West &East)
b. Location and capacity of Rapid Loading System for PB (NW) Quarry

7.5.2. **General**

The coal handling plant has been designed to crush the ROM (-) 1000-1200mm feed from different pits to produce (–) 50 mm sized coal. The major process facilities of proposed CHP will comprise of the following:

- Receiving hopper
- Primary / Crusher equipped with apron feeder and hopper
- Long distance belt conveyor
- Secondary crushing
- Product stockpiling & Reclaiming
- Cross country conveyor from reclaimer to Railway Loading point
- Loading & dispatch

The coal from active faces/different benches will be transported by 60T dumpers and fed to the s / Crushers through apron feeders, placed at suitable locations in the surface to generate (-)250 mm product. The belt conveyor will transport the crushed coal to secondary s/ Crushers to further reduce the product size to (-) 50 mm. The CHP has been planned to handle ultimate total capacity of 3 Mty of coal.

7.5.3. DESIGN PARAMETERS

7.5.3.1 BASIC DATA

- Production capacity in MTY - 3.0
- No. of working days / annum - 330
- No. of working shifts / day - 3
- Duration of each shift (hours) - 8
- Feed size of R.O.M coal (mm)- 1200
- Product size in mm - (-) 50

7.5.3.2 CHP WORKING SCHEDULE

Crushing, storage and loading will be done in three shifts per day and seven days a week.

SPECIFICATION OF PRIMARY CRUSHER

• Nos.	02
• Material to be handled:	Coal
• Feed size of ROM. coal (in mm)	1200
• Product size (in mm)	(-) 250
• Average HGI of coal	45 (max.)
• Bulk density of coal	1000 kg/m3
• Crushing capacity	Rated-300tph
• Designed	350 tph
• Moisture content	upto 10%
• Ambient temperature	50 deg C
• Duty	Continuous,
Hrs. /day	20
Days a year	350
• Power Supply:	3.3kV, 3phase, 50Hz,

7.5.6. SECONDARY CRUSHING

Crushed Coal of (-) 200-250 mm size from primary shall be fed directly onto the secondary crushing arrangement for further sizing of coal to (-) 50mm. The crushed coal shall be transported to surface hoppers through conveyor system.

SPECIFICATION OF SECONDARY CRUSHER

• Nos.	04 (Four)
• Material to be handled	Coal
• Feed size of ROM. coal (in mm)	(-) 250
• Product size (in mm)	(-) 50
• Average HGI of coal	45 (max.)
• Bulk density of coal	1000 kg/m3
• Crushing capacity	Rated-300tph
• Designed	350 tph

• Moisture content	upto 10%
• Ambient temperature	50 deg C
• Duty	Continuous,
Hrs. /day	20
Days a year	350
• Power Supply:	3.3kV, 3phase, 50Hz,

7.5.7. Product stockpile

Open air product stockpile of 400m x 200m dimension has been proposed with facility of stacking and reclaiming through rail mounted stackers & reclaimers with capacity of 600 tph each. There will be a bypass arrangement at product stock pile wherein the sized coal can be directly fed to the cross country conveyor, without stacking, for loading into the wagons through silos. The product stockpile can accommodate 1 lakh tons of coal ie. about 10 day production of the mine at rated capacity.

BROAD TECHNICAL PARAMETERS OF STACKER-RECLAIMER

The main characteristics of the Stacker-Reclaimer shall be as follows.

1) Type : Rail mounted, self propelled, luffable, slewable, Boom type Stacker cum Bucket wheel Reclaimer.

2) Nos. : 02 (Two)

3) Material to be handled: Coal

4) Duty: Continuous, 20 hrs/day, 350 days a year.

5) Capacity, tph: Stacking
Rated: 600, Designed: 650
Reclaiming
Rated: 600, Designed: 650

6) Power Supply:
3.3kV, 3phase, 50Hz, through Flexible Cables and Cable Reeling Drums.

7) Boom length: To suit the stock-pile width

8) Track centres: 6.0 m

9) Length of travel: 250m

10) Travel speed: Forward 0-20 m/ min stepless

11) Hoisting speed: 2 m/min (approx)
/Luffing Range to suit the stock-pile width/ length
(With respect to discharge pulley)

12) Cross section of the stock file: Triangular

13) Bottom width of stock pile: 25 m

14) Height of stock: 10-15 m Pile w.r.t. to rail level.

7.5.8. Wagon loading system

Fast loading Silo having 2000 T capacity suitable for flood loading of Indian Railway Rakes 58 Box 'N' or long 116 Box 'N' has been proposed. Silo shall be of RCC construction each fitted with two nos. pre-weigh bins and telescopic swing chutes suitable for loading at the rate of 3500 TPH.

The brief specification of silos is as follows.

i) Capacity selected	2000 T
ii) Diameter (apprx.)	18 m
iii) Height (apprx.)	25 – 30 m

7.6. DUST CONTROL SYSTEM

The objective of this system is to eliminate the air born coal dust or suppress the dust at its source. The system involves confinement of the dust within the dust producing area by a curtain of moisture and wetting the coal dust by direct contact between the particles and droplet of water. Adequate number of precision anti-clog nozzles will be installed at suitable locations for suppressing dust by spraying water mixed with suppressant. Suitable control for dust suppression shall be provided and the system shall be so inter-locked that it functions only when the conveyor system is operating or the loading operation is on. Fog type dust suppression system will be provided wherever possible.

7.7. NOISE CONTROL

Noise pollution causes fatigue to operating personals. Provision will therefore be made to keep down the noise level to the extent possible. All machine mountings will have in their foundations anti-vibration pads/sheets for reducing the vibration and thereby noise. All transfer chutes and hoppers, silo shall have wear resistant rubber or ultra-high molecular weight plastic / synthetic liners of various thickness as per design requirement and their suitability.

7.8. FIRE FIGHTING SYSTEM

Necessary firefighting system has also envisaged for the plant, which includes fire hydrant tees at strategic locations at equal spacing of 25 to 35 meters with suitable water supply pipe lines. Also portable type fire extinguishers to deal with electrical / oil /ordinary fires shall be provided at all strategic locations in the plant.

7.9. PLANT CLEANING SYSTEM

To facilitate cleaning at strategic locations ample number of high pressure water servicing points have been envisaged. These service points will be so located that with a 15/20 m long hose any working area in the plant or equipment working place can be reached. These service points will be provided with quick connecting hose couplings for easy fixing and dismantling of hoses.

7.10. PLANT PREVENTIVE MAINTENANCE

For effective maintenance of all the equipment, there will be sufficient working space around the equipment/machinery. All the equipment and conveyor discharge drums/transfer points, etc shall have covered and well ventilated housing complete with access stair ways, hand rails, platforms, cross-over ladders, etc as required.

Necessary mono-rails electric hoists and chain pulley blocks at suitable points of adequate capacity will also be provided on respective floors for operational Control.

A control desk cum mimic panel will be provided in the control room from where the entire plant from crushing to ground stacking will be controlled. However for loading operation from silo, separate control desk cum panel shall be provided in the control room at rapid loading station. At the time of start, an alarm through

hooter will be blown to warn the working personnel.

7.11. ELECTRICALS

The main switching station for the coal handling plant shall be suitably located and will receive power from the Project substation.

The electrical system shall comprise:

- Power reception and distribution system
- Centralized sequence control–cum–interlocking, automation, signaling and instrumentation system
- Illumination of plant and adjacent area Illumination shall be provided as per Indian Electricity Rules.
- Centralized welding circuit
- Earthing arrangement for the plant shall be provided as per Indian Electricity Rules.

7.12. COAL SAMPLING

It is proposed to install automatic sampling system in the CHP. Coal from conveyors shall be collected by the sampler at pre- determined intervals to assess the quality of the coal being dispatched. The coal samplers shall be suitably located. The samples collected shall be sent to the laboratory for further analysis.

7.13. CIVIL & STRUCTURALS

The civil and structural work shall cover all aspects of civil and structural design based on detailed survey, soil and hydrological investigations, seismic data, etc.

7.14. MODE OF DESPATCH

RAILWAY SIDING

Considering the topography of the area, site near Banka Village, located at a distance of about 14 km from the block has been selected for the Railway Siding. Benadag Railway siding shall be constructed by NTPC This Railway siding is under construction which shall be connected with Hazaribagh Railway Station at approx. 9 km from Benadag Siding.

Three no. of Loading silos shall be constructed on the over the tracks out of which two silos of 4000T each capacity shall cater to the PB West & East Quarry the third shall be of 2000T capacity which will cater to the requirement of PB-NW Quarry.

ROAD TRANSPORTATION

Cross Country Conveyor System from the mine to Benadag Siding is presently under construction. Till the completion of the conveyor system coal shall be transported to the nearest Railway siding (Benadag) by road.

7.15. WASHING

Coal Block was explored during the period 2003-04 and no washability studies were conducted. As per the Geological Report average grade of the coal is G-10 (Grade –E) with a calculated GCV of about 4300 Kcal/kg. Based on the Geological Report the range of ash percentage varies from 16-51% in PB West & East Quarry and 7-50% in North West Quarry. The average ash for the mined out coal is estimated to be about 34%, hence no provision for coal washery has been made as of now.

It is proposed to dispatch the ROM sized coal (-50mm) by conveyor followed by rail to the End Use Plants (EUPs).

7.16. COAL QUALITY MONITORING LABORATORY

For quality assurance and control, it is proposed to establish a Coal Laboratory with all the necessary equipment for daily analysis of the coal quality at Mine end.

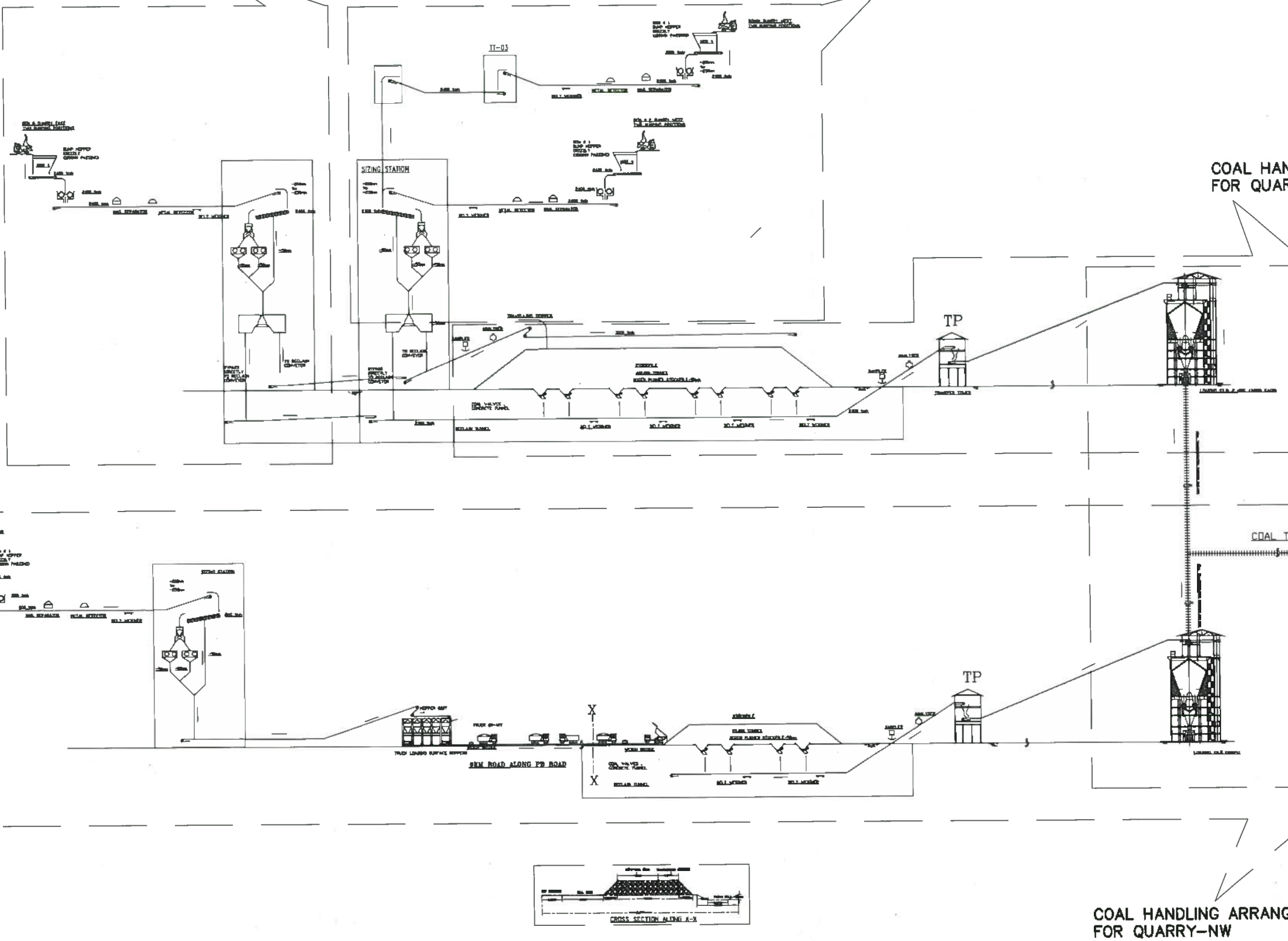
7.17. DRAWINGS

A Coal flow diagram for proposed CHP has been given in the drawing.

COAL HANDLING ARRANGEMENT FOR QUARRY–EAST

COAL HANDLING ARRANGEMENT FOR QUARRY–WEST

COAL HANDLING ARRANGEMENT FOR QUARRY–EAST&WEST



LEGEND

- Roller Screen
- Apron Feeder
- Primary Sizer
- Magnetic Separator
- Metal Detector
- Belt Weigher
- Flap Gate
- Secondary Sizer
- Bifurcating Chute
- Coal Sampler
- Coal Analyser
- Stockpile Discharger(SPD)
- Railway Track
- Loading Silo
- Road Weigh Bridge

Sl. No.	Name of Quarry	Peak Capacity	Year of Commence ment	Life of Quarry
1	Quarry-West	18MTPA	1st	25 Years
2	Quarry-East	18MTPA	20th	18 Years
3	Quarry-North-Western	3MTPA	1st	38 Years

COAL TRANSPORTATION THROUGH RAILWAY

POWER PLANT AREA

COAL LOADING ARRANGEMENT AT BENADAG YARD

COAL HANDLING ARRANGEMENT FOR QUARRY–NW

आई० पी० नागपाल/ I.P. NAGPAL
अवर सचिव/ Under Secretary
कोयला मंत्रालय/Ministry of Coal
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Note:

1. Pakri Barwadih is the basket source of coal for NTPC power Plants.
2. Provisions of two ground bunkers have been made one each for Quarry–NW and Quarry West&East.
3. The coal flow diagram is tentetive and may change during implementation stage.
4. Two loading Silos shall be provided to load the coal for Quarry West & East. One loading Silo shall be provided to load the coal of Quarry–A
5. There shall be two streams of cross country conveyors both working for Quarry–East & West.
6. There shall be one streams of cross country conveyor for Quarry–NW
7. Size of coal loaded on the Railwat wagon shall be (–50mm)
8. Length of Cross country Conveyors shall be 14Km(approx). Its takeoff point shall be on the Northern side of block and shall terminate at Benadag Yard.
9. Coal Handling plant of west quarry shall be used for east quarry , which shall be dismantled in phases on exhoustion of WP–3 & WP–4.

NTPC

N T P C LIMITED
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION
(MINE PLANNING & DESIGN)

PROJECT: PAKRI BARWADIH COAL BLOCK

TITLE: REVISED MINING PLAN (1st Revision)

SUBJECT: COAL HANDLONG PLANT/COAL FLOW DIAGRAM

ACTIVITY	NAME	DESIG.	DATE	SIGN.
DESIGN			04.01.2016	
DRAWN			04.01.2016	
CHECKED			04.01.2016	
APPROVED			04.01.2016	

SCALE : NTS SHEET : 1 OF 1 DATE: 04.01.2016

DRG. NO.: 7010–199–POM–J–42 PLATE NO. 42

CHAPTER VIII

INFRASTRUCTURE FACILITIES PROPOSED AND THEIR LOCATION

CHAPTER-VIII

MINING INFRASTRUCTURE & FACILITIES

8.1 Introduction

Pakri Barwadih mine is planned to produce 18 Mt of coal per annum by Open Cast method of mining. Life of the mine shall be approximately 52 years as per the calendar programme. Besides maintaining large fleet of HEMM and ancillary equipment, it will employ approximately 2863 manpower including 367 manpower for operation of PB East in the initial two years. To improve overall availability/utilization of the mining equipment there is a need for flawless extraction of coal and OB, transportation and despatch of coal to the end use plant. Further to ensure proper administration and welfare of the personnel employed, there is a need to construct the infrastructure for safe and economic exploitation of coal. The layout has been designed to achieve the above objectives. All necessary facilities have been provided in the workshop to cater the need of the project.

Mostly separate infrastructure is planned for PB West quarry and PB NW Quarry. Infrastructure proposed for PB West quarry such as CHP, substation, workshop, administrative buildings etc. shall be utilised progressively for PB East quarry on restart after 25th years of Mining Operation and proportionate to the production. But the infrastructure/facilities which could not be shared with PB West quarry shall be constructed separately for initial two year as well as after the restart of PB East quarry (haul roads, culverts drainage system etc.). Certain facilities such as coal sampling lab, environmental cell, vocational training centre etc. shall be common for all quarries.

The target capacity & water requirements for each quarry are given in **Table 8.1**.

Table 8.1

Sl. No.	Quarry Name	Target Capacity in MTPA	Water Demand in MGD
1.	PB West &East Quarry	15	0.91
2.	PB North-West Quarry	3	0.2
	Total for PB Mine	**18**	**1.11**

As explained above separate infrastructure is proposed for PB-West & East quarry and PB- NW, details are as following:

8.2 Infrastructure and facilities for PB West & East Quarry

8.2.1 Infrastructure facilities proposed

The area for the infrastructure facilities will be secured by a boundary fence and a soil bund on the edge of the mine. The proposed major buildings within and precincts of the mine boundary are as follows:

1. Heavy Earth Moving Machinery (HEMM) Workshop
   - a Welding Shop
   - b Tool Store
   - c Electrical Shop
   - d Office space for workshop management
   - e Shift in change room
   - f Washing facilities and toilets
2. Light Vehicle (LV) Workshop
3. Tyre Workshop & Tyre Storage Bay (open area)
4. Equipment Washing Facility
5. Office Building
6. Worker's Bathhouse and Canteen
7. Dispensary
8. Store
9. Engineering Section
10. Security Office
11. Fuel Depot
12. Coal Evacuation System and Coal Handling Plant
13. Electrical Power supply
14. Mobile Service Van
15. Approach Roads
16. Other roads and culverts
17. Domestic and Industrial water supply & sewerage
    - a Sources of water
    - b Industrial water supply
    - c Effluent Treatment Plant
    - d Industrial Sewerage
    - e Sewage Treatment Plant
18. Temporary Workshop

1. Heavy Earth Moving Machinery (HEMM) Workshop (Maintenance Workshop)

The Maintenance Workshop shall have a concrete grade slab that is designed to support the loads by the next larger size of the heaviest unloaded vehicle in the quarry's fleet. It shall have minimum of six vehicle maintenance bays to handle the next larger size of the largest vehicle in the quarry equipment fleet. At least four of the six bays shall be "drive through" to allow the trucks to be serviced.

The Maintenance Workshop shall also provide separate space, of adequate size for the equipment being maintained.

A minimum of two bays shall be provided with rails embedded in the concrete grade slab. These rails shall be spaced to support all of the tracked equipment off of the concrete and the supporting rebar mat membrane shall be design to distribute this load without the concrete cracking.

The facilities shall include overhead crane(s) sized for the largest of the largest component load of the next largest size of the largest truck or the currently planned truck. The crane(s) shall service all of the maintenance bays and run the length of bays as required for positioning components for the vehicles being maintained.

The Maintenance Workshop shall primarily be an open frame steel structure without walls and with a roof height sufficient for truck/overhead crane clearance. Work areas which are sequestered from the main area (for reasons of safety, security etc.) shall be petitioned from the main areas with masonry walls. The facility shall have walls as required to frame in the crane and to provide a complete roof above the truck maintenance level. The roof shall include Control of rain runoff away from main access areas.

The ground level maintenance bays shall be an open structure except where access limitations have been described. A full building skin shall be provided at a level sufficient for truck clearance of the next largest of the largest truck in the mine fleet.

a. Welding Shop

Welding shop for repair of shovels, buckets, equipment etc. will be part of the HEMM Workshop.

b. Tool Store

Tool store will be provided in the HEMM Workshop to store the tools.

c. Electrical shop

Electrical shop will be provided as part of the HEMM Workshop for repairing

of electrical parts.

Apart from the above, office space for the workshop management, shift change room, washing facilities and toilets shall also be provided. In addition to the Main Workshop, a temporary workshop has also been envisaged to cater to daily maintenance and routine checking of HEMM deployed in the mine.

d. Office space for workshop management

Office space in the separate building equipped with computers, communication facilities stationary and furniture shall be provided for workshop management. Office climate control shall also be provided based on the prevailing ergonomics.

e. Shift in change room

A separate shift in-charge room along with the office of Mine Time Keeper shall be provided. This room shall be equipped with computers, communication facilities stationary and furniture for manpower management during the shift operations. Office climate control shall also be provided based on the prevailing ergonomics.

f. Washing facilities and toilets

Washing facilities and toilets shall be provided as per requirement.

2. Light Vehicle Workshops

A separate maintenance workshop for highway vehicles shall consist of a minimum of six bays with a separate office and a secure storage room for parts and tools. This facility shall include a concrete grade slab, and primarily framed from steel with reinforced masonry walls. No garage doors are required but the facility shall have walls on two sides and shall have a complete roof. The roof shall include control of rain runoff away from main access areas.

3. Tyre Workshop

This facility shall consist of a heavy floor slab sufficient to support the haul track and the forces induced from a floor jack or lift as required to change wheels tyres on the haul truck. This facility shall also include a complete roof to control rain runoff away from main access areas. The facility shall also incorporate a secure tool storage room locker with benches to allow workmen to change from their work clothing, a toilet and an office.

4. Equipment Washing Facility

This facility shall include a large concrete grade slab with rail embedded to protect the slab from tracked equipment. The slab shall be sloped to direct water to the settlement basins. This facility shall include the washing

equipment, including water cannon; access platforms; setting tanks; oil traps and oil collecting tanks. The settling tanks shall be designed to allow a small pay loader to drive in to the tank to collect large deposits of silt or other materials deposited from washing the vehicles.

5. Office Building with Medical Clinic

A single-story Office Building shall be provided to serve mine support functions such as; engineering; mine supervisors and managers; the canteen; document storage; information Technologies (IT) and computer backup; mine administration; secret ration; secretarial and other support staff. The building shall also provide a minimum of four meeting rooms and have a waiting room. This office building will also include First Aid Medical clinic.

6. Worker's Bathhouse and Canteen

A separate canteen for the hourly staff shall be provided. It shall have showers, changing areas, toilets, kitchen, a canteen serving area and an area for recreation. For employee morale, plans for this facility shall include features that make this a facility that the workers enjoy.

7. Medical unit (Dispensary)

This facility shall comprise of containers for first aid and handling medical emergencies, offices for doctors & nursing staff, emergency ward, ward for patients, toilets, kitchen, medicine room, ambulance van etc. It shall be equipped for treating the medical emergencies.

8. Ware house and warehouse building (Store)

The ware house shall be an open two-story facility with extensive fenced storage yard adjacent to the facility. Access to the fenced storage and the main equipment storage entry shall be controlled through a gate. A tool shop, the main switchboard, radio room, offices, toilets and meeting rooms shall be provided within this facility. Office space shall be provided to supplement the main office building.

9. Engineering Section

This is broadly divided in to five sub-sections

i. Machine shop
ii. Electrical repair shop
iii. Welding & structural shop

iv. CHP & Mechanical repair shop

v. Repair shop for Pumps and Pipes

The Engineering section is also equipped with a small workshop substation, scrap yard etc. A common 10/5 t capacity EOT has been envisaged to serve all the above mentioned shops of Engineering section to facilitate inter-shop equipment movement smoothly.

10. Security Office

Security offices shall be provided where access to the mine is required to be controlled. Suitable monitoring, recording and secure access controls shall be provided as appropriate where items stored are dangerous or easily removed

11. Fuel Depot

A fuel storage facility shall be provided to ensure that the mine can operate for a period of about one month during an interruption of fuel delivery.

The facilities shall include containment walls of sufficient height to assure if any one tank is compromised any fuel stored shall that may be spilled shall be contained. The facility shall also include perimeter collection concrete culverts that drain to an oil interceptor which shall be design to collect localize spills that occur during normal fuelling. The trucks are to be fuelled on a concrete grade slab which is surrounded by the concrete culverts. Continuous grating shall be installed over the culverts which shall support any vehicle in the mine fleet.

12. Coal Evacuation System and Coal Handling Plant

Proposed coal evacuation system and coal handling plant has been elaborated in **Chapter VII**.

13. Electrical Power Supply

13.1 Construction Power Supply

It is proposed to arrange construction power at 11 kV from JSEB, Langatu substation located at about approx. 4 km from the project site before establishment of permanent power supply arrangement.

The 11 kV switchgear will be envisaged at main receiving substation for receiving construction power at 11 kV. The power supply for all construction activities, mine office and other amenity buildings can be fed at 11 kV. Provision of DG sets has also been made in the report to meet the construction power requirement at the time of power failure.

13.2 Intermediate Power Supply

It is anticipated that construction of 220 KV line from Patratu Thermal Power Station of JSEB may get delayed due to administrative & statutory requirements and therefore a provision has been kept for intermediate power supply by drawing power at 33kV from Langatu sub-station of JSEB to charge 33KV switchgear of Main Receiving Sub-station. This will support the requirement of 5 MVA power during initial period of mine operation.

13.3 Permanent Power Supply Arrangement, Main Substations and Power Distribution:

The maximum power demand estimated for the mine including CHP will be 32 MVA. The source of power will be made available is from JSEB, Patratu at 220 KV. Main receiving Substation of 220/33/11 KV will be constructed at Pakri Barwadih Coal Block.

Other substations like Coal Substation, OB Substation, Colony Substation and CHP substations are also being proposed for further distribution of power inside mine block. All the 33kV substations will receive power at 33kV from the double circuit power line originated from the 33KV switchgear of Main Receiving substation.

Layout of the proposed Sub-stations and power supply system broadly covers the following:

1. Power reception & distribution system.
2. Illumination of workshop and adjacent area.
3. Earthing

The power for workshop shall be made available from project sub-station.

Quarry area is proposed to be illuminated by "HIGH-MAST-TOWERS" located along quarry periphery with Sodium Vapour Lamps on each tower haul Road and inside quarry shall be illuminated by Mobile Towers with Metal-Halide lamps. Proper earthling has been envisaged for Electrical System. All electrical System will have protection from lightening and high voltage surges

14. Mobile Service Van

Provision of a mobile service van has been envisaged to cater the need of repair of heavy equipment at site itself. Following equipment will be required to be installed:

- Welding Transformer, Gas cutting complete set
- Air compressor two stage displacement ,Tyre Inflation gauge

- Water container for drinking water
- Work table, Bench vice to be fitted on work table (1 no.)
- Lighting, Mechanical crane lifting device capacity 1 t
- Hand lamp 100 watts with 25 meters long wire
- Generator set complete with Engine Alternator coupling etc.
- 12/24 Volts D.C. Generator, Distribution board
- Hand operated pneumatic Grinder, Hand operated pneumatic drill
- Fire Extinguisher, First aid box

15. Approach Road

Hazaribagh -Tandwa road passes through eastern part of the block and this road shall be used as main approach road for the block. During operation of Quarry east this road shall be diverted to the easternmost periphery of the block. Approximate distance of road for connecting to quarry west is 10 km.

16. Other Roads & Culverts

16.1 Haul Road

For both the technological options, the length of double lane haul road has been estimated as 10.25 Km for plying of largest dumpers. Another haul road to the dump site having an estimated length of 4km has also been envisaged.

16.2 Heavy duty Road

The dumpers deployed in the benches will also go to the workshop for maintenance. Hence a provision of heavy duty road of 0.25Km has been envisaged in the present report.

16.3 Approach road to the Township

Approximately 10km long, 7.5m wide black top road connecting to the Residential colony has been envisaged.

16.4 Approach road to Magazine

The proposed magazine building has been envisaged to be located at a suitable location keeping in view safety and security requirements. Provision for 1.0Km magazine road has been envisaged in the present report.

16.5 Road along CCT conveyor

A 14 km long, 3.75m wide black top road from block to Banadag yard has been envisaged as road along CCT conveyor.

Additionally, Strengthening of 4 nos. of bridges / culverts on Hazaribagh PKB Highway has also been envisaged.

17. Water Supply & Sewerage

The Water demand assessed for PB West and PB East Quarry is indicated in **Table 8.2.**

Table 8.2.
The Water demand

Potable Water Demand in MGD for OCP	Industrial Water Demand in MGD for OCP	Total Water Demand in MGD
0.31	0.60	0.91

Separate sewerage system for domestic & industrial sewage has been envisaged for the Project.

17.1 Source of water

Three sources of groundwater have been identified.

i. Surface water such as existing ponds, reservoir, nalla or river
ii. Borewells
iii. Mine sump water

During construction years, there is actually no excavation taking place for extraction of coal, but water will be required for building of infrastructure, drinking & service purposes. During first year of operation sump water is not available as mine shall not intersect the aquifer due to lesser depth of the mine. For above period bore wells shall be drilled exclusively to draw water for meeting the water requirement of mine & residential colony. As the mine goes deeper & wider during later year of mining operation the sump water availability vis a vis water requirement of mine shall increase and the water requirement in these operational years shall be met by both sump water & ground water (Bore well water).From this period & beyond when the mine shall be producing 15 MTPA and water requirement expected to reach approx. 4000 m3/day, entire water requirement shall be met with the sump water. Sump water shall also be treated for drinking water purposes and bore well water shall be ceased to use.

As Permission/clearance for drawl and use of groundwater is in place revised Permission/clearance for drawl and use of groundwater shall be obtained from Central Ground Water Board. If necessary Hydrogeological study shall be carried out to assess availability of ground water.

17.2 Industrial water supply

For both the options, ground water in the construction period and mine water has been envisaged as source of water for the project. For the initial years, ground water shall be drawn from bore wells. Afterwards, mine water shall be used. Raw water shall be stored in a bulk water reservoir from which water shall be treated and stored in a separate reservoir. From this reservoir, water will be taken to individual overhead tanks for consumption through pipe network at different points through gravity flow.

For firefighting purposes in the industrial areas like workshops, stores and quarry area, separate distribution networks have been proposed from the ground reservoir. Provision towards requirement of water for public utilities like garden, afforestation etc. has been made in this report. It has been envisaged that the distribution network for firefighting purposes shall also be utilized for these purposes.

17.3 Effluent Treatment Plant (ETP)

Effluent treatment Plant (ETP) of requisite capacity for treatment of industrial sewerage shall be installed.

17.4 Industrial sewerage

It has been considered that the industrial waste from workshop and other industrial establishments would be led through oil & grease traps. The effluent coming out of the industrial premises is proposed to be treated and led to the settling tank and to be recycled for various industrial uses of this project. The domestic sewage generated in the industrial premise has been considered to be dealt through sewerage disposal system.

Furthermore, to divert run off water for the northern side catchment area, a nallah along the northern boundary has been envisaged.

17.5 Sewerage Treatment Plant (STP)

Sewerage treatment Plant (STP) of requisite capacity for treatment of industrial sewerage shall be installed.

18. Temporary Workshop

In addition to the Main Workshop, a field workshop has been envisaged to cater to daily maintenance and routine checking of HEMM deployed in the mine. This workshop shall be shifting as the mine advances and preferably kept in the near proximity to the access of quarry. This workshop shall constitute bays of Daily Maintenance shop occupying requisite area. The shop area is enough to deal with 4 to 5 dumpers at a time, which will meet the requirement of total number of dumpers to be dealt in each shift.

Dumpers after being washed at the washing station shall enter these sheds and daily maintenance requirement like checking nuts & bolts, tyre pressure checking, inspection of hydraulic systems for any leakages and their rectification, electrical system general check-up, battery check-up shall be carried out. Similarly dumpers after complete washing / cleaning will move to the Daily Schedule Maintenance where they will have oil levels checked, lubrication points greased, air cleaner, dust pans cleaned, water level and / or anti-freeze checked. The air, oil and fuel filters will be changed if required as per the maintenance schedule and tyres inflated if necessary.

Besides providing Parking space for HEMM specific jobs to be performed in the Temporary Workshop are as follows:

i. Daily maintenance & washing of HEMM.
ii. Scheduled maintenance, lubrication & inspection of equipment.
iii. Fuelling of dumpers and dozers etc.
iv. Air system check
v. Hydraulic system check
vi. Electrical check
vii. Mechanical check

If on inspection, repair of any component / assembly is required, and then the machine will be sent to Dumper repair shed in the main workshop.

8.3 Infrastructure and facilities for PB North West Quarry

8.3.1 Infrastructure facilities proposed

In line with the infrastructure facilities for PB West & East Quarry the area for the infrastructure facilities will be secured by a boundary fence and a soil bund on the edge of the mine. Distance between PB-West quarry is approximately 3 Km, . from the viewpoint of ensuring better management, control and ease of access some of the facilities have been planned separate for PB-NW Quarry The broad specifications shall be in line with the specifications adopted for PB-

West & East Quarry. Proposed infrastructure within and precincts of the mine boundary are as follows:

1. Heavy Earth Moving Machinery (HEMM) Workshop
   a Welding Shop
   b Tool Store
   c Electrical Shop
   d Office space for workshop management
   e Shift change room
   f Washing facilities and toilets
2. Light Vehicle (LV) Workshop
3. Tyre Workshop & Tyre Storage Bay (open area)
4. Equipment Washing Facility
5. Office Building
6. Worker's Bathhouse and Canteen
7. Dispensary
8. Store
9. Engineering Section
10. Security Office
11. Fuel Depot
12. Coal Evacuation System and Coal Handling Plant
13. Electrical Power supply
14. Mobile Van
15. Approach Road
16. Other roads and culverts
17. Water Supply and Sewerage
    a Source of Water
    b Industrial water supply
    c Effluent Treatment Plant
    d Industrial sewerage
    e Sewage Treatment Plant
18. Temporary Workshop

1. Heavy Earth Moving Machinery (HEMM) Workshop (Maintenance Workshop)

In line with the Maintenance Workshop proposed for PB West & East Quarry, separate Maintenance Workshop shall be provided for NW quarry also.

2. Light Vehicle Workshops

In line with the Light Vehicle Workshop proposed for PB West & East Quarry, separate Light Vehicle Workshop shall be provided for NW quarry also.

3. **Tyre Workshop**

In line with the Tyre Workshop proposed for PB West & East Quarry, separate Tyre Workshop shall be provided for NW quarry also.

4. **Equipment Washing Facility**

In line with the Equipment Washing Facility proposed for PB West & East Quarry, separate Equipment Washing Facility shall be provided for NW quarry also.

5. **Office Building with Medical Clinic**

In line with the Office Building with Medical Clinic Facility proposed for PB West & East Quarry, separate Office Building with Medical Clinic Facility shall be provided for NW quarry also.

6. **Worker's Bathhouse and Canteen**

In line with the Office Building with Worker's Bathhouse and Canteen Facility proposed for PB West & East Quarry, separate Worker's Bathhouse and Canteen Facility shall be provided for NW quarry also.

7. **Medical unit (Dispensary)**

In line with the Dispensary proposed for PB West & East Quarry, separate Dispensary shall be provided for NW quarry also.

8. **Ware house and warehouse building (Stores)**

In line with the ware house and warehouse building proposed for PB West & East Quarry, separate ware house and warehouse building shall be provided for NW quarry also.

9. **Engineering Section**

In line with the Engineering Section proposed for PB West & PB East Quarry, separate Engineering Section shall be provided for NW quarry also.

10. **Security Office**

In line with the Security office proposed for PB West & PB East Quarry, separate Security office shall be provided for NW quarry also.

11. Fuel Depot

In line with the Fuel Depot proposed for PB West & PB East Quarry, separate Fuel Depot depending upon the magnitude of consumption of oil & lubricants shall be provided for NW quarry also.

12. Coal Evacuation System and Coal Handling Plant

Proposed coal evacuation system and coal handling plant has been elaborated in **Chapter VII**.

13. Electrical Power Supply

The maximum power demand for mine including CHP shall be 15MVA.

Electrical Power Supply system shall broadly cover the following:

1. Power reception & distribution system.
2. Illumination of workshop and adjacent area.
3. Earthing.

In line with the Electrical Power Supply system proposed for PB West & East Quarry, separate Electrical Power Supply system depending upon the magnitude of consumption of electrical power shall be provided for NW quarry also. The identified source of construction Power, Intermediate power and permanent power proposed for PB West & PB East Quarry, shall remain same for NW quarry also.

The power for workshop, HEMM, buildings, facilities, illumination etc. shall be made available from PB-NW project sub-station. Power shall be drawn from 33KV switchgear of PB west main receiving substation through O/H lines running on the northern periphery of PB West Quarry.

14. Mobile Service Van

In line with the Mobile Service Van proposed for PB West & East Quarry, separate Mobile Service Van shall be provided for NW quarry also to cater the need of repair of heavy equipment at site itself.

15. Approach Road

The approach road for PB West Quarry will be used to access PB-NW Quarry. The proposed approach road for PB West Quarry shall be extended upto PB NW (sector-A) quarry form northern periphery of PB West Quarry.

16. Other Roads & Culverts

In line with the other roads such as haul roads, heavy duty roads, culvers on such roads and bridges proposed for PB West & East Quarry, separate other roads such as haul roads, heavy duty roads, culvers on such roads and bridges shall be provided for NW quarry also for transportation of coal/OB/topsoil/other purposes.

Road along CCT conveyor

In addition to the 14 km long, 3.75m wide black top road from block to Banadag yard proposed for PB West & PB East Quarry CCT a separate 14 km long, 3.75m wide black top road along with culverts/bridges as required from block to Banadag yard shall be provided for NW quarry also.

17. Water Supply & Sewerage

The Water demand assessed for the NW Quarry is indicated in the following Table. 8.2.

Table. 8.2

Water Demand for the NW Quarry

Potable Water Demand in MLD	Industrial Water Demand in MGD	Total Water Demand in MLD
0.55	1.5	2.05

In line with the sewerage system for industrial sewage proposed for PB West & East Quarry, separate sewerage system for industrial sewage shall be provided for NW quarry also.

a Source of water

Three sources of groundwater have been identified.

i. Surface water such as existing ponds, reservoir, nalla or river
ii. Borewells
iii. Mine sump water

During construction years, there is actually no excavation taking place for extraction of coal, but water will be required for building of infrastructure, drinking & service purposes. During first year of operation sump water is not

available as mine shall not intersect the aquifer due to lesser depth of the mine. For above period bore wells shall be drilled exclusively to draw water for meeting the water requirement of mine & residential colony. As the mine goes deeper & wider during later year of mining operation the sump water availability vis a vis water requirement of mine shall increase and the water requirement in these operational years shall be met by both sump water & ground water (Bore well water).From this period & beyond when the mine shall be producing 3 MTPA and water requirement expected to reach approx. 2000 m^3/day, entire water requirement shall be met with the sump water. Sump water shall also be treated for drinking water purposes and bore well water shall be ceased to use.

As Permission/clearance for drawl and use of groundwater is in place revised Permission/clearance for drawl and use of groundwater shall be obtained from Central Ground Water Board. If necessary Hydrogeological study shall be carried out to assess availability of ground water.

b Industrial water supply

In line with the industrial water supply system proposed for PB West & PB East Quarry, separate industrial water supply system for industrial sewage shall be provided for NW quarry also,

c Effluent Treatment Plant (ETP)

Effluent treatment Plant (ETP) of requisite capacity for treatment of industrial sewerage shall be installed.

d Industrial sewerage

In line with the industrial sewerage system proposed for PB West & East Quarry, separate industrial sewerage system shall be provided for NW quarry also.

e Sewerage Treatment Plant(STP)

In line with the industrial sewerage system proposed for PB West & East Quarry, Sewerage treatment Plant (STP) of requisite capacity for treatment of industrial sewerage shall be installed.

18. Temporary Workshop

In line with the Temporary Workshop proposed for PB West & East Quarry, separate industrial sewerage system shall be provided for NW quarry also.

8.4 Common Infrastructure and facilities

The area for the common infrastructure facilities will be secured by a boundary fence and a soil bund on the edge of the mine. The proposed major buildings intended for common usage within and outside the precincts of the mine boundary are as follows:

1. Residential Colony
2. Magazine
3. Core Shed
4. Coal Laboratory
5. Disaster Management Cell
6. Environmental Laboratory
7. Vocational Training Centre
8. Community Buildings
9. Communication System
10. Rehabilitation & Resettlement Colony
11. Coal Washery

1. Residential colony

a General Connectivity

The block is connected by Hazaribagh – Khelari metal Road. The nearest railway stations are Ranchi Road and Chatarpur on the Gomoh Barkakana – Dehri-on-Sone loop lines of SE Railway and are about 70- 75 kms from the block. Ranchi, which is the state capital of Jharkhand, is about 125 kms from the block.

The nearest township is Hazaribagh; located at a distance of about 24 kms from Barkagaon located in the southern part of the block. It has been envisaged that the proposed colony shall come at Village Sikri near Barkagaon on the Tandwa road.

A residential colony suitable for living condition with proper ventilation, drainage shall be provided to officers, staff and workman employed in the mine as per prevailing statute. The colony shall be an integrated residential facility with PB block which shall be situated within 5 km from the block.

As this colony has been proposed to be located near Barkagaon Town on Tandwa Road thereby enabling the residents to avail the facilities of the Town as well as making it easy for them to reach the project site. The proposed project has been envisaged as highly mechanised mine needing skilled manpower. This manpower is required to be housed near the project site for smooth and continuous operation of the mine. With this background, 55% housing satisfaction has been considered for the project.

Residential colony has been considered for 1561 persons. Separate provisions have been made for colony and industrial water. It has been envisaged that there will be separate bulk reservoirs, water treatment plants and treated water reservoirs. From these treated water reservoirs, water shall be taken to the colony and for industrial purposes.

Relevant Standard Specifications shall be adopted for the construction of residential and service buildings. Requirement of residential units are given in **Table 8.3**.

Table 8.3

Requirement of residential units

Manpower for OC Project	Total No. of residential units
2863	1575 including 36 Unit Hostel

Hostel accommodation has been proposed as 20% of type -A quarters, and reduction in proposed type – A quarters has been made accordingly.

The buildings have been envisaged as RCC-cum-brick masonry structures.

b **Colony water supply**

Ground water has been envisaged as source of water for the colony. This water shall be stored in a bulk water reservoir, would be treated through treatment plant and stored in ground reservoir. From these ground reservoirs, water would be pumped to overhead reservoir from which water will be distributed to the points of consumption through gravity flow.

c **Colony sewerage**

Colony sewage has been proposed to be dealt through sewerage disposal system. Sewerage treatment Plant (STP) of requisite capacity for treatment of colony sewerage shall be installed.

d **Colony Roads**

The 3.75 m wide trunk and 10m wide gate roads of length as per requirement shall be provided for residential colony. Provisions have also been made towards culverts/bridges, tree guards and drains along these roads.

2. Magazine

A magazine having storage capacity of 12 tonnes of explosive will be provided for this coal block. This shall be constructed as per the design approved by Chief Controller of Explosive and shall at all times be kept in state of good repair (or maintained in good condition). Magazine shall be constructed at ground level only and it will be a single storey building. Safety distance shall be kept as per prescribed norms. It shall be made of heavy construction, i.e. steel, reinforced concrete, brick, stone or preformed concrete blocks. Maximum security is attainable only with steel or reinforced concrete structures. The internal dimensions of the magazine shall be such that there is ready access to all explosives. Suitable traverse or mound i.e. a solid mass of earth, sand, concrete or a brick work around the magazine shall be erected to prevent protection against effects of explosion. A distance of 15 metres surrounding the magazine shall be kept clear of dried grass or bush or flammable materials.

Magazine shall have attached thereto one or more efficient lightning conductors designed and erected in accordance with specification laid down by Bureau of Indian Standards. A cemented trough at least fifteen centimetres deep shall be provided near each entrance of magazine and shall be kept filled with clean water. Magazine shall be provided with a shelter for the security guard(s) on duty near the magazine at a suitable location not less than thirty metres away from the magazine. The magazine shall be kept securely closed or locked at all times except when goods are being placed in or taken from it or when it must be kept open for some other purpose in connection with the management of such premises.

Magazine shall be used only for keeping explosives specified in the licence and of receptacles, tools or implements for work connected with the keeping of such explosives. At the end of every month a return in Form RE-6 shall be submitted to the District Magistrate, Superintendent or Commissioner of Police in whose jurisdiction the magazine is situated in the proforma prescribed from time to time so as to reach the above authorities by 10th day of the succeeding month.

3. Core shed

The Core shed shall be a minimal facility used to store and prepare coal samples.

All facilities shall include lighting via windows and light fixtures, bollards, electrical connections and shall be design to all in the purpose the facility is designated to be used for.

4. **Coal Laboratory**

The Coal Laboratory shall include two offices, toilet with extensive washing facilities and a separate testing room. The testing room shall have independent ventilation equipment. One of the offices shall be for the chief technician and the other shall to house all other technical staff.

5. **Disaster Management Cell**

A Control Room shall be set up within mining lease, which shall work round the clock. The control Room shall be provided with manpower, communication system and other equipment so as to deal with any disaster and provide necessary help affected persons.

The Control room shall also be provided with communication system to call for help from other Govt. or private organisation at the time of major disaster.

6. **Environmental Laboratory**

A fully equipped laboratory to carry out testing and analysis as per the prscribed norm for quality of water, soil, air and other mandatory environmental parameters will be provided as common facility of all the quarries. The testing room apart from state of the art equipment's shall have independent ventilation equipment.

7. **Vocational Training centre**

Training facility for the employees shall be provided comprising of training rooms, workstations, offices for training personnel, toilets, kitchen etc. This facility shall house safety and include a mobile equipment simulator if needed. This building shall be constructed from reinforced masonry.

8. **Community Buildings**

Facilities required to have a healthy living for the employees have been envisaged and shall be provided as common facility for all the quarries.

9. **Communication System**

For effective management of different production, service units and for ensuring safety, the following communication facilities have been envisaged:

- Voice Communication
- Data Communication System

- Truck Despatching System

a) EXTERNAL COMMUNICATION SYSTEM (ECS)

Twenty telephone lines have been provided for BSNL communication and access to public communication grid. These telephone sets would be located in the residences and offices of key personnel of the project, sub-station, railway siding, CHP, workshop, etc. Besides fixed line BSNL telephones, 20 nos. of BSNL cell one Mobile connection with sets may also be provided to important personnel of the project.

b) PLANT COMMUNICATION SYSTEM (PCS)

A 25-point Plant Communication System is proposed for voice communication in the CHP. Loud speaking facility for broadcasting of messages/instructions shall be available in the PCS. The Plant Communication System shall have the facility of private communication between any two handset stations, handset to central station, in addition to the loud speaking facility.

c) MOBILE COMMUNICATION SYSTEM (MCS)

Instead of simplex type mobile sets, the TETRA-based system is proposed for mobile communication in the entire operational area of the Project including all important locations. The TETRA-based system has facility to incorporate GPS based Automatic Vehicle Location System (AVLS) and is very advantageous compared to the presently used VHF walkie-talkie sets. The system based on TETRA (Terrestrial Trunk Radio) is cost-effective, reliable, extremely spectrum efficient and has higher quality reception for voice, data and multimedia.

d) TRUCK DESPATCH SYSTEM (TDS)

To achieve optimum utilisation of the HEMM in O/C mines, there is a need to provide an efficient means of data acquisition & control system. With the advancement in the TDS, the use of GPS for determining the points of different moving vehicles & automatic data transmission system for efficient control of vehicles has been found quite efficient & viable in Opencast mines.

10. REHABILITATION AND RESETTLEMENT COLONY

The resettlement colony shall be considered where the PAPs are those HSOs who have not opted for self-resettlement. The land for Rehabilitation Colony

shall be made available by NTPC free of any encumbrances preferably at one place Government land for RC is preferable. The cost in that case will also be borne by NTPC. Location of the RC could be decided in consultation of the project and could be slightly away but in the vicinity of the project. Basic infrastructure facilities for CD works will be provided in RCs.

The infrastructure facilities and basic minimum amenities shall be augmented in the RCs, the project affected villages and in the vicinity of the project to ensure that the displaced population (HSOs) in the resettlement colony or the village may secure for themselves a reasonable standard of community life.

The facilities/ amenities will vary depending upon local requirements. The focus areas would be Connectivity, Drinking Water, Sanitation apart from Education and Health related infrastructure. These may include the following:

a. Internal and the approach roads with proper drainage, with preference for concrete roads
b. One or more sources of safe drinking water like hand pump, borewells with water outlet platforms etc., as per need and requirement
c. Tree plantation including fruit trees
d. Community halls/ Panchayat Ghar
e. Primary educational facilities
f. Primary health facilities
g. Street lighting in the Resettlement Colonies
h. Public cremation ground/ burial ground
i. Common grazing land/ small distributaries for irrigation
j. Drainage
k. Sanitation
l. Drinking water for cattle
m. Community Ponds
n. Children playground

11. COAL WASHERY

Coal washability study has not yet been carried out for Pakri Barwadih Coal. Coal quality parameters obtained from the proximate analysis of coal revealed that ash percentage in all probability is likely to remain 34% or below which does not call for commissioning of coal washery. However space provision is kept for providing a Coal Washery at mine end in future, if required.

FOR JSEB'S CHATRA S/S (FUTURE)

FROM JSEB, 220KV PTPS SWYD

TO CHATTI-BARIATU/KERANDHARI

MAIN BUS-I

220KV

MAIN BUS-II

BUS CVT-I

BUS CVT-II

50MVA 220/34.5KV OLTC ±10% Yyn0

50MVA 220/34.5KV OLTC ±10% Yyn0

CABLE

33KV

VT

CAPACITOR BANK(**) (TYP)

SPARE

TIE TO DG SWGR

MDO PB'EAST'

MDO PB'A'

MDO PB'WEST'

CHP NTPC

33/11.5KV 7.5MVA

2Rx1Cx150SQ.MM. (TYP)

CHP NTPC

MDO PB'EAST'

MDO PB'A'

MDO PB'WEST'

TIE TO DG SWGR

SPARE

CAPACITOR BANK(**) (TYP)

VT

CABLE 33KV 1Rx1Cx300SQ.MM. (TYP)

33KV OVER HEAD LINE

33/11KV JSEB S/S AT BARKAGAON (LANGATU VILLAGE) MINE SITE

33KV POT HEAD#1

33KV POT HEAD#2

11KV

VT

CONST POWER

SPARE

ADMN BLDG.

ADMN BLDG.

SPARE

CONST POWER

VT

11KV POT HEAD#1

11KV POT HEAD#2

1Rx1Cx150SQ.MM. (TYP)

11/.433KV 630KVA

7Rx1Cx630SQ.MM. (TYP)

415V

630A

TYP. FOR LIGHTING

D.G. FEEDER

MLDBS (TYP)

Sanjiv

SANJIV KUMAR SINGH
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Ministry of Coal, Govt. of India

आई० पी० नागपाल/ I.P. NAGPAL
अवर सचिव/ Under Secretary
कोयला मंत्रालय/Ministry of Coal
शास्त्री भवन/Shastri Bhawan
भारत सरकार/Govt. of India
नई दिल्ली/New Delhi-110001

⊛ TILL PERMANENT POWER SUPPLY IS AVAILABLE, 33 KV MINE S/S SHALL BE CHARGED FROM JSEB S/S AT LANGATU S/S.

(**) PROVISION FOR CAPACITOR BANK TO BE KEPT. RATING OF CAPACITOR BANK TO BE DECIDED BASED ON OVERALL SYSTEM REQUIREMENTS.

e	FEEDERS FOR EACH MDO OF MINE BLOCK i.e PB-A, PB WEST & PB EAST MARKED.
d	REVISED SOURCE FROM 220KV JSEB PTPS.
c	132/33 KV TRANSFORMER NO.3 ADDED. RATING REVISED TO 50 MVA. PROVISION OF CAP. BANK AT 33 KV SWGR.

एन टी पी सी NTPC

N T P C LIMITED
(A GOVT. OF INDIA ENTERPRISE)
COAL MINING ENGINEERING

PROJECT: PAKRI BARWADIH COAL BLOCK

TITLE: REVISED MINING PLAN (2nd Revision)

SUBJECT: SINGLE LINE DIAGRAM 220/33/11KV SUB STATION

SCALE: NTS | SHEET: 1 of 1 | DATE: 26.07.2010

DRG. NO. 7010-199-POM-04 | PLATE NO. 13

CHAPTER IX

LAND REQUIREMENT

SANJIV KUMAR SINGH
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No. 340 (CP)/2009-CPAM
Ministry of Coal, Govt. of India

CHAPTER IX

LAND REQUIREMENT

9.1 Village wise land

4695 Ha of land is proposed for the Open cast project, which would be utilized for different purposes to carry out extraction of coal. There are 27 villages identified in the core zone of Pakri Barwadih coal block. The list of the villages along with area (ha) in the core zone are given in the **Table-9.1**.

Table 9.1
Village wise Land in the Core Zone

Sl. No.	Name of Village	Total Area within core zone (ha)
1	Deoria Kalan	87.00
2	Dewria Khurd	56.00
3	Urub	321.00
4	Itij	49.00
5	Chirudih	234.00
6	Nagri	218.00
7	Darikalan	282.00
8	Chepa-Khurd	100.00
9	Jugra	170.00
10	Arahara	296.00
11	Pakri-Barwadih	625.00
12	Barkagaon	166.00
13	Langatu	389.00
14	Sonbarsa	197.00
15	Sinduari	109.00
16	Churchu	145.00
17	Keri	197.00
18	Lakura	214.54
19	Chepa- Kalan	316.00
20	Bariatu	212.09
21	Basaria	48.13
22	Beltu	16.57
23	Jabra	12.85
24	Kandaber	65.18
25	Nawadih	43.42
26	Sirma	45.37
27	Urub	41.38
28	Other	38.46
	Total	**4695.00**

9.2 Category wise existing land use pattern

Out of total project area of 4695 ha, 38.06% is designated as forest land. Tenancy land and Government non forest land for which breakup is not presently available constitutes 2713 ha which constitutes 61.93%. Category wise pre mining (existing) land use pattern is given in **Table 9.2**.

Table 9.2

Pre Mining Land Use Pattern

Sl. No.	Type		PB West & East (including u/g)	PB NW	Total of PB
1	Tenancy	Agricultural	2731.48	176.52	2908.00
		Habitation			
		Grazing			
		Barren			
2	Govt Non Forest	Agricultural			
		Habitation			
		Grazing			
		Barren			
3	Forest	Forest	1478.52	308.48	1787.00
	Total		**4210.00**	**485.00**	**4695.00**

9.3 Land Use during mining and Post Mining:

Land Use During Mining

Actual excavation shall take place over 1982 ha which is 42% of total area of the project. 29% of total project area shall be unutilized due to various reasons such as presence of hills and rationalization etc. Top soil dump is planned in flatter land over an area of 47 ha.

Post Mining (End of Life) Land Use Pattern

Mining operations has an impact on the land use pattern. In the proposed project, the impact on the land is due to:

- Overburden removal and extraction of coal
- Dumping of overburden as well as Coal
- Construction of infrastructure and facilities such as, workshop, office, road etc. coal handling plant within and outside project area.

Post mining the land use pattern shall be very different from pre mining land use pattern. Due to Mining, dumping, diversion of nallas/rivers and wter filled reservoirs, aesthetic appearance of landform shall be changed.

Even after maximization of in pit dumping void shall remain over 668 ha and backfilled area consisting of hillocks shall be over 1294 ha of area. Various buildings, coal handling plants, sub stations & other statutory facilities shall be occupying around 291 ha land.

9.4 Post Closure Land Use Pattern

Although progressive mine closure activities shall be carried out during various stages of mining operations. Final mine closure activities shall commence from 52nd year of mining operations and shall continue upto 55th year. Mine shall be closed as per Mine Closure Plan. Overall land use Pattern is given in **Table 9.3.**

Table 9.3
Overall land use Pattern

Area in Ha

Pre Mining Land Use"Ha"			Land Use "Ha"								
					Post Closure						
Type		Ha	Type	During Mining	End of Life	Agricultural	Plantation	Water Body	Public Use	Forest Land (Returned)	Undisturbed	Total
	Agricultural	2638.00	Excavation Area	[illegible]								
	Township		Backfilled Area	1294.00	1294.00	719.00	581.00					1294.00
	Grazing		Excavated Void	688.00	688.00			688.00				688.00
	Water Bodies		Top Soil Dump	[illegible]								
Tenancy	Road		External Dump	885.00	885.00		885.00					885.00
	Community		Safety Zone	50.00	50.00		50.00					
	Inhabited		Haul Road between quarries									
	Barren		Road Diversion	[illegible]	[illegible]				[illegible]			
	Agricultural	370.00	Diversion/Below River/Nalla	[illegible]	[illegible]				[illegible]			
Govt. Non Forest	Township		Settling Pond	[illegible]	[illegible]							
	Grazing		Road & Infrastructure Area	[illegible]	[illegible]		[illegible]		[illegible]			
	Barren		Rationalization Area									
Forest		1787.00	Garland Drains	[illegible]								

	Embankment	20.00	20.00		20.00					
	Green Belt	18.00	18.00		18.00					18.00
	Water Reservoir Near Pit									
	UG Entry	18.00	18.00							
	Undisturbed/Mining Right for UG	1383.00	1382.00							
	Resettlement									
Free Hold	Agricultural Land									
Total	4695.00	4695.00	4695.00	713.00	1772.00	700.00	109.00		1401.00	4695.00

* Within Excavation area

9.5 Land Restoration

Efforts will be made to restore the land to the original land use to the extent possible. Post closure land use will serve following purposes:

1. Voids shall be made safer by erection of fencing and development of Ghats. This shall also be a source of water for nearby locality and a picnic spots for use of general public.

2. Water from the voids shall be used for irrigation, watering the forest at early stage which is expected to attract avifauna.

3. As per present plan the depth of the void is 280 m (approx.). As per the direction of MoEF, if necessary, post mining, depth of the void shall be reduced to the recommended level.

4. Industrial, residential and other buildings used for the purpose of project will be handed over to the state government.

5. The civil or mechanical installations prejudicial to the safety of the general public will be dismantled or suitably disposed or transferred to other locations as deemed fit by NTPC.

6. Roads will be thrown open for public use under the observation of state/local government.

7. Agricultural land shall be developed over 713 ha land and handed over to the state/local government at their disposal.

8. Substantially thick plantations will be developed in the identified areas to improve aesthetic look of the surroundings.

9. Overburden dump both external & internal will be planted and afforested with the local varieties of trees in consultation with Forest Department, Government. Backfill Percentage = 65.28% Plantation Area = 1772 ha

Year wise land restoration Plan is given in **Table -9.4**.

Table -9.4
Year wise land restoration Plan

Area in Ha

Stage	Cumulative area(Ha)							Cumulative Plantation area(Ha)					
	Excavation	Backfilling	Void	Topsoil dump	Ext. dump	Others	Total	Backfill	Dump	Green area	Infrastructure	Agriculture/ Grazing land	Total
Y1	57.18	0.00	57.18	26.25	84.30	4527.27	4695.00	0.00	0.00				0.00
Y3	142.98	0.00	142.98	36.00	193.23	4322.79	4695.00	0.00	19.00				19.00
Y5	292.69	0.00	292.69	47.12	261.67	4093.52	4695.00	0.00	83.00	10.00			83.00
Y10	750.14	289.76	460.38	25.18	316.61	3603.07	4695.00	0.00	260.00	10.00			260.00
Y20	1025.34	512.34	513.00	25.18	911.07	2733.41	4695.00	67.00	456.00	15.00			523.00
Y30	1541.81	608.39	933.42	0.00	913.54	2239.65	4695.00	311.00	669.00	20.00			980.00
Y40	1935.00	1192.00	743.00	0.00	885.00	1875.00	4695.00	524.00	885.00	38.00	124.00	665.00	2074.00
Y52	1982.00	1294.00	688.00	0.00	885.00	1828.00	4695.00	581.00	885.00	48.00	258.00	48.00	2485.00

CHAPTER X

ENVIRONMENT MANAGEMENT PLAN

SANJIV KUMAR SINGH
Recognised Qualified Person
No. 342 (F-5)/2009-CPAM
Ministry of Coal, Govt. of India

CHAPTER X

ENVIRONMENTAL MANAGEMENT PLAN

10.1 General

Pakri Barwadih Mine is designed to produce 18 MTPA of coal for the estimated life of 52 years which may have potential to release harmful substances into the soil, air, and water. The environmental impact of Pakri Barwadih mining includes erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater, surface water by chemicals from mining processes. Besides creating environmental damage, the contamination resulting from leakage of chemicals may also affect the health of the local population. NTPC is required to follow environmental conditions mandated by EC and rehabilitation and resettlement standards as per R&R plan.

Erosion of exposed hillsides, mine dumps, tailings dams and resultant siltation of drainages, creeks and rivers can significantly impact the surrounding areas. It may also cause destruction and disturbance of ecosystems and habitats, and in areas of farming it may disturb or destroy productive grazing and croplands. It may also may produce noise pollution, dust pollution and visual pollution.

To maintain ecological balance and to check / mitigate harmful effects due to mining and allied activities at Pakri-Barwadih Mine, environmental control measures have been integrated into the process of mine planning. Many of the areas of environmental management planning require multidisciplinary approach.

The changes warranted as per site specific conditions are to be accounted for, during actual implementation. Further, in the light of experience likely to be gained during the initial years of operation, proposed schemes shall be periodically modified/ updated. Physical, chemical, biological and socio-economic control measures shall be taken in various areas to implement most effective environment control throughout the life of mining operation.

10.2 Environmental Clearance

Ministry of Environment, Forest and Climate Change, vide letter no. No.J-11015/692/2007-IA.II(M), dated 19th May 2009 accorded EC for Pakri Barwadih Coal Mine Project for a production capacity of 15 MTPA in a total lease area of

3319.42 ha, which consists of Phase-I of 39 years of operation and comprises of opencast operations only. Copy of EC is placed at **Annexure-XII**.

The present mining plan is envisaged for rated production of 18 MTPA for the life of 52 years and includes PB NW quarry additional area also. Thus present mining plan is at a variance with the EC.

It is recommended to seek EC for PB NW Quarry for rated production of 3 MTPA.

Further Baseline Environmental Data have not yet generated for PB NW area, the available Baseline Environmental Data as per study of PB West and PB East Quarry, shall be used to assess the environmental impacts for PB NW Quarry and accordingly checks/mitigative environmental measures are suggested.

10.3 Baseline status of Environment

Different element of environment namely land, water, air and ambient noise status of the area was studied in winter, 2005-06 (supplemented with data from June, 2006). All attempts have been made to gather the available data on the present environment in the study area which is the area within 10 km radius of the proposed mine site.

10.3.1 Existing Land Use pattern

Existing (pre-mining) land use in lease area is given in Chapter-9 "Land Requirement" is reproduced below.

		Forest	Non-Forest		
1.0	**Within the block**		Govt.	Private	**Total**
1.1	***Opencast Area***		-		
1.1.1	Excavation & Dump Area				**2866.0**
1.1.2	Infrastructure & undisturbed				**635.0**
	Sub-total(1.1)	1252.44	275.24	1973.31	**3501.0**
1.2	Underground	89.88	81.54	399.38	**570.8**
1.3	Unutilized Area	357.08			**357.08**
	Sub-total(1.0)	1699.4	356.78	2372.69	**4428.9**
2.0	Outside Block (External Dump, Coal Evacuation	87.6	31.02	147.46	***266.08***

		Forest	Non-Forest		
1.0	**Within the block**		Govt.	Private	**Total**
	Corridor, Railway Siding, Mine Infra)				
Grand-total		**1787**	**388**	**2520**	**4695**

10.3.2 Soil Quality

To assess the quality of soil in and around the mining area, soil samples were collected from eight locations during June, 2005 (before the onset of monsoons) as well as during November, 2005 for physicochemical analysis. **Table 10.1** lists the soil sampling locations.

Table 10.1

List of Soil Sampling Locations

Sample No.	Location	Type of Land
S1	Village Pakri-Barwadih	Forest Land
S2	Village Chiradhi	Forest Land
S3	Village Chepakhurd	Agricultural Land
S4	Horam	Agricultural Land
S5	Barkagaon	Fallow Land
S6	Kanrtari	Sediment From Haharo river
S7	Mahugain Khurd	Fallow Land
S8	Kandaber	Agricultural land

The results of analysis are given in Tables 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9, 10.10, and 10.11.

Table 10.2

Physical Properties of Soil in June, 2005

Sample No.	Texture Analysis*			Type of Soil
S1	Sand: 6	Silt: 18	Clay: 76	Clay Loam
S2	Sand:8.5	Silt:12.8	Clay: 78.7	Clay Loam
S3	Sand: 12.5	Silt: 62.5	Clay:25	Silt Loam
S4	Sand: 9.4	Silt: 37.5	Clay:53.1	Clay Loam
S5	Sand: 3.9	Silt: 21.6	Clay: 74.5	Clay Loam
S6	Sand: 6.1	Silt: 20.4	Clay: 73.5	Clay Loam
S7	Sand: 13.6	Silt: 17.6	Clay:68.6	Clay Loam
S8	Sand: 6.2	Silt: 8.8	Clay: 75	Clay Loam
				* All values in %

Table 10.3

Physical Properties of Soil in November, 2005

Sample No.	Texture Analysis*			Type of Soil
S1	Sand: 7.9	Silt: 13.1	Clay: 79	Clay Loam
S2	Sand:8.5	Silt: 14	Clay: 74	Clay Loam
S3	Sand: 15	Silt: 15	Clay: 70	Silt Loam
S4	Sand: 16.7	Silt: 14.6	Clay: 68.7	Silty Clay Loam
S5	Sand: 14	Silt: 8	Clay: 78	Loamy Sand
S6	Sand: 16.3	Silt: 6.1	Clay: 77.6	Silt Loam
S7	Sand: 8.9	Silt: 31.3	Clay: 60	Sand
S8	Sand: 14.3	Silt: 9.5	Clay: 76.2	Sandy Loam
				* All values in %

Table 10.4

Chemical Properties of Soil during June, 2005

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
pH (1:5) at 25° C	6.85	6.86	6.84	6.52	6.85	7.8	6.3	7.01
Electrical Conductivity (1:5)in (µs/cm) at 25 ° C	89.06	79.95	70.71	97.78	342	132.7	182	158

Table 10.5

Chemical Properties of Soil during November, 2005

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
pH (1:5) at 25 ° C	6.94	6.74	6.9	6.31	7.09	7.56	6.46	7.09
Electrical Conductivity (1:5) in (µs/cm) at 25 °C	138	141	149	93	103	147	167	119

Soil pH plays an important role in the availability of nutrients. Soil microbial activity is also dependent on pH. In the study area the soil pH is slightly acidic to slightly alkaline (6.30<pH<7.80 in summer; 6.31<pH<7.56 in winter).

Electrical conductivity (EC) is a measure of the soluble salts and ionic activity in the soil. In the collected soil samples the conductivity ranged from 70.7 to 158.01 µs/cm in summer and from 93 to 167 µs/cm in winter.

Table 10.6

Available NPK Contents in Soil in June, 2005

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
Organic Carbon in % & Rating	0.21	0.33	0.33	0.76	0.7	1.11	1.08	0.17
	Low	Low	Low	High	Medium	High	High	Low
	245.86	215.13	282.74	384.16	357.5	276.6	461.78	208.98

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
Available Nitrogen in g/ha & rating	Low	Low	Medium	Medium	Medium	Low	Medium	Low
Available Potassium in kg/ha & Rating	370.72	164.64	179.2	163.52	265.08	306.88	222.62	448
	High	Medium	Medium	Medium	Medium	High	Medium	High
Available Phosphorous in kg/ha & rating	1.43	2.09	1.98	1.65	41.34	1.87	41.88	1.1
	Low	Low	Low	Low	High	Low	High	Low

Rating based on:			
Available Nitrogen	<280 - Low	280- 560 -Medium	>560 - High
Organic carbon	<0.50- Low	0.5-0.75 - Medium	> 0.75 - High
Available Phosphorus	<10 - Low	10 – 25 - Medium	>25 - High
Available Potassium	<120 - Low	120 - 280 -Medium	>280 – High

Table 10.7

Available NPK Contents in Soil in November, 2005

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
Organic Carbon in % & Rating	0.35	0.25	0.46	0.63	0.75	0.96	0.24	0.38
	Low	Low	Low	Medium	Medium	High	Low	Low
Available Nitrogen in g/ha & rating	175.18	212.06	371.86	304.25	248.94	227.42	221.28	239.72
	Low	Low	Medium	Medium	Low	Low	Low	Low
Available Potassium in kg/ha & Rating	285.60	239.68	691.60	143.81	360.08	234.08	274.40	228.48
	High	Low	High	Low	High	Medium	Medium	Medium
Available Phosphorous in kg/ha & rating	6.74	6.06	4.97	3.96	10.11	33.85	7.59	1.09
	Low	Low	Low	Low	Medium	High	Low	Low

Rating based on:			
Available Nitrogen	<280 - Low	280- 560 -Medium	>560 - High
Organic carbon	<0.50- Low	0.5-0.75 - Medium	> 0.75 - High
Available Phosphorus	<10 - Low	10 – 25 - Medium	>25 - High
Available Potassium	<120 - Low	120 - 280 -Medium	>280 – High

Phosphorus and Nitrogen are limiting nutrients, especially phosphorus. During June, 2005, in the tested soil samples, availability of phosphorus is low except in S5 and S7, where it is high; available Nitrogen is low to medium; organic carbon content is low to high while potassium content is low to high. During November, 2005 except in S5 and S6 availability of phosphorus is low; available Nitrogen is low to medium; organic carbon content is low to high while potassium content is low to high.

Table 10.8

Exchangeable Soil Cations in June, 2005

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
Calcium (meq/100gm)	20.91	22.81	64.64	18.24	18.24	45.62	9.6	26.61
	(74.7)	(74)	(68.4)	(61.7)	(70.5)	(67.5)	(67.5)	(67.5)
Magnesium (meq/100gm)	11.48	11.48	47.86	51.69	6.77	36.37	9.67	19.15
	(23.5)	(21.7)	(28.2)	(33.3)	(26.6)	(29)	(29)	(29)
Sodium (meq/100gm)	0.23	0.34	0.8	0.34	2.04	1.38	1.7	0.8
	(1.3)	(2.2)	(2.5)	(2.5)	(1.3)	(1.6)	(1.6)	(1.6)
Potassium (meq/100gm)	21.16	9.4	9.59	9.34	7.57	17.52	6.33	25.58
	(0.5)	(2.1)	(0.9)	(2.5)	(1.6)	(1.9)	(1.9)	(1.9)
Figures in ( ) gives the % contribution of the respective ions to base saturation								

Table 10.9

Exchangeable Soil Cations in November, 2005.

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
Calcium (meq/100gm)	70.70	82.80	60.60	68.68	70.70	76.75	58.58	45.45
	(56.1)	(56.8)	(56.3)	(49.8)	(52.1)	(52.3)	(55.2)	(55.7)
Magnesium (meq/100gm)	50.30	53.29	37.22	62.37	58.34	61.42	42.25	33.20
	(39.9)	(36.5)	(34.6)	(45.2)	(43.0)	(41.9)	(39.8)	(40.7)
Sodium (meq/100gm)	0.81	0.97	0.91	0.81	0.91	0.86	0.70	0.70
	(0.64)	(0.67)	(0.85)	(0.59)	(0.67)	(0.59)	(0.66)	(0.86)
Potassium (meq/100gm)	4.25	8.79	8.96	6.11	5.63	7.62	4.64	2.21
	(3.4)	(6.0)	(8.3)	(4.4)	(4.15)	(5.2)	(4.37)	(2.7)
Figures in ( ) gives the % contribution of the respective ions to base saturation.								

The above results show that the tested soil samples have high proportions of calcium and magnesium whereas proportions of exchangeable sodium and potassium were low.

Table 10.10

Available Micronutrients in Soil in June, 2005

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
Copper	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	0.041	0.060	0.042	0.032	<0.013	0.030	0.022	0.031
Iron	26	47.5	29.25	35.10	0.57	31.29	2.39	37.14
								(Values in mg/kg).

Table 10.11

Available Micronutrients in Soil in November, 2005

Paramete	S1	S2	S3	S4	S5	S6	S7	S8
Copper	1.8	2.22	3.14	1.96	2.24	2.08	1.14	1.24
Zinc	6.88	24.73	11.42	8.44	8.38	9.26	5.94	7.48
Iron	20.70	31.50	32.99	24.30	23.60	22.90	15.70	15
								(Values in mg/kg).

Soil micro-nutrients also play an important role in plant growth and can act as limiting nutrients. Soil micro-nutrient analysis can be employed as a diagnostic tool for predicting the possibility of deficiency of a nutrient and the profitability of its application. For this, it is essential to fix the critical limits. The critical limit of micro-nutrient in a soil is that content of extractable nutrient at or below which plantation practiced on it will produce a positive response to its application. The critical limits of copper, zinc and iron are 0.20-0.66 mg/kg, 0.50-0.65 mg/kg and 4.5-6.0 mg/kg respectively.

From the above Tables it can be seen that during June, 2005 in all the soil samples, micro-nutrient levels, other than that of iron, are very low; iron levels are very high. During November, 2005, availability of all the tested micro-nutrients was high in all the samples. Excessive micro-nutrients are detrimental to plant growth as excess of one more micro-nutrients adversely affects the uptake of other micro-nutrients. Excess of copper affects uptake of Molybdenum, another micro-nutrient. Excess of Zinc, Manganese and Copper affect Iron uptake. Excess Iron, Copper and Zinc affect Manganese uptake. Thus due to the antagonistic effect of some micro-nutrients, uptake of other nutrients is adversely affected which hampers plant growth i.e. the fertility of soils in the study area are low.

10.3.3 Quality of Air, Ambient Noise and Water

The existing quality of Air and Water are discussed in 11.4 and 11.3 respectively.

a. Ambient Noise Levels

In order to have an idea about the existing noise level of the study area, noise monitoring has been carried out at five locations listed in **Table 10.12**.

Table 10.12

Ambient Noise Monitoring Stations

Stn. No.	Location	Core Zone/ Buffer Zone	Distance & Direction (from Centre of proposed project)
N1	Pakri-Barwadih	Core	-
N2	Chepa Khurd	Core	-
N3	Pundaul	Buffer	.0 Km south-east of Core one
N4	Road, just outside lease area	Core	-
N5	Sirma	Core	-
N6	Kandaber	Buffer	.1 Km west of Core Zone
N7	Garrikalan	Buffer	.1 Km west of Core Zone
N8	Horam	Buffer	.0 Km south-east of Core one
N9	Sikri	Buffer	.0 Km south-west of Core one
N10	Kadmadih	Buffer	.1 Km south of Core zone

b. **Noise Monitoring Frequency**

Monitoring was carried out once during June, 2005. At each ambient noise monitoring station, Leq. Noise level has been recorded at hourly intervals for 24 hours continuously by operating the noise-recording instrument for fifteen (15) minutes during each hour. At work-zone noise monitoring stations, Leq. noise was recorded at hourly intervals for 8 hours continuously by operating the noise-recording instrument for fifteen (15) minutes during each hour.

c. **Results and Discussions**

The summarised results of ambient noise monitoring in June, 2005 are given in **Tables 10.13**. The results have been compared with the standard specified in Noise 2000 Standards in Environmental Protection Rules given in **Table .10.14**.

Table 10.13

Summarised Results of Noise Monitoring During June 2005

Stn. No.	Location	Results					
		Day (0600-2200 hr.)			Night (2200-0600 hr.)		
		Max.	Min	Mean.*	Max.	Min.	Mean.*
N1	Pakri-Barwadih	66	36	58.3	48	29	40.2
N2	Chepa Khurd	62	30	55.3	52	22	43.9
N3	Pundaul	67	35	59.8	45	26	37.3
N4	Road, just outside	69	40	62.9	44	28	39.1
N5	Sirma	52	30	49.7	28	24	27.9
N6	Kandaber	58	32	52.8	42	24	35.0
N7	Garrikalan	74	48	66.8	66	30	57.1
N8	Horam	68	41	60.8	46	30	40.8
N9	Sikri	54	37	50.8	38	23	31.4
N10	Kadmadih	58	34	54.2	44	25	36.0
							* Logarithmic Averages
							All Values in dB (A).

Table 10.14

Ambient Air Quality norms in respect of Noise

(As Per Schedule III, Rule 3 of Environment Protection Rules)

Type of Area	Day (0600 - 2200 hrs.)	Night (2200 – 0600 hrs.)
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40
		All Values in dB (A)

All the noise monitoring stations are "Residential Areas". (There are no areas of the other types in the study area). During day time, the noise levels were high in some locations due to movement of traffic and village activities. At

night, the noise levels were mostly within the norms, except at one location (N7 – Garrikalan) because of operation of a DG Set in the village.

10.4 Environmental Impact Assessment

An essential step in Environmental Impact Assessment (EIA) is to identify all potential environmental impacts (both beneficial and adverse). The identified impacts due to mining and associated activities have been studied in relation to the following areas:

10.4.1 Impact on land use

Existing (pre-mining) land use in lease area is given in "Land Requirement" Chapter-IX. Mining, dumping, road, built area etc. will change the existing land use pattern by degrading/utilizing forest and non-forest land. Plantation/utilization break-ups have been given in "Land Requirement" **Chapter-IX**.

10.4.2 Impact on water quality

Washing of coal has not been envisaged at present.

10.4.3 Impact on noise levels

The noise level in and around the mine may increase in future due to mechanized mining operation, blasting and operation of crusher. However, the noise levels in and around the area is expected to be below 75 dB (A).

10.4.4 Impact on Air Environment

Mining operations such as excavation, loading and unloading, movement of dumpers on haul roads, back filling, crushing screening and also drilling and blasting are expected to generate airborne fugitive dusts. Emission of pollutants like nitrous fumes (Nox), Sulphur oxides (SOx), carbon monoxide (CO) etc. from diesel operated equipment will also have little contribution.

The ambient air quality of the area shows that the pollutants like SPM, SOx, Nox CO and dust fall are well within the specified tolerance limits. As such the air environment of the mine is not likely to be adversely affected during the five years period.

10.4.5 Vibration levels (due to blasting)

Blasting pattern has been designed to minimise the vibration levels. However, vibration levels will be studied once the blasting is done in the lease area.

10.4.6 Impact on Water regime

The mining operation starting from western side of the coal block will affect Dumuhani Nallah and its tributary streams and streamlets joining it from northern part of the block. The Nallah flows in more or less NNE to SSW direction across the western part of the lease and finally joins the Haro Nadi outside the southern part of lease. Ground water level of the area varies from 25 to 35 m from the surface. The opencast mining below ground water level shall involve release of water in the order of 500 m^3/hr through pumping which will be discharged to the proposed garland nallah along north eastern boundary of lease. The drawl of this quantity of water is expected to be recharged through rains during monsoon which is 200-800 mm in monsoon and 100 – 200 mm in post & pre monsoon season. In addition water requirement of 526 m^3 /day for the domestic purposes shall also be met through bore wells. Industrial water requirement for drilling, spraying over road, washing of machinery etc. shall be met through creating a small reservoir on Dumuhani nallah at eastern boundary of the lease and drawl through pumping.

The active mining activity for the five years period does not encounter any stream/ nallah. As such accumulation of surface water is not envisaged in any quarry even during rainy season. Suitable storm water drains will be made above the top bench to channelise the surface run-off during rainy season.

10.4.7 Impact on Socio-economics

Displacement of human settlement will be involved due to the proposed mining activities. Adequate settlement and rehabilitation schemes will be implemented as per the guidelines of State/Central Govt. Mining activities will have a positive effect on the socio-economic condition of the people nearby, as it is a steady source of income for them. With the continuation of mining operation

employment opportunities, communication, medical facilities, schooling etc will be improved further.

10.4.8 Historical Monuments

There is no historical monument in and around the mining lease boundary other than a Megalith Structure at PB East Quarry. As directed by MoEF 500m radius is left for its preservation. No coal shall be mined beneath the influence zone.

10.5 Environment Management

10.5.1. Year-wise program for reclamation of affected land

As per the year wise excavation programme envisaged in the mining plan, the mine benches will remain active till the end of first five years of operation. Accordingly, the reclamation of mined out area will not be possible during first five years. However, the back filling of mined out area will start after 6th year of mine operation in western pit. Once the internal dumping in the mined out area starts, limited quantity will be dumped at the external dump. Mining benches will be filled upto 450 mRL in the western pit of the Block and subsequently raised to 540 mRL. Yearly coverage of reclamation areas are given below in **Table 10.15**.

Table 10.15

Yearly Details of reclamation of land

Stage	Reclamation Area (Ha)
1st year Stage	-
3rd year Stage	19
5th year Stage	64
10th year Stage	177
20th year Stage	389

Stage	Reclamation Area (Ha)
30th year Stage	557
40th year Stage	617
Final Stage	334

10.5.2. Afforestation Programme

During first four years period of mine planning a total of 487 Ha (in non-forest) of land will be broken in western part of the Block both for Mining and Dumping. To compensate for the above, plantation over 100 ha area will be undertaken during first 5 Years as per the following plantation schedule.

Table 10.16

Year	Area to be covered (ha)	Number of trees to be planted (@ 1250 saplings/ha), 75 % survival rate
First year	15	18750 (all around the lease boundary, along the access road, facilities)
Second year	20	25000 (Along the access road, outside the dump area and compensate the plant died)
Third year	20	25000 (On the external dump/mine periphery & along road)
Fourth Year	20	25000 (On the external dump/mine periphery & along road)
Fifth Year	25	31250 (On the external dump/mine periphery & along road)

10.5.3. Stabilization, vegetation and management of dumps

The quantities of OB, Parting (Excluding of Topsoil) to be dumped during first five years for West & East Quarry have been estimated at 99.47 Mm^3.The external waste dump will be stabilized by terracing the slopes. Plantation will be

carried out over the stabilized external dump to increase the stability of dump & also to make the surroundings more eco-friendly. Only local species will be planted under the guidance of state forest department.

A 1.5 m high barrier wall will be erected along the outer edge of external dump at a distance of 15 m form dump toe to arrest the rolling stones down the dump edge. A drainage channel will be dug inside the wall to channelize the rain water falling over the dump area. The channel will be cleaned periodically particularly before the onset of monsoon. Dozer has been envisaged for terracing of dump slopes as well as maintaining the drainage. The details of year wise stabilization and vegetation of dumps is given in **Table 10.17**.

Table 10.17

Yearly stabilization and vegetation of dump

Year	Dump Stabilization & Vegetation (Ha)
First Year Stage	-
3rd year Stage	19
5th year Stage	64
10th year Stage	177
20th year Stage	389
30th year Stage	557
40th year Stage	617
Final Stage	334

10.5.4. Measures to control erosion/sedimentation of water courses

Continuous monitoring will be done to remove overburden material and loose sediments from the working mine benches and excavation zone to avoid rolling of the same into the water course and thereby prevent the erosion and sedimentation. Retention wall will be constructed around the dump to prevent rolling down of loose sediments. Settling pits will be constructed at appropriate

locations along the water channels to arrest sediments and clean water will be allowed to flow into natural water course.

10.5.5. Treatment and disposal of water from mine

The water inside the mine pit is expected from the rain water during rainy season. Entire precipitation over the pit will be channelised systematically into natural drainage. In order to ensure the discharge of clean water into the natural drainage, sedimentation ponds will be made at suitable location to arrest the sludge. Accumulated sludge will be scraped off time to time to maintain the proper mine water discharge. In order to monitor and subsequent management of water quality, monitoring stations will be located near settling pit. Effluent treatment plant is envisaged for treatment of water discharge from workshop as well as domestic waste.

10.5.6. Management of air quality

In the proposed lease area, the existing air quality is within the norms as specified by the National Ambient Air Quality Standards (NAAQS). Fugitive dust shall be generated in open cast mine due to drilling, blasting, handling of overburden & coal. To control dust from various operations following measures will be resorted to.

- Drilling area will be wetted prior to drilling
- Water will be sprayed during loading/unloading of OB and ore
- Periodical water spraying will be done on haul road, overburden dump & stacks of coal
- Trees will be planted on road side.
- Dumps will be stabilised by planting grass/trees

It has been proposed that all mining and ore processing equipment will have dust extraction and separation attachment to minimise air pollution. In order to monitor and subsequent management of air quality, monitoring stations will be located near dust generating areas such as haul road, OB dump, coal handling plant etc.

10.5.7. Protective measures for ground vibration/air blast caused by blasting

Loosening of rock mass will be done by the blasting of 10 to 15 m deep and 160/250 mm diameter blast holes. Burden and spacing have been proposed as 4.5 m and 5.0 m respectively. Milli-second delay detonators have been envisaged to minimise the ground vibration. Use of non-electric detonators will be used wherever required. Blast vibration studies will be conducted to optimise the burden & spacing and explosive requirement so as to minimise the vibration effect due to the blasting.

Blasting will be carried out in a periodical manner so as to minimize the impact on the local habitants and the faunal species.

10.5.8. Measures for protecting historical monuments and for rehabilitation of human settlements

Historical monuments do not exist within 5 km radius of the proposed ML area. Adequate scheme for rehabilitation for human settlement within the leasehold area, will be implemented in line with the policies of Central/State Govt.

10.5.9. Socio-economic benefits arising out of mining

The activities involved in mining and subsequent preparation of coal at proposed leasehold area will generate employment potential both directly or indirectly. As the proposed mining and transportation has been envisaged through contractual means, through Mine Developer & Operator (MDO), local

people will have employment opportunities as skilled, semi-skilled and unskilled labourers in mining, transportation and allied activities. Thus there will be overall improvement in the socio-economic status of the people of the surrounding areas. Mining activities will have a positive effect on the socio-economic condition of the people nearby, as it is a steady source of income for them. With the continuation of mining operation employment opportunities, communication, medical facilities, schooling etc will be improved further.

10.5.10. Monitoring schedules for different environmental components right from the commencement of mining and other related activities

The environmental staff will make and conduct routine field monitoring and inspections and interact closely with operations personnel. The necessary planning of environmental field activities such as topsoil removal, storage and replacement will be performed by the environmental staff.

Environmental monitoring and reporting will be conducted to provide a close supervision on the surrounding natural environment and provide early warnings of any adverse changes that may be related to some dimension of the mining and allied operations. The activity can be categorised into routine tasks.

In order to carry out routine tasks in a systematic manner, Environmental group will practice the following:

- Plan a site-based strategy to control pollution. The strategy should include formulation of code of actions for controlling air, water, noise, soil pollution, managing blasting effects, phase wise afforestation scheme and actions to be taken in respect of socio economic development. Frequency of monitoring/ sampling and inspection of various parameters / factors will also be planned.
- Oversee environmental control measures are implemented as per approved action plan.
- Plan conservation programmes in respect of water and energy.

- Identify and record the constraints in respect of environmental planning and implementation.
- Systematically document all the field monitoring and laboratory analysis results. Analyse the monitoring results and inspection findings. The results can be compared with various standards/ Norms. Prepare periodic progress reports, which will include the analysis and inspection results. Environmental audit results and actions taken should also be systematically documented.

Monitoring and compliance shall be done as per Environmental, Forest and other statutory clearances accorded for the project. However, tentative monitoring schedules are provided in **Table 10.18.**

Table 10.18

Monitoring Schedule

Sl. No.	Description of Parameters	Schedule and Duration of Monitoring
1	Slope Failure	Bi-Weekly
2	Land Erosion	Weekly
3	Drainage	Daily
4	Blasting effect	As per mine workings and blasting
5	Re-vegetation and Green belt development	Yearly
6	Monitor Plantation Measures	Yearly
7	Surface Subsidence	Bi-Weekly
8	Water Quality Monitoring(Ground & Surface)	
	Water quality of Surface and ground water around the site (All parameters specified by JSPCB)	Monthly
9	Emissions and Air Quality (RPM,SO_2, NO_x ,CO)	24 hourly samples with analysis carried out

Sl. No.	Description of Parameters	Schedule and Duration of Monitoring
		monthly all-round the year.
10	Meteorological Station	Continuous
11	Air Quality	Continuous
12	Noise Quality	Continuous
11	Occupational Health	Bi-Weekly

10.6 ENVIRONMENT MANAGEMENT OF PAKRI BARWADIH NORTH WEST (SECTOR-A) QUARRY

Environmental Clearance for Pakri Barwadih Project (covering Western and Eastern Part of the Block) was accorded by MoEF on 19.05.2009 for rated production of 15 MTPA. At that time the North Western (Sector-A) part of this block was unexplored. Subsequent to detailed exploration, NTPC submitted Mining Plan which could not be presented to MoC. In compliance to the MoC letter no- 13013/29/2003- CA-I dated 09.10.2014 NTPC is submitting Mining Plan of Pakri Barwadih (Rev.1) for consideration of. MoC. Base line environmental data is unavailable for this part of the block.

In the present Pakri Bawadih West & East and Pakri Barwadih NW are integrated as a result this mine shall be producing 18 MTPA. As the clearance is already obtained for 15 MTPA, NTPC shall conduct EIA/EMP for PB-NW part and submit proposal to MoEF & CC for consideration.

The environmental management plan shall include the evaluation of impacts of carrying out mining activities, mitigation of environmental pollution and monitoring of environmental parameters such as land, water, air etc.

Environmental mitigation measures and monitoring and control of environmental parameters shall be carried out in line with that proposed for Pakri Barwadih West and East Quarry.

Salient features of the PB NW Quarry (sector-A) for planning the study are briefly given in **Table 10.19**

Table 10.19

Salient Features of PB NW (Sector-A) Quarry

a)	Applied Lease area	485 ha (Equal to Block area)
b)	Core Zone	485 ha Block area
c)	Nature of land	Habitated land, Agricultural land, waste land, Forest land and Water bodies
d)	Mineral to be mined	Coal
e)	Scale of operation	The capacity of proposed mine is 3.00 million tonnes per annum (Mtpa)
f)	Anticipated life of mine	38 years (excluding two years of construction period)
g)	Method of mining	Opencast
h)	Surface transport	By trucks and CHP within the ML, by combination of road, CHP and railways from pit head to the thermal power plant

10.6.1 SOCIO ECONOMIC STUDY

Socio Economic Survey Study is under process and the findings of the study will be incorporated after finalization of SES report.

10.6.2 EXISTING LAND USE PATTERN

Mining, dumping, road, built area etc. will change the existing land use pattern by degrading/utilizing forest and non-forest land. Post mining land use pattern is given in **Chapter-IX.**

CHAPTER XI

PROGRESSIVE AND FINAL MINE CLOSURE PLAN

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Ministry of Coal, Govt. of India

a. Coal Mines Regulation 1957
b. Mines Act 1952
c. Mines Rules 1966
d. Vocational Training Rules 1966
e. Indian Electricity Rules 1956
f. DGMS circulars from 1948 (up-to-date)
g. Factories Act1948 (as applicable to mines)
h. Explosive Act and Rules
i. Conditions attached to statutory permissions and exemptions granted by DGMS to Mines of CIL.
j. Recommendations of National Safety Conferences, Tripartite Safety Review
k. Special guidelines issued by DGMS following accident enquiries etc.
l. ILO code of Safety and Health and in open cast Mines (1991).

Special conditions imposed while execution of lease deed, approval of Mining Plan, directive issued by the Ministry of Coal, conditions imposed by the MoEF, State Pollution Control Board or by any other statutory organizations shall be followed. All conditions stipulated in the Approved Mining Plan, Environmental clearance, Forest clearance and other future clearances shall be complied. List of clearance along with their status is given in **Table 11.1**

Table 11.1

LIST OF CLEARANCES FOR PB EAST, WEST and NORTH WEST QUARRY

Sl. No.	Clearances	Status for PB West & East Quarry	Status for NW Quarry
1.	Approval of Mining Plan by MoC	Approved	Not Approved
2.	Revised Mining Plan (1st Revision) and Mine Closure Plan	Under approval	Integrated with PB West and East as one mine mine

3.	Public Hearing conducted by SPCB	Completed	Not done
4.	Environment clearance by MoEF	Obtained	Not Available
5.	Forest clearance by MOEF(Stage I and Stage II)	Obtained	In Process
6.	Permission for Diversion of Nalla passing through West Quarry of PB from Govt. of Jharkhand	Obtained	Not Available
7.	Permission for Withdrawal of Ground Water from CGWA	Obtained	In Process
8.	Land Acquisition / surface rights - State Govt. /Govt. of India	In Process (Section 11 under CBA Act has been notified)	In Process
9.	Clearance for use of explosives and construction of magazine	In Process	Integrated with PB WE as one mine mine
10.	Permission for opening of coal mine from DGMS	Obtained	In Process

11.1.3 CLOSURE PLAN PREPARATION

Conceptual Final Mine Closure Plan has been prepared. However, Final

Mine Closure plan shall be prepared 5 years before the likely cessation of mining operations shall continue for 3 years after likely cessation of mining operations and will have the approval of the Board of Directors.

11.2 MINE DESCRIPTION

The entire coal block has been considered for opencast mining in the interest of conservation of reserves and techno economic considerations.

The minimum workable in-band thickness of seam for opencast mining has been taken as 1.00 m. In case of opencast potentiality, a seam has been considered as splitted if the parting between the two sections has attained a thickness of more than 1.00 m and is persistent.

During the course of mining operations, Khora, Dumuhani and Hardara Nala will need to be diverted at different stages of mining operations to ensure safety of mine workings as also for releasing the coal reserves which otherwise would be lost in the safety barriers required to be left against this water channel. Care would also be necessary to provide suitable garland drains as well as embankment along diverted nala route to avoid any inundation of opencast mine workings.

11.2.1 Mine Boundaries

It is proposed to mine maximum area leaving a barrier of 7.5 m on surface from block boundary which is a statutory requirement. The boundaries of PB West & East Quarry PB-NW Quarry are delineated and given in **Table-11.2**.

Mine parameters for the delineated mine boundaries are shown below:

Table 11.2
Boundaries up to 300 m depth line

Particulars	WEST QUARRY				EAST QUARRY	NORTH WEST QUARRY	
	WP -1	WP -2	WP -3	WP -4		PIT-1	PIT-2
North-West Boundary	Incrop of seam I	F_{13} and Incrop of seam I	Incrop of seam I	Incrop of seam I	Incrop of seam I	in-crop of K -1 seam Quarry surface has been projected at 45° on the surface, with respect to the quarry floor.	in-crop of K -1 seam Quarry surface has been projected at 45° on the surface, with respect to the quarry floor.
West Boundary	Khora nala and Incrop of	Khora nala and Incrop of	Arbitrary line	Khora nala	F_3 F_4	20 m from the Khora – B Nala.	20 m from the Khora – B Nala.

	seam I	seam I					
East Boundary	F_{14} & Incrop of seam I	F_{10} - F_{11}	F_5	F_5	F_1 F_1/F_2 F_2	60 m from the Khora - A Nala.	60 m from the Khora - A Nala.
South-East Boundary	F_{13}	F_{10} & F_{11}	F_5 and FRL of 300 Seam-II	300 m depth line/ FRL of 120 m Seam II	300 m depth & FRL of 120 m of Seam II	Quarry surface has been projected at 45° on the surface as well as on the confluence of Khora Nala - A & B.	Quarry surface has been projected at 45° on the surface as well as on the confluence of Khora Nala - A & B.

Note: 7.5m space width is left from the outer boundary of PB NW quarry

Some major system parameters are given in **Table 11.3**.

Table-11.3

System Parameters

Sl. No.	Particulars	PB-West & East	PB -NW
1.	Maximum Bench Height		
	Top OB	15m	15m
	Coal and Intervening parting	5 - 15m	5 - 15m
2.	Proposed minimum Bench Width		
	Working Bench	50m	40m
	Non-Working Bench Width	25m	25m
3.	Width of the permanent haul road	30m	25m
4.	Width of the temporary transport ramp	10m	10m
5.	Usual height of the spoil dump bench (1Tier)	30m	30m
6.	Width of the active dump bench	30m	30m
7.	Bench Slope		
	OB Bench	70^0	70^0
	Coal Bench		70^0
	Dump bench	37^0	37^0
	Overall (Ultimate) pit slope	**37^0** (300 m depth)	43^0 (155m depth)

11.2.2 Geology

The Pakri-Barwadih block (East & West Quarry) comprises of Talchir, Karharbari, Barakar, Barren Measures and Raniganj Formations belonging to Damudas, a Sub-Group of Lower Gondwana.Talchir Formation rest directly over the Pre-Cambrains. The Karharbaris and Barkars are the main coal bearing formations in the block. Stratigraphic succession of the formations in the PB West & East and PB NW is given in the following **Table-11.4 A**.

Table-11.4 A

Stratigraphic Sequence of Pakri-Barwadih Block

Period	Group	Sub-group	Formation	Thickness Range	Lithology
Recent	Lower Gondwana	Damuda	Alluvium	3.50 – 25.85	Detrital and Alluvial soil & subsoil
Upper Permian			Raniganj	1.50 – 324.50	Fine to medium grained micaceous sandstone, interbanded shale and sandstone, Carbonaceous shale & thin uneconomic Coal seams.
Upper Permian			Barren Measures	5.14 – 353.00	Dark shale, sandy shale & interbanded shale & sandstone.

			Barakar	12.50 - 268.85	Fine to coarse grained sandstone, Shale, Conglomerate, Carbonaceous shale & Coal seams.
			Karharbari	10.00 – 81.60	Medium to coarse grained sandstone, Shale, silicified quartzite rock & thin coal seams.
Permo Carbonitero us	--	--	Talcher	0.80 – 13.50	Green coloured shale, Boulder & Congolomerate
----------Unconformity----------					
Pre-Cambrian	--	--	Metamorphics	--	Granite, Gneisses & Quartizites

There are a few small outliers of Barakar/ Kaharbari/ Talchir Formations occurring over the Pre-Cambrian Basements immediately north of the Pakri-Barwadih Block.

However, in PB North West (sector-A) area small exposures of sand stone and coal seam are found near the bank of Khora Nala in the western margin of the block. At places Karharbari Formation also rest directly over metamorphic. The geological succession established in the PB North West area (sector-A) of the block from sub-surface exploration data is given in **Table 11.4 B.**

Table-11.4 B

STRATIGRAPHIC SUCCESSION OF PB NW (SECTOR-A) AREA OF COAL BLOCK

Period	Group	Sub-Group	Formation (Thickness)	Lithology
Recent & Sub-Recent			Alluvium (3.00 to 23.00m)	Soil & Sub-soil
----------Unconformity----------				
Middle Permian			Barren Measure (44.00 – 138.70m)	Predominantly shale with intercalation of sandstone and shale and arenaceous shale
Lower Permian	Lower Gondwana	amuda	Barakar (19.07m – 137.10m) Karharbari (5.14m to 91.52m)	Fine to coarse grained sand-stones, shale, carbonaceous shale and coal seams. Fine to coarse grained sandstone with bands of shale and coal seams
Permo - Carboniferous			Talchir 0.65m to 4.64m)	Green coloured shale, boulders and conglomerates
----------Unconformity----------				
Precambrian			Metamorphics (2.80-11.00m)	Gniesses, granites and quartzites

As per the geological report, no major, minor and trace elemental analysis of different rock types was available. The chemical analysis of coal indicates presence of nontoxic minerals. The sandstones of Barakar Formation constitute major part of area forms a principal aquifer. The chemical analysis of ground water shows the trace element like Cu, Mn, Hg, Cd, Se, As, Pb, Zn, Cr, Al and B are present below deduction limit.

B. Ground water sources

The groundwater in sedimentary formation occurs under confined conditions and is limited to the thickness of the formation. The Barakar formation acts as a good aquifer due to high porosity and permeability in the formation. Predominantly western part of the study area comprises of hills and rugged topography, the water level is at great depth as compared to the Pedi plain areas. Mostly the rainwater gets run-off in this area and hence the percentage of recharge of ground water is very less. The water table of this area varies from 5m to 20m; in the valley-fill areas, the water table is at shallow depth. The ground recharge in these areas is very high. The major source of drinking water is dug wells and hand pumps, which are available in almost all the villages in the study area.

11.2.7.2 Existing Water Quality (Surface and Groundwater)

Water quality monitoring was carried out in order to collect baseline data on existing water quality, which can be used to predict the impacts due to the project on water regime. Samples were collected from fifteen (15) locations within the block area.

The results of analysis of surface water is given in **Table 11.9**. The results have been compared with the IS: 10500. It can be seen that at all seven monitoring stations, water from these sources can be used for drinking after conventional treatment and disinfection.