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MINING PLAN AND MINE CLOSURE PLAN
FOR
BASUNDHARA (WEST) EXTENSION OCP
(8.75 MTY)

IB-VALLEY COALFIELD
MAHANADI COALFIELDS LIMITED

(TEXT & PLATES)

RQP: RAKESH KUMAR DAS, NO. 34011/(22)/2005-CPAM, Dtd.07.09.2010
Under Rule 22(C) of Mineral Concession Rules 1960

MARCH, 2017

CENTRAL MINE PLANNING & DESIGN INSTITUTE LIMITED
(A Subsidiary of Coal India Ltd.)
REGIONAL INSTITUTE-VII
BHUBANESWAR-751013.

राकेश कुमार दास
मुख्य प्रबन्धक (खनन)
सी.एम.पी.डी.आई.सं.से.
34011/(22)/2005-CPAM dt. 17.09.2010

F. No. 34012/(04)/2011-CPAM
Government of India
Ministry of Coal

New Delhi, the 22nd March, 2017

To

Shri S.K. Kundu,
General Manager (Projects & Planning),
Mahanadi Coalfields Limited,
At/P.O. Jagruti Vihar, Burla, MCL
Distt. SAMBALPUR-768 020 (ODISHA) (e-mail:mlprajapat5@gmail.com)

Subject	**MCL**-Mining Plan and Mine Closure Plan for Basundhara (West) Extension OCP (8.75 Mty) dated March, 2017.

Sir,

I am directed to refer to MCL's letter No.MCL/HQ/Sambalpur/General Manager (Projects & Planning)/17/2054 dated 20.03.2017 on the above cited subject and to forward herewith **04 copies** of Mining Plan and Mine Closure Plan for Basundhara (West) Extension OCP (8.75 Mty) dated March, 2017 of MCL duly approved and signed on all pages by Adviser (Projects), Ministry of Coal.

Yours faithfully,

Encl: As above.

(A.K. Mandal)
Under Secretary to the Govt. of India

MINING PLAN AND MINE CLOSURE PLAN
FOR
BASUNDHARA (WEST) EXTENSION OPENCAST PROJECT
(8.75 MTY)

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LIST OF ANNEXURE

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DOCUMENTS ENCLOSED

(i) Copy of the Allotment Order.

- The proposed Basundhara West Extension OCP lies in Chaturdhara, Basundhara West and Basundhara East (partly) geological blocks which belong to MCL and where opencast mine is being operated.

(ii) Copies of earlier approvals of the Mining Plan and mine closure plan, if any.

- This is the first Mining Plan and mine closure plan of Basundhara (West) Extension OCP.

(iii) Copy of MOC's letter granting recognition to RQP for preparation of Mining Plan and Mine closure plan.

Enclosed as page (b).

(iv) Letter of Authorisation by the Block Allottee/Applicant to the RQP for preparing Mining Plan and mine closure plan.

- Copy of Annual Work Programme of P&D Department, CMPDI, RI-VII for 2016-17.

(v) A certificate by the RQP that he has been duly authorized by the mining company to prepare mining plan and mine closure plan on their behalf and that he has a valid recognition from MOC under MCR, 1960 to prepare the mining plan and mine closure plan and that provisions of all relevant rules and regulations have been considered while preparing the mining plan and mine closure plan.

- Certificate is enclosed as page (d).

(vi) 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 and mine closure plan does not encroach on any other Coal/Lignite Block.

- This is to confirm that the proposed area has been verified with the relevant plans available in CMPDI and the area under consideration is under jurisdiction of MCL.

राकेश कुमार दास
मुख्य प्रबन्धक (उत्खनन)
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(vii) Copy of the document to establish that the Geological Report has been duly purchased from CMPDI, GSI/MECL as the case may be.

- The Geological Reports were prepared by CMPDI, for Chaturdhara block in March,1991 for Basundhara East block in May,2000 and for Basundhara West block in March,2003.

(viii) Index of chapters contained in the Mining Plan and mine closure plan.

- Contents of the present Mining Plan and mine closure plan showing the index of chapters is being enclosed as CONTENT.

(ix) No of volumes in the Mining Plan and mine closure plan and their contents.

- One volume containing Text and Plates.

(x) List of Plans/drawings.

- List of Plans/drawing is enclosed as CONTENT.

(xi) List of Annexures.

- Letter of approval of Basundhara (West) Extn OCP Normative Capacity 7.0 Mty, Peak Capacity 8.75 Mty is enclosed as Annexure-I.

(xii) List of Abbreviations used.

- MOC : Ministry of Coal
- MOEF : Ministry of Environment and Forest
- CMPDIL : Central Mine Planning and Design Institute Limited.
- MCL : Mahanadi Coalfields Limited.
- NCDC: National Coal Development Corporation.
- FCI- Fertilizer Corporation of India
- OC : Opencast
- IBM : Indian Bureau of Mines
- MECL: Mineral development Corporation Limited
- RH- Relative Humidity
- UHV- Useful Heat Value
- PR : Project Report
- CBA(A&D) Act- Coal Bearing Areas (Acquisition & Development) Act

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- BG method- Blasting Gallery Method
- RPE method- Rib Pillar extraction Method
- Yr 1,2,3- Production year 1,2,3
- Mt- Million tonnes
- Mty- Million tonnes per year
- OB- Overburden
- TPD- Tonnes per day
- kW- kilo watt
- kV-kilo volt
- FLP- Flame Proof
- lps-liters per second
- CO- Carbon Monoxide
- CH_4- Methane
- CHP- Coal Handling Plant
- MTK room- Mine Time Keeper Room
- RPM- Rounds per Minute
- SPM- Suspeded Particulate Matter
- NO_x- Nitrogen Oxide/s
- EMP- Environmental Management Plan
- RCE- Revised Cost estimate

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मुख्य प्रबन्धक (उत्खनन)
सी.एम.पी.डी.आई.क्षे.सं.-7
54011/172/2005-CPAM dt. 17.09.2010

GENERAL INFORMATION

1	NAME AND ADDRESS OF THE APPLICANT	:	MAHANADI COALFIELDS LIMITED JAGRUTI VIHAR, BURLA, SAMBALPUR-768020 (ORISSA)
2	STATUS OF THE APPLICANT	:	CENTRAL PUBLIC SECTOR UNDERTAKING (A SUBSIDIARY OF COAL INDIA LTD.) A GOVT. OF INDIA UNDERTAKING REGISTERED UNDER COMPANIES ACT, 1956
3	MINERAL WHICH THE APPLICANT INTENDS TO MINE	:	COAL
4	NAME, ADDRESS OF PERSON WHO PREPARED MINING PLAN AND MINE CLOSURE PLAN	:	SHRI RAKESH KUMAR DAS CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED, RI-VII, PLOT NO.E4, NEAR GANDHI PARK, AT:SAMANTAPURI, BHUBANESWAR-751013 RQP REF.NO.-No. 34011/(22)/2005-CPAM, DTD. 07.09.2010
5	NAME AND ADDRESS OF PROSPECTING AGENCY	:	CENTRAL MINE PLANNING & DESIGN INSTITUTE LIMITED, REGIONAL INSTITUTE-VII, PLOT NO.E4, NEAR GANDHI PARK, AT:SAMANTAPURI, BHUBANESWAR-751013 (ODISHA)

राकेश कुमार दास
मुख्य प्रबन्धक (उत्खनन)
सी.एम.पी.डी.आई.क्षे.सं.-7
34011/(22)/2005-CPAM-II 17.09.2010

By Registered Post

No. 34011(22)/2005-CPSM
Government of India
Ministry of Coal

New Delhi, 7th September 2010

To
Chairman-cum-Managing Director
Central Mine Planning & Design Institute Limited,
Gondwana Place,
Kanke Road,
Ranchi-834 031 (Jharkhand)

Subject	Grant of recognition to technically qualified executive of CMPDI as competent person to prepare Mining Plan for Coal/Lignite blocks.

Sir,

I am directed to refer to your letter No. [illegible] dated 15.7.2010 on the above mentioned subject and to convey the approval of the Central Government to the grant of recognition in favour of Shri Debashis Roy and Shri P.K. Das, technically qualified executives of CMPDI as competent person to prepare Mining Plan for the assignment/jobs undertaken only by CMPDI for 'OC Mines' under Rule 22B of Mineral Concession Rule, 1960 from the date of issue of this letter.

2. The application for grant of recognition as RQP in respect of Shri Shri Sanjiv Kumar Dhar could not be considered due to incomplete application.

3 Your attention is also invited towards the decision of Standing Committee that "additional area beyond the block boundary may be considered in a mining plan subject to the condition that proper justification is given in the mining plan, and that annexed area is non coal bearing and does not infringe upon any already allotted or identified coal/lignite blocks"

Yours faithfully

(A.S. [illegible])
Under Secy

राकेश कुमार राय
मुख्य प्रबन्धक (उत्खनन)
सी.एम.पी.डी.आई.ई.सं.-7
34011(22)/2005-CPSM dt. 17.09.2010

ANNUAL WORK PROGRAMME OF P&D DEPTT: 2016-17

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]

[illegible]

1. [illegible]

OR

[illegible]

2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]

[illegible]

1. [illegible]
2. CONCEPTUAL NOTE [illegible]
3. [illegible]
4. [illegible]
5. ANY OTHER JOB AS AND WHEN REQUIRED

[illegible]

1. CONCEPTUAL NOTE [illegible]
2. [illegible]
3. ANY OTHER JOB AS AND WHEN REQUIRED
4. [illegible]

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]
4. ANY OTHER JOB AS AND WHEN REQUIRED

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]

[illegible]

1. [illegible]
2. ANY OTHER JOB AS AND WHEN REQUIRED
3. [illegible]

[illegible]

राकेश कुमार दास
मुख्य प्रबंधक (उत्खनन)
सी.एम.पी.डी.आई.क्षे.सं.-7

CERTIFICATE

1. *Certified that M/s Mahanadi Coalfield Limited has requested M/s Central Mine planning and Design Institute Limited to prepare the Mining plan and Mine closure plan of Basundhara (West) Extension OCP. It is also certified that the undersigned has a valid recognition from Ministry of Coal under MCR,1960 to prepare the mining plan.*

2. *Certified that the provisions of Mineral Conservation and Development Rules, 1988 and MCR, 1960 have been observed in the preparation of "Mining Plan and Mine closure Plan for Basundhara (West) Extension OCP of MCL" and wherever specific permissions are required, the applicant will approach the concerned authorities.*

3. *Certified that provisions of Mines Act, 1952 and of the Rules and Regulations made their under have been observed in the preparation of this Mining Plan and Mine closure plan and that wherever specific permission is required the applicant will approach Director General of Mines Safety in the matter.*

3. *Certified further that the information furnished in this Mining Plan and Mine closure plan is true and correct to the best of my knowledge.*

RAKESH KUMAR DAS
RQP NO.34011/(22)/2005-CPAM DTD. 07.09.2010.
Place : Bhubaneswar
Date :

राकेश कुमार दास
मुख्य प्रबन्धक (उत्खनन)
सी.एम.पी.डी.आई.ले.रो.-7
34011/22/2005-CPAM dt. 17.08.2010

SUMMARISED DATA

राकेश कुमार दास
मुख्य प्रबन्धक (उन्नयन)
भी.एम.पी.डी.आई.डी.सं.-7
3401/(22)/2005-CPAM dt. 17.09.2010

SUMMARISED DATA

1.	**General**	
a)	Name and address of the Applicant Company	Mahanadi Coalfields Ltd.(MCL) Jagriti vihar, Burla Dist:- Sambalpur(Odisha)-768020
b)	Name and address of the Block Allottee	Mahanadi Coalfields Ltd.(MCL)
c)	Relationship between the applicant and allottee company	MCL is a subsidiary of Coal India Ltd. which is a Govt. of India Undertaking
d)	Status of the Applicant Company: Central /Public Sector Undertaking/State Government Undertaking/JV Company/ Pvt. Company/Public Co/Others (Specify)	Central Public Sector Undertaking
e)	Name of the Coal Block together with name of Coalfield & State where located	Basundhara (West) Extension is located in Chaturdhara block, Basundhara (West) block and partially in Basundhara (East) block of Ib-Valley coalfield, Odisha.
f)	Date of allotment	Block is being worked by Mahanadi Coalfields Limited, A subsidiary of Coal India Limited(Govt. of India undertaking)
g)	End Use of Coal/Lignite as per Approval by the Competent Authority	Sale in the market for miscellaneous use
h)	ROM Quantity proposed to be produced as per Mining Plan	8.75 Mt
i)	Norms adopted for calculating ROM quantity requirement in case it differs from the quantity indicated in the Allotment Order	Not Applicable
j)	Beneficiation required – Yes/No	Not required
k)	Requirement of Beneficiated Coal & expected availability thereof	N/A
l)	Period for which Mining Lease has been granted/is to be renewed/ is to be applied for.	Land acquired under CBA(A&D), Act, 1957
m)	Date of Expiry of earlier Mining Lease, if any	N/A
n)	RQP who has prepared the Mining Plan Name Address Phone No/Fax/Email ID Registration No & date till valid Date of grant/Renewal of RQP Status Validity	Rakesh Kumar Das Central Mine Planning and Design Institute limited, RI-VII, Plot No.E4, Near Gandhi Park, At:Samantapuri, Bhubaneswar-751013 Phone No. 0674-2301271. FAX-0674- 2301762. E-Mail-[illegible] RQP NO.34011/(22)/2005-CPAM Dtd. 07.09.2010.

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मुख्य प्रबन्धक (उत्खनन)
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34011/(22)/2005-CPAM dt. 17.09.2010

D. Information regarding earlier approved Mining Plans, if any.

a)	Approval Letter no. and Date	-This is the first Mining Plan and Mine closure plan. - Not Applicable.	
b)	Lease Area		
c)	Date of grant of Lease:		
d)	Date of Expiry of Lease		
e)	Targeted Production		
f)	Proposed date of start of Production		
g)	Proposed date of achieving the targeted production level		
h)	Envisaged life of the mine (in years)		
i)	Date of actual commencement of Mining Operations, if operations already started		
j)	Likely date of Mining Operations, if operations not yet started & reasons for non-commencement of operations		
k)	Planned production and actual levels achieved in last 3 years		
l)	Coal :- U/G O/Cast OB		
m)	Reasons for difference between the planned and actual production levels		
n)	Reason for revision of the Mining Plan	**Old Plan**	**New Plan**
o)	Details of changes in the new mining plan compared to earlier approval (i) Lease Area (ii) Block Boundary (iii) Production level (iv) Reserves (v) Mining Technology(Additional sheets to be used, if required)	N/A	

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34011/(12)/2005-CPAM dt. 17.03.2016

E	**LOCATION**	
a)	Location of the Block Taluka/ Village/ Khasra/ Plot / Block Range / etc. District / State	Sundargerh district Odisha
b)	Name of the Coalfield/ Coal belt	Ib – Valley coalfield
c)	Particulars of adjacent blocks: North, South, East, West	North- No Coal zone South- Banapatra & Siarmal Block East- Basundhara East OCP South east- Kulda OCP West- Rampia Block
d)	Area of the Allotted Block (hectares) i Geological block area (Chaturdhara) ii Mining Area	 583 306.35
e)	Reference no. of plan of block boundary issued by CMPDI/ SCCL/ NLC (A copy of the Plan also to be annexed)	The Mining Plan is based on the Geological Reports on Chaturdhara block (March,1991), Basundhara West Block (March 2005) and Basundhara (East) Block (May,2000), Ib River Coalfield, Dist.- Rampia, Odisha
f)	Whether the lease boundary/ required boundary is same as demarcated by CMPDI/ SCCL/ NLC for delineating block/sub- block	Yes
g)	Existing mining Lease Area in case of existing mines, (hectares)	N/A
h)	Applied/ required Lease Area as per the Mining Plan under consideration (hectares)	Land acquired under CBA Act.
i)	Whether the applied lease area falls within the allotted block	Yes
j)	Area (hectares) of lease which falls outside the block/sub-block delineated by CMPDI/SCCL/NLC	The proposed area is under the leasehold of MCL
k)	Details of outside area: - Whether forms part of any other coal block - Whether it contains any coal/lignite reserves - Purpose for which it is required, e.g. roads/ OB dumps/ service buildings/ colony/ safety zone/ others (specify)	N/A
l)	Whether some part(s) of the allotted block has not been applied for mining lease. - Total area in Ha of such part(s). - Total reserves in such part(s). - Brief reasoning for leaving such part(s).	No, Not Applicable
m)	Type of Land involved in Hectares - Forest Land - Non Forest Land i Tenancy Land ii Govt. Land	- 227.67 - 31.29 - 45.01

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n)	Broad Land Use Pattern (Forest, Township, Industrial, Agricultural, Grazing, Barren etc.)	Not Applicable
o)	Proximity of public road / railway line/major water body if any and approximate distance	Nearest rail head Himgir—35km by road Jharsuguda is 62 km vie Sundargarh by state Highway no.- 10
p)	Topo sheet No. with latitude and longitude	No.-64N/12 on RF 1:50,000 Lat 22°04'40.47"-22°04'40.61.0"N Long 83°40'20.48"-83°42'22.56" E

F	GEOLOGY AND EXPLORATION		
a)	Name of the Geological Block and area in hectares	Chaturdhara- 3.57 sq. km. Basundhara West- 1.90 sq. km. Basundhara East- 0.36 sq. km.	
b)	Name of the Geological Report (GR) with year of preparation	G.R. on Chaturdhara block (March,1991) G.R. on Basundhara West block, March 2003. G.R. on Basundhara East block, May, 2000	
c)	Name of the agency which conducted exploration and prepared GR	CMPDI	
d)	Period of conducting exploration	1984 to Feb. 2002	
e)	Details of drilling (by all agencies)	Agency	No. of BHs
		CMPDI	55
		GS	1
		Total	56
f)	No. of boreholes drilled within the block (Chaturdhara Block)	55	
g)	Overall borehole density within the block (no./ sq. km)	16.4/ Sq.Km	
h)	Area covered by 'detailed' exploration within the block (hectares)	3.57 Sq.Km	
i)	Area covered by 'detailed' exploration outside the block (hectares) - No. of boreholes drilled outside the block - Bore hole density for outside area (no./sq. km)	Not Applicable	
j)	Whether entire lease area has been covered by 'detailed' exploration	Yes	
k)	Whether any further exploration is required or suggested and timeframe in which it is to be completed	No	
l)	Number of coal/lignite seams/horizons	8 Seams – Rampur-V, Rampur- IV, Rampur- IVB, Rampur- III, Rampur-II, Rampur- I	
	- thickness range of coal seams		Range (in metre)
		Rampur-V	- 2.00 - 3.00
		Rampur-IV	- 11.00 - 15.00
		Rampur-IVB	- 1.00 - 2.00
		Rampur-III	- 4.00 - 6.00
		Rampur-II	- 2.00 - 4.00
		Rampur-I	- 4.00 - 5.00
	- Minimum & maximum depth of coal seams		

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34611(22)/2005-CPAM dt. 17.09.2010

m) Useful Heat Value(UHV in K.Cal/Kg), of coal as per GR :	Coal Seam / UHV (K.cal/kg.): Rampur-V: 2200-4000 Rampur-V: 1400-2200 Rampur-IVE: 1400-2000 Rampur-III: 2000-3500 Rampur-II: 2300-4800 Rampur-I: 2400-4000
n) Quality (Grade) of coal as per GR : Range Mean	 D To G F
o) Total geological reserves in the block (Chaturdhara)	115.971 million tonne
p) Depletion of reserves (in case of running mine) over Basundhara (W) Block & Basundhara (E) Block	58.99 million tonne till 2015-16
q) Additional reserves established (if any for running mine) (over Chaturdhara Block)	92.73 Mt over the annexed 3.06 sq.km
r) Geological reserves considered for mining by Opencast	 101.06 Mt
s) Corresponding Extractable reserves by Opencast mining	 92.73 Mt
t) Percentage of recovery w.r.t. geological reserves by Opencast	91.76

*** Seam wise details of items (f) to (t) to be included in the relevant chapter.**

राकेश कुमार दास
मुख्य प्रबंधक (उत्खनन)
सी.एम.पी.डी.आई.क्षे.सं.-7
34011/22/2005-DRAM dt. 17.09.2010

G.	MINING	
a)	Existing and proposed method of mining (Opencast for OB & coal. OB by shovel – dumper and Coal by surface miners.)	Surface miners- 8.75 Mt
b)	Targeted capacity in mtpa when the mine is fully developed and the year in which proposed to be achieved By Opencast : Total :	8.75 Mt in Yr.3. 92.73Mt by Yr.12
c)	Life of the mine : Opencast workings : Overall :	12 Years 12 years
d)	Indicate quantum of production and expected grade as in table below :-	

Year	OC Production Mt		Washery rejects (Mt)
Yr 1	1.50 Mt	D To G Grade (non-coking)	Not Applicable
Yr 2	5.50 Mt		
Yr 3	8.75 Mt		
Yr 4	8.75 Mt		
Yr 5	8.75 Mt		

Detailed calendar programme of coal production year wise and seam wise along with OB removal have been furnished in the relevant chapter.

e)	Whether the proposed external OB dump site is coal/ lignite bearing: - If so, whether coal/lignite below waste disposal area is extractable.	N/A
f)	Whether negative proving for coal / lignite in the proposed site for OB dump/ infrastructure has been done.	N/A
g)	Proposed configuration of HEMM for OC (Coal & OB) & Major Equipment for OC.	Elec. Hyd. Shovel 10-12 cum Elec. Rope Shovel 5.0 cum Diesel Hyd. Backhoe – 5.0 cum Diesel Hyd. Backhoe 2.5-3.0 cum Surface Miner- 3000-3800 mm F.E.Loader- 5-6 cum Rear Dumper 100 T Rear Dumper 60 T Rear Dumper 50 T Rear Dumper 35 T Elec. RBH Drill 250 mm Diesel Drill 160 mm Dozer with ripper attachment 860 HP Dozer 410 HP Wheel Dozer 300 HP

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h)	Mode of entry for underground mines (shaft, incline, adit):	N/A
i)	Operations that are proposed to be outsourced	NIL
j)	Proposed coal evacuation facilities	
	Face to Surface	Rear Dumpers- 60 T & 50 T Tippers
	Surface to end use plants	From surface to end use plants or railway siding by trucks

H.	END USE OF COAL/ LIGNITE	
a)	Capacity of the approved end use plants	MCL will supply coal to its consumers, especially steel industry/ coal gasification through linkage/ e-auction as per guidelines of MoC.
b)	Coal/ lignite requirement for end use plant with grade/quality	
c)	%age of end use requirement to be met from this mine	
d)	If washing / beneficiation of the coal/ lignite is planned to be conducted on site or adjacent to the extraction area, briefly describe the nature of the beneficiation and recovery rate.	N/A
e)	Proposed Use of Rejects/Middlings	N/A

I.	ENVIRONMENTAL MANAGEMENT	
a)	Existing land use pattern	Existing : Forest land - 149.50 ha Non-forest land - 287.60 ha Total land - 437.10 ha Additional : Forest land - 227.62 ha Non-forest land - 96.30 ha Total land - 323.92 ha
b)	Land area indicating the area likely to be degraded due to mining, dumping, roads, workshop, washery, township etc.	Excavation Area: 306.35ha External dump: 0.00 Infrastructure: 17.57 Total: 323.92
c)	Surface features over the block area	Railway siding close to the southern and south-eastern boundary of the mine Departmental roads passing close to the railway siding
d)	No. of villages/Houses to be shifted	2 villages, 316 families
e)	Additional Population to be affected by	1395

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f)	Year wise proposal for reclamation of land affected by mining activities	Land affected by mining activities would be reclaimed regularly and systematically.	
g)	Monitoring schedules for different environmental components after the commencement of mining and other related activities.	For air quality	Two days in a month at each station (once in a fortnight)
		For water and effluent quality	Once in a month for each station (for drinking water quality), once in a fortnight (for 4 parameters) and once in a year (23 parameters) (for effluent quality)
		For ground water level monitoring	4 times in a year in a year (i.e. April/May, August, November & January)
		For noise level	Once in a day-time and once in a night-time in fortnight from each station

J	**PROGRESSIVE AND FINAL MINE CLOSURE PLAN (A separate chapter is also to be incorporated)**	
a)	Estimated total capital expenditure for mine closure activities	
b)	Major closure Activities with proposed Capital expenditure	
	Preparation of survey and disposal reports	Approximately Rs.3646.44 lakhs (Cost base Aug,2016) will be required to be deposited in Escrow Account as per the guidelines for Mine Closure circulated by Ministry of Coal.
	Subsidence Area study	
	Disposal of P&M items	
	Subsided Area (Technical & biologically reclaimed)	
	Dismantling of Industrial Structure (Like substation / water treatment plant / / ETP / STP, etc.)	
	Levelling & gradient	
	Fencing of subsided area	
	Cleaning of coal stock and infrastructure area	
	Disposal / Dismantling of Residential colony	

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Plantation and landscaping on subsided/backfilled area	
Plantation over cleaned land of infrastructure	
Environmental monitoring	
Permanent lighting arrangement in and around mine periphery	
Total	

K	OTHERS	
a)	Base date of Mining Plan	September, 2016
b)	Calendar year from which the production will start	2017-18
c)	Results of any investigation carried out for scientific mining, conservation of minerals and protection of environment; future proposals.	Not Applicable
d)	Signature of RQP Date Place	

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Chapter - 1

INTRODUCTION

1.1 BACKGROUND OF THE PROJECT

The Basundhara West Extension OCP is located in north-western central part of Ib River coalfield of Odisha, known as Gopalpur sector, (**Plate G-1**). This coalfield is the southern middle part of lower Gondwana basin of Son Mahanadi Valley and occupies an area of about 1460 sq.km with potential coal bearing area of around 1050 sq.km. The Ib River coalfield lies in between latitude 21º31' to 22º14' North and longitude 83º32'00" to 84º10'00" East and falls mainly in Sundergarh, Jharsuguda and Sambalpur districts of Odisha.

The proposed Basundhara West Extension OCP has been formulated within Chaturdhara block in the Gopalpur Sector of Ib-valley coalfield. Basundhara river separates Chaturdhara block from Basundhara block. Basundhara river is the boundary of Siarmal-Basundhara block and Basundhara-Chaturdhara blocks. But due to river Basundhara on western side, approach to Chaturdhara block has become a major hurdle for its development. Initial overburden from proposed mine is to be carried to void of Basundhara West OCP. Barrier coal between Basundhara and Chaturdhara to be left due to non diversion of Basundhara river. Diversion of Basundhara river is not possible due to its perennial water supply to that area. The Project Report is based on Geological Reports of Chaturdhara block. The proposed mine area lies on the west of Basundhara West OCP (8.75 Mty) on the western side of Basundhara river. Basundhara West OCP is an ongoing project with remaining life of two years. To its west lies the private captive block Rampia, to its south Chaturdhara nala and Banapatra block, to its north incrop (floor line) of Rampur-I seam and to its east Basundhara river and Basundhara West OCP.

1.2 BRIEF DESCRIPTION OF IB VALLEY COALFIELD

Ib-valley coalfield (also known as Ib-river coalfield) is located in Jharsuguda, Sambalpur and Sundergarh districts of Odisha between latitudes 21^{O}31' to 22^{O}14'N and longitudes 83^{O}32' to 84^{O}10'E (ref. Plate No. Gen-I). The coalfield is named after the river Ib, a tributary of the river Mahanadi. The Howrah-Mumbai railway line passes through the coalfield. The nearest rail head is Brajrajnagar. The Chaturdhara block, lie towards north western part of Ib River coalfield in Odisha state and together covers an area of 3.57 sq.km.

The block is situated between the Latitude 22^{o}04'0"-22^{o}05'0"N and Longitude 83^{o} 40'39" – 83^{o}42'02" E in Survey of India topo-sheet no.-64N/12 on RF 1:50,000.

Mining in this coalfield in south-eastern part started with the support of available infrastructures around Brajrajnagar township in the first half of this century. The first UG mine to start was Hingir Rampur Colliery (1909) and subsequently Orient UG mine No.1 (1940).

Coal reserves of this coalfield are about 23.04 billion tonnes (as on 1.4.2012) of which about 14.39 billion tonnes lie within a depth range of 300m. Quality of coal varies from grade C to G (largely F), suitable for power generation.

The details of coal reserves of Ib-valley coalfield as per GSI (as on 1.4.2012) are given below:

Depth Range (m)	Reserves (Mt)			
	Proved	Indicated	Inferred	Total
0-300	8309.03	5532.59	543.84	14385.46
300-600	166.59	3891.78	4564.32	8622.69
600-1200	0.00	27.52	0.00	27.52
Total	**8475.62**	**9451.89**	**5108.16**	**23035.67**

The coal movement to western and southern India power houses is convenient from this coalfield by virtue of its locational advantage. Many private entrepreneurs are interested to build and operate power plants in this coalfield in the

neighbourhood of Hirakud water reservoir due to ease of availability of coal and water. Thus the coalfield has gained importance in recent times.

1.2.1 DIVISION OF COALFIELD INTO SECTORS

The coalfield is broadly divided into three sectors as under:

- North-western sector/Gopalpur tract.
- West-central sector/Hingir tract.
- South-eastern sector/Rampur tract.

NORTH-WESTERN SECTOR/GOPALPUR TRACT

This sector has favourable geomining characteristics. However, due to its remoteness from the existing mine field and absence of rail link, the development of large scale mining activities in this sector is linked to establishment of pit-head power stations in this region.

This sector has been divided into 17 nos. of geological blocks (ref. Plate Gen-II) which are under different stages of exploration. All of them are virgin except Basundhara & Kulda blocks. At Basundhara coal production had commenced in 96-97 in Basundhara (East) OC project which has exhausted in 06-07. Mining operations in Basundhara (W) OC project have started after the approval of the PR in October,2003. Mining operations in Kulda OC project have started in 07-08 after approval of the PR in January,2005.

WEST-CENTRAL SECTOR/HIMGIR TRACT

West-central unexplored region is covered by the exposures of Barren measures, Raniganj and Kamthi measures where coal seams are likely to be deep-seated, as indicated from regional drilling and needs to be proved by detailed exploration. As such, this sector does not offer any scope for mining activities in near future.

SOUTH-EASTERN SECTOR/RAMPUR TRACT

This sector of Ib-valley coalfield is under maximum exploitation.

It has eleven exploration blocks and all of them are explored in detail. These are Belpahar-I & II, Belpahar-III, Talabira-I, Talabira-II, Talabira-III, Kudupalli, Rampur, Rampur Extension, Orient Block-IV, Northern part of Orient and Lajkura.

Most of the blocks are under active mining operation except Talabira blocks i.e. Talabira-I, II and III which were earmarked for private mines. Talabira-I block has been allotted to M/s. HINDALCO and the mining operations are going on in this block. However, Government has already released Talabira-III block in favour of MCL, for which a PR of 6.50 Mty capacity had been formulated in March,2001. Later as decided by the Government, MCL, NLC and HINDALCO have formed a joint venture company which would mine Talabira-II & III blocks as a single mega project. PR for the same for a capacity of 20 Mty has been prepared and the same is under various stages of implementation.

1.2.2 STATUS OF NORTH-WESTERN SECTOR (GOPALPUR TRACT)

STATUS OF EXPLORATION

Extension of the coalfield towards north-west remained unexplored in past mainly due to lack of communication. GSI took up regional exploration of this area in 1981 followed by detailed exploration by CMPDIL from 1985 onwards.

CONSTRAINTS FOR DEVELOPMENT

Development of mines in this remote area was held up due to lack of infrastructural facility such as rail link, power supply and road network etc. Nearest railway line i.e. Mumbai-Howrah of East Coast Railways, is about 20 km away, as the crow flies.

Actions have been taken in the recent past by the coal company to create infrastructural support like road network and formulation of power supply schemes. M/s. RITES were entrusted to conduct survey for the railway line of the East Coast

Railways. M/s. RITES have completed the work and submitted the final report with three alternatives. IIIrd alternative i.e. from Jharsuguda to Sardega has been approved by MCL Board in December,2007 for Rs.465.09 crore and the same is under implementation.

STATUS OF MINING ACTIVITIES

Detailed exploration work was undertaken in this part of coalfield in the recent past and the latent potentiality of this area has been realised. This area contains very thick coal seams like Lajkura and Rampur at shallow depth with relatively flat gradient. Favourable stripping ratio makes the seams amenable for large opencast mines at short gestation period economically. Besides, Ib seam is also available in mineable proposition in parts.

With this background, a few project reports have been formulated, the details of which are given in table no. 1.1.

Table 1.1
Status of projects in Gopalpur tract

Sl. No.	Project	Capacity (Mty)	Approval status
1	Basundhara(E)	0.60	Exhausted project
2	Basundhara(W)	7.00	Ongoing project
3	Kulda	10.00	Ongoing project
4	Garjanbahal	10.00	Awaiting approval. AAP under implementation

1.2.3 STATUS OF SOUTH-EASTERN SECTOR (RAMPUR TRACT)

In this part of the coalfield, potential coal seams are Ib, Rampur and Lajkura which occur in ascending order. All the coal seams outcrop in this part with almost north-south strike with basal Ib seam in the eastern extremity followed by exposure of younger seams to the west in succession.

Due to nearness of Howrah-Mumbai railway line and availability of infrastructural facilities, this part of the coalfield has developed rapidly after nationalisation.

Details of existing mines, completed & ongoing projects in Ib valley coalfield are given below:

Existing Mines, Completed & Ongoing Projects

Sl. No.	Mine/Project	Annual capacity (Mt)	Seam worked
A.	**Existing Mines**		
1	Orient group U/G mines (Orient-1,2,3&4)	0.79	Ib/Rampur & Lajkura
2	Rampur group UG mines (Hingir Rampur colliery & Hirakhand Bundia Incline)	0.56	Rampur
B	**Completed Projects**		
3	Lajkura OC	1.00	Lajkura
4	Belpahar OC & Expansion	3.50 (2.00+1.50)	Ib/Rampur
5	Lilari OC	0.80	Lajkura
6	Samaleswari OC & its expansions	7.00(3.00+1.00+ 1.00+2.00)	Lajkura
7	Lakhanpur OC & Expn.(Ph-I)	5.00+5.00	Lajkura
8	Basundhara West OC	2.40	Ib & Rampur
C	**Ongoing Project**		
9	Basundhara West Expn. OC	4.60 (Incr.)	Ib & Rampur
10	Lakhanpur Expn. OC (Phase-II)	5.00(Incr.)	Lajkura
11	Kulda OCP	10.00	Ib, Rampur & Lajkura
12	Lajkura Expn.OCP	1.50 (Incr.)	Lajkura
13	Hirakhand Bundia UG (Aug.)	0.42 (Incr.)	Rampur
14	Talabira OCP	20.00 (JV project, MCL's share- 14 Mty)	Ib and Rampur

Expansion proposal of Belpahar mine for an incremental production of 1.50 Mty was sanctioned by the MCL Board in August,2004 and has since been completed in 06-07. Expansion proposal for Lakhanpur OC mine for incremental production of 5.00 Mty (Total 10 Mty) was approved by CIL Board in February,2004 and the same was declared completed in March 2010. PR for Lakhanpur OCP Exp. (Phase-II) has also been sanctioned for 15 Mty (5 Mty Incremental) in September,2008. PR for Samaleswari OCP Expansion, 4.00 Mty (1.00 Mty incremental) was sanctioned by MCL Board in November,2004. In addition to the above, another PR for Samaleswari OCP Expansion, 5.00 Mty (1.00 Mty incremental)

has also been sanctioned by MCL Board in June,2005 and has since been completed in 06-07. Further, PR for Samaleswari OCP Expn. (Phase-III), 7.00 Mty (2.00 Mty incremental) has also been sanctioned in April,2007 by MCL Board for and the same is also now a completed project. Still further, the PR of Samaleswari OCP Expn. (Phase-IV) (Normative capacity 12.00 Mty, 5.00 Mty incremental) (Peak Capacity 15.00 Mty), has been approved by MCL board in February,2011. The same is under implementation.

Mine-wise production achieved in 2015-16 in Ib-valley coalfield is given below:

Sl. No.	Name of the Project	2015-16 Coal (Mt)
1	Belpahar OC	09.00
2	Lajkura OC	01.89
3	Lakhanpur OC	18.75
4	Lilari OC	00.40
5	Samaleswari OC	14.59
6	Basundhara (W) OC	03.73
7	Kulda	08.02
	Sub-total OC	**56.38**
1	HRC U/G	0.00
2	HBI U/G	0.47
3	Orient Mine 1&2 U/G	0.26
4	Orient Mine 3 U/G	0.13
5	Orient Mine 4 U/G	0.04
	Sub-total U/G	**0.90**
	TOTAL OF IB-VALLEY	**57.28**

1.3 LOCATION OF END USE PLANTS

Coal produced from the mine will have basket linkage.

1.4 DEMAND AND SUPPLY SCENARIO OF MCL

Long-term demand projection of coal is quite complex issue owing to rapid changes in the relative availability & fresh coal linkages or cancellation of linkages under New Coal Distribution Policy (NCDP) - 2007. However, as the position stands now, the overall coal balance of MCL is given below:

Projected coal demand on MCL
(both Talcher and Ib-valley coalfield)

Sl. No	Particulars	2011-12	2016-17	2021-22
A.	**Existing Units**			
1	Total commitment under FSA & other wise (based on last three years average) for Power (Utility)	67.249	67.249	67.249
2	Total commitment under FSA & otherwise for Non-power (Utility)	28.555	28.555	28.555
Sub-Total(A)		**95.804**	**95.804**	**95.804**
B	**Future Units (LOA issued by MCL)**			
3	LOA Power (U)	92.97	130.085	156.085
4	LOA Power (captive)	16.148	16.148	19.448
5	LOA Cement	0.457	0.457	0.457
6	LOA Sponge	2.34	2.34	2.34
Sub-Total (B)		**111.195**	**149.03**	**178.33**
Total Demand on MCL (A+B)		**207.719**	**244.834**	**274.134**

The consumers of MCL are linked to the company and not to any specific coalfield. The actual supply from any coalfield of MCL will depend upon the production and transport logistics. Under the above circumstances coalfield wise demand has been assessed based on the production share of these two coalfield which is as below:

Projected coal demand on MCL from Ib-valley coalfield

(Fig. in Mt)

Sl.No	Particulars	2011-12	2016-17	2021-22
1	Total Demand on MCL	207.72	244.83	274.134
2	Projected coal demand on Ib-valley coalfield	70.62	97.93	120.56
3	Coal Availability	46.39	69.61	70.40
	Gap	**(-)24.23**	**(-)28.32**	**(-)50.16**

1.5 JUSTIFICATION

As per the latest estimate, the projected gap between demand and availability of MCL by the terminal year of XII Plan (2016-17) is estimated to be 28.32

Mt from Ib-valley coalfield alone. Further new coal linkages have been given to MCL for which MCL has already issued LOA. The proposed project will meet the coal demand from the coalfield, especially to the new consumers and reduce the gap between demand and availability.

The coal seams in the block under consideration for the project (Basundhara West Extension-Chaturdhara) are thick and occur at shallow depth. The entire coal reserve of 115.97 Mt has high quarriable potentiality.

Considering the coal demand on MCL and quarriable potential of the blocks, formulation of the present opencast mine for rated capacity of 8.75 Mty is justified.

The Project Report was prepared at cost base of October,2013

The proposed Basundhara West Extension OCP has no consumer specific linkage. A basket of new consumers may be linked to the project who have been issued LOA (Letter of Assurances) by MCL under NCDP-2007. Based on the information collected from MCL and transport logistics, the proposed new consumers for the OCP are described.

MINING PLAN & MINE CLOSURE PLAN

The present Mining Plan & Mine closure plan for Basundhara (W) Extension OCP has been prepared as desired by MCL, using the extant guidelines. The information/data incorporated in the present Mining Plan & Mine closure plan is based on the sanctioned Project Report (approved by MCL Board on 07.05.2014, at MCL Office, Sambalpur).

1.6 DIFFICULTIES AND CONSTRAINTS

Following constraints are envisaged and should be considered while implementation of the report:

a) Construction of bridge over Basundhara river for coal transportation to the existing infrastructure for dispatch of coal by road transport to existing railway siding, and overburden to the void in Basundhara West Expansion OCP.

b) Embankment along the Basundhara river not to be constructed because of high surface level more than 10m above HFL.

c) Non-availability of land for external dump. The initial dumping will be in the void generated in the Basundhara west quarry.

1.7 PROJECT OBJECTIVES AND TARGET BENEFICIARIES

Gopalpur sector of Ib-valley coalfield forms the north western part of Ib River coalfield which is a green field area with huge mining potential. Detailed exploration was undertaken by CMPDI to assess the quarriable potentiality of coal seams with primary view of opening up of new mining projects to the extent possible. This sector has high potential for opencast mining operations including the proposed project namely Basundhara West Extension Opencast Project.

Coal demand from Ib-valley coalfield has increased many times due to its strategic location with Howrah-Mumbai railway line passing through the coalfield. Coal of this coalfield is suitable for thermal power plants.

The southern, western & central India power stations have to depend on Ib valley coalfield for their growth. The Howrah-Mumbai line passes through the coalfield. So coal can move from this coalfield to western India power houses via rail route. Coal to Tamil Nadu Electricity Board is also supplied via rail-cum-sea route through Vishakhapatnam and Haldia ports. Necessary infrastructures for quick coal evacuation are being augmented in the region by the railways. Coal can easily move from this coalfield to Eastern India and Northern India as well. Necessary infrastructures like rail and port facilities are being developed/ augmented in the region.

The proximity of Ib-valley coalfield to Hirakud reservoir has generated a lot of opportunities for setting-up super thermal power stations in the vicinity of the coalfield.

To meet the increasing demand of power in the country, more and more super thermal power stations are being planned in western, northern and eastern India, majority of which are coal based and may be linked from Ib-valley coalfield. Power Houses of Punjab State Electricity Board, Haryana State Electricity Board have also been linked to MCL and will be supplied coal from this coalfield. The New Power houses of TNEB, KPCL, WBPDCL, CESC and DVC are also linked to the coalfield.

Chapter – 2

DETAILS OF EARLIER APPROVAL OF MINING PLAN & MINE CLOSURE PLAN

2.1 STATUS

This is the first Mining Plan & Mine Closure plan prepared for the project.

Chapter - 3

LOCATION, TOPOGRAPHY & COMMUNICATION

3.1 LOCATION

3.1.1 BROAD LOCATION OF PROJECT AREA IN RELATION TO GEOLOGICAL BLOCK AND COALFIELD WITH LATITUDES AND LONGITUDES

The proposed Basundhara West Extension OCP has been formulated within Chaturdhara block in the Gopalpur Sector of Ib-valley coalfield.

The Chaturdhara block is located in north-western central part of Ib River coalfield of Odisha, known as Gopalpur sector. This coalfield is the southern middle part of lower Gondwana basin of Sone-Mahanadi Valley and occupies an area of about 1460 sq. km. with potential coal bearing area of around 1050 sq.km. The Ib River coalfield lies in between latitude 21^{o}31' to 22^{o}14' North and longitude 83^{o}32'00" to 84^{o}10'00" East and falls mainly in Sundergarh, Jharsuguda and Sambalpur districts of Odisha.

The Chaturdhara block, lie towards north western part of Ib River coalfield in Odisha state and together covers an area of 3.57 sq.km. The blocks are situated between the Latitude 22^{o}04'40.47"- 22^{o}04'40.61"N and Longitude 83^{o}40'20.48" – 83^{o}42'22.58" E in Survey of India topo-sheet no.-64N/12 on RF 1:50,000.

3.1.2 AREA OF THE PROJECT

The project covers an area of 3.06 sq.km. Basundhara west Extension OCP will replace production of Basundhara OCP in future.

3.1.3 LIMITING BOUNDARIES OF THE PROJECTISED AREA

The boundary of Basundhara West Extension OCP is defined as below:

North - Incrop (floor line) of Rampur I seam.

East - Basundhara river and Basundhara West block.

South - Chaturdhara Nala and Banapatra block.

West - Rampia block.

The maximum extents of the block are about 3.3 km along strike direction and about 1.8 km along dip direction in the eastern part of the block.

3.2 TOPOGRAPHY WITH DRAINAGE PATTERN OF AREA

The block under reference is represented by forest land, river and paddy field. Major part of the block is however, covered by forest land.

Basundhara river, flowing north-south to the east of the eastern boundary of the block separates the blocks from Basundhara block. Chaturdhara nala flowing west to east in the southern boundary of the block separates the blocks from Siarmal /Banapatra blocks

The general topography of the block is undulating and is mostly forest land and some patches of barren lands are also featuring in the block. The general altitude of the block is varying from 270 metres to 334 metres. The lowest elevation is about 270 metres near borehole CMHG-088 along the Basundhara river within Chaturdhara block and highest elevation of 334 metre and is located near the north-western corner near boreholes CMHG-038.

3.3 ACCESSIBILITY AND COMMUNICATION

District headquarter Sundergarh, on State Highway-10 (Sambalpur to Rourkela), is at a distance of about 46 km. from the blocks. The block is also connected by black top road with two important towns of Orissa namely Rourkela at 145 km and Jharsuguda at 75 km. The blocks come under Himgir Tahsil and Balinga police station in the district of Sundergarh, Orissa. The Siarmal and dip extension blocks are around 6 km. south west of Basundhara West mines and are connected by part metallic road.

The village Tola Telendihi is considerably a small one, lying towards the southern part of the block. Thermal Power Station of OPGC is at a distance of 65 km.

south east from the blocks and is connected through fair weather/all weather roads from Siarmal village. The blocks are connected by road to the state capital Bhubaneswar through State Highway-10 and National Highway-42, with a total distance of around 450 km. The blocks are well connected with MCL HQ at Sambalpur situated at a distance of about 100 km.

Nearest railhead is Himgir on Mumbai-Howrah Broad Gauge of South Eastern Railway at a distance of about 35 km from the blocks. Jharsuguda railway station on Jharsuguda-Sambalpur-Bhubaneswar rail line of East Coast Railway is at a distance of about 75 km. The nearest port at Bay of Bengal is Paradip and situated at a distance of about 600 km. from the block. The Jharsuguda Airport, is the nearest airport from the block.

3.4 CLIMATE AND RAINFALL DATA

The area experiences a sub-tropical warm temperature. The mean annual precipitation is 1514.5mm of which 85% occurs during rainy season.

The mean temperature varies from 9.3^{o}C to 44.1^{o}C.

The wind speed varies from 1.1kmph to 8.3kmph. The average relative humidity varies from 15% (in April) to 90% (in July).

Chapter – 4

EXPLORATION, GEOLOGY, SEAM SEQUENCE, COAL QUALITY AND RESERVE

4.1 INTRODUCTION

4.1.1 BACKGROUND

Basundhara West Extension OCP, (8.75 Mty) is located in the north western part of Ib-valley coalfield, Odisha (ref. GEN-II). The geological information in this chapter has been compiled from "Geological Report on Chaturdhara Block, Ib-River Coalfield," Odisha, prepared by CMPDI in March 1991.

4.1.2 BLOCK BOUNDARY (Ref. Plate GEN-II)

The boundary of Chaturdhara OCP is defined as below:

North	-	Incrop (floor line) of Rampur I seam.
East	-	Basundhara river and Basundhara West block.
South	-	Chaturdhara Nala and Banapatra block.
West	-	Rampia block.

4.2 EXPLORATION STATUS

A total of 55 boreholes have been drilled within the area involving a total meterage of 4196.45m. (excluding 1 borehole No. HGR - 18 drilled by GSI involving 164.10m.) in an area of 3.57 sq.km. Coal bearing area is 3.57 sq.km out of which major part is covered by forest. The borehole density/sq.km is about 15.4.

4.2.1 SEQUENCE OF COAL SEAMS

Three coal seams viz. Ib, Rampur and Lajkura have been proved to occur in this block under report. Ib-seam is the bottom most seam occurring in the area. This seam is thin and impersistent and has no potentiality in this block except for eastern

part of the block. Rampur seam is the thickest seam and occur in 6 sections viz. RAMPUR I, RAMPUR II, RAMPUR III, RAMPUR IV B, RAMPUR IV and RAMPUR V. Parting between Ib seam and Rampur group of seams varies from 4.62m. to 12.85m. Lajkura is the uppermost seam occurring in this area and is restricted along southern boundary and largely falling within barrier zone of Chaturdhara Nala, where it is occurring in 3 sections viz. LAJKURA I, LAJKURA II B and LAJKURA II T1 (incrop). The parting between Lajkura and Rampur seam varies from 71.04m. to 75.73m. Representative graphic litholog of boreholes are given in plate no. VIII.

4.2.2 **PROXIMATE ANALYSIS OF COAL**

Band by band analysis has been carried out for all boreholes. Seam overall proximate analysis has also been carried out on 60% RH and 40^{o}C for BCS and I_{100} samples. In BCS samples, all dirt bands of carbonaceous shale (Ash+Moisture > 55%) and obvious dirt bands have been excluded. In I_{100} samples, dirt band (Ash + moisture > 55%) and obvious dirt bands having thickness more than 1m have been excluded. Since seam overall proximate analysis carried out on 60% RH and 40^{o}C generally does not tally with the correlated seam splits, the seam overall data in respect of moisture% and ash% have been computed afresh. Seam overall data have, thus, been calculated from band by band data. The calculated values obtained from band by band data on air dried basis have been converted to equilibrated basis (60% RH & 40^{o}C) by using M_{100} values for respective coal seams. Average M_{100} value for different coal seams are as follows:

Lajkura	–	Not assessed.
Rampur V	–	8.4
Rampur IV	–	7.6
Rampur IV B	–	9.5
Rampur III	–	6.6
Rampur II	–	6.6
Rampur I	–	16.6
IB	–	Not assessed.

M_{100} value of Rampur Bottom seam as per GR of Chaturdhara block is taken as such for present correlation of its splits seams namely Rampur III, Rampur II & Rampur I considered for PR purpose.

Summarized quality including UHV of seams is given in seam-wise description.

4.3 GEOLOGY AND STRUCTURE

4.3.1 IB VALLEY COALFIELD

Geological succession pertaining to Lower Gondwana formation of IB Valley Coalfield as proposed by G.S.I. during regional exploration is given in table-4.3.1.

Table-4.3.1

Geological Succession of IB Valley Coalfield

Age	Formation	Lithology	Thickness in metre
Recent & sub-recent		Alluvium, Laterite, gravels and conglomerate.	
Upper Permian	Kamthi (Upper)	Pebbly sandstone, ferrugenous sandstone and red shales.	Upto 100
----------	----------	Unconformity ----------	----------
Upper Permian	Kamthi (Middle) or Raniganj	Fine grained sandstone, silt-stone, coal seams (thin).	60 - 80
Upper Permian	Kamthi (Lower) or Barren Measures	Grey shales, carbonaceous shales, sandstone, clay and ironstone nodules.	300
Lower Permian	Barakar	Grey sandstone, carbonaceous shale, silt stone with thick coal seams and fire clay.	300-600
Lower Permian	Karharbari	Black carbonaceous sandstone, pebble bed, coal seams	90 - 125

Upper Carboni-ferous	Talcher	Diamictite, greenish sandstone, olive and chocolate shales, rhythmites.	60 - 150

---------- Unconformity ----------

Pre-cambrian	Metamorphics	Granite, Gneisses, Schists, etc.

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4.3.2 **GEOLOGY OF THE AREA EXPLORED**

Chaturdhara Block spreads over an area of 3.57 sq.km. is a part of north-western sector of Ib-valley coalfield. Topographic plan and geological plan showing incrop of coal seams are given in plate nos. II & III, respectively.

The coal seams occurring in Chaturdhara block are continuation of adjoining blocks i.e. Basundhara West block in the east and Rampia block in the west.

Talcher, Karharbari and Barakar Formations of Lower Gondwana group constitute lithological sequence of Chaturdhara block under report. The stratigraphic sequence established on the basis of surface mapping and sub-surface data is furnished in table-4.3.2 A.

Table-4.3.2 A

Stratigraphic Succession, Chaturdhara Block

Age	Formation	Lithology
Recent/ Sub-recent	-	Soil, alluvium.
Lower Permian	Barakar	Fine to coarse grained sand-stone, micaceous at places, carb shale, greyshale, fire clay, sandy shale, alternate shale and sand stone with thick coal seams.
	Karharbari	Carbonaceous medium grained sandstone with undecomposed feldspar pieces, coarse grained to pebbly and gritty sandstone with impersistent coal seam.
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Upper Carbo-niferous	Talchir	Fine to medium grained greenish sandstone & green shale.
---------- Unconformity ----------		
Pre-cambrian		Granite, mica schists and gneisses.

Precambrians are exposed in north of the area and have been encountered in 5 boreholes. Talchirs are exposed as a very thin strip in north eastern part of the block. It has been intersected in 17 boreholes. Conclusive exposures of Karharbari formation have not been traced in the area. However, the formation has been encountered in 7 boreholes. Barakars are well exposed over considerable part of the block comprising both Rampur and Lajkura group of seams.

Thickness of different formations encountered in the boreholes are given in table 4.3.2 B.

Table - 4.3.2 B
Thickness range of different formations as encountered in the boreholes drilled in Chaturdhara Block

Formation	Thickness (m)	
	Min	Max
Recent/Sub-recent	0.80 (CMHG-021)	6.25 (CMHG-200)
Barakar	8.00 (CMHG-025)	134.80 (CMHG-069)
Karharbari	3.84 (CMHG-088)	27.06 (CMHG-066)
Talchir	1.05 (CMHG-018)	17.20 (CMHG-001)
Precambrian	3.00 (CMHG-023)	12.25 (CMHG-188)

4.3.3 **GEOLOGICAL STRUCTURE**

The behaviour of strata is smooth with minor undulations. The strike is roughly E-W which gradually turns to ESE-WNW in the western part of the block. The dip is southerly and varies from 6° to 8°. Extreme values of 4° and 11° have, however, been recorded on the surface along southern bank of Chaturdhara nala in the eastern and western part of the area respectively. Floor contours plans have been drawn for Rampur group of seams in Plate no. IV 1 to IV 6.

No positive evidence of any fault anywhere within the block has been observed either during mapping or in the boreholes. However possibility of occurrence of minor faults/slips of less than 5 metres throw, cannot be ruled out.

Three numbers of geological cross-sections along A-A', B-B' and C-C' are given in Plate no. VII.

4.4 DESCRIPTION OF COAL SEAMS

4.4.1 GENERAL

For the sake of convenience, every split of coal horizons (Rampur and Lajkura seams) has been named and described as an individual coal seam. The representative isochore/isograd and isoparting plans have been given in Plate nos. V 1 to V 6 and VI 1 to VI 6 respectively.

Quality and thickness details of coal seams and their range, assessed on the basis of borehole analysis, are given in the seam-wise tables.

4.4.2 IB SEAM

No. of boreholes intersected	:	7 (In 43 boreholes seam is not developed and 5 boreholes not drilled upto the seam)
Thickness range in metres	:	0.25 (CMHG-086) to 2.36 (CMHG-088)
Depth range (Roof) in metres	:	53.18 (CMHG-088) to 137.98 (CMHG-066)

Ib seam is the bottom most coal seam in Chaturdhara block occurring within Karharbari formation. The thickness of the seam varies from 0.25m (CMHG-086) to 2.36M (CMHG-088). The depth of occurrence of seam from surface varies from 53.18 m to 137.98 m. Ib seam has attained workable thickness only in two boreholes CMHG-013 (1.55m) and CMHG-088 (2.36m) located in eastern part of the block. The coal seam is less than one metre thick in remaining 5 boreholes (CMHG-066, 086,

164, 170 & 196), all of which are located in the extreme southern part of the block. The seam is not developed in rest of the area. However, in adjoining Basundhara West block, this coal seam occurs in two sections.

In the absence of analytical data quality parameters of this seam are not given. Due to its inconsistent development, the seam has hardly any economic importance.

4.4.3 RAMPUR I SEAM

No. of boreholes intersected	:	49 (6 boreholes are falling within incrop region)
Thickness range in metres	:	1.11 (CMHG-037) to 9.61 (CMHG-090)
Depth range (Roof) in metres	:	7.90 (CMHG-263) to 128.48 (CMHG-066)

STRATIGRAPHIC POSITION

RAMPUR I seam occurring within Barakar formation overlies Ib seam with a parting varying from 4.62m. (CMHG-088) to 12.85m. (CMHG-170). Seam thickness varies from 1.11m. (CMHG-037) to 9.61m. (CMHG-090) and is generally more than 1 metre.

INCROP

Incrop of the seam has been encountered in 6 boreholes with depth ranging from 1.50m. (CMHG-258) to 20.66m. (CMHG-031) in northern part of the block.

THICKNESS

Thickness of the seam varies from 1.11m. (CMHG-037) to 9.61m. (CMHG-090). The prevalent thickness of RAMPUR I seam is 4m. to 6m.

ROOF & FLOOR

Immediate roof of seam comprises mostly of shale and sandy shale and floor is composed of shale and alternate shale and sandstone.

DIRT BANDS

Summarized statement of dirt bands is given in table-4.4.3 A.

Table-4.4.3 A

Dirt Bands of Rampur I seam

Coal seam thickness range in mtr.	Dirt bands of less than 1m Th.			Dirt bands of more than 1m Th.			Total dirt bands		
	No.	Th. (m)	%	No.	Th.(m)	%	No.	Th.(m)	%
1.11-9.61	0-13	0.00-2.08	0.0-27.4	1-2	1.20-2.02	20.2-21.02	0-13	0.00-2.08	0.0-27.4

QUALITY

Details of quality are given in table - 4.4.3 B.

Table-4.4.3 B

Quality of Rampur I seam

Thickness range (metre)	Moisture%	Ash%	UHV K.Cal/kg.	Grade	Borehole considered
A. **Full thickness zone**					
2.26 (CMHG-085) - 9.61 (CMHG-090)	4.6 - 7.1 (CMHG-033) - (CMHG-021)	25.4 - 48.5 (CMHG-021) - (CMHG-033)	1572 - 4415 (CMHG-033)- (CMHG-021)	D-G	30
General Range	5.5 – 6.5	30.0 – 40.0	2400 - 4000	E - F	

4.4.4 RAMPUR II SEAM

No. of boreholes intersected	:	47 (3 boreholes are falling within incrop region and 5 boreholes are falling beyond incrop)
Thickness range (in metres)	:	0.58 (CMHG-199) to 5.77 (CMHG-002)
Depth range (Roof) in metres	:	5.10 (CMHG-259) to 124.53 (CMHG-066)

STRATIGRAPHIC POSITION

RAMPUR II seam occurring within Barakar formation overlies RAMPUR I seam with a parting varying from 0.10m. (CMHG-013) to 2.99m. (CMHG-069). Thickness of the seam varies from 0.58m. (CMHG-199) to 5.77m. (CMHG-002) and is generally more than 1 metre thickness in entire area.

INCROP

Incrop of the seam has been encountered only in 3 boreholes with depth ranging from 4.93m. (CMHG-263) to 18.49m. (CMHG-262) in northern part of block.

THICKNESS

Thickness of the seam varies from 0.58m. (CMHG-199) to 5.77m. (CMHG-002). The prevalent thickness of RAMPUR II seam is 2m. to 4m.

ROOF & FLOOR

Immediate roof as well as floor of the seam comprises mostly of grey shale and sandy shale.

DIRT BANDS

Summarized statement of dirt bands is given in table-4.4.4 A.

Table-4.4.4 **A**

Dirt Bands of Rampur II seam

Coal seam thickness range in metr.	Dirt bands of less than 1m Th. No.	Th. (m)	%	Dirt bands of more than 1m Th. No.	Th.(m)	%	Total dirt bands No.	Th.(m)	%
1.48-5.77	0-1	0.00-0.66	0.0-18.0	Nil	Nil	Nil	0-1	0.00-0.66	0.0-18.0

QUALITY

The details of quality are given in following table - 4.4.4 B

Table-4.4.4 B
Quality of Rampur II seam

Thickness range in metre	Moisture%	Ash%	UHV K.Cal/kg.	Grade	Borehole considered
A. **Full thickness zone**					
1.48 (CMHG-072) - 5.77 (CMHG-002)	4.2 - 7.5 (CMHG-072) - (CMHG-088)	21.4 - 51.7 (CMHG-088) - (CMHG-072)	1186 - 4995 (CMHG-072)- (CMHG-196)	UG-C	25
General Range	6 – 7	25 - 35	2900 - 4800	D - F	

4.4.5 **RAMPUR III SEAM**

No. of boreholes intersected : 46 (1 borehole is falling within incrop region and 8 boreholes are falling beyond incrop)

Thickness range (in metres) : 2.42 (CMHG-020) to 8.57 (CMHG-015)

Depth range (Roof) in metres : 5.0 (CMHG-015) to 116.94 (CMHG-066)

STRATIGRAPHIC POSITION

RAMPUR III seam occurring within Barakar formation overlies RAMPUR II seam with a parting varying from 0.10m. (CMHG-188) to 3.0m. (CMHG-088). Thickness of the seam varies from 2.42m. (CMHG-020) to 8.57m. (CMHG-015) and is more than 1 metre.

INCROP

The incrop of seam has been encountered only in 1 boreholes with depth of 2.30m. (CMHG-259) in northern part of the block.

THICKNESS

The thickness of seam varies from 2.42m. (CMHG-020) to 8.57m. (CMHG-015). The prevalent thickness of RAMPUR III seam is 4m. to 6m.

ROOF & FLOOR

Immediate roof of seam comprises mostly of shale, sandy shale and rarely by carbonaceous shale and the floor is composed of grey shale and sandy shale.

DIRT BANDS

Summarized statement of dirt bands is given in table-4.4.5 A

Table-4.4.5 A
Dirt Bands of Rampur III seam

Coal seam thickness range in mtr.	Dirt bands of less than 1m Th.			Dirt bands of more than 1m Th.			Total dirt bands		
	No.	Th. (m)	%	No.	Th.(m)	%	No.	Th.(m)	%
2.42-8.57	0-3	0.00-1.10	0.0-22.0	Nil	Nil	Nil	0-3	0.00-1.10	0.0-22.0

QUALITY

The details of quality are given in following table - 4.4.5 B

Table-4.4.5 B
Quality of Rampur III seam

Thickness range in metre	Moisture%	Ash%	UHV K.Cal/kg.	Grade	Borehole considered
A. **Full thickness zone**					
2.42 (CMHG-020) - 8.57 (CMHG-015)	4.3 - 5.4 (CMHG-035) - (CMHG-013)	31.4 - 43.1 (CMHG-072) - (CMHG-035)	2359 - 3822 (CMHG-035)- (CMHG-072)	G-E	32
General Range	4.5 – 5.5	35.0 – 45.0	2600 - 3500	E - F	

4.4.6 RAMPUR IV B SEAM

No. of boreholes intersected	:	44 (2 boreholes are falling within incrop region and 9 boreholes are falling beyond incrop)
Thickness range (in metres)	:	0.33 (CMHG-196) to 3.58 (CMHG-088)
Depth range (Roof) in metres	:	9.65 (CMHG-264) to 112.56 (CMHG-066)

STRATIGRAPHIC POSITION

RAMPUR IV B seam occurring within Barakar formation overlies RAMPUR III seam with a parting varying from 1.82m. (CMHG-033) to 7.14m. (CMHG-197). Thickness of the seam varies from 0.33m. (CMHG-196) to 3.58m. (CMHG-088) and is generally more than 1 metre in thickness in entire area.

INCROP

The incrop of the seam has been encountered only in 2 boreholes with depth ranging from 2.00m. (CMHG-016) to 6.25m. (CMHG-200) in northern part of the block.

THICKNESS

Thickness of seam varies from 0.33m. (CMHG-196) to 3.58m. (CMHG-088). The prevalent thickness of RAMPUR IV B seam is 1m. to 2m.

ROOF & FLOOR

Immediate roof of seam comprises mostly of shale and carbonaceous shale and the floor is composed of shale and sandy shale.

DIRT BANDS

Summarised statement of dirt bands is given in table-4.4.6 A.

Table-4.4.6 A

Dirt Bands of Rampur IV B seam

Coal seam thickness range in mtr.	Dirt bands of less than 1m Th. No.	Th. (m)	%	Dirt bands of more than 1mTh. No.	Th.(m)	%	Total dirt bands No.	Th.(m)	%
1.15-3.58	0-2	0.00-1.42	0.0-70.0	1	1.30	36.0	0-2	0.00-1.42	0.0-70.0

QUALITY

The details of quality are given in the following table - 4.4.6 B.

Table-4.4.6 B

Quality of Rampur IV B seam

Thickness range in metre	Moisture%	Ash%	UHV K.Cal/kg.	Grade	Borehole considered
A. **Full thickness zone**					
1.20 (CMHG-069) - 2.36 (CMHG-090)	3.7 - 4.6 (CMHG-033) - (CMHG-001)	43.1 - 52.0 (CMHG-001) - (CMHG-033)	1213 - 2538 (CMHG-033)- (CMHG-090)	UG-F	19
General Range	4.0 – 5.0	40.0 – 50.0	1400 - 2000	G	

4.4.7 **RAMPUR IV SEAM**

No. of boreholes intersected : 34 (10 boreholes are falling within incrop region and 11 boreholes are falling beyond incrop)

Thickness range (in metres) : 3.44 (CMHG-193) to 15.95 (CMHG-203)

Depth range (Roof) in metres : 8.25 (CMHG-032) to 95.35 (CMHG-066)

STRATIGRAPHIC POSITION

RAMPUR IV seam occurring within Barakar formation overlies RAMPUR IV B seam with a parting varying from 0.58m. (CMHG-001) to 8.12m. (CMHG-260). Thickness of the seam varies from 3.44m. (CMHG-193) to 15.95m. (CMHG-203) and is more than 1 metre thickness in entire area.

INCROP

The incrop of the seam has been encountered in 10 boreholes with depth ranging from 3.35m. (CMHG-264) to 12.07m. (CMHG-260) in the northern part of the block.

THICKNESS

The thickness of the seam varies from 3.44m. (CMHG-193) to 15.95m. (CMHG-203). The prevalent thickness of RAMPUR IV seam is 11m. to 15m.

ROOF & FLOOR

Immediate roof of seam comprises mostly of sandy shale and floor is composed of grey shale and carbonaceous shale.

DIRT BANDS

Summarized statement of dirt bands is given in table-4.4.7 A

Table-4.4.7 A
Dirt Bands of Rampur IV seam

Coal seam thickness range in mtr.	Dirt bands of less than 1m Th.			Dirt bands of more than 1m Th.			Total dirt bands		
	No.	Th. (m)	%	No.	Th.(m)	%	No.	Th.(m)	%
3.44-15.95	0-14	0.00-5.40	0.0-37.0	1-3	1.03-5.76	8.0-42.0	0-14	0.00-5.76	0.0-42.0

QUALITY

The details of quality are given in the following table - 4.4.7 B:

Table-4.4.7 B
Quality of Rampur IV seam

Thickness range in metre	Moisture%	Ash%	UHV K.Cal/kg.	Grade	Boreholes considered
A. **Full thickness zone**					
9.33 (CMHG-037) - 15.66 (CMHG-069)	4.1 - 5.5 (CMHG-194) - (CMHG-001)	39.2 - 52.2 (CMHG-001) - (CMHG194)	1131 - 2731 (CMHG-194)- (CMHG-001)	UG-F	28
General Range	4.0 – 5.0	40.0 – 50.0	1400 - 2200	G	

4.4.8 RAMPUR V SEAM

No. of boreholes intersected : 33 (1 borehole is falling within incrop region and 21 boreholes are falling beyond incrop)

Thickness range (in metres) : 0.58 (CMHG-083) to 6.70 (CMHG-170)

Depth range (Roof) in metres : 5.80 (CMHG-032) to 90.96 (CMHG-066)

STRATIGRAPHIC POSITION

RAMPUR V seam occurring within Barakar formation overlies RAMPUR IV seam with a parting varying from 0.43m. (CMHG-033) to 7.60m. (CMHG-034). Thickness of seam varies from 0.58m. (CMHG-083) to 6.70m. (CMHG-170) and is generally more than 1 metre thickness in entire area.

INCROP

The incrop of seam has been encountered only in 1 borehole with depth from 5.59m. (CMHG-088) in northern part of the block.

THICKNESS

Thickness of seam varies from 0.58m. (CMHG-083) to 6.70m. (CMHG-170). General thickness of RAMPUR V seam is 2m. to 3m.

ROOF & FLOOR

Immediate roof of seam comprises mostly of shale and rarely sandy shale and carbonaceous shale and the floor is composed of shale, sandy shale and occasionally carbonaceous shale and alternate shale and sandstone.

DIRT BANDS

Summarized statement of dirt bands is given in table-4.4.8 A

Table-4.4.8 A
Dirt Bands of Rampur V seam

Coal seam thickness range in mtr.	Dirt bands of less than 1m Th.			Dirt bands of more than 1m Th.			Total dirt bands		
	No.	Th. (m)	%	No.	Th.(m)	%	No.	Th.(m)	%
1.01-6.70	0-3	0.00-1.26	0.0-28.0	2	2.43-2.58	38.5-41.0	0-3	0.00-2.58	0.0-41.0

QUALITY

The details of quality are given in the following table - 4.4.8 B:

Table-4.4.8 B
Quality of Rampur V seam

Thickness range in metre	Moisture%	Ash%	UHV K.Cal/kg.	Grade	Boreholes considered
A. **Full thickness zone**					
1.01 (CMHG-069) - 6.70 (CMHG-170)	3.8 - 5.9 (CMHG-033) - (CMHG-090)	27.4 - 49.5 (CMHG-090) - (CMHG-033)	965 - 4305 (CMHG-037)- (CMHG-090)	UG-D	21
General Range	4.5 – 5.5	30.0 – 40.0	2000 - 4000	G - E	

4.4.10 **LAJKURA SEAM**

This is the upper most seam in present area under assessment and is underlain by Rampur V seam. No detailed study has been done because of its occurrence is restricted only along southern boundary of the area largely falling within 60m barrier zone of the Chaturdhara nala. Only incrop of the seam was intersected in 4 boreholes (CMHG-066, 086, 196 & HGR-018). Only incrop of seam occurs within the area.

Depth of occurrence of seam from surface varies from 4.40m to 6.35 m whereas floor depth ranges from 6.40 m to 15.46 m. Thickness (part) of seam intersected is varying from 2.00m. to 10.56m.

The roof of seam comprises soil and carbonaceous shale, whereas floor is characterized by sandstone, shale and sandy shale.

Since only incrop of seam is available within the area, quality of part thickness of seam falling within incrop zone has been assessed which comes to grade F. Detailed studies about quality and other parameters of the seam have not been assessed.

4.5 **COAL RESERVES**

4.5.1 **COAL BEARING AREA OF THE BLOCK**

Coal bearing area covers 3.57 Sq. kms. Eight coal seams, viz Ib, RAMPUR I, RAMPUR II, RAMPUR III, RAMPUR IV B, RAMPUR IV, RAMPUR V and Lajkura seams occur within Chaturdhara OCP area. Of these, last seven coal seams have attained workable thickness (more than 1m) either in the entire block or in a substantial part of it. The bottom most Ib seam is unworkable almost in the whole block except a very small patch in southeastern part around borehole CMHG-013 and CMHG-088. Reserves of this seam has, therefore, not been estimated. Grade-wise and barrier-wise reserves of all other seams have been estimated.

4.5.2 THICKNESS / QUALITY CONSIDERATION

For the purpose of calculation of reserves, I_{100} thickness (iso chore line drawn on I_{100} basis) has been taken into consideration. The bands having thickness 1 m or less have been included within seam thickness, irrespective of nature i.e. combustible or non-combustible, persistent or impersistent. Iso-grad lines have also been drawn from useful heat value on I_{100} basis. Thickness of in-seam dirt bands both combustible and non-combustible of more than one metre have been included in thickness of overburden.

4.5.3 COAL RESERVE

Reserve has been estimated for coal seams separately for incrop zone, full thickness zone and barrier zone. In all **115.971** million tonnes (M.T.) of reserve of coal has been estimated within the area out of which **14.911** M.T. is locked up within the 60 m. barrier zone of Chaturdhara nala / Basundhara river and **101.060** M.T. lies beyond the barrier zone.

Table – 4.5.3 A
Seam-wise, Grade-wise Total Net Proved Reserves
(Including reserves in Incrop and barrier zones)

SEAM	Grade					Net Proved Reserves (mt.)	SEAM-WISE PERCENTAGE
	C	D	E	F	G		
LAJKURA	-	-	-	2.368	-	**2.368**	**2.04%**
RAMPUR V	-	0.010	2.016	3.133	1.021	**6.180**	**5.33%**
RAMPUR IV	-	-	-	1.632	40.119	**41.751**	**36.00%**
RAMPUR IV B	-	-	-	0.337	4.479	**4.816**	**4.15%**
RAMPUR III	-	-	4.492	16.741	0.155	**21.388**	**18.44%**
RAMPUR II	0.100	2.515	7.341	2.557	1.264	**13.777**	**11.88%**
RAMPUR I	-	0.902	12.073	10.902	1.814	**25.691**	**22.15%**
ALL SEAMS	**0.100**	**3.427**	**25.922**	**37.670**	**48.852**	**115.971**	**100%**
GRADE-WISE PERCENTAGE	**0.09%**	**2.96%**	**22.35%**	**32.48%**	**42.12%**	**100%**	

Table – 4.5.3 B

Seam-wise, Grade-wise Net Proved Reserves (Beyond Barrier)

SEAM	Grade					Net Proved Reserves (mt.)	SEAM-WISE PERCENTAGE
	C	D	E	F	G		
LAJKURA	-	-	-	0.931	-	**0.931**	**0.92%**
RAMPUR V	-	0.010	1.692	2.687	0.719	**5.108**	**5.05%**
RAMPUR IV	-	-	-	1.632	35.800	**37.432**	**37.04%**
RAMPUR IV B	-	-	-	0.216	3.843	**4.059**	**4.02%**
RAMPUR III	-	-	3.528	15.208	0.155	**18.891**	**18.69%**
RAMPUR II	0.100	1.943	6.371	2.300	1.264	**11.978**	**11.85%**
RAMPUR I	-	0.607	10.605	9.825	1.624	**22.661**	**22.42%**
ALL SEAMS	**0.100**	**2.560**	**22.196**	**32.799**	**43.405**	**101.060**	**100%**
GRADE-WISE PERCENTAGE	**0.10%**	**2.53%**	**21.96%**	**32.45%**	**42.95%**	**100%**	

Table – 4.5.3 C

Seam-wise, Grade-wise Net Proved Reserves (Within Barrier)

SEAM	Grade				Net Proved Reserves (mt.)	SEAM-WISE PERCENTAGE
	D	E	F	G		
LAJKURA	-	-	1.437	-	**1.437**	**9.64%**
RAMPUR V	-	0.324	0.446	0.302	**1.072**	**7.19%**
RAMPUR IV	-	-	-	4.319	**4.319**	**28.97%**
RAMPUR IV B	-	-	0.121	0.636	**0.757**	**5.08%**
RAMPUR III	-	0.964	1.533	-	**2.497**	**16.75%**
RAMPUR II	0.572	0.970	0.257	-	**1.799**	**12.06%**
RAMPUR I	0.295	1.468	1.077	0.190	**3.030**	**20.32%**
ALL SEAMS	**0.867**	**3.726**	**4.871**	**5.447**	**14.911**	**100%**
GRADE-WISE PERCENTAGE	**5.81%**	**24.99%**	**32.67%**	**36.53%**	**100%**	

Table – 4.5.3 D

Seam-wise, Grade-wise Net Proved Reserves (Within Incrop)

SEAM	Grade				Net Proved Reserves (mt.)	SEAM-WISE PERCENTAGE
	D	E	F	G		
LAJKURA	-	-	2.368	-	**2.368**	**53.64%**
RAMPUR V	-	-	0.003	-	**0.003**	**0.07%**
RAMPUR IV	-	-	-	1.786	**1.786**	**40.45%**
RAMPUR IV B	-	-	-	0.009	**0.009**	**0.20%**
RAMPUR III	-	0.029	0.114	-	**0.143**	**3.24%**
RAMPUR II	0.003	0.012	0.001	-	**0.016**	**0.36%**
RAMPUR I	0.030	0.060	-	-	**0.090**	**2.04%**
ALL SEAMS	**0.033**	**0.101**	**2.486**	**1.795**	**4.415**	**100%**
GRADE-WISE PERCENTAGE	**0.75%**	**2.29%**	**56.31%**	**40.66%**	**100%**	

4.5.4 **OVERBURDEN**

All non-combustible and combustible material (Ash + Moisture content exceeding 55%) of 1 metre and above in thickness and occurring above floor of bottommost quarriable seam (Rampur I) has been considered as overburden irrespective of its occurrence of both within and outside the seam.

Overburden has been divided into 3 categories for the sake of estimation of its volume.

i) Strata overlying topmost coal seam,

ii) Parting between two adjacent coal seams; and

iii) Dirt bands of 1 metre and above in thickness occurring within coal seam (in-seam overburden).

Overburden falling in category (i) and (ii) above are composed largely of sandstone and grey shale with little carbonaceous shale whereas in-seam overburden (category-iii) consists largely of carbonaceous shale and grey shale.

A total of **167.599** mil.cu.m. of overburden has been estimated for the entire block out of which **19.728** mil.cu.m. lies in the barrier zone and **147.871** m.cu.m. beyond the barrier zone.

Table – 4.5.4 A

Seam-wise Details of Overburden

WASTE ABOVE SEAM	VOLUME OF OB, PARTING & IN SEAM BAND ≥ 1m (MCM)	VOLUME OF COAL SEAM < 1M (MCM)	VOLUME OF UNGRADED COAL (MCM)	TOTAL VOLUME OF WASTE (MCM)
LAJKURA	1.781			1.781
RAMPUR V	113.203	0.435	0.027	113.665
RAMPUR IV	18.305	0.028	0.708	19.041
RAMPUR IV B	10.938	0.624	0.022	11.584
RAMPUR III	12.382	0.062	0.000	12.444
RAMPUR II	5.071	0.106	0.164	5.341
RAMPUR I	3.675	0.068	0.000	3.743
GRAND TOTAL	**165.355**	**1.323**	**0.921**	**167.599**

4.5.5 **STRIPPING RATIO**

Volume of overburden (in million cubic metre) required to be removed for 1 million tonne of coal has been referred to as Coal:OB stripping ratio. Since figures of overburden are available for all types of reserves, stripping ratio has been calculated directly by dividing volume of overburden by reserve of coal available in the area. Seam-wise Coal:OB stripping ratio is given in Table 4.5.5 A.

Table – 4.5.5 A

Statement showing details of seam-wise net-proved reserves, overburden and stripping ratio

SEAM	NET PROVED RESERVES (MT) (Table 4.5.3 A)	TOTAL VOLUME OF WASTE (MCM) (Table 4.5.4 A)	SEAM-WISE STRIPPING RATIO (CU.M./T)	SUCCESSIVE CUMULATIVE RESERVES (MT)	VOLUME OF SUCCESSIVE CUMULATIVE WASTE (M.CU.M.)	SUCCESSIVE CUMULATIVE STRIPPING RATIO (CU.M./T)
LAJKURA	2.368	1.781	0.8	2.368	1.781	0.8
RAMPUR V	6.180	113.665	18.4	8.548	115.446	13.5
RAMPUR IV	41.751	19.041	0.5	50.299	134.487	2.7
RAMPUR IV B	4.816	11.584	2.4	55.115	146.071	2.7
RAMPUR III	21.388	12.444	0.6	76.503	158.515	2.1
RAMPUR II	13.777	5.341	0.4	90.28	163.856	1.8
RAMPUR I	25.691	3.743	0.1	115.971	167.599	1.4
TOTAL	**115.971**	**167.599**				

Chapter - 5

MINE BOUNDARY, RESERVE AND MINE LIFE

5.1 INTRODUCTION

Basundhara OCP mine has been under operation since 2003-04 and 58.99 Mt of coal has already been extracted upto 31.3.16 with corresponding overburden removal of 29.30 Mcum. The project report Basundhara opencast, 2.40 Mty capacity of Ib-valley coalfield was sanctioned by Govt. of India. The mine started coal production from 2004-05. Subsequently, another report, viz. PR of Basundhara West Expn. OCP (7.00 Mty) was prepared in January,2009. In the PR, it was proposed to extend the mining limit of the mine and also its capacity. The mine had life of 5 years as on 01.04.2009.This expansion PR was approved in March 2009.

MCL has proposed an extension of the same quarry to meet the increased demand of coal from the coalfield. Accordingly, it has been proposed to open and run a new mine over the virgin Chaturdhara block with an area of 3.06 sq.km., annexed to the mine to the west of Basundhara river (flowing on the west of Basundhara Expansion OCP).

The project report of Basundhara West Extn. OCP has been prepared for an area of 3.06 sq.km. as proposed by MCL. This area lies over Chaturdhara block, west of Basundhara river, flowing on the west of Basundhara West Expn. OCP.

5.2 PIT FORMULATION STRATEGY

Three coal seams viz. Ib, Rampur and Lajkura have been proved to occur in this block. Ib seam is the bottom most seam occurring in the area and is thin and impersistent, encountered with workable thickness in two boreholes only. Rampur is the thickest seam and occurs in six sections viz. RAMPUR-I, RAMPUR-II, RAMPUR-III, RAMPUR-IVB, RAMPUR-IV and RAMPUR-V. Lajkura is the upper most seam occurring in this area and is restricted along southern boundary and largely falling within barrier zone of Chaturdhara nala. There also only incrop of the seam was

intersected in 4 boreholes. Therefore, Lajkura and Ib seams, occurring insignificantly, are not considered quarriable.

Considering the long strike and a flat gradient of the block, shovel dumper system is proposed to develop OB benches by horizontal slicing while coal seams and partings will be worked by inclined slicing. Coal seams are to be mined by surface miner while parting will be extracted by shovel dumper.

It is proposed to drive an access trench to north west of borehole CMHG-024 to touch the floor of Rampur I seam in the incrop zone of the quarry (ref. Plate MIN-II).

5.2.1 **PRESENT STATUS OF MINING**

Basundhara West Expansion OCP is the running project, working partly over the patch of 36ha - the extension of Quarry-1 and partly over the dip side of Quarry-2. This project was opened in 2003-04 and coal production was started in 2004-05. The cumulative production upto 2015-16 is 58.99 Mt and corresponding OB removed is 29.30 Mcum. It will be exhausted by March,2017. To continue the production at its capacity of 8.75 Mty, extension quarry is to produce 1.5 Mt in Yr-1.

5.3 **MINE BOUNDARIES**

Considering the river on its east and nala on the south, mine boundaries have been fixed and are described below (ref. Plate MIN-I).

North	:	Incrop of Rampur-I seam.
East	:	Surface boundary is arrived after leaving 60m surface barrier against Basundhara river and straightening/ smoothening in the south east corner.
South	:	Surface boundary is fixed after leaving surface barrier of 60m against Chaturdhara nala.
West	:	Surface boundary is arrived after leaving 7.5m gap from the western block boundary of Chaturdhara block.

5.3.1 MINEABLE RESERVE

It is estimated that 92.73Mt of mineable coal would be available for extraction within the boundaries explained in para 5.3 against the total net geological reserve of 113.61Mt (excluding the reserve in Lajkura seam of 2.37Mt).

The total overburden to be removed is estimated as 97.22Mcum. Thus overall stripping ratio works out to 1.05cum/t.

While assessing coal reserve, specific gravity of 1.70 is adopted. A deduction of 10% of account of mining losses has also been made from net geological reserves to arrive at net mineable reserve. Table 5.1 gives seamwise, gradewise details of mineable coal. The details of overburden and partings between various seams are given in table-5.2.

Table – 5.1
Seamwise, gradewise mineable reserve

Seam	Grade				
	D	E	F	G	Total
Rampur-V	-	1.50	2.01	0.53	4.04
Rampur-IV	-	-	1.36	39.68	41.04
Rampur-IVB	-	-	0.39	3.27	3.66
Rampur-III	-	3.21	12.65	0.05	15.91
Rampur-II	1.24	5.39	1.87	1.13	9.63
Rampur-I	0.40	9.42	7.22	1.41	18.45
Total	1.64	19.52	25.50	46.07	92.73

An average coal grade G12 has been considered for the coal seams in the project.

Table – 5.2
Details of Overburden and Parting

Particulars	Grand total
Total Top OB	80.66
Parting above seam Rampur-IV	2.57
Parting above seam Rampur-IVB	5.31
Parting above seam Rampur-III	5.68
Parting above seam Rampur-II	2.00
Parting above seam Rampur-I	1.00
Total parting	16.56
Grand total	97.22

5.3.2 TARGET OUTPUT & MINE LIFE

An annual target of 8.75 Mt is proposed. At the targeted capacity, the mine life would be 12 years.

5.4 GEO-MINING CHARACTERISTICS

5.4.1 GRADIENT

The strata dip southerly and the gradient varies from 6^o to 8^o.

5.4.2 GEOLOGICAL DISTURBANCES

The block is structurally simple with no positive evidence of any fault anywhere within the block. In general, the block exhibits a simple structural disposition.

5.4.3 DETAILS OF SEQUENCE OF COAL SEAMS AND PARTING

Ib is the bottom most seam and occurs in workable thickness range over a small part only of the block area. It has attained workable thickness only in two boreholes located in eastern part of the block.

Lajkura seam occurs at the top and is incroping on the dipside edge of the block and has not been studied in detail because of its restricted occurrence within 60m barrier zone of the Chaturdhara nala. It incrops over a small zone of the quarry's southern boundary and thereby not considered.

Rampur seam underlying Lajkura seam and overlying Ib seam occurs in six splits and is considered the only workable seams in this report. The seams in ascending order are RAMPUR-I, RAMPUR-II, RAMPUR-III, RAMPUR-IVB, RAMPUR-IV and RAMPUR-V. All these seams are of considerable thickness. Gradewise, seamwise reserves of all these have been estimated. Table-5.3 ahead gives the thickness range of seams and the parting between them.

Table – 5.3
Thickness and Parting

Seams	Thickness range (m)
RAMPUR-I	4 - 6
Parting	0.10 - 2.99
RAMPUR-II	2 - 4
Parting	0.1 - 3.0
RAMPUR-III	4 - 6
Parting	1.82 - 7.14
RAMPUR-IVB	1 - 2
Parting	3.44 - 15.95
RAMPUR-IV	11 - 15
Parting	0.43 - 7.60
RAMPUR-V	2 - 3
Top OB	5.80 - 70

5.4.4 BASIC MINE PARAMETERS

Following table shows broad mining parameters of the proposed mine:

Table – 5.4
Geo-Mining Characteristics
(including mined out area)

Sl. No.	Particulars	Unit	As per Extn. PR (7.5 Mty)
1	**Area**		
i)	Along final quarry floor(Total)	Ha	254.05*
ii)	Along final quarry surface(Total)	Ha	306.05*
2	Mineable Reserve	Mt	92.73
3	Overburden	Mcum	97.22
4	Stripping ratio	M^3/t	1.05
5	Annual production	Mt	**8.75**
6	Life of quarry	Yrs.	**12**
7	**Strike length**		
i)	Minimum	m	951
ii)	Maximum	m	2757
8	**Depth of quarry**		
i)	Minimum	m	3
ii)	Maximum	M	116
9	Avg. seam thickness	M	**24.05**
10	Gradient	-	3^0 - 8^0
11	Quarry perimeter Total	M	8653.82

***** Quarry's Mining Plan has been divided into phase-1 and phase-2 as entire land has not been considered, as explained in chapter-9 (Land

Requirement). The Geomining characteristics shown above are for the entire quarry (phase-1 and phase-2).

5.5 MINING METHOD

The proposed mining block represents presence of multiple coal seams with intermediate varying partings. Seams occur in wide area having power grade coal reserve. So this will make the project most viable by adopting opencast mining method.

5.5.1 CHOICE OF TECHNOLOGY

Different technologies like shovel-dumper mining, dragline mining, bucket wheel excavator mining and surface miner-payloader-truck mining are available for opencast mining.

For coal deposit in block under consideration, surface miner-payloader-dump truck mining is proposed. In the earlier approved report, shovel dumper mining system was proposed for removal of OB above the seams. The same is to continue.

Considering the annual target capacity of 8.75 Mt and corresponding yearly overburden removal, higher capacity of shovel and dumpers are suggested for top overburden removal. Top overburden above various seams will be removed by level slicing method.

Operation of surface miner is found to be successful and environment friendly as it does not require drilling, blasting and crushing of coal. For the proposed extension project report it is assumed that incremental coal production of 8.75 Mty will be by surface miners. Surface miners will be working in windrowing method. In windrowing mode the cut material is directly discharged behind the machine without using a conveyor. Therefore the cutting operation is independent from the truck loading operation, but the coal has to be rehandled by the front end loader which in turn loads the coal into the dump truck. For many reasons, the higher productivity in windrowing method compensates the rehandling cost. In addition, no belt wear and

no operating cost for conveyor will arise when working with windrowing mode of operation.

5.6 MINING SYSTEM & SYSTEM PARAMETERS

Benches will be aligned along general strike. Bench floor should follow own seam floor/roof or that of adjacent seam. Main bench parameters for above mentioned equipments are:

Maximum bench height	:	10-12 m for 10 cum electric rope shovel and 10m or less for 2.5-3Cum hydraulic shovel.
Bench width	:	22-32 m for overburden with 10cum electric rope shovel.

Coal bench width will be kept at a minimum width of 50m for surface miner operations.

Working angle : 70^0 with horizontal for individual working bench.

Again, bench dimensions may vary with different equipments deployed.

5.6.1 CONSTRAINTS ON MINE DEVELOPMENT

The proposed mining area includes an extension of the approved quarry boundary, by approximately 3.3km to its west. This results in an additional quarry area of 306.05 ha (3.06 sq.km.). This area has been annexed on the western side of the quarry, crossing Basundhara river, flowing from north to south. There is no constraint in mine development upto the presently fixed mine/ quarry boundaries.

5.6.2 MINING STRATEGY / MINING SEQUENCE

Top soil is proposed to be removed and stacked either in temporary storage areas or directly transported to backfilled area and leveled for reclamation.

Top overburden would be excavated by $10m^3$ electric hydraulic shovels and parting would be excavated by $5m^3/2.5m^3$ hydraulic shovels.

Coal is proposed to be excavated by deploying surface miner along with a combination of F.E.L. 5-6 cum & 60T rear dumpers.

5.6.3 ACCESS TRENCH

This quarry has been developed using an access trench originating 80m (approx.) north of CMHG-024 and the same will be used for this quarry during its advance towards dipside. The main haul road is proposed to be advanced straight along the (approx.) dip direction of the quarry.

5.6.4 MINE DEVELOPMENT

The seam gradient varies from 3^o to 8^o. Higher capacity shovels are proposed to be deployed for top overburden removal. Partings are proposed to be removed by smaller capacity shovels.

5.7 EQUIPMENT SELECTION

Overburden below the top soil will be excavated by 10 cum electric hydraulic shovel, 5 cum diesel hydraulic shovel and 5 cum electric rope shovel. Partings are proposed to be excavated by smaller capacity hydraulic shovels. For better management and higher capacity utilization, large size excavators have been proposed. When compared with rope shovels, they are better in maneuverability and have lesser cycle time. Their modular design enables achieving higher availability. They are also more useful for selective mining of bands and for wide variations in strata thicknesses. The top soil and sub-soil upto a depth of 1.5m will be excavated and stacked separately or utilised directly for covering the backfill. At present 5.0 cum electric rope shovels, 3.7cum hydraulic shovels and 2.5/1.5 hydraulic shovels or backhoes are deployed for overburden removal.

Two types of drills have been proposed. 250 mm drills will be deployed for benches in thicker parting and top overburden, 160 mm drills will be deployed for thinner parting horizons.

Dozer of 410 HP have been proposed. At places dozing and loading by front-end-loaders have to done for thin seams/partings. Other supporting equipments like graders, cranes, tire-handler etc, of appropriate sizes have been provided.

5.7.1 DESIGN CRITERIA

The following design criteria has been adopted for mining operations as per prevalent norms of mine design considered in CIL mine :

Round the year working with 7 days a week is envisaged for coal production and overburden removal. However, for the purpose of assessing annual production of equipment, following schedule is assumed:

i) Annual working days : 330
ii) No. of shifts per day : 3
iii) Duration of shift : 8

EXCAVATION CATEGORY

Following categories of excavation have been assumed:

i) Top soil : Cat.I/Cat.II
ii) Overburden : 50% Cat.III + 50% Cat.IV
iii) Coal : Cat.III

INSITU VOLUME WEIGHT

- For coal : 1.70 t/cum
- For overburden : 2.4 t/cum

5.7.2 EQUIPMENT PRODUCTIVITY

Design parameters are same as approved standards of CMPDI. The annual productivity considered for excavators and dumpers are given below:

Table – 5.5
EXCAVATORS

Figures in Mcum

Sl.No	Shovel and Dumper Combination	Annual Productivity (M.cum)
	Overburden	
1	10 cum EHS with 100T Dumper	2.60
2	5 cum Hyd. shovel with 60T Dumper	1.29
3	5 cum Rope shovel with 60T Dumper	1.00
4	2.5 – 3.0 cum Hyd. shovel with RD 60T	0.80
5	2.5 – 3.0 cum Hyd. shovel with RD 50T	0.79
6	2.5-3.0cum Hyd. shovel with RD 35T	0.76
	COAL	
1	3000-3800mm drum dia. surface miner	2.40
2	5-6 cum FE loader with 60T Rear Dumper	1.30

* Capacity of surface miner may vary according to drum diameter and method of working, productivity is assumed as per present practice of

approx 900 ton per hour capacity as there is no existing CMPDI norm on productivity of surface miners. Capacity of surface miner may vary depending on working condition and model adopted.

Table – 5.6
DUMPER PRODUCTIVITY

HEMM combination	Annual Productivity			
	4.25km	4.75km	2.75km	3.25km
10 cum EHS with 100T Dumper	0.2312	0.2169	0.2909	0.2661
5 cum Hyd. shovel with 60T Dumper	0.1482	0.1391	0.1863	0.1705
5 cum Rope shovel with 60T Dumper	0.1283	0.1205	0.1634	0.1496
2.5 – 3.0 cum Hyd. shovel with RD 60T	0.1266	0.1195	0.1551	0.1434
2.5 – 3.0 cum Hyd. shovel with RD 50T	0.1071	0.1009	0.1325	0.1220
2.5 – 3.0 cum Hyd. shovel with RD 35T	0.0727	0.0682	0.0961	0.0836
COAL	2.0km	2.50km	3.0km	3.25km
F.E. Loader 5-6cum with 60T dumper	0.2665	0.2453	0.2240	0.2153
F.E. Loader 5-6cum with 50T dumper	0.2275	0.2088	0.1902	0.1825

5.8 EQUIPMENT SCHEDULE

OVERBURDEN REMOVAL

By drilling-blasting and shovel dumper working as adopted.

COAL EXTRACTION

Coal production is by surface miner, pay loader and rear dumpers. Total 8.75 Mty production will be by surface miner, pay loader and dumpers.

Year wise population of shovels, dumpers and drills has been estimated based on yearwise quantities from different strata as shown in production programme.

5.9 EXCAVATION

CALENDAR PROGRAMME OF EXCAVATION

Yearly schedule of overburden removal and coal extraction is based on sector-wise quantities of coal and overburden. Year-wise schedules of coal production and overburden removal and stripping ratio are given in table 5.8.

It is envisaged that production of 8.75 Mty can be achieved under present geo-mining conditions.

The below calendar programme is subject to timely possession of land, forestry clearance/ EMP clearance/ R & R etc.

Table – 5.8

PRODUCTION PROGRAMME

YEAR	Coal (In Mt)	Total OB (In Mcum)	SR (In cum/t)
Yr 1	1.50	2.18	1.45
Yr 2	5.50	3.89	0.71
Yr 3	8.75	6.83	0.78
Yr 4	8.75	7.65	0.87
Yr 5	8.75	10.05	1.15
Yr 6	8.75	10.83	1.24
Yr 7	8.75	10.81	1.24
Yr 8	8.75	10.84	1.24
Yr 9	8.75	10.98	1.26
Yr 10	8.75	11.04	1.26
Yr 11	8.75	10.75	1.23
Yr 12	6.98	1.37	0.20
TOTAL	92.73	97.22	1.05

5.10 TRANSPORTATION

Based on yearly work load, excavator requirement has been assessed. Dumpers have been calculated as per year wise average lead separately for coal, partings and top overburden. Following table shows year-wise average lead distances for coal and overburden.

Table – 5.9

Particulars	Yr.1	Yr.2	Yr.3	Yr.5 onwards
Overburden	4.25	4.75	2.75	3.25

Particulars	Yr.1	Yr.3	Yr.7	Yr.9	Yr.11
Coal	2.00	2.50	2.75	3.00	3.25

5.11 DRILLING AND BLASTING

Overburden and parting are to be drilled and blasted before excavation. Coal is to be mined using blast free method. Drilling and blasting parameters are to be arrived after conducting a series of trial blasts. However, following blasting pattern is tentatively suggested based on the assumed powder factors of 0.35 kg/cum for OB and is given in Table-5.10.

Table – 5.10
Blasting pattern

Description	Bench height	Blasting pattern
Overburden	10-12m	9m x 7.5m

5.12 DUMPING STRATEGY

In the quarry, the overburden removed completely from the first two years and partly from the third year is to be dumped over the existing quarry void on 36ha patch at its eastern end. Of the total overburden volume of 97.22Mm^3, 7.66Mm^3, removed over the initial years is to be dumped outside the working quarry.

Present quarry, however, is an extension quarry – an extension of the presently working Basundhara (West) expansion 7.0 Mty. The 36 ha patch on the south eastern end of the expansion quarry has been earmarked for the above mentioned volume of 7.66Mm^3 of overburden removed during the first three years. By the end of Yr-1, a volume of 2.18Mm^3 of overburden will be accommodated in +215.5m tier over 36ha patch dump site (ref. Plate No. MIN-II), followed by a further volume of 5.48Mm^3 over the next two years upto +245m level (ref. Plate MIN-III).

In Yr-3, 5.24Mm^3 and from Yr-4 onwards the total volume of overburden removed from the quarry will be backfilled inside the extension quarry. A total volume

of 89.56Mm^3 is to be backfilled in this extension quarry, upto +360m, tier, shown in stage plans of Yr-3, Yr-5, Yr-10 and final stage dump plan (ref. Plate Nos. MIN-III, MIN-IV, MIN-V, MIN-VI).

Total overburden removed	=	97.22Mm^3
To 36ha Expn. quarry void (Internal Dump-I)	=	7.66Mm^3
To Extn. quarry's internal dump	=	89.56Mm^3

Average height of the internal dump above surface level will be around 50m, overall slope of internal dump is 28^0, individual dump tiers will be constructed at a maximum height of 30m at an angle of 37^0 and a leveled berm of width 30m is kept between individual tiers. Calendar programme of dumping/backfilling is given in Table-5.11.

Table - 5.11
Calendar Programme of Backfilling

Year of Operation	Programmed total coal (Yearly)	Programmed total OB (Yearly)	OB to internal dump-I (Yearly)	OB to internal dump (Yearly)
Yr 1	1.50	2.18	2.18	--
Yr 2	5.50	3.89	3.89	--
Yr 3	7.00	6.83	1.59	5.24
Yr 4	8.75	7.65	--	7.65
Yr 5	8.75	10.05	--	10.05
Yr 6	8.75	10.83	--	10.83
Yr 7	8.75	10.81	--	10.81
Yr 8	8.75	10.84	--	10.84
Yr 9	8.75	10.98	--	10.98
Yr 10	8.75	11.04	--	11.04
Yr 11	8.75	10.75	--	10.75
Yr 12	8.73	1.37	--	1.37
TOTAL	**92.73**	**97.22**	**7.66**	**89.56**

Chapter – 6

MANPOWER, SAFETY AND SUPERVISION

6.1 REQUIREMENT OF MANPOWER

The present Basundhara west Expansion project (7.0 Mty), will be exhausted within two years. The existing manpower (i.e. 538) of the project will be diverted to Basundhara Extension Project in Chaturdhara block. Total existing manpower has been considered in extension project.

The estimation for Project manpower has been considered on the basis of existing manpower i.e. 538 and additional manpower for departmental variant. Manpower requirement has been estimated for the above two variants as given below:

Break-up of manpower requirement is given below in table-6.1 :

Table – 6.1
Manpower requirement

Sl. No.	Particulars	Manpower up to target year	Manpower beyond target year	Total manpower
1	OB	205	144	349
2	Coal	108	16	124
3	Common	301	45	346
4	Land reclamation	35	0	35
	Total :	**649**	**205**	**854 ***

* including existing manpower

6.1.1 GROUPWISE MANPOWER

Break-up of manpower in various groups is given in table-6.2.

Table – 6.2
Groupwise manpower upto target year

Sl. No.	Particulars	Manpower
1	Executive	15
2	Monthly rated	71
3	Daily rated (category)	188
4	Daily rated (excavation)	375
	Total :	**649**

6.2 SAFETY AND SUPERVISION

PREAMBLE

Opencast mining operation in general is associated with a number of hazards/risks.

Some of the various anticipated sources of danger are enumerated as under:

- Slope failure.
- Dangers due to handling and use of explosives and accidents due to fly-rocks and air-blasts following a faulty heavy blast.
- Hazards associated with use of electricity.
- Accidents due to unruly operation of HEMM.
- Dust hazards.
- Fire hazards due to spontaneous heating of coal in stock piles and exposed benches.
- Fire hazards in stores & workshops where inflammable & highly inflammable materials are stored or used.
- Danger of inundation from surface and/or ground water.

Adequate provisions have been made for safe working of the mine in form of design of operational systems, provision of safety measures for safe use of explosives, electricity and HEMM etc. Sufficient financial provisions have been made under different heads for procurement of necessary safety equipments.

Adequate skilled & trained manpower has also been provided, for compliance of safety provisions. Regular training/refresher courses, "on job" training shall be conducted & mock rehearsals shall be made to make the manpower conversant with various rules, regulations, methods of prevention & combat with hazards.

6.3 SAFETY MANAGEMENT

6.3.1 A) SLOPE STABILITY

COAL/OB BENCHES

The exposed ends of the coal seams and OB shall be left with a safe slope to avoid slope failure and collapse of benches. Similarly, at the end of mining operation, safe terminal pit slope is provided to avoid pit failure. At design stage, a safe angle of not steeper than 40 degrees has been proposed as quarry slope. Detailed site specific tests for slope stability shall be carried out and site specific parameters determined. Present provision is a broad guideline.

Considering the gradient in the proposed quarry area, it is proposed to excavate benches by parallel slicing method. Based on the above consideration the following parameters have been adopted in the PR.

Maximum bench height : 12m for shovel

Bench width : 24-36 m for overburden/coal benches with 10-12 cum hydraulic shovels/backhoes.

Coal bench width will be kept at a minimum width of 50m for surface miner operations.

Working angle : 70^0 for individual working bench

Again, bench dimensions may vary with different equipments deployed.

OB DUMP

It is proposed to locate the dump on the southern side of the worked out quarry in the initial period during implementation. Dump is suitably planned by matching the overburden removal and void available in different stages. Dumps will be formed in 30m tiers with an overall slope of about 26^o.

For better stability of internal dumps it is suggested to rip the mine floor in strips before backfilling. It is suggested to level the dumps and grade them outward properly to obviate water accumulation and will be followed by garland drains all along the periphery of the dump.

6.3.1 B) HAZARD AND RISK ASSESSMENT OF OB DUMPS

Hazard of OB dump failure is mainly governed by following factors :

1. Height of benches.
2. Slope of benches.
3. Nature of material.
4. Slope of foundation rock.
5. Nature of foundation rock.
6. Drainage of foundation.
7. Depth of ground water table.

The following precautions will be taken to reduce the risk of dump failure.

1. OB benches will be made of <30m ht in each tier.
2. The angle of repose of OB benches will be around 37^{o}.
3. Soil should be scraped separately, so that it is not mixed in OB rock.
4. The slope of ground is kept mild so that it will not have any adverse effect.
5. The soil from the foundation ground should be scrapped before starting of OB dumping.
6. Garland drain to be made around OB dump area to avoid water flow during monsoon below the OB dump.
7. Ground water table is generally 3-5m below ground level hence may have no adverse impact.
8. Leveling, grading and drainage arrangement for top of OB dumps will be done.
9. Technical & Biological reclamation will be done.

6.3.2 HAUL ROAD MAINTENANCE

For proper haul road maintenance, following aspects have to be considered and implemented:

i) Proper design and maintenance of the haul roads

ii) Formulation, approval and enforcement of traffic rules regarding :
   a) Speed limit
   b) Parking and standing
   c) Overtaking

iii) One way traffic, otherwise width should not be less than 3 times the width of the largest vehicle.

iv) Gradient should not be greater than 1 in 16.

v) Berm should not less than 1 m in width.

vi) Separate machines and personnel for maintenance of haul road.

During rainy season soil erosion will take place and it will deteriorate the haul road corridor and therefore.

i) Proper drainage arrangement shall be made along the haul road.
ii) Cross slopes (1 in 50 to 1 in 25) shall be provided on the haul road so that water flows into the drain.
iii) Water barrier, cross drains, relief drains etc. should be constructed and maintained properly.
iv) Culverts shall be designed, installed and maintained to withstand the vertical soil pressure, weight of the vehicles plying over the road etc.

6.3.3 BLASTING

SAFE USE OF EXPLOSIVES

Site Mixed Slurry (SMS) has been proposed to be used for good fragmentation and to obviate storage of bulk quantum of explosives. However, for storage of explosives meant for priming, detonating fuse and detonators, two explosive magazines have been provided in this report.

For transportation of explosives, explosive van of approved type is also envisaged.

For proper blasting and minimizing the adverse side effects due to blasting viz. noise, ground vibration, back-breaks, air blast and fly rocks etc., the optimal blast design parameters will be suggested during the mine operation after conducting a study for determining the blasting parameters.

Provision has been made in the PR for qualified blasting-in-charge with requisite number of assistants. Adherence to relevant statutory safety provisions as stipulated by DGMS, Chief Controller of Explosives and others shall be made.

Blasting danger zone of 300m for blasting has been taken in non-forest area. In forest area this demarcation will be done on the ground as only 7.5m has been considered as safety zone for permissive possession in case of forest area. Accordingly, land beyond the quarry limit is envisaged to be acquired for the project from safety considerations. It is suggested to resort to controlled blasting near built-up areas and surface features, if any, within the safety zone.

6.3.4 **USE OF ELECTRICITY**

To prevent shock hazards, in use of electricity, proper earthing system has been envisaged. It has been proposed to use restricted earthed neutral system of power supply and adoption of fail-safe electronic relays to minimise shock hazards.

Moving towers/posts shall be provided for mine illumination in addition to fixed towers.

It is suggested to strictly comply with the relevant provisions of Indian Electricity Rules, 1956 to obviate hazards due to use of electricity. Provision of Electrical Supervisors has been provided in the manpower requirement to fulfill the statutory needs as per the rules, regulations pertaining to mining industry.

Provision for proper illumination of quarry faces, haul roads and other working places have also been made as per the statutory guidelines. The details are given in Chapter-13.

6.3.5 **USE OF HEMM**

Based on the excavation requirement of the mine and envisaged calendar programme, adequate number of HEMM has been envisaged in the PR.

A well equipped workshop is suggested in the PR to cater to the maintenance needs of HEMM and other equipments besides provision of necessary maintenance crew. A project store is provided for storage of slow and fast- moving spares and other necessary spares of vital importance.

Adequate number of trained/skilled operators and maintenance crew are provided in the PR with due consideration of leave/sick provisions.

Properly designed haul roads are envisaged in the PR, away from the general and traffic congestion. The traffic rules as enforced by the DGMS shall be strictly followed by the operators of mobile equipments like rear dumpers, water sprinklers, tippers and other light motor vehicles. All mobile equipments shall be provided with audio-visual alarms.

Safety devices like fire alarm and control, operated by sensors should be inbuilt in the equipment/HEMM. Flashers should be fitted in relevant HEMM. The haul roads should be sufficiently wide to prevent accidents.

Inter-locking of starting with normal positioning of dumper body should be provided, so that dumper cannot be started when the body is in lifted position beyond a certain limit.

6.4 **DUST SUPPRESSION**

INVENTORY OF DUST GENERATION SOURCES

The likely dust generation sources due to various mining operations in the project are envisaged as under :

- Drilling, blasting, excavation and transportation of overburden material ;
- Drilling, blasting, excavation, crushing and transportation of run-of-mine (ROM) coal;
- Construction and demolition activities like land clearing, material/debris storage and handling, etc;
- Loading of coal at stockpile, reclaiming from pile and movement of vehicle and loading equipment;
- Wind erosion;
- Movement of vehicles on haul roads (black topped and non-black topped) for transportation of coal and overburden.

DUST POLLUTION CONTROL MEASURES

Systematic and regular air quality monitoring is necessary to examine objectively the status of compliance with the statutory standards and for making a real assessment of ambient air quality.

The following measures are suggested in the PR to contain the pollution arising out of dust emission within limits:

- All the drills are provided with well designed dust extraction/suppression system;
- Blasting operations are designed in such a way so that these produce minimum dust;
- Effective use of sprinklers and dust suppression units during loading, transportation and handling of ROM/processed coal and overburden;
- Dust extraction/suppression system is installed in coal handling plant;
- Provision of greenbelt around quarry, industrial and residential areas and avenue plantation along the haul roads on surface;

- Black-topping of permanent service roads besides proper maintenance, wetting of the surface by deploying water tankers/sprinklers to reduce dust generation from haul roads.

6.5 FIRE AND SPONTANEOUS HEATING

FIRE DUE TO SPONTANEOUS HEATING IN COAL BENCHES & GROUND STOCKS

The following measures will be taken to avoid spontaneous heating:

a) Coal bench slopes and seam outcrops will be overlain with an impervious layer of soil/clay.

b) Treatment of exposed coal seams & outdoor coal stocks with anti-pyrogenic substances.

c) Exposure of coal benches for long time shall be avoided.

6.5.1 FIRE IN PROJECT STORES & WORKSHOPS

Sufficient provision has been made in the PR for the prevention & control of fire in the project store, both E&M & HEMM workshops & sub-stations by way of installing fire extinguishers of right type & size. Timely inspection & refilling of fire extinguishers will be done.

Systematic layout of both stores & workshops has been made so that inflammable highly inflammable materials do not come in contact with any spark or flame. Adequate number of cautions in the form of hoardings will be displayed near such places.

6.5.2 INUNDATION

Due care has been taken while formulating the PR to prevent water ingress during mining operations from the higher ground local rivers/reservoir.

Embankment is not required because HFL against Basundhara river is 259 m above the mean sea level. Surface of the quarry is more than 10 m above the HFL.

6.6 SCIENTIFIC STUDIES

It is proposed that scientific studies in respect of effects of vibration and flying fragments on surface buildings/ structures due to blasting is carried out. Studies regarding slope stability should also be carried out.

6.6.1 ADDITIONAL PERMISSION/RELAXATIONS REQUIRED FROM DGMS

For the purpose of usage of bulk explosive, following permission from the competent authority will be required :

i) Permission for will be required for under CMR 161 clause (1) and CMR 168(5) for usage of explosive in other than cartridge form and other type of explosive.

ii) Permission for sleeping of holes shall be obtained.

6.7 CONSERVATION OF COAL

Opencast method provides maximum conservation.

Chapter - 7

COAL HANDLING PLANT

7.1 INTRODUCTION

The existing coal handling plant of Basundhara west OCP consists of two numbers of Feeder breaker circuits to crush the ROM coal size upto (-)200mm and load through the existing truck loading hoppers. Presently, the crushed coal is being dispatched by road to existing Kanika siding. The blast free coal is also being dispatched to the Kanika siding by trucks.

The proposed Basundhara west extension is planned to have a capacity of 8.75 Mty. Total life of the project is 12 years. The entire production of coal will be blast free coal size of (-)100mm and the same will be dispatched from coal face to surface coal stock by departmental dumpers. Contractual transport will be done from surface coal stock to Kanika siding about 35 km through trucks. The coal will be dispatched through the wharf-wall siding located at Kanika by basket linkage to meet the demand of the future thermal power stations. Coal will continue to be despatched from Kanika siding till the railway siding at Sardega/Barpalli comes up.

7.2 WASHING

There is no scheme of washing of coal in this project.

Chapter - 8

INFRASTRUCTURE FACILITIES PROPOSAL AND THEIR LOCATION

8.1 GENERAL

The proposed Basundhara west Extension opencast mine is planned to have a capacity to handle the production of 8.75 Mty from the mine. The space for existing workshop and stores will be utilized for the present extension project. It is proposed to deploy additional equipment for both HEMM and E&M workshop to cater the increased production and shall be accommodated within the existing workshop premises.

It is proposed for repairing and overhauling of the HEMM and E&M equipment will be done from the additional shop provided for the extension of the project.

Additional scope of work, provision of facilities, capabilities of workshop, requirement of equipment etc. have been given in subsequent paragraphs here under:

8.2 SCOPE OF WORK

The scope of work will be as follows:

8.2.1 HEMM SECTION

i) Daily maintenance including washing of equipment.
ii) Scheduled technical maintenance including lubrication and inspection.
iii) Day-to-day minor repairs/replacement of components and sub-assemblies.

8.2.2 **E&M SECTION**

Lubrication, inspection and minor repairs of the E&M equipment for water pumps and pumping installations and other E&M equipment.

8.3 SHOP FACILITIES

The following facilities have been provided for incremental production also:

a) **HEMM /E&M SECTION**

- Mechanized washing of dozers and dumpers.
- Daily maintenance shop for dumpers.
- Scheduled inspection, lubrication and maintenance shops for dumpers.
- Maintenance and minor repair shop for dozers.
- Heavy repair shop for repairs and overhauling of assemblies of shovels, drills, cranes and other auxiliary equipment.
- Engineering shops like machine shop, welding and structural shop etc.
- Open/concrete pavements for parking of dumpers.
- Machine shop for routine maintenance and minor repair of water pumps and other allied E&M equipment etc.

8.4 SHOP LAYOUT

The existing shop layout of the HEMM, E&M workshop and Store complex is shown in **Plate No. Engg. I**. The additional space to cope up with the additional equipment for HEMM and E&M shall be accommodated within the same premises. The shops are mostly self sufficient.

In addition to the above facilities additional washing station for dumpers, parking areas for dumpers, pavement within the HEMM section have also been envisaged.

8.5 PUMPING AND DRAINAGE

In the proposed extension report of Basundhara west opencast mine of 8.75 Mty in Chaturdhara block, the excavated area and the maximum depth of the mine has been calculated and accordingly volume of water to pump out from the catchment area has been analyzed. The existing pumps deployed against the Basundhara west mine are not sufficient to deal with additional production. So, additional pumps and pipe fittings will be required.

The principal drainage in the block is controlled by a Basundhara river flowing west to east on the southern side of the block as well as south to north on the eastern side of the block. The river maintains base flow even in the summer.

Two variants have been made for this project namely OB & Coal departmental variant and OB outsourcing & coal departmental variant. For Both the variants the pumping will be same.

8.6 BASIC CONSIDERATIONS

The following considerations have been made for calculating the pumping requirement and selection of pumps:

1. Water garland drains shall be developed in advance for each stage of mine working so that water is collected by the garland drains and discharged to the nearby streams of Basundhara river/nalah.

2. Excavated mine area and its depth.

3. Maximum rainfall per day (150mm continuous rainfall for 24 hours).

4. Inflow from seepage water has been assumed as 10% of the make of water due to direct rainfall. Make of ground water has also been taken as 10% of rainfall.

5. Pumping requirement has been assessed on the basis that the make of water on the day of maximum rainfall will be pumped out in following five days.

6. Coal and OB working faces and the haul roads shall be maintained free of water as far as possible.

7. Within the quarry, the faces shall be so laid that water from the working areas shall flow into the sump by gravity. From the sump the water will be pumped out to the surface and will flow into the surface drainage system.

8. Concurrent backfilling will be done in the de-coaled areas of the quarries.

9. For the purpose of pumping calculation, effective pumping hours per day has been taken as 18.

10. An adequate number of standby pumps have been provided.

8.7 MAKE OF WATER AND PUMP SPECIFICATION

Based on continuous rainfall of 150mm covered in 24 hours and with proper back filling, the make of water has been assessed. Five days pumping time has been envisaged to dewater the backlog due to heavy downpour as stipulated above. A sample calculation for the additional make of water and pumping capacity for the expansion project is given below:

SAMPLE CALCULATION

INPUT DATA	**Yr 1**	**Yr 10**
Surface Area of the mine (Ha)	28.33	17.12
Internal dumped area (Ha)	0.00	0.00
Area beyond excv. (Ha)	1.42	0.86
Mine depth (m)	38	79
Maximum daily rainfall (m)	0.15	0.15
Velocity of flow (m/sec)	2.50	2.50

Volume of water likely to fall in the quarry(Q)=Axhxn
Where ,
A = Catchment area in sq. m
h = Max. daily rainfall in m
n = Run off co-efficient.

Catchment Area in sq m	**Yr 1**	**Yr 10**
A1 = Surface area of mine excv. & n = 0.6	283300.00	171200.00
A2 = Area beyond excv. normally 5% of A1, n = 0.1	14165.00	8560.00

A3 = Internal dumped area & n = 0.15	0	0
Maximum daily rainfall (in m)	0.15	0.15
Max.water accumulated in catchment area (in m^3)	**Yr 1**	**Yr 10**
Q = ((A1-A3) x h x . 6) +A2xhx.6+ A3xh x.15 =	25709	15536
Considering 20% seepage from strata Q1 = 1.2Q	30851	18644
Qty. of water to be pumped / day = Q1/W =	6170	3729
Qty. of water to be pumped / min (m^3/min) =	5.71	3.45
Qty of water to be pumped in LPS=	95.24	57.55
W= no. of pumping days to dry the sump		
[For monsoon period W = 5]		
Working hours per day =18		
SELECTION OF PUMPS	**Yr 1**	**Yr 10**
Capacity (LPS)	38.00	80.00
Population (Nos of pumps)	2.51	0.72
Mine depth (m)	38.00	79.00
Considering head loss 15-20% , Pump head	50.00	90.00
Required Motor Power =(QHy)/(60x102)/0.7 =	27.14	102.84
Selected Motor Power =	30.00	110.00
(Considering y=1020 for water)		

8.8 SELECTION OF PUMPS (ADDITIONAL)

MAIN PUMPS

Main pumps will handle the quantity of water inflow during a day of peak rainfall in monsoon in excess of the capacity of the sump. The additional main pumps have been envisaged as working without standby due to existing pumps. The following specification has been suggested with the existing pumps and it will be deployed within target year.

Discharge	38 lps	Head	60 m
Power	37 kW	Voltage	415V
Population	1		

These pumps will work as main pump during initial period. In later stage it will be utilized as stage pumping to feed main sump.

The other main pumps working beyond target year are selected as under: -

Discharge	80 lps	Head	90 m
Power	110 kW	Voltage	6.6 kV
Population	1		

Discharge	120 lps	Head	120 m
Power	200 kW	Voltage	6.6 kV
Population	1		

These pumps will work as main pump during the entire life of the project. These high head pumps will be gainfully utilized at lower head by changing the impeller dia. These pumps will be installed in the main sump.

OTHER PUMPS

During rainfall, the water inflow into the sump will contain clay & silt. To handle slurry water, additional one number of slurry water pumps of 80lps capacity, 60 m head and power of 110 kW has been provided.

Chapter – 9

LAND REQUIREMENT

9.1 GENERAL

Implementation of proposed Basundhara West Extension Opencast Project (8.75 Mty) will extend in Chaturdhara block which require about 323.92 ha of land for its operation in the 1st phase (phase-1). This includes the area required for actual excavation, safety zone, other infrastructural facilities etc. In the second phase (phase-2), additional 6.5 ha of land will be required (7.5 m width beyond the present boundary).

The infrastructure facilities have been proposed avoiding forest land as far as possible (**refer Plate GEN-III)**. Infrastructural facilities like workshops, stores, substations, Project office etc. have been proposed near the access trench because of non forest land.

9.2 LAND REQUIREMENT

As mentioned above, land requirement for the 1st phase is described in this chapter.

As mentioned above, land requirement for the 1st phase is described in this Chapter. Total land requirement under different heads as given by Project authorities is indicated in table 9.1 below:

Table-9.1

(Area in Hectares)

Village	Land required for Mining				Land required for Infrastructure/ Safety zone				Grand Total			
	Forest	GNF	Tenancy	Total	Forest	GNF	Tenancy	Total	Forest	GNF	Tenancy	Total
Ratansara	36.94	0.63	11.11	48.68	0	0	0	0	36.94	0.63	11.11	48.68
Gopalpur	167.05	44.38	40.18	251.61	17.57	0	0	17.57	184.62	44.38	40.18	269.18
Reserve forest (Jamkani)	6.06	0	0	6.06	0	0	0	0	6.06	0	0	6.06
Total	210.05	45.01	51.29	306.35	17.57	0	0	17.57	227.62	45.01	51.29	323.92

PROTECTION OF FOREST LAND

Total forest land for diversion has been estimated as 227.62 ha. As per new guideline of MoEF forest land falling within the blasting danger zone requires to deposit funds with forest department for protection and regeneration of degraded forest. This area will be fenced and enriched with forest growth. Arboriculture is also proposed as per the guidelines laid by Department of Environment, Govt. of India.

9.3 VILLAGES AFFECTED

The core zone of the project comprising of excavation zone, infrastructure area, OB dump sites, safety zone for blasting, etc., covers partly and/or fully the land from two (2) villages namely, Telendih village and Ratansara Village (50% of total village). The Project effected families will be resettled and rehabilitated socially, culturally and economically along with other displaced such as major married sons, unmarried daughters of 30 years of age, etc., as per latest Norms of Govt. of Odisha, May, 2006. Details of PAF & PAP given in Environmental management chapter.

However the exact number of project affected families will be known after due enumeration by the Project Authority.

9.4 EMBANKMENT AGAINST WATER BODIES

Embankment is not required because HFL against Basundhara river is 259 m above the mean sea level. Surface of the quarry is more than 10 m above the HFL.

9.5 PROPOSED SURFACE REORGANISATION

a) Infrastructural facilities and dumps have been located, as far as possible, to avoid forest land. Surface master plan is given in **Plate GEN-III**.

b) A proper resettlement and rehabilitation (R&R) plan is to be drawn up in consultation with the state govt. and project affected persons (PAPs) taking into consideration the existing norms of Government of Odisha.

c) Suitable provision for compensatory afforestation, arboriculture and technical reclamation have been made as per latest guidelines of EAC. Government land shall be chosen for compensatory afforestation and resettlement of PAPs. These shall be finalised during implementation.

d) In rainy season, water from the proposed mining area flows down to Basundhara river mainly. Mining operation may disrupt the existing drainage system. Garland drains around the periphery have therefore, been provided. (**Ref. Plate GEN-III**).

9.6 REMARKS

a) Online application for diversion of forest land by the project has already been made on 22.07.16 vide ref. no. FP/OR/MIN/20559/2016. As per this application, the project has applied for the mining lease upto the quarry surface boundary only, without considering 7.5 m safety zone beyond it. Therefore, an inside boundary of 7.5m within the so applied boundary of land has been marked and shown on Plate no. MIN-I as statutory safety zone boundary. This may be considered as Phase-I of the quarry. In this phase, a reserve of 2.15 Mt remains blocked in the safety zone.

b) The project has accepted this fact and has proposed to make a new application for the additional land for safety zone of 7.5m all around the quarry area inclusive of the additional forest land, in the next phase, phase-2, in due course of time.

c) The above action (b) will lead to the availability of the mining of entire reserve, i.e. 92.73 Mt, upto the Final Quarry Surface boundary. The same has been taken into consideration in chapter-5 of Mining Technology of this Report.

Chapter - 10

ENVIRONMENTAL MANAGEMENT

10.0 INTRODUCTION

Basundhara West Extension, 8.75 Mty is located in north-western part of Ib-valley coalfield in the district of Sundergarh, Odisha. The project comes under administrative control of MCL, Sambalpur. The limit of the block in terms of geographic co-ordinates are between the latitude 22º00'43" to 22º05'57" North and longitude 83º40'06" to 83º40'30" East. The block is covered under Survey of India's toposheet No.64N/12 on RF 1:50,000.

The topography of the block is represented by small hillocks and flat ground. The western part of the project area is covered by small hillocks which are prominent in the north- western part. Major part of block is however covered by agriculture land.

The area experiences a sub-tropical warm temperature. Mean annual precipitation is 1514.5mm of which 85% occurs during rainy seasons. Mean temperature varies from 6º to 49º.

10.1 EXISTING ENVIRONMENT QUALITY

10.1.1 AMBIENT AIR QUALITY IN CORE & BUFFER ZONE

Routine monitoring in each fortnight is being carried out for Basundhara OCP and Kulda OCP which are nearer to Chaturdhara OCP.

The following stations are monitored regularly and average values of SPM, RPM, SO_2 and NO_X recorded from last three months i.e. (January'16 to March'16) are given below:

($\mu g/m^3$)

04-Jan-16	Khamarpara	459	244	17	21	74	East to west sunny
04-Jan-16	Near CHP	452	276	18	23	92	East to west sunny
04-Jan-16	Near Embankment	390	194	14	19	96	East to west sunny
18-Jan-16	Khamarpara	244	148	18	22	78	West to east sunny
18-Jan-16	Near CHP	375	233	11	16	81	West to east sunny
18-Jan-16	Near Embankment	166	104	10	14	66	West to east sunny
01-Feb-16	Khamarpara	598	234	18	21	111	West to east sunny
01-Feb-16	Near CHP	587	289	19	22	73	West to east sunny
01-Feb-16	Near Embankment	392	208	15	18	65	West to east sunny
16-Feb-16	Khamarpara	350	147	14	17	77	West to east sunny
16-Feb-16	Near CHP	503	298	15	19	127	West to east sunny
16-Feb-16	Near Embankment	348	248	16	18	60	West to east sunny
02-Mar-16	Khamarpara	292	182	13	16	85	West to east sunny
02-Mar-16	Near CHP	531	220	17	19	97	West to east sunny
02-Mar-16	Near Embankment	387	240	13	17	107	West to east sunny
16-Mar-16	Khamarpara	251	146	13	15	88	West to east sunny
16-Mar-16	Near CHP	558	222	15	19	115	West to east sunny
16-Mar-16	Near Embankment	554	263	14	18	103	West to east sunny

10.1.2 **WATER QUALITY**

Drinking water are surface water from different villages is collected in and around Basundhara OCP. Various parameters are being analyzed. All the parameters of drinking water and surface water qualities are within the limits.

Project	Basundhara OCP	Basundhara OCP	Basundhara OCP	Basundhara OCP		
Monitoring Station	Bashundhara Colony Tap water	Bashundhara Colony Tap water	Bashundhara Colony Tap water	Water of Intake well at Basundhara nala	Indian Drinking Standards (IS-10500):2012	
Dt. of sampling	05.01.2016	05.01.2016	02.03.16	02.03.16	Desirable	Permissible
Colour(Hazen)	2	2	2	4	5	15
Odour	Unobjectionable	Unobjectionable	Agreeable	Agreeable	Unobjectionable	Unobjectionable
Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity(NTU)	4	4	3	7	1	10
pH	8.16	8.16	8.24	7.97	6.5-8.5	No relaxation
Total Alkalinity(mg/L)	92	92	84	56	200	600

Total Hardness(mg/L)	148	148	140	96	200	600
Iron(mg/L)	<0.06	<0.06	<0.06	<0.06	0.3	1
Chloride(mg/L)	32	32	30	22	250	1000
Residual Free chlorine(mg/L)	nil	nil	nil	nil	0.2	—
Total Dissolve Solid(mg/L)	252	252	240	168	500	2000
Calcium(mg/L)	33.6	33.6	32	22.4	75	200
Copper(mg/L)	<0.03	<0.03	<0.03	<0.03	0.05	1.5
Manganese(mg/L)	<0.02	<0.02	<0.02	<0.02	0.1	0.3
Sulphate(mg/L)	49	49	49	29	200	400
Nitrate(mg/L)	4.87	4.87	6.2	5.32	45	100
Fluoride(mg/L)	0.28	0.28	0.19	0.14	1	1.5
Selenium(mg/L)	<0.002	<0.002	<0.002	<0.002	0.01	No relaxation
Arsenic(mg/L)	<0.002	<0.002	<0.002	0.005	0.01	No relaxation
Lead(mg/L)	<0.005	<0.005	<0.005	<0.005	0.01	No relaxation
Cadmium(mg/L)	0.0016	0.0016	<0.0005	<0.0005	0.003	No relaxation
Zinc(mg/L)	0.04	0.04	0.02	<0.02	5	15
Hexavelent Chromium(mg/L)	<0.01	<0.01	<0.01	<0.01	0.05	No relaxation
Boron(mg/L)	<0.20	<0.20	<0.20	<0.20	0.5	5
Phenolics(mg/L)	<0.001	<0.001	<0.001	<0.001	0.001	0.002

10.1.3 **NOISE QUALITY**

Noise quality is monitored in and around of Basundhara & Kulda OCPs. The noise level is being monitored in day time (6:00AM – 10:00PM) and night time (10:00PM – 6:00AM) on each fortnight.

Noise level shows the measurements are within limits.

10.1.4 **FLORA AND FAUNA**

FLORA

The reserve and protected forests in the buffer zone are found to be degraded due to biotic interference. Occurrence of dense forest is very rate. Open canopied dry deciduous forests with species like *Diospyrus melanoxylon* (Kendu),

Holarrhena antedysenterica (Kurei), *Madhuca indica* (Mahula), etc. The area does not have any rare or endangered floristic elements.

FAUNA

Fauna found in the area are few. Wild animals found in the area are *Felis chaus* (Jungle cat), *Canis aureus* (Jackal), *Hyena striata* (Hyena), etc. Domestic mammals found in the area are *Bos domesticus* (Cow), *Canis familiarisis* (Dog), etc. Avi-fauna found in the area are *Columbia livia* (Pigeon), *Milvus migrans* (Common kite), *Pavo cristatus* (Common peafowl), etc. Reptilia seen in the area are poisonous snakes like *Bangarus coerulus* (Common krait), *Naja tripudians* (Common cobra), etc. and non-poisonous snakes. No endangered or rare species are found in the area. The area is not a common migratory route for any wild animal.

10.1.5 SOCIO-ECONOMIC STATUS

The core zone falls in Telendih village and Ratansara Village (Part). **316** families will be displaced due to the project. Total population of the core zone is 1396. Male is 45.84% of total population. Total SC population is 83. Total ST Population is 1243. The overall literacy level is 70.42%. Female is 1083/1000 male.

10.2 ENVIRONMENTAL IMPACT

10.2.1 AIR QUALITY

The mining and its related activities will cause ambient air pollution. The ambient air will be polluted due to presence of RPM, SPM, SO_2 & NO_x which will be generated due to various activities related to the project. The concentration of pollutants will vary depending upon micro-meteorological parameters of area.

10.2.2 WATER QUALITY

The likely sources of water pollution from this project will be as follows:

* Sanitary (Domestic) wastewater.
* Industrial wastewater from workshop.

* Mine discharge water.
* Surface run-off passing through coal stockpiles and OB dump.
* Storm water from leasehold and built-up areas.

The impact of mining at this project on both surface water source and ground water resource has been assessed as follows:

➢ **SURFACE WATER SOURCES**

* Disruption of natural drainage pattern in the core zone.
* Deterioration of water quality & pollution of water bodies.
* Siltation and choking of water courses causing scarcity of surface water and flooding problem in the area.

10.2.3 GROUND WATER RESOURCES

Due to excavation, ground water aquifers are disrupted.

* Due to pumping of mine water, the water table of the region may get lowered.

10.2.4 NOISE IMPACT

The adverse effect of high noise level like health effect (both auditory and non-auditory), masking effect, sleep interference, change in personal behavior.

10.2.5 FLORA AND FAUNA

IMPACT ON FLORA

- Forest land in the core zone, and particularly in the excavation area, will be diverted for mining.
- The combined impact of operating coal mines and proposed coal projects may influence the forest land in the buffer zone.
- Due to biotic interference and forest fire, even the reserve forests in the area will not find to harbor many species of floral population. The reserve forests will be in degraded conditions.
- Both core and buffer zones are found to be free from ecologically sensitive and biologically rich areas/habitats, such as national parks, sanctuaries, biosphere reserves and areas rich in genetic resources.

- There are no rare, threatened and endangered plant species in the buffer zone.

IMPACT ON FAUNA

- The population of fauna, especially mammals, is found to be low. So there will be no adverse impact on the fauna existing in the project impact area as they will migrate to the nearby forests.
- The area is not the migratory route for any wild animal.
- There are no rare, threatened and endangered faunal species in the buffer zone except *Rana tigrina* and *Varanus* which is also found in the other parts of the district and state.

10.2.6 IMPACT ON LAND USE

The major direct impacts on existing land use during the pre-mining phase area the removal of vegetation and resettlement of displaced population. There may also be land use changes with respect to agriculture, fisheries, recreation sites, housing, forestry areas, etc. Land reclamation / restoration of mined out lands may give rise to enhanced beneficial land use.

There exists major environment impacts due to landscape disruption particularly visuals (unsightly huge dumps, voids, mine structures, subsidence, mine fires, etc.). During mining and post-mining phases drastic changes in landscape with landforms take place. The major associated impacts are soil-erosion, loss of top soil, change in complete geology, creation of huge dumps & voids, disposal of wastes, deforestation, etc.

Irrespective of the type of mining used for extracting coal, mining invariably results in enormous land disturbance – e.g. large scale excavation, removal of top soil, dumping of solid wastes, cutting of roads, creation of derelict land, etc. Opencast mining has more potential impact on land than underground mining. With improved technology, opencast coal mining is being used extensively because of its cost effectiveness and productivity; though it results in large-scale land disturbance. The

alteration in land use pattern due to infrastructure is not to be considered as true change as these facilities can be utilized for some other purposes after the mining operation is over. The alteration in land use pattern due to activities of quarrying and external dumping of OB materials may be considered as true change in land use pattern.

10.2.7 IMPACT ON SOCIO-ECONOMIC

The major adverse impact will be displacement and rehabilitation/ resettlement of affected people including change in culture, heritage & related features. The crime and illicit activities also prop-up due to sudden economic development of the area.

SOCIAL IMPACT

- **POPULATION GROWTH**

Skilled manpower required for the project may not be available in the area. Only semi-skilled and unskilled workers will be available from the local population. So people will migrate to this segment both from within and outside the district as well as the state due to creation of new employment opportunities.

- **EDUCATIONAL FACILITIES**

A number of educational institutes are already there in the buffer zone and its neighbourhood. The facilities already provided in the neighbouring projects will cater to the need of this project. So migration of population will not strain the local educational facilities already available. Further, the educational institutes owned by MCL are also accessible to local population.

- **HEALTHCARE FACILITIES**

The coal company has a number of healthcare centres including a well equipped Regional Hospital and a specialised **"referral"** hospital in the coalfield area. Provisions of healthcare facilities have been provided in the project report. Healthcare facilities have been provided in the neighbouring

projects. The above facilities will cater to the need of employees of this project. The local people can also avail these healthcare facilities.

- **ECONOMIC IMPACT**
  - Loss of agricultural land
  - General improvement of economy of the area
  - Increase in revenue of the state exchequer

- **IMPACT ON VILLAGE HABITATION**

The core zone of the project comprising of excavation zone, infrastructure area, OB dump sites, safety zone for blasting, etc., covers partly and/or fully the land from two (2) villages namely, Telendih village and Ratanpur Village (Part) About 316 families will be displaced due to mining and other associated activities of this project. These families will be resettled and rehabilitated socially, culturally and economically along with other displaced such as major married sons, unmarried daughters of 30 years of age, etc., as per latest Norms of Govt. of Orissa, May, 2006. Details of project affected families and project affected persons are given below:

Name of village	Project affected families	Project affected persons
Telendih village	199	928
Ratanpur Village (Part)	117	468
Total	**316**	**1396**

However, the exact number of project affected families will be known after due enumeration by the Project Authority.

10.3 ENVIRONMENT MANAGEMENT

10.3.1 AIR QUALITY MANAGEMENT

Appropriate air control measures will be adopted to maintain the ambient air quality within the stipulated standard. The control measures will be adopted for various operations like drilling operation, blasting operation, loading and transport, coal handling plant, fires at coalfaces and coal stock yard, OB dump(s) and workshop and stores, etc.

- **Drilling Operation**

  All drills will be equipped with dust extraction.

- **Blasting operation**

  The operation shall be conformity to the extent laws with more closure control of blasting parameters.

- **Loading & transporting**
  - Surfacing all service roads by asphalt.
  - Un-metaled roads shall be kept free of ruts.
  - Provision has been made for instant shower system.
  - Development of greenbelt.
  - Provision of silo system.
- **Coal handling plant & transportation system**
  - Suppression of dust by fixed sprinklers in all critical points.
  - Covered conveyor belts.
  - Provision for Silo loading has been proposed.
  - Total coal will be transported to silo from the CHP directly by covered conveyor belts.
- **Fires at coalfaces, coal stock yard**
  - Provision of adequate fire fighting.
  - Storage of water at all critical points.
  - Regular supervision.
- **OB dumps**
  - Blanketing with OB materials to put off the oxygen supply
- **Workshop & store**
  - Proper ventilation system.

10.3.2 WATER QUALITY

* Sedimentation ponds/tanks to treat mine discharge water for suspended solids.

* Oil and grease traps and sedimentation tanks for industrial wastewater.

* The domestic wastewater will be treated for Bio-chemical Oxygen Demand (BOD) and Total Suspended Solids (TSS).

* Garland drains with settling tanks for surface run-off.

10.3.3 **NOISE MANAGEMENT**

* Proper designing of plant & machinery by providing inbuilt mechanism like silencers, mufflers and enclosures for noise generating parts and shock absorbing pads at the foundation of vibrating equipment.

* Greenbelts around infrastructure site, service building area and township.

* Adoption of personal protective devices like earplugs, etc.

10.3.4 **FLORA AND FAUNA MANAGEMENT**

- The enhancement of forest area occurs due to measures like biological reclamation of backfilled area, arboriculture/afforestation, compensatory afforestation creation of greenbelt and avenue plantation.
- Water body created by the final voids will be beneficial to flora as the area is prone to water scarcity.
- This project will have no detrimental impact on diversity of floral species within terrestrial and aquatic habitats.

CONTROL MEASURES TO REDUCE IMPACT ON FAUNA

- The balance in the regional population will be maintained in natural course, owing to existing undisturbed forest areas in the vicinity of the project. The increase in green cover due to implementation of various measures like biological reclamation of backfilled area, arboriculture / afforestation adopted by the mine establishment will be an added bonus, though expected in distant future.
- The mine will be a "**zero-discharge**" one. If required, water will be discharged only after suitable treatment with exceptional monsoon period. No adverse impact on downstream aquatic life of surface water courses will be expected.
- The project will not likely to have impact on the faunal species diversity within the terrestrial and aquatic habitats.

10.3.5 LAND RESOURCE MANAGEMENT

- Solid waste generated due to coal extraction will be dumped externally and internally. The external dump and internal dump should be reclaimed biologically and technically.
- During the process, the geometrical shape of the dumps will be altered to make it amenable to effective biological reclamation and also to provide safety and stability.
- The face slopes of the dump will be maintained at the natural angle of repose of the material and at overall slope angle of 28^{o}.
- Suitable drainage arrangement for smooth disposal of storm water.
- Appropriate garland drain will be provided to collect run-off.
- Backfilled area will be reclaimed bio-logically and technically.
- Topsoil shall be progressively and concurrently utilized during physical/ technical reclamation of external OB dumps and backfilled area, thus obviating the necessity of storage of topsoil separately.
- Arboriculture will be carried out in the vacant areas.
- Proper afforestation/plantation will be carried out for greenbelt development.

10.4 ENVIRONMENTAL MANAGEMENT SYSTEM

Environmental management system is a system for maintaining and reviewing the sustainable development in the environment. It is the part of the overall management system which includes on organization structure, planning activities responsibilities, practices, procedures process and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy.

AIMS OF ENVIRONMENTAL MANAGEMENT SYSTEM

- Identification and control of aspects, impacts and risks.
- Establishing an environmental policy, objectives and targets including compliance with legislation.

- Indentifying environmental opportunities.
- Monitoring and continual improvement of environmental performance.

PROCEDURES FOR IMPLEMENTATION

- For the implementation of the Environmental Management System within an organization, the first step is to define the environmental policy.
- The top management of the organization should define and document its environmental policy.
- The second step is to conduct an initial environmental review like legislative and regulatory requirement, an identification of significant environmental aspects, an examination of all existing environmental management practices and procedures and an evaluation of feedback from the investigation of the previous incidents to assess the company's environmental conditions.

10.5 NATURE OF PD AND CD WORKS

MCL will undertake social corporate responsibility in various spheres. Different peripheral development and community development works will be taken.

(a) **DRINKING WATER SUPPLY**

(i) Renovation / installation of handpump
(ii) Renovation / construction of well
(iii) Renovation / digging of ponds
(iv) Water supply through pipe line in some villages around the mining area.

(b) **EDUCATION**

(i) Construction / repair of educational building.
(ii) Providing additional facilities, furniture, lab instruments, etc.

(c) **RURAL HEALTH CARE**

(i) Organizing camps for eye operations / post operation care / welfare camps.
(ii) Providing medical instruments to the village hospitals
(iii) Providing medical facilities to the rural population through mobile medical van.

(d) **ROADS**

(i) Construction and repair of rural roads.
(ii) Construction and repair of roads connecting mining area
(iii) Construction and repair of culverts
(iv) Construction and repair of bridges

(e) **RECREATION CENTRES**

(i) Construction of community centers
(ii) Providing financial aid to the various social institutions
(iii) Preparation of play grounds & organising sports.

(f) **ENVIRONMENT**

(i) Plantation of various species in the nearby villages of mining area.
(ii) Distribution of saplings – fruit bearing plants, medical plants & avenue plants.

(g) **OTHER MISCELLANEOUS HEADS**

(i) Street lighting.
(ii) Providing facilities to various institutions.
(iii) Providing facilities to district administration offices.

Chapter – 11

MINE CLOSURE PLANNING

11.1 LEGISLATIVE REQUIREMENTS

- All coal mines shall adopt Mine Closure Plan comprising progressive closure plan and final closure plan duly approved by the competent authority as per circular No.55011-01-2009-CPAM, Govt. of India, and Ministry of Coal, dated 27th August, 2009, and the subsequent amendments latest by 07.01.2013.
- Coal projects who has been accorded approval of Mining Plan / Project Report without mine closure plan are required to prepare and obtain the approval of Mine closure plan within a period of 1 year as per the circular.

  Name of the lessee; MAHANADI COALFIELDS LIMITED which is a subsidiary of Coal India Limited, a central public sector company.

OBJECTIVES OF MINE CLOSURE PLANNING

- To allow a productive and sustainable after-use of the site which is acceptable to the mine owner and the regulatory authority;
- To protect public health and safety;
- To alleviate or eliminate environmental damage and thereby encourage environmental sustainability;
- To minimize adverse socio-economic impacts.

VARIOUS ASPECTS OF MINE CLOSURE PLANNING

The mine closure planning broadly involves the following aspects:

(a) Technical aspects;
(b) Environmental aspects;
(c) Social aspects;

(d) Safety aspects;

(e) Financial aspects.

MINE CLOSURE OBLIGATION

There is a need to define the liabilities, responsibilities and authorities of the mine management, other regulatory bodies, Central and State Governments after mine closure. Some obligations relating to the mine management are as follows:

(a) **Health & Safety**: Regulation Nos. 6, 61, 106, 112 of Coal Mines Regulations, 1957 and its related DGMS Circulars;

(b) **Environment**

(i) Water (Prevention & Control of Pollution) Act, 1974;

(ii) Air (Prevention & Control of Pollution) Act, 1981;

(iii) Environmental (Protection) Act, 1986 and Environmental Protection (Amendment) Rule, 2000;

(iv) DGMS Directives on Noise & Ground Vibration;

(c) **Forest**

Forest (Conservation) Act, 1980.

(d) **Rehabilitation**

CIL's Policy and Odisha State Govt. Policy. Latest Policy / Norms of Govt. of Odisha is followed for this project.

(e) **Decommissioning/asset disposal, etc.**

Decommissioning of infrastructure is done, the land occupied by the infrastructure will be restored to some useful purpose. The salvaging and shifting operation of mining machinery and other equipment will be done considering the ground realities existing during the period 1 year advance of final closure of the mine.

TYPES OF MINE CLOSURE PLAN

There are two types of mine closure plan :

- Progressive mine closure plan
- Final mine closure plan

PROGRESSIVE MINE CLOSURE PLAN

This is a progressive plan for the purpose of providing protective reclamation and rehabilitation measures in a mine or part there of.

FINAL MINE CLOSURE PLAN

This plan means for the purpose of decommissioning rehabilitation and reclamation in the mine or part there of after cessation of mining and its related activities that has been prepared in the manner to address all environmental aspects taking into consideration.

The final mine closure activities would start towards the end of mine life, and may continue even after the reserves are exhausted and / or mining is discontinued till the mining area is restored to an acceptable level to create a self sustained ecosystem.

ASPECTS FOR PREPARATION OF MINE CLOSURE PLAN

The following points will be incorporated while preparing mine closure plan.

TECHNICAL ASPECTS

1. Mine description
2. Reseason for closure
3. Management of mined out land
    a. Present land use
    b. Final stage and post operation stage.

4. Management of top soil.
5. Management of wastes.
6. Management / decommissioning of infrastructure.
7. Management of disposal of mining machinery.

ENVIRONMENTAL ASPECTS

1. Management of hydrology & hydrogeology during mine period and post mining closure period.
2. Drainage arrangement for external OB dump.
3. Reclamation of dump(s) & adjoining areas.
4. Rehabilitation & resettlement.
5. Management of air quality.

SOCIAL ASPECTS

1. Redeployment of workforce
2. Management of community facilities
3. Management of association and consultation with stake holders.

SAFETY AND SECURITY ASPECTS

1. Disaster management
2. Care and maintenance during temporary discontinuance
3. Management of fire

FINANCIAL ASPECTS

COST OF MINE CLOSURE INVOLVES

1. Cost of reclamation of mined out area.
2. Cost of air quality protection measure.
3. Decommissioning cost of infrastructure
4. Cost of safety & security

5. Socio-economic cost
6. Cost of organization for executing the closure activities.
7. Cost of post project monitoring for five years.

11.2 TECHNICAL ASPECTS

11.2.1 SAFETY HAZARDS INCLUDING MANAGEMENT OF FIRE

Keeping in view the three basic principles i.e. prevention, preparedness (both pro-active and reactive) and mitigation of effect through rescue, recovery, relief and rehabilitation; a comprehensive blue print for risk assessment and management has been drawn-up for the project incorporating the following:

- Identification and assessment of risks.
- Recommendation of measures to prevent damage to life and property against such risks.

SLOPE FAILURE IN MINE PIT

The exposed ends of the coal seams and OB will be left with a safe slope to avoid slope failure and collapse of benches. Similarly, at the end of mining operation, safe terminal slope will be provided to avoid pit failure.

BLASTING

For proper blasting and minimizing the adverse side effects due to blasting, viz. noise, ground vibration, back-breaks, air blast, fly rocks, etc., the following precautions have been suggested to avoid dangerous situations:

- A safety zone for blasting has been provided around the quarry.
- Before blasting is done, warning sound will be given so that people can move to safe places.
- Controlled blasting with site mixed slurry. Use of millisecond delay detonators that are initiated by shock tube initiation system, between rows and between holes in same row.

- Optimisation of quantity of explosive in a blast hole.
- Blasting shall be carried out in conformity of extant laws with more closer control of blasting parameters including blasting results like desire fragmentation, permitted vibration, etc.

EXPLOSIVE HANDLING

The present day technology of blasting with site mixed slurry (SMS) explosive shall be used with milli second delay detonators that are initiated by shock tube initiation system. SMS is stored by the supplier as per GOI Notification. Further, transport and charging are also done by the supplier on the spot. Only priming will be done by the project authority. For storage of explosives meant for priming, detonating fuse and detonators, one service magazine have been provided.

SAFETY RULES

Mining operations follow statutory mine safety rules administered by the Directorate General of Mine Safety (DGMS), Chief Controller of Explosives and others. Planning and design of electrical installations will take into account the existing electricity rules to obviate the hazards due to use of electricity.

For creating safety awareness and imparting education on safe practices, the following steps shall be taken:

- Holding annual safety weeks.
- Imparting basic and refresher training to new and old employees respectively as per Vocational Training Rules.

MINE INUNDATION

Provisions in Coal Mine Regulations shall be followed. The mine pit would receive water from three sources namely, direct precipitation over excavated area, surface run-off from the surrounding area and seepage from the strata. During heavy

rainstorms, there may be a situation when mine may get flooded. This may cause loss of human life and equipment, etc. All the necessary precautions will be taken against such eventuality through out the life of the project.

FIRE

Adequate fire fighting arrangement has been provided. Adequate number of fire extinguishers will be provided for stores and other service buildings. While calculating total water demand for the project, provision for fire fighting has also been made.

ROAD ACCIDENTS

Sufficient arrangements for illumination of roads including haul roads will be made. Road crossings has been properly planned and designed to prevent vehicular accidents.

MANAGEMENT OF FIRE

The measures for management of fire at coal faces in the mine and coal stockyard will be adopted / to be adopted and there will be no safety hazards for the neighbouring community after the mine closure.

11.2.2 MANAGEMENT OF PIT SLOPES AND WASTE DUMPS

EXTERNAL OB DUMPS

The face of slope of external dump will be maintained at the natural angle of repose and at overall slope angle of 26^{o}. Once the external dump will reach its predetermined level, top surface shall be leveled and graded. Gradiant of surface shall be maintained less than 2% i.e. very gently slopping to prevent standage of water. Drainage arrangement will be provided for smooth disposal of storm water to avoid gully formation. Garland drains shall be provided around the external dump to collect run off sedimentation ponds one to be provided in order to avoid silt.

INTERNAL DUMP

Major part of the quarry will be backfilled with overburden. The backfilling will be carried out in a phased manner. Once the backfilling has reached a certain predetermined reduced level, the plots will be levelled, graded and cleared of large stone pieces lying on the surface. The slope of the ground will be made very gentle as far as possible (preferably less than 2%). The graded and levelled area will be divided into small sectors and small check bunds will be constructed to retain moisture and humus in the soil. The outer slope of each bench will be kept at the natural angle of repose of the spoil material and at overall slope angle of 26^{O} considering all benches.

DRAINAGE ARRANGEMENT FOR EXTERNAL OB DUMP & FOR INTERNAL DUMP

- **DRAINAGE ARRANGEMENT FOR OB DUMPS**

  - **CATCH DRAIN**

    An open drain of appropriate size will be provided on all terraces at the foot of next bench to receive the storm water from upper benches. This will be discharged to the lower benches through masonry chute, thus minimizing gully formation in the slope of external dump.

  - **FOOT DRAIN**

    A foot drain of proper size will be provided around the OB dump. This drain collects run-off from dump and direct it to settling tank/sedimentation pond before discharge to nearby natural water courses.

- **DRAINAGE ARRANGEMENT FOR INTERNAL OB DUMPS**

  A part of the quarry will be backfilled with overburden. The backfilling will be carried out in a phased manner. Once the backfilling has reached a certain predetermined reduced level, the plots will be levelled graded and cleared of large stone pieces lying on the surface. The slope of the ground will be made very gentle as far as possible

(preferably less than 2%). The graded and leveled area will be divided into small sectors and small check bunds will be constructed to retain moisture and humus in the soil. The drainage arrangements for precipitation run-off are as follows:

- During working stage, the run-off will be collected from internal dump by foot drain for diverting to mine sump for pumping.
- In the post-mining period, the drainage pattern of the reclaimed area will be such that the run-off will be diverted to final void of the quarry which will be developed as a water reservoir for **water harvesting** and also recharging the aquifer in the surrounding area.

There is an intricate relationship between surface water and ground water. In the monsoon period, till the aquifer attains its original ground water level, surface water bodies like stream, ponds & lakes recharge the aquifer. As soon as ground water recoups and attains its level, it contributes again to surface water bodies. After post-monsoon period, this process is reversed again as ground water level gets lowered from the original level.

The mine dewatering brings down ground water level in the immediate vicinity of the mine. Maximum effort will be made to recycle or reuse the treated mine discharge water totally to the extent possible by keeping the make up water in different sumps or low lying areas of the project. In unusual situations during monsoon, mine discharge water will be allowed to go as recharge/run-off in the same basin of the area.

As such, this area is having an average annual rainfall of 1270 mm. This rainfall replenishes the annual ground water draft every year. This will enhance the recharge of the aquifer in the area for mitigating the lowering of ground water level in the area surrounding the mine.

11.2.3 MANAGEMENT OF HYDROLOGY AND HYDRO-GEOLOGY

- Assessment of hydrology and hydro-geology of the area

  Investigations have been carried out in and around the area comprising of core and buffer zones of this project. The matter has been dealt.

- Estimation of ground water availability of the area

  Ground water availability of the area comprising of core and buffer zones of this project has been assessed.

- Water demand, dewatering of the mine and waste water management

  The above details have been given in this report.

- Impact of the mine on ground water and surface water

11.2.4 DETAILS OF DE-COMMISSIONING OF THE INFRASTRUCTURES AND PLANT AND MACHINERY

MANAGEMENT / DECOMMISSIONING OF INFRASTRUCTURE

The infrastructure like workshop, office buildings, residential colony, roads and transmission lines, etc., will be provided for the project. Considering the ground realities existing during the period just 1 year before mine closure, plan for reutilization in neighbouring mines or decommissioning will be made. If decommissioning of infrastructure is done, the land occupied by the infrastructure will be restored for some useful purpose. The cost for decommissioning will be met from the **'Corpus Fund'** created for mine closure activities.

MANAGEMENT OF DISPOSAL OF MINING MACHINERY

The salvaging and shifting operation of mining machinery and other equipment will be planned considering the ground realities existing during the period 1 year advance of final closure of the mine.

11.2.5 **FENCING AROUND MINED OUT AREAS**

Fencing will be provided through out the periphery of the proposed mine for safety and security.

11.3 **ENVIRONMENTAL ASPECTS**

11.3.1 **MANAGEMENT OF FINAL VOIDS**

The life of the mine is 15 years. Total OB (103.63 Mcum) will be removed and all the OB will be backfilled. Backfilling will start from 3rd year of operation and will be continued upto end of mine life. Overall slope will be maintained at an angle 26^{o}. Gradient of the surface shall be maintained less than 2% i.e. very gently slopes.

11.3.2 **RECLAMATION OF FOREST/VEGETATION**

Compensatory afforestation will be carried out in forest land diverted for mining and its allied activities. An amount including net present value will be provided for compensatory afforestation including fencing.

11.3.3 **MANAGEMENT OF RECHARGE AREAS**

Mining operation of this project will create voids or depressions, which will induce / accelerate rainfall recharge and decrease run-off in the mining area. Maximum effort will be made to recycle or reuse the treated mine discharge water totally to the extent possible by keeping the make of water in different sumps or low lying areas of the mine. The remaining water will be discharged to the natural drainage for ground water recharge in the same basin. The final voids of the quarry will be left as a water reservoir for water harvesting and also recharging the aquifer in the surrounding area.

11.3.4 **ACCEPTABLE SURFACE AND GROUND WATER FLOWS**

The drainage arrangement for smooth disposal of storm water from OB dump will be made to avoid gully formation on the dump body and also siltation problem of the nearby natural drains.

11.3.5 **ALTERNATIVE USE OF LAND**

There are several options available for land use pattern of the reclaimed land. The following factors have been considered for selection of appropriate land use pattern:

- Pre-mining land use pattern
- Topsoil/sub-soil quality
- Socio-economic parameters of the area
- Availability of technology for land reclamation
- Climatic conditions of the area
- Local flora.

The alternatives available for utilising the reclaimed land are :

- Agricultural use
- Afforestation

The option for using the reclaimed backfilled area for agricultural purpose immediately is ruled out due to the following reasons :

- The reclaimed land is very different from its pre-mining conditions. It cannot sustain crops as the soil has poor fertility status. So the agriculture may prove uneconomic venture compared to afforestation.
- The development of soil regime for agriculture will take a considerable time.
- Reclamation is proposed to be done progressively and concurrently with mining operation. Carrying out agriculture within mining activity area by releasing reclaimed area in a phase-wise manner, may not be advisable from safety point of view.

In view of the above, it is suggested to utilise the reclaimed land for afforestation purpose which will help improve the soil status i.e texture and nutrient levels, etc.

11.4 SOCIAL ASPECT

11.4.1 RE-DEPLOYMENT OF WORK FORCE

The peak workforce required for mine operations is in the first few years of the mine when construction activities as well as operational activities achieve their peak. This workforce slowly goes down with completion of development and when only the operational work remains. Again, near the end of mine life say, 5 years advance of closure, the activity of the mine starts getting reduced and therefore, management will get opportunity to taper the operational manpower. After closure, skeleton service people will be left for continuing the actual closer operations. The reduction of manpower will be effected by following options:

- Retraining and redeployment of younger groups upto 40 years of age.
- Transfer of experienced middle aged groups between 40-50 years to the other projects.
- Implementation of VRS for age group of above 50.
- Retrenchment with suitable compensation after exhausting the above.

11.4.2 MANAGEMENT OF COMMUNITY FACILITIES

The peripheral village community facilities developed by the Mine Authority will be left to the Local Body / State Govt. for management.

11.4.3 EMANCIPATION FROM PAPs

- The resettlement site shall be named suitably.
- If any place of worship like temple, church, etc. are acquired, the same shall be provided on the replacement basis.
- A community of a particular caste, creed and religion shall be allowed to resettle in a particular area in the resettlement colony to foster the communal harmony.
- Training facilities shall be extended to the woman folk to give aequate access to income generating opportunities for raising their social status.

11.5 FINANCIAL ASPECT

1. Cost of reclamation of mined out area.
2. Cost of air quality protection measure.
3. Decommissioning cost of infrastructure
4. Cost of safety & security
5. Socio-economic cost
6. Cost of organization for executing the closure activities.
7. Cost of post project monitoring for five years.

11.6 DETAILS OF MINECLOSURE ACTIVITIES WITH TIME SCHEDULE

11.6.1 LANDUSE

Total land required is 323.92 Ha out of which 227.62 Ha is forest land. Tenancy and Govt.Lands are 51.29 Ha and 45.01 Ha respectively.

11.6.2 ECONOMIC REPERCUSSIONS OF CLOSURE OF MINE

GENERAL

Basundhara west extention OCP will enhance the socio-economic activities in the adjoining areas. This has resulted in following benefits:

- Improvement in Physical Infrastructure.
- Improvement in Social Infrastructure.
- Increase in Employment Potential.
- Contribution to the Exchequer (both State and Central Govt.).
- Post-mining Enhancement of Green Cover.
- Improvement of Electrical Power Generation and consequently rise in electric power consumption there by improvement in overall economic growth of the country.

Agriculture is the main stay in the occupation of the people living in the area. However, other professions like mining and quarrying have dominant role in the economic scene of the buffer zone.

Infrastructures like roads, power line etc will be developed and the local people will gain out of it. Healthcare facilities will be provided in this project. The local people can also avail these healthcare facilities.

Overall there has been positive impact in socio-economic area due to increased economic activities, creation of new employment opportunities, infrastructural development and better educational and healthcare facilities. Even after closure of the mine, these facilities will continue.

MANPOWER FOR CLOSURE ACTIVITIES

The manpower of the project will slowly decrease towards the end of the mine. A skeletal manpower and vehicle support will be needed after closure of the mine. The manpower required for the closure activities and then post-project monitoring are given below:

Manpower for closer activities and post-project monitoring

Sl.No.	Designation	No.
1.	Asst. Colliery Manager	1
2.	Overman	1
3.	Mining Sirdar	1
4.	Watchman	2
	Total :	**5**

ASSESSMENT OF INCOME SCENARIO OF LOCAL PEOPLE

a) All local employees will be redeployed in other projects of the company till their superannuation.

b) People engaged in indirect employment/ ancillary activities will find no financial loss due to the mine closure as their activities will be shifted in the new or expansion mines located in the coalfield area.

All the manpower in the role of MCL will be engaged in other projects of MCL till their superannuation. So overall there will be positive impact in socio-economic area due to increased economic activities, creation of new employment opportunities, infrastructural development and better educational and healthcare facilities. It is expected that , all the people engaged in indirect manner related to ancillary activities will be continue to better employment in the future projects indirectly.

So the income generation of the local people, both direct and indirectly employed in this OCP will not be affected due to closure of the mine.

c) Resettlement/Redeployment of (a) & (b)

The displaced families are being resettled and rehabilitated socially, culturally and economically along with other displaced families such as major married sons, unmarried daughters of 30 years of age, divorcee/deserted women/widows, physically handicapped and/or mentally retarded persons irrespective of age and sex, unmarried brothers/sisters whose parents are not alive, homestead less families (unobjectionable encroachers) and landless families (un-objectionable encroachers) as per latest **'Norms of Govt. of Odisha'**.

d) If no redeployment is possible then sustenance plan

Not applicable.

e) Views of society and expectation on closure of mine.

'Mine Closure Plan' is an important activity in the "**Life Cycle Analysis**" of this project. This will be implemented as per the details outlined with due consideration of views & expectations of the society in this report in an eco-friendly manner. It will be responsibility of the mine owners to ensure that the protective measures contained in the mine closure plan including reclamation and rehabilitation works have been carried out in accordance with the approved mine closure plan and final mine closure plan.

11.6.3 **TIME SCHEDULE**

The closure of mines evolves environmental, technical, social aspect and financial assurance for implementing activities will run for three years. The following activities will be implemented as per bar chart. The details of time schedule for all closure operation which are applicable for both Progressive and Final Mine Closure Plan has been described with bar chart.

IMPLEMENTATION SCHEDULE FOR MINE CLOSURE OF BASUNDHARA WEST EXT. OCP (LIFE OF THE MINE : 12 YEARS)

Sl.No	Activity	Time Frame	Year-1 to year-4	Year-5 to year-8	Year-9 to year-12	Post Closure Phase		
						PC1	PC2	PC3
A	**Dismantling of Structures**							
	Service Buildings	2 years						
	Residential Buildings	2 & ½ years						
	Industrial structures like CHP, Workshop, field sub-station, etc.	2 & ½ years						
B	**Permanent Fencing of mine void and other dangerous area**							
	Random rubble masonry of height 1.2 metre including leveling up in cement concrete 1:6:12 in mud mortar	2 years						
C	**Grading of highwall slopes**							
	Levelling and grading of highwall slopes	2 years						
D	**OB Dump Reclamation**							
	Handling/Dozing of OB Dump and backfilling	Throughout the life of the mine including 3 years after cessation of mining operation						
	Technical and Bio-reclamation including plantation and post care	Throughout the life of the mine including 3 years after cessation of mining operation						
E	**Landscaping**							
	Landscaping of the open space in the leasehold area to improve esthetics and eco value	Throughout the life of the mine including 3 years after cessation of mining operation						

Sl.No	Activity	Time Frame	Year-1 to year-4	Year-5 to year-8	Year-9 to year-12	Post Closure Phase		
						PC1	PC2	PC3
F	**Plantation**							
	Plantation over cleared area obtained after dismantling	2 years						
	Plantation around the quarry area and in safety zone	Throughout the life of the mine including 3 years after cessation of mining operation						
	Plantation over the external OB Dump	Throughout the life of the mine						
G	**Post Closure Env Monitoring / testing of parameters for three years**							
	Air Quality	3 years						
	Water Quality	3 years						
H	**Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	Throughout the life of the mine						
I	**Miscellaneous and other mitigative measures**	Throughout the life of the mine including 3 years after cessation of mining operation						
J	**Post Closure Manpower cost for supervision**	3 years						

PC1 : Post Closure Year 1

PC2 : Post Closure Year 2

PC3 : Post Closure Year 3

11.6.4 **MINE CLOSURE COST FOR OPENCAST MINE**

The cost of the mine closure of the project has been estimated comprising of cost of reclamation of mined out area, cost of air quality protection measure, decommissioning cost of infrastructure, cost of safety & security, socio-economic cost, cost of organization for executing the closure activities, cost of post project monitoring for three years, rehabilitation of mining machinery (disposal of mining machinery), arboriculture and land scaping including biological reclamation and cost of barbed wire fencing all around working area. **The mine closure cost as mentioned above, for Basundhara west Extension OCP has been considered Rs.8.476 lakh per ha [as per WPI (Nov., 2016) (provisional)].** Annual closure cost has been computed considering the total leasehold area as per guide line. The Money to be levied per hectare of mining lease is to be deposited every year after commencement of any activity on the land for the mine after opening an **Escrow Account**. Mining Company/owner including all Public Sector Unertakings will deposit the yearly amount in a Schdeluded Bank. The details of the final mine Closure Plan along with the details of the cost estimate for various mine closure activites and Escrow Account shall be submitted to the Ministry of Coal for approval. An amount equal to the annual cost is to be deposited each year throughout the mine life compounded @ 5% annually. Annual closure cost is to be computed considering the total leasehold area at the above mentioned rates and dividing the same by the life of mine. When implementation of the final mine closure scheme is undertaken by the mine owner starting five years before the scheduled closure of mining operations, the Coal Controller may permit withdrawals (four years before final mine closure date) from the Escrow Account propositionate to the quantum of work carried out, as reimbursement. The withdrawn amount each year shall not exceed 20% of the total amount deposited in the account.

Total Project area involved	:	323.92 Ha
Mine closure cost/Ha (November 2016 cost base)	:	Rs.8.487 lakh
Total Mine closure cost (November 2016 cost base)	:	Rs.2749.11 lakh

PHASING OF MINE CLOSURE COST

The annual closure cost is to be computed considering the total leasehold area (Total project area) and dividing the same by the life of the mine. An amount equal to the annual cost is to be deposited each year throughout the mine life compounded @5% annually.

Total mine closure cost estimated : Rs.2749.11 lakhs

Life of the project : 12 years

Out of the 12 years last 5 years are for final implementation of mine closure activities, for annual cost calculations 12 years period has been considered:

Annual mine closure amount to be deposited with Coal Controller:

2749.11 lakhs/12 years = 229.09 lakhs per year.

Yearly phasing of mine closure cost is as below:

Year	Mine closure cost(Rs. in lakh)
Yr-1	229.09
Yr-2	240.55
Yr-3	252.57
Yr-4	265.20
Yr-5	278.46
Yr-6	292.38
Yr-7	307.00
Yr-8	322.35
Yr-9	338.47
Yr-10	355.39
Yr-11	373.16
Yr-12	391.82
TOTAL	**3646.44**

Total estimated mine closure cost compounded @5% annually for 12 years is : Rs. 3646.44 lakhs.

The mine closure cost deposited and amount released to mine owner/lease holder will be as per guidelines issued by Ministry of Coal vide letter no.55011-01-2009-CPAM, Dt.7/1/2013.

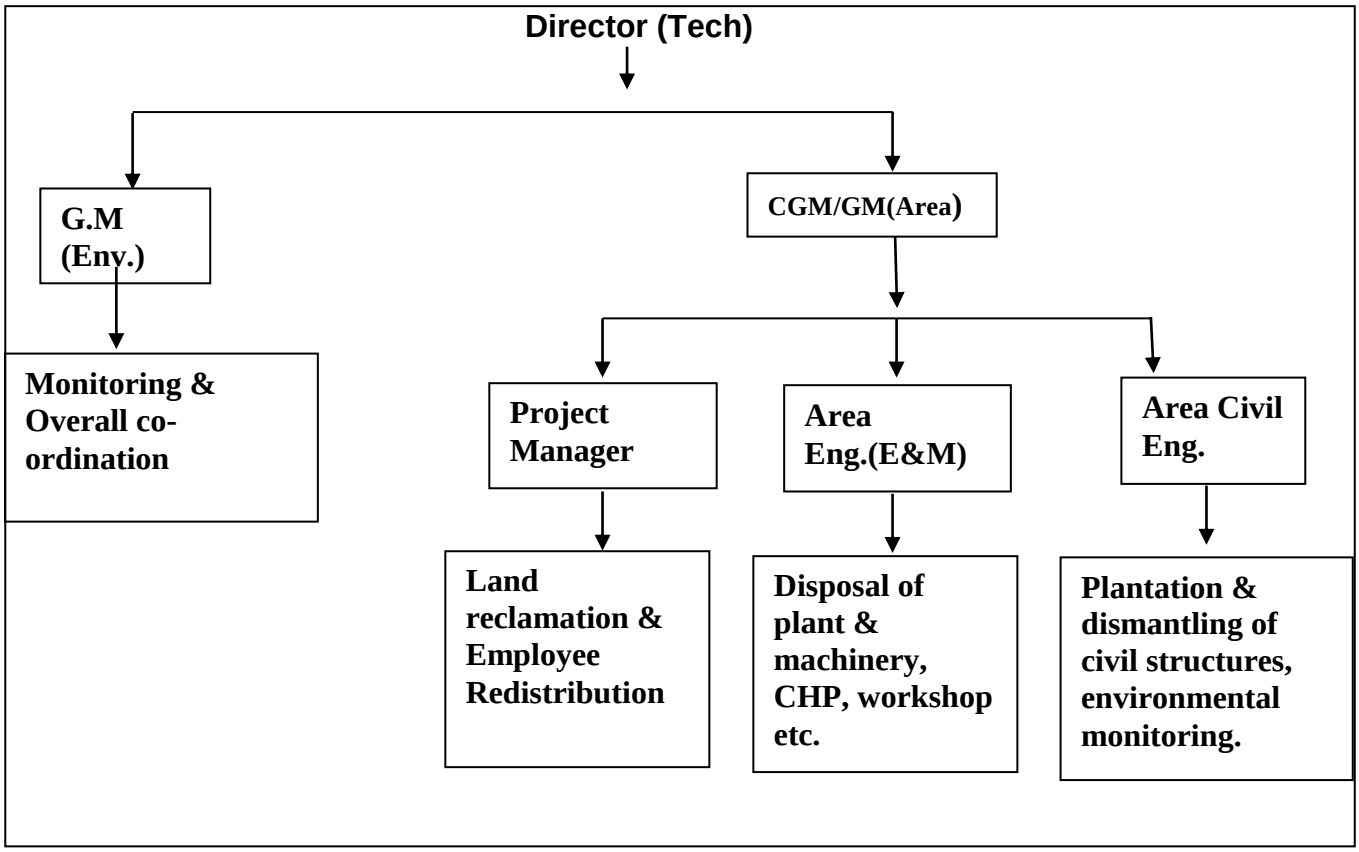
11.6.5 MANPOWER REQUIREMENT AND PROGRESSIVE & FINAL MINE CLOSURE COST DISTRIBUTION

Activity wise manpower requirement and Progressive & Final Mine Closure cost distribution is given in table below:

Sl. No.	ACTIVITY	Manpower Required (No.)	Mine Closure Cost (percentage weightage)	Remarks
A	Dismantling of Structures			To be included in final mine closure plan
	Service Buildings	42	0.2	
	Residential Buildings	101	2.67	
	Industrial structures like CHP, Workshop, field sub-station, etc.	125	0.3	
B	Permanent Fencing of mine void and other dangerous area			To be included in final mine closure plan
	Random rubble masonry of height 1.2 metre including leveling up in cement concrete 1:6:12 in mud mortar	87	1.5	
C	Grading of highwall slopes			To be included in final mine closure plan
	Levelling and grading of highwall slopes	54	1.77	
D	OB Dump Reclamation			
	Handling/Dozing of OB Dump and backfilling	396	88.66	71% for progressive and 17.66% for final mine closure.
	Technical and Bio-reclamation including plantation and post care.	130	0.4	Equal weightage throughout the life of the mine.
E	Landscaping			
	Landscaping of the open space in leasehold area for improving its esthetics an eco value	17	0.3	Equal weightage throughout the life of the mine.
F	Plantation			
	Plantation over cleared area obtained after dismantling	Included in 'D'	0.5	To be included in final mine closure plan
	Plantation around the quarry area and in safety zone	Included in 'D'	0.2	Equal weightage throughout the life of the mine.
	Plantation over the external OB Dump	Included in 'C'	0.02	Equal weightage throughout the life of the mine.
G	Post Closure Env Monitoring / testing of parameters for three years			For three years after mine closure
	Air Quality	8	0.22	
	Water Quality		0.2	
H	Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people	To be out-sourced	0.26	Equal weightage throughout the life of the mine.
I	Miscellaneous and other mitigative measures	To be out-sourced	2.0	Equal weightage throughout the life of the mine.
J	Post Closure Manpower cost for supervision	Included in 'A' to 'F'	0.8	To be included in final mine closure plan
	TOTAL		100.00	

11.6.6 **IMPLEMENTATION PROTOCOL**

For implementing the mine closure activities, the following organizational structure has been proposed:



Environmental monitoring for three years after closure of mine will be carried out to evaluate the environmental quality of the area. It need be, proper mitigation measures will be taken up after evaluating the environmental quality. The funds for this have been provided in the cost estimate. Before closure of the mine, Area GM will prepare survey and disposal report and the same will be submitted to DGMS for acceptance.

11.6.7 **BOND/INSURANCE FOR THE CLOSURE COST**

The effective implementation of the mine closure plan requires detailed consultation and association with stake holders like employee, trade union, mine related business, state and central govt. agencies, etc. Which will make them actively involved, and thus smooth mine closure operation may be possible.

ANNEXURE - 1

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महानदी कोलफील्ड्स लिमिटेड
Mahanadi Coalfields Limited
(A subsidiary of Coal India Limited)

Office of the Company Secretary
At/Po. Jagruti Vihar, Burla, MCL
Dist. Sambalpur - 768020 (Odisha)
CIN: U10102OR1992GOI003038
Tele/Fax No. 06632542277
Email id: [illegible]
Website: www.mcl.gov.in

MCL

Ref. No. MCL/SBP/CS/Ex-157/Extr/2014/ 7956 Date: 15.06.2014

गोपनीय/CONFIDENTIAL

सेवा में,
GM(CP&P)
महानदी कोलफील्ड्स लिमिटेड, सम्बलपुर

विषय: **Extract from the minutes of 157th meeting of the Board of Directors of MCL held at 10.00 AM on 07.06.2014 at MCL Office, Sambalpur.**

प्रिय महोदय,

आप के सूचनार्थ एवं उचित कार्यवाही हेतु एम. सी. एल. की निदेशक मण्डल की 157 वीं बैठक का Extract of Minutes दिये जा रहे हैं।

157.C/10 **Approval of Annual Plan 2014-15.**

10.1 The Board deliberated on the proposal in detail and approved the Annual Plan 2014-15 based on Coal Production of 127.00 MT, OB Removal of 113 M.T. Cum and Offtake of 132 MT as per the details brought out in the agenda note.

157.C/11 **Approval of Annual Action Plan 2014-15.**

11.1 The Board deliberated on the proposal in detail and approved the Annual Action Plan 2014-15 based on Coal Production of 127.00 MT, OB Removal of 113 M.T. Cum and Off-take of 132 MT as per the details brought out in the agenda note.

157.C/12 **Approval of Project Report for Basundhara (West) Extension Opencast Project (Normative Capacity-7.00 Mty) (Peak Capacity 8.75 Mty).**

12.1 The Board deliberated on the Project Report for Basundhara (West) Extension Opencast Project (Normative Capacity-7.00 Mty) (Peak Capacity 8.75Mty) and based on the recommendation of the Technical Sub-committee in its 12th meeting held on 02nd April, 2014, agreed for getting EMP clearance for peak coal production level of 8.75 Mty, to be implemented in Variant-I i.e. coal and OB by departmental means with an additional capital investment of Rs. 479.15 crore up to target year and ₹141.26 crore beyond target year and at the same time retaining outsourcing option as per requirement.

157.C/13 **Approval of Project Report for Jagannath Re-organization OCP (Normative Capacity 8.00 Mty) (Peak Capacity 7.50 Mty).**

13.1 The Board directed to re-submit the proposal after evaluating the impact of weighted average GCV of all the seams.

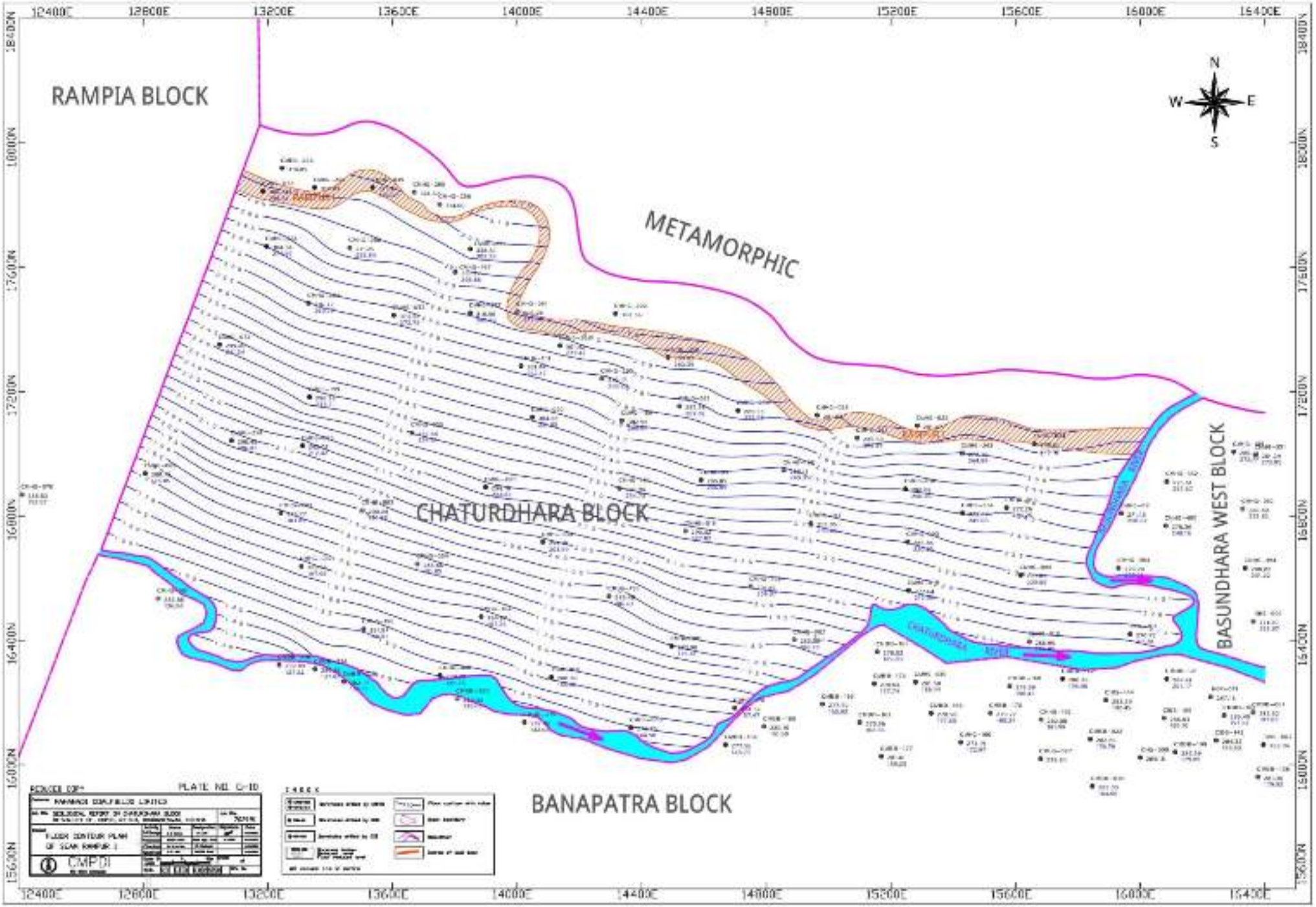
157.C/38 **Approval of tender document & estimate for selection of Transaction Advisor for Siarmal Pilot Project under PPP.**

38.1 The Board deliberated on the proposal in detail and based on the facts brought out in the agenda note, accorded 'in principle' approval to the proposal of approval of tender document and estimate for selection of Transaction Advisor for Siarmal Pilot Project under PPP as per the details brought out in the agenda note.

157.D/2 **Appraising the board regarding MoU 2014-15 between Mahanadi Coalfields Limited and Coal India Limited authenticated by DPE.**

2.1 The Board noted the information as per the details brought out in the agenda note.

कृते,
कंपनी सचिव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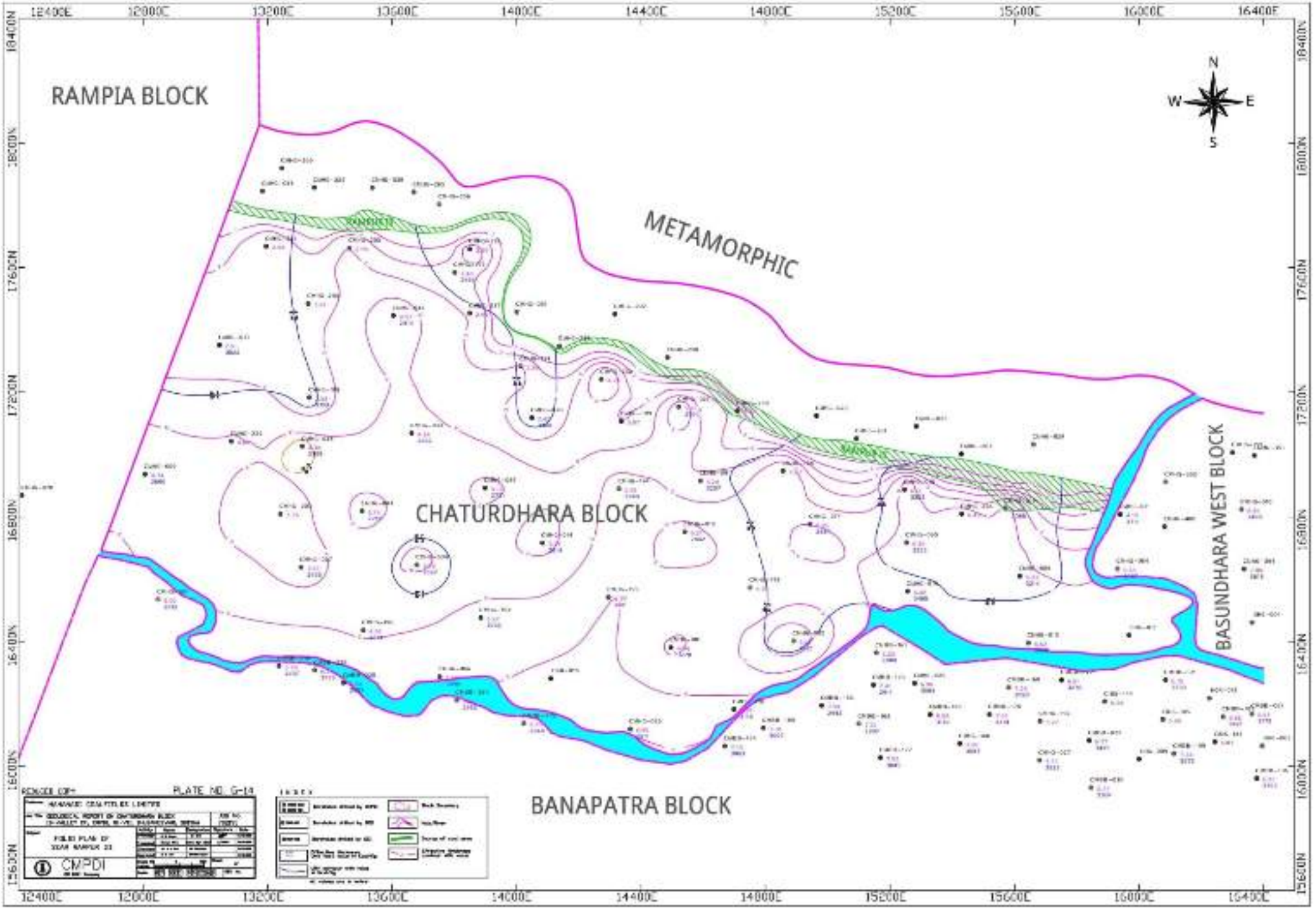
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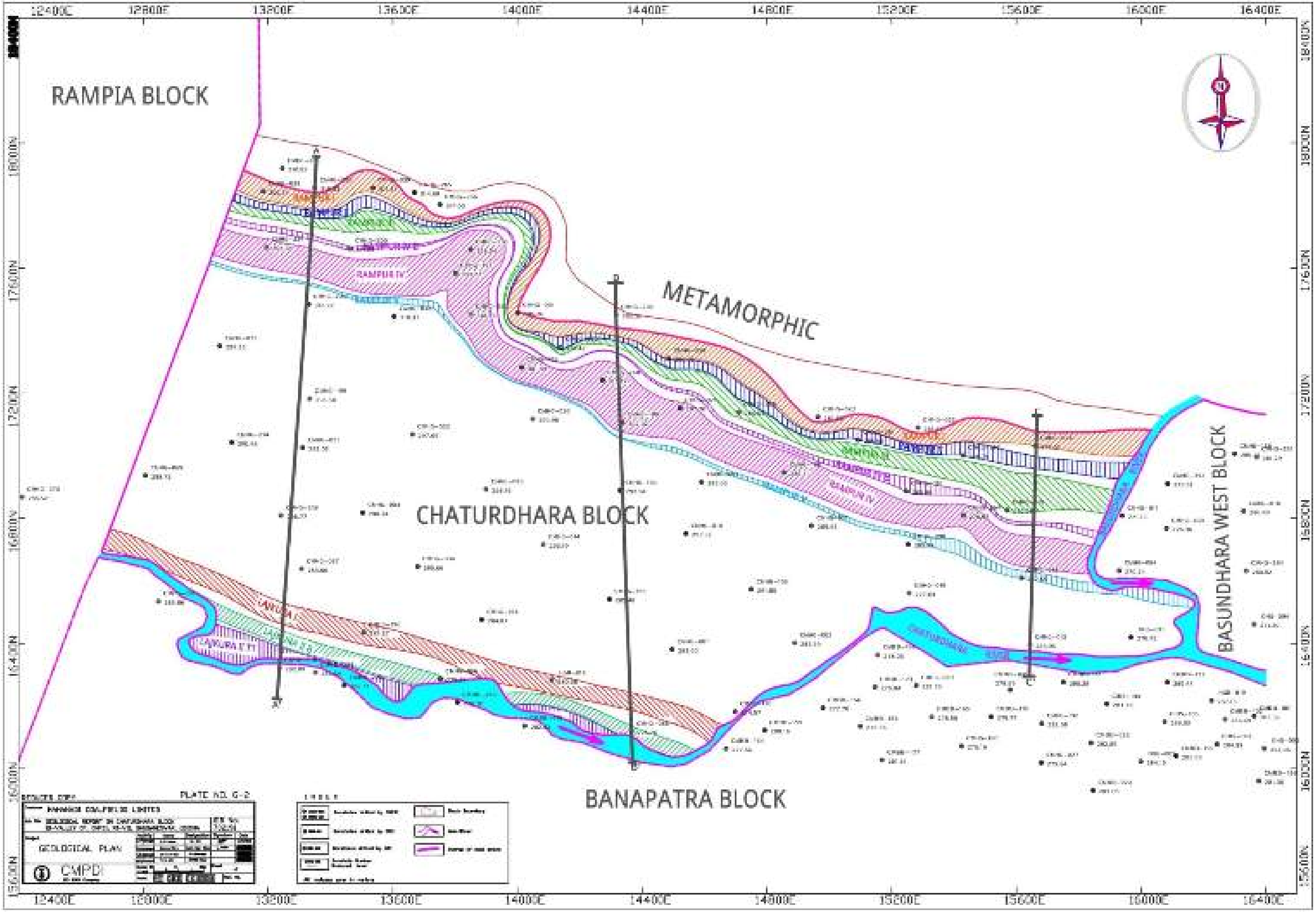
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GEOLOGICAL PLAN
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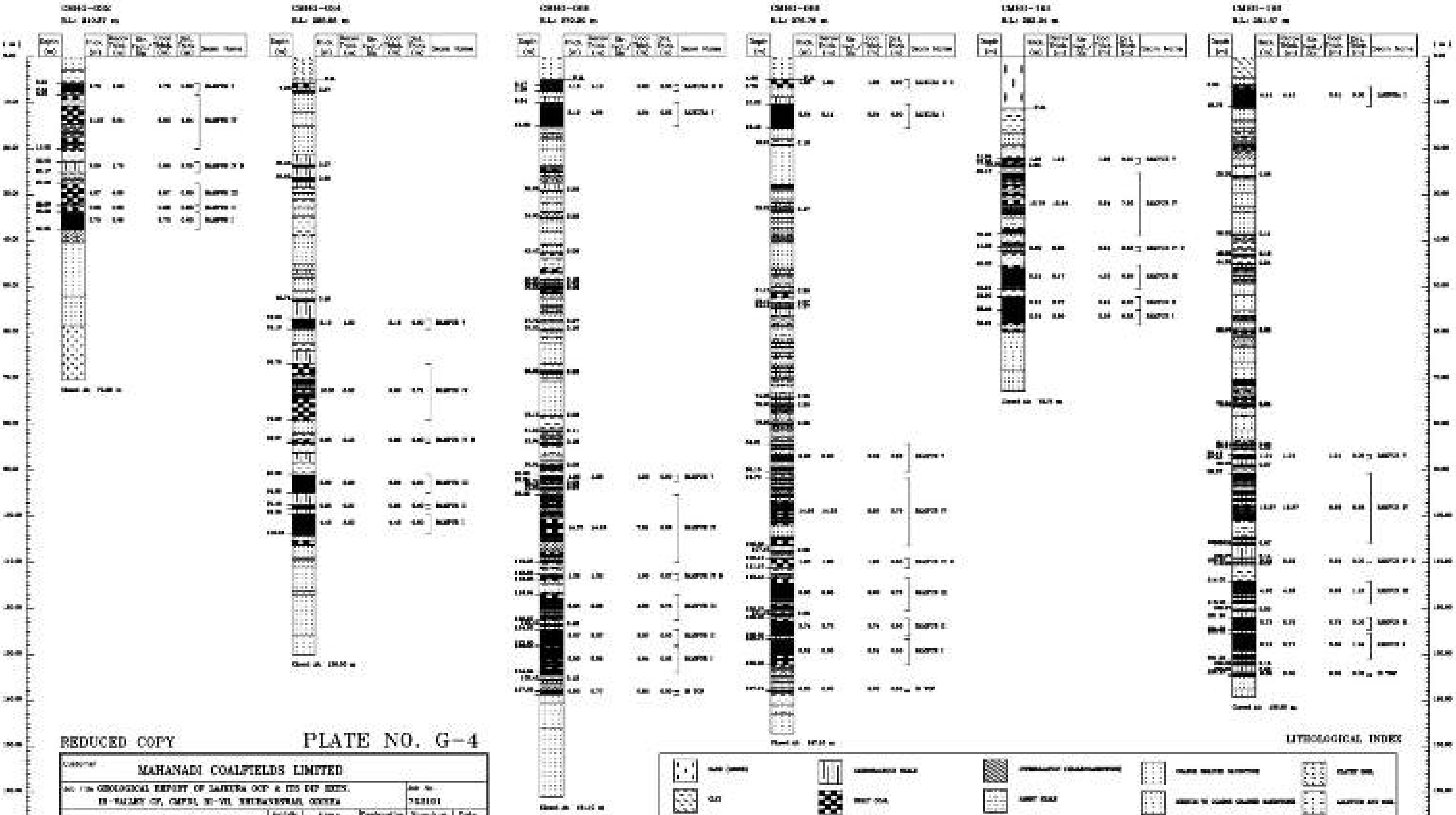

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PLATE NO. G-4

Customer: MAHANADI COALFIELDS LIMITED

GEOLOGICAL REPORT OF LAJKURA OCP & ITS DIP EXTN.

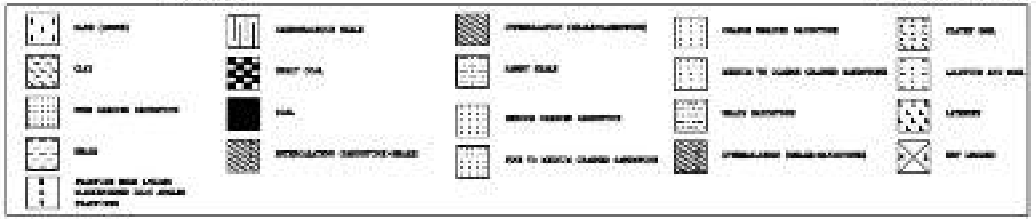
Job No. 703101

Subject: REPRESENTATIVE GRAPHIC LITHOLOGS OF CHATURDHARA OCP

CMPDI

ISO 9001 Company

LITHOLOGICAL INDEX

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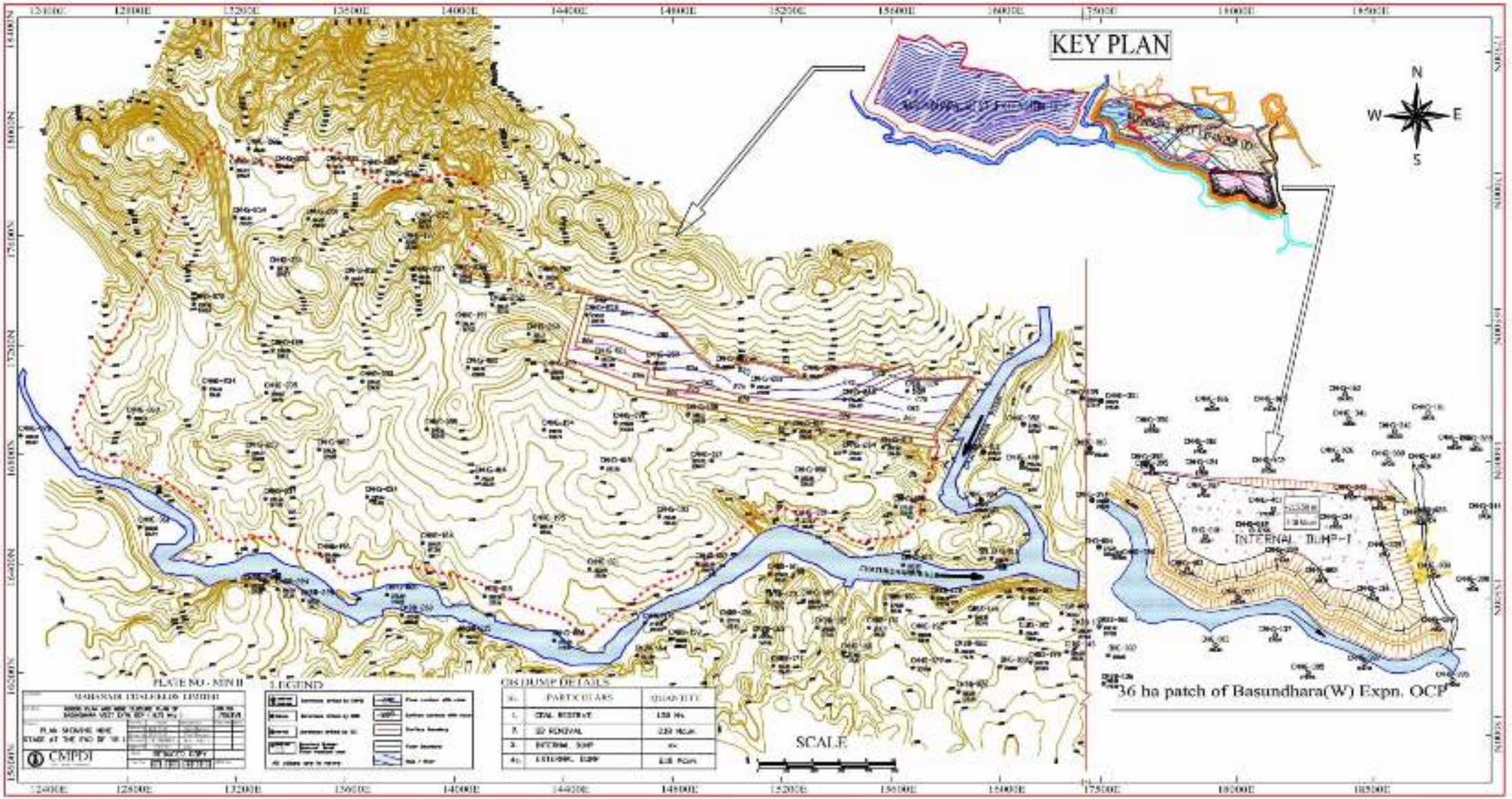
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36 ha patch of Basundhara(W) Expn. OCP
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OB DUMP DETAILS
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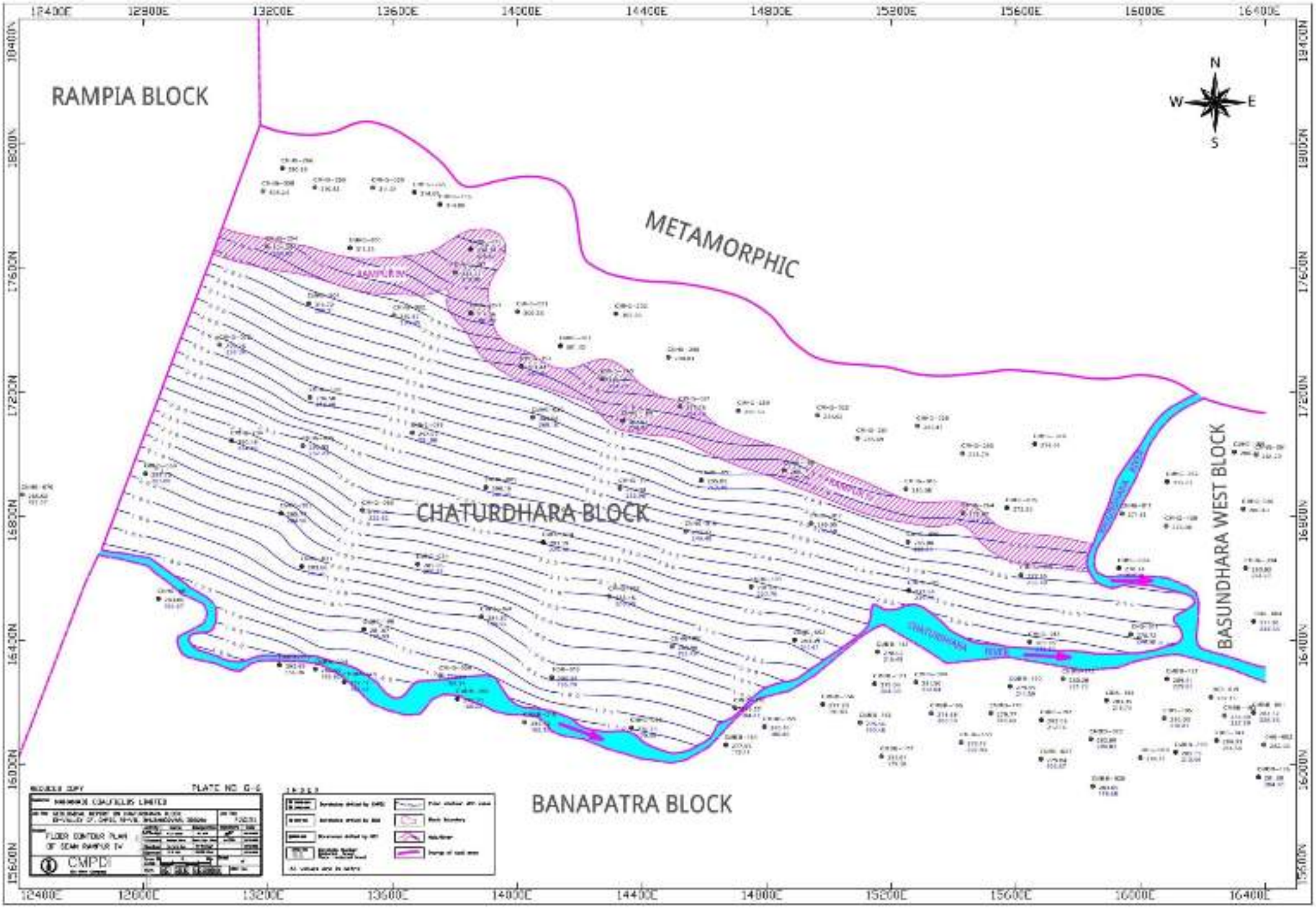
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FLOOD CONTOUR PLAN
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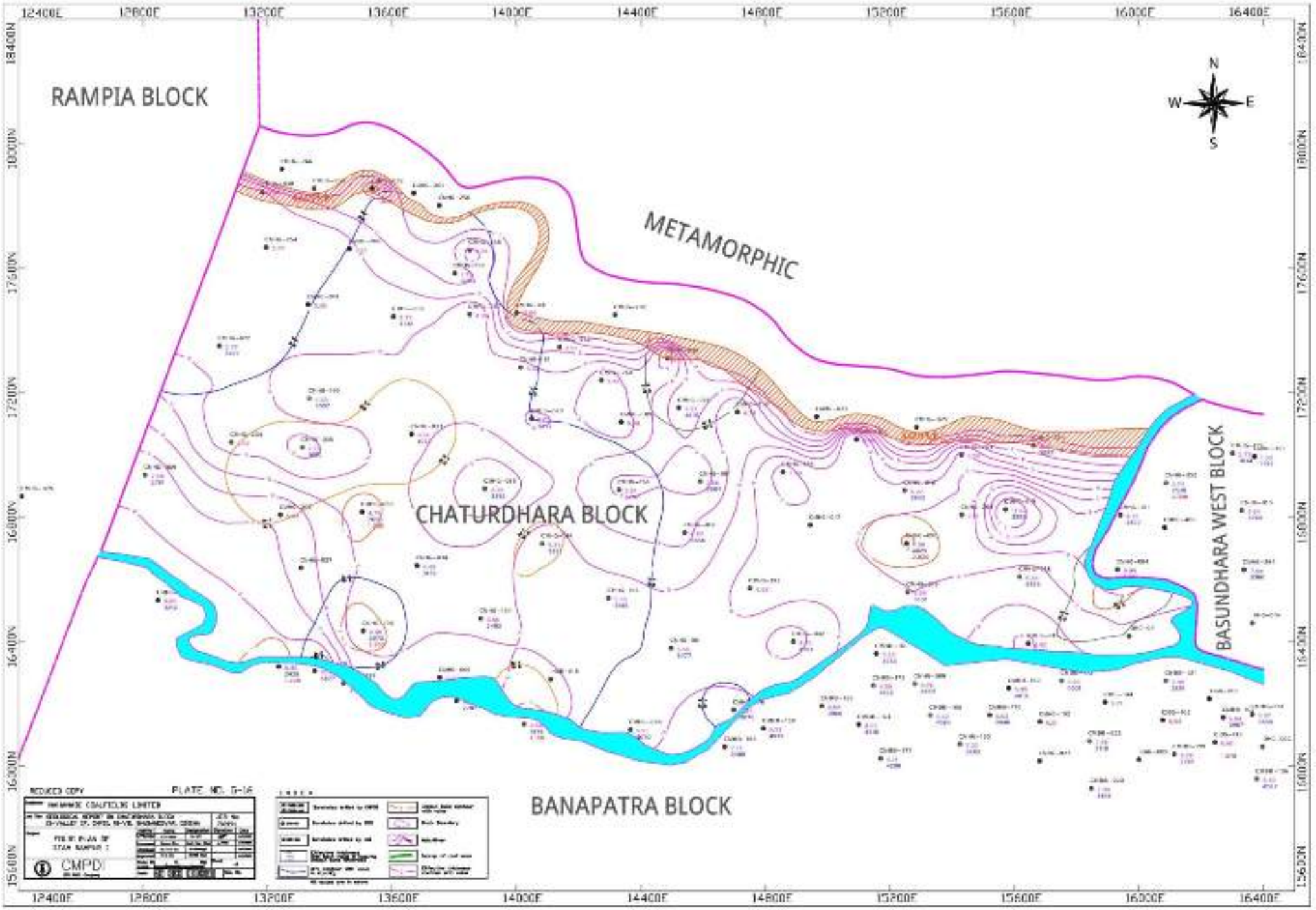
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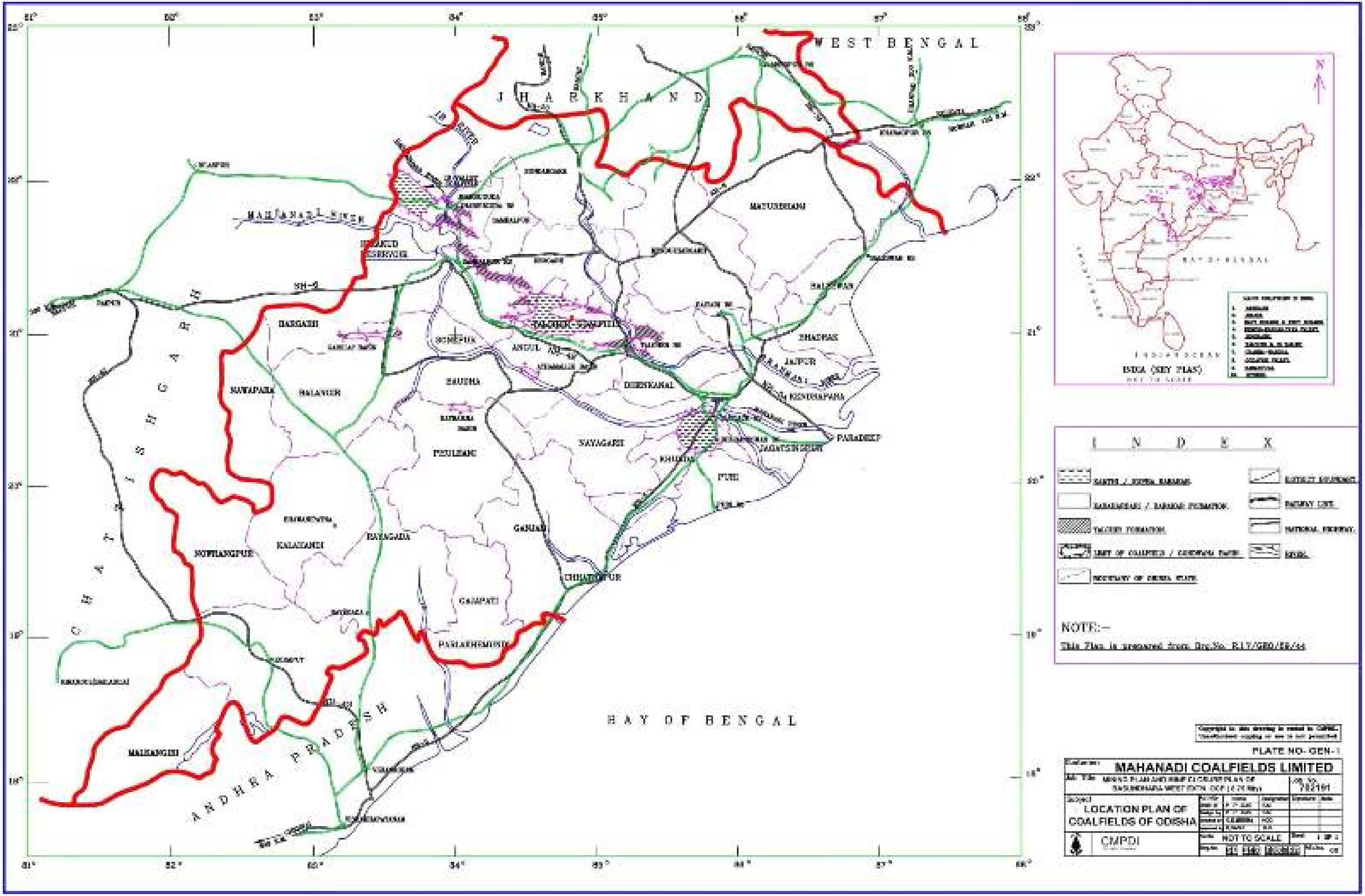
PLATE NO. G-16
CMPD


WEST BENGAL
JHARKHAND
CHHATISGARH
ANDHRA PRADESH
BAY OF BENGAL
MAHANADI RIVER
NH-6
SAMBALPUR
BARGARH
NAWAPARA
BALANGIR
SONEPUR
ANGUL
BAUDHA
PHULBANI
NAYAGARH
DHENKANAL
KHURDA
PURI
JAGATSINGHPUR
PARADEEP
KENDRAPARA
JAJPUR
BHADRAK
BALASORE
MAYURBHANJ
KALAHANDI
RAYAGADA
NOWRANGPUR
GANJAM
GAJAPATI
PARLAKHEMUNDI
CHHATRAPUR
MALKANGIRI
INDIA (KEY PLAN)
BAY OF BENGAL
INDIAN OCEAN
INDEX
TALCHER FORMATION.
RAILWAY LINE.
NATIONAL HIGHWAY.
NOTE:-
This Plan is prepared from Drg.No. R17/GEO/58/44
PLATE NO- GEN-1
MAHANADI COALFIELDS LIMITED
LOCATION PLAN OF
COALFIELDS OF ODISHA
NOT TO SCALE
CMPDI

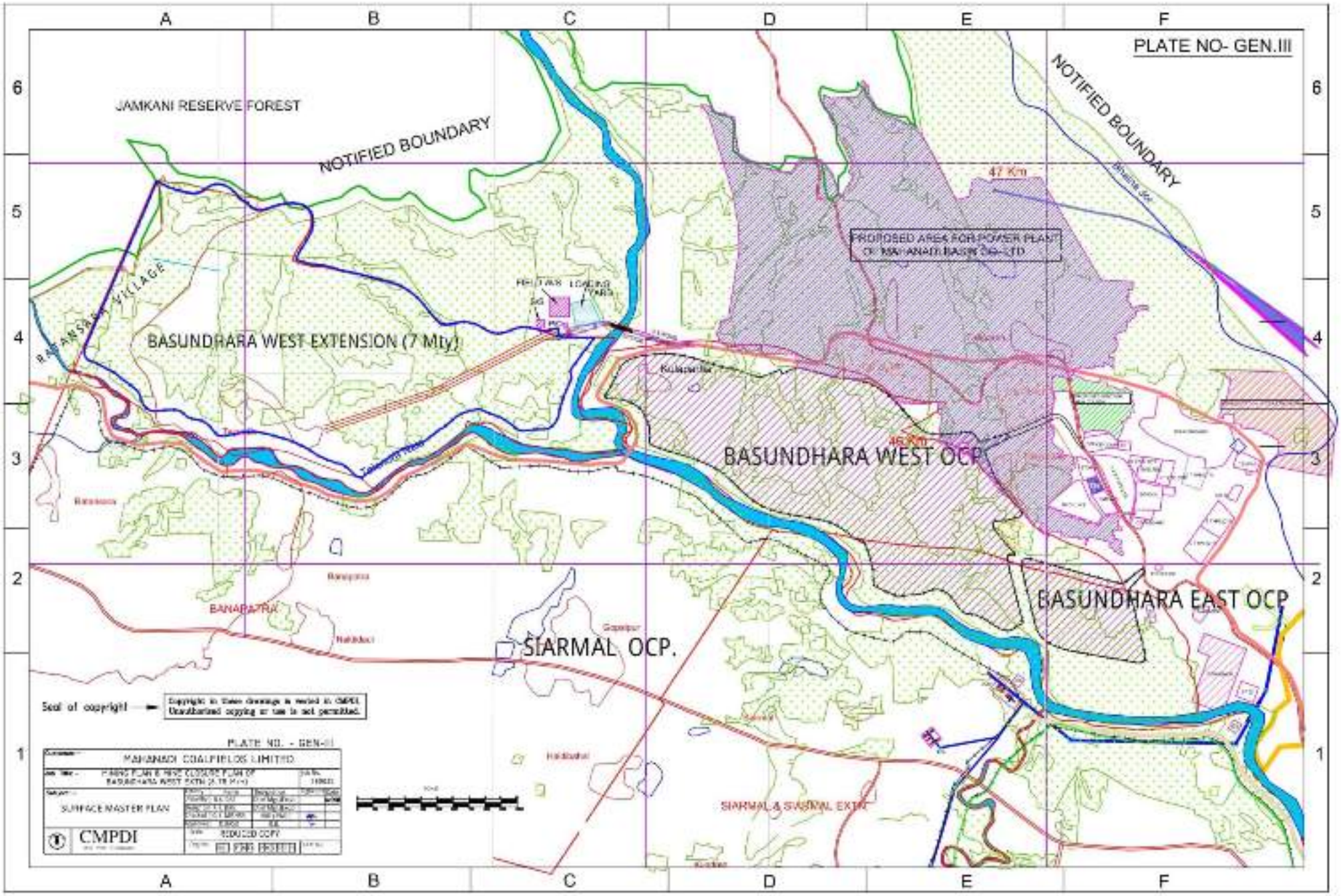
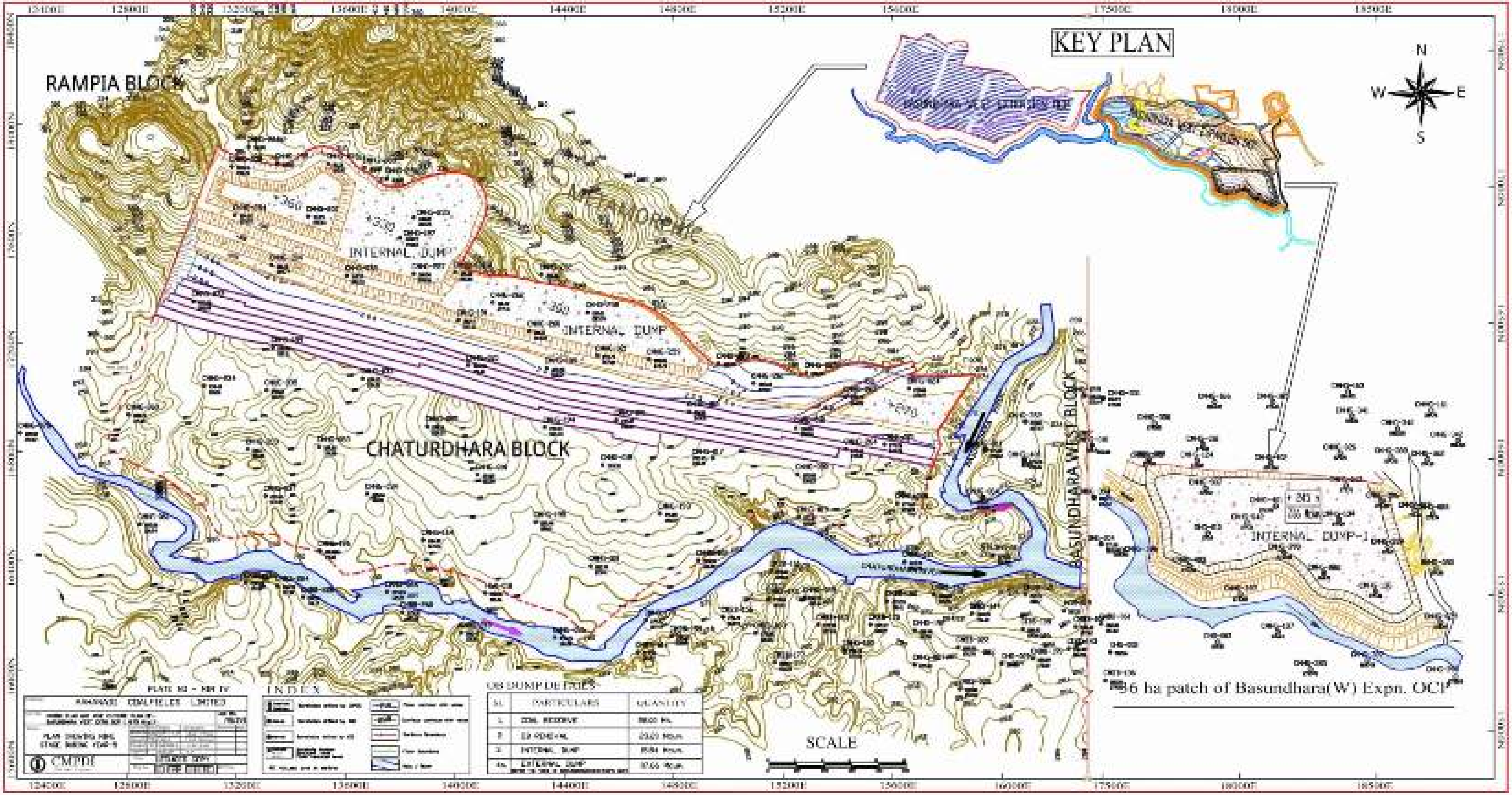
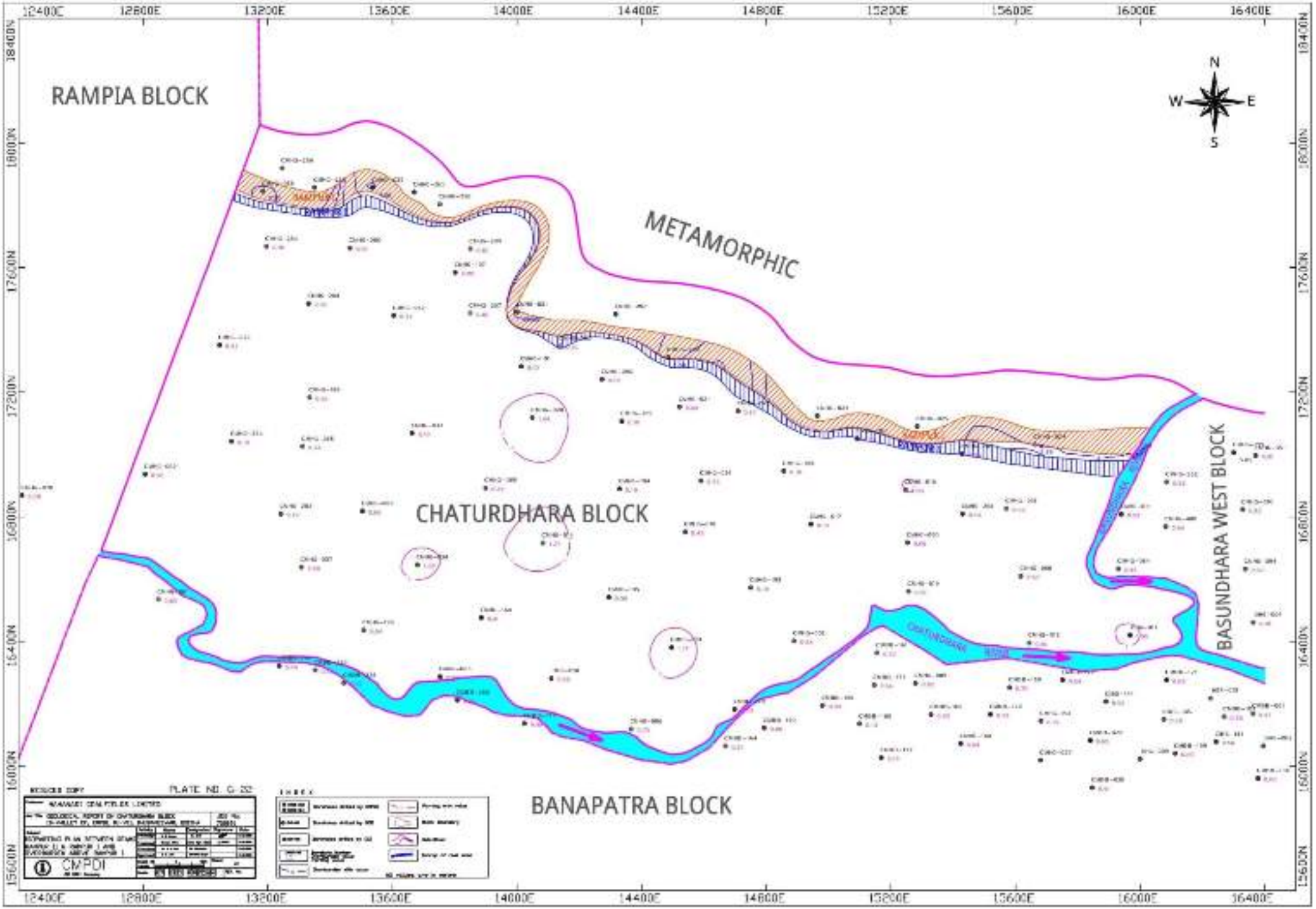


PLATE NO- GEN.III
JAMKANI RESERVE FOREST
NOTIFIED BOUNDARY
NOTIFIED BOUNDARY
47 Km
PROPOSED AREA FOR POWER PLANT OF MAHANADI BASIN (P) LTD
BASUNDHARA WEST EXTENSION (7 Mty)
BASUNDHARA WEST OCP
BASUNDHARA EAST OCP
SIARMAL OCP.
SIARMAL & SIARMAL EXTN
BANAPATRA
Seal of copyright
PLATE NO. - GEN-III
MAHANADI COALFIELDS LIMITED
SURFACE MASTER PLAN
CMPDI
REDUCED COPY


KEY PLAN
N
S
E
W
RAMPIA BLOCK
CHATURDHARA BLOCK
INTERNAL DUMP
INTERNAL DUMP
BASUNDHARA WEST BLOCK
INTERNAL DUMP-1
36 ha patch of Basundhara(W) Expn. OCP
SCALE
INDEX
PARTICULARS
COAL RESERVE
INTERNAL DUMP
EXTERNAL DUMP
CMPDI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CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
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14000E
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INDEX

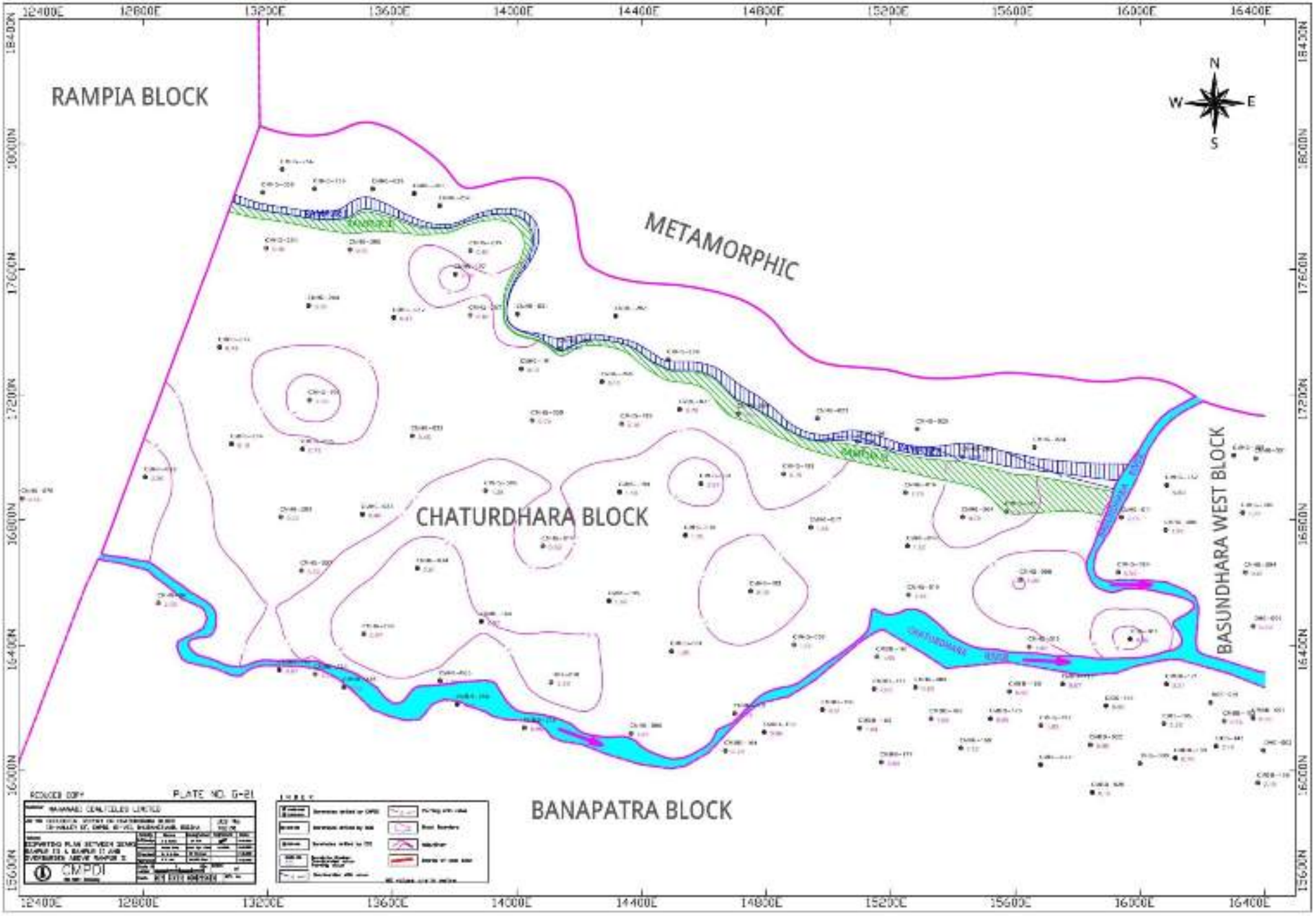
RAMPIA BLOCK
METAMORPHIC
CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
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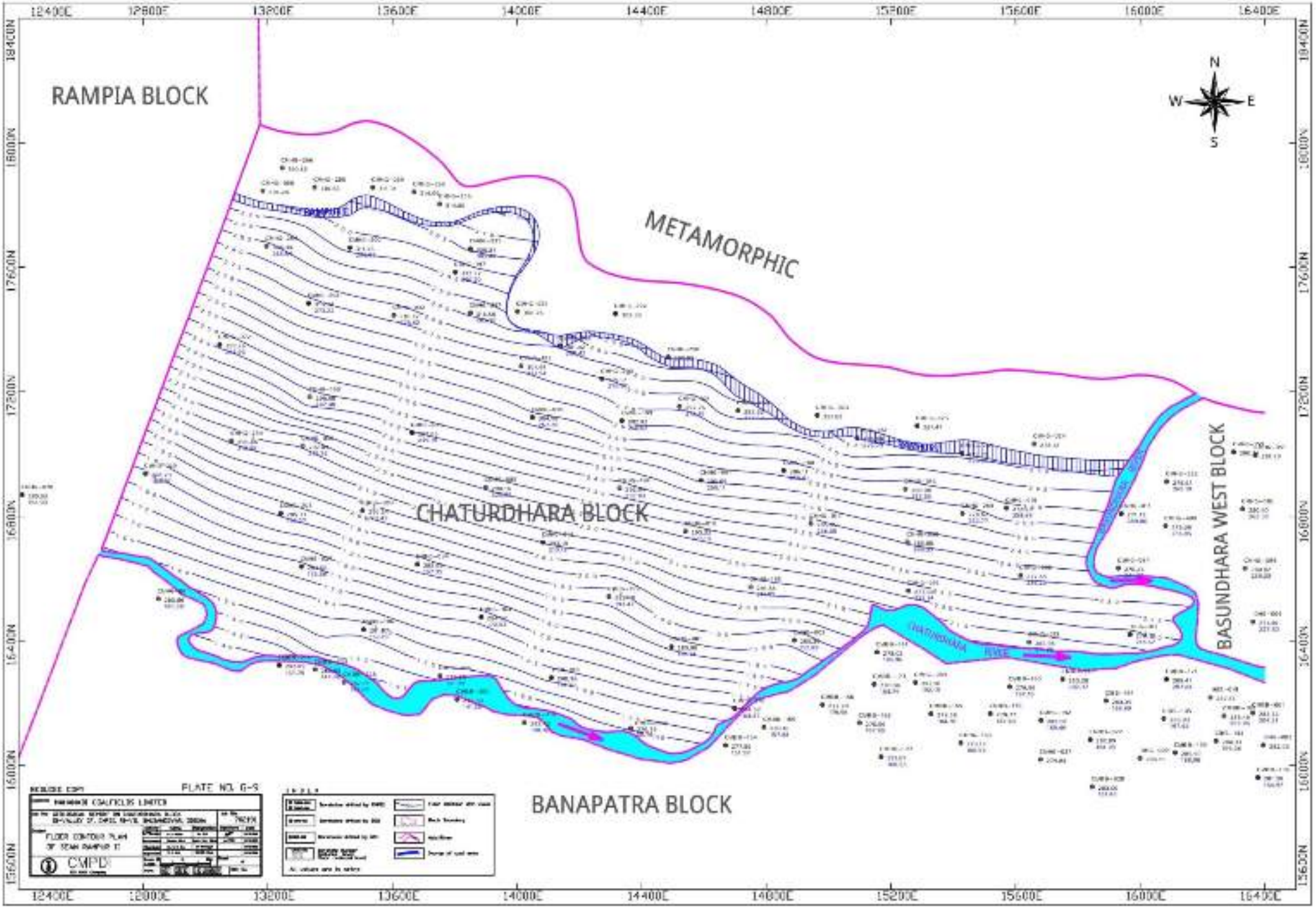
PLATE NO. G-21
CMPDI


RAMPIA BLOCK
METAMORPHIC
CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
CHATURDHARA RIVER
N
S
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W
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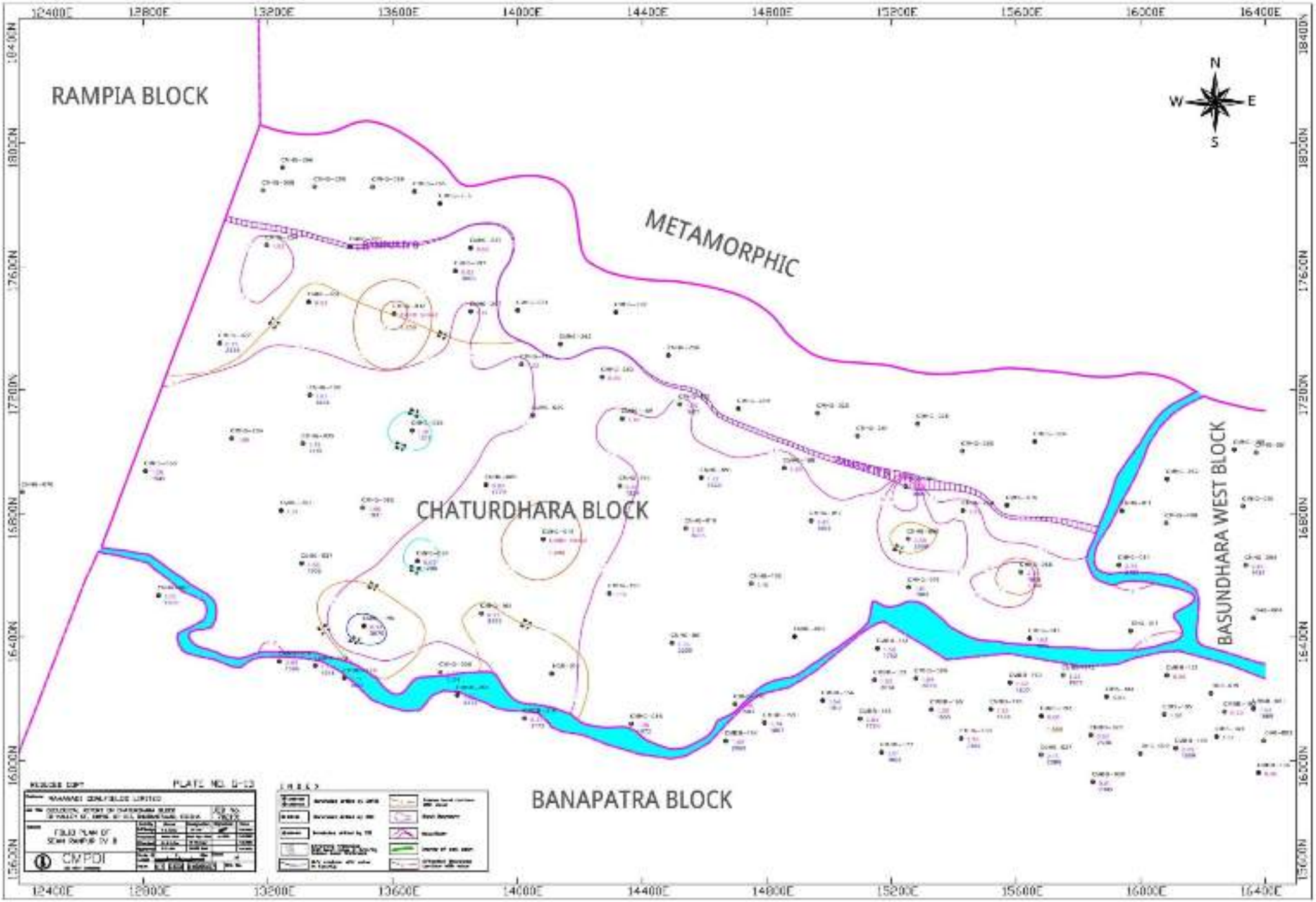
PLATE NO. G-9
CMPDI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METAMORPHIC
CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
N
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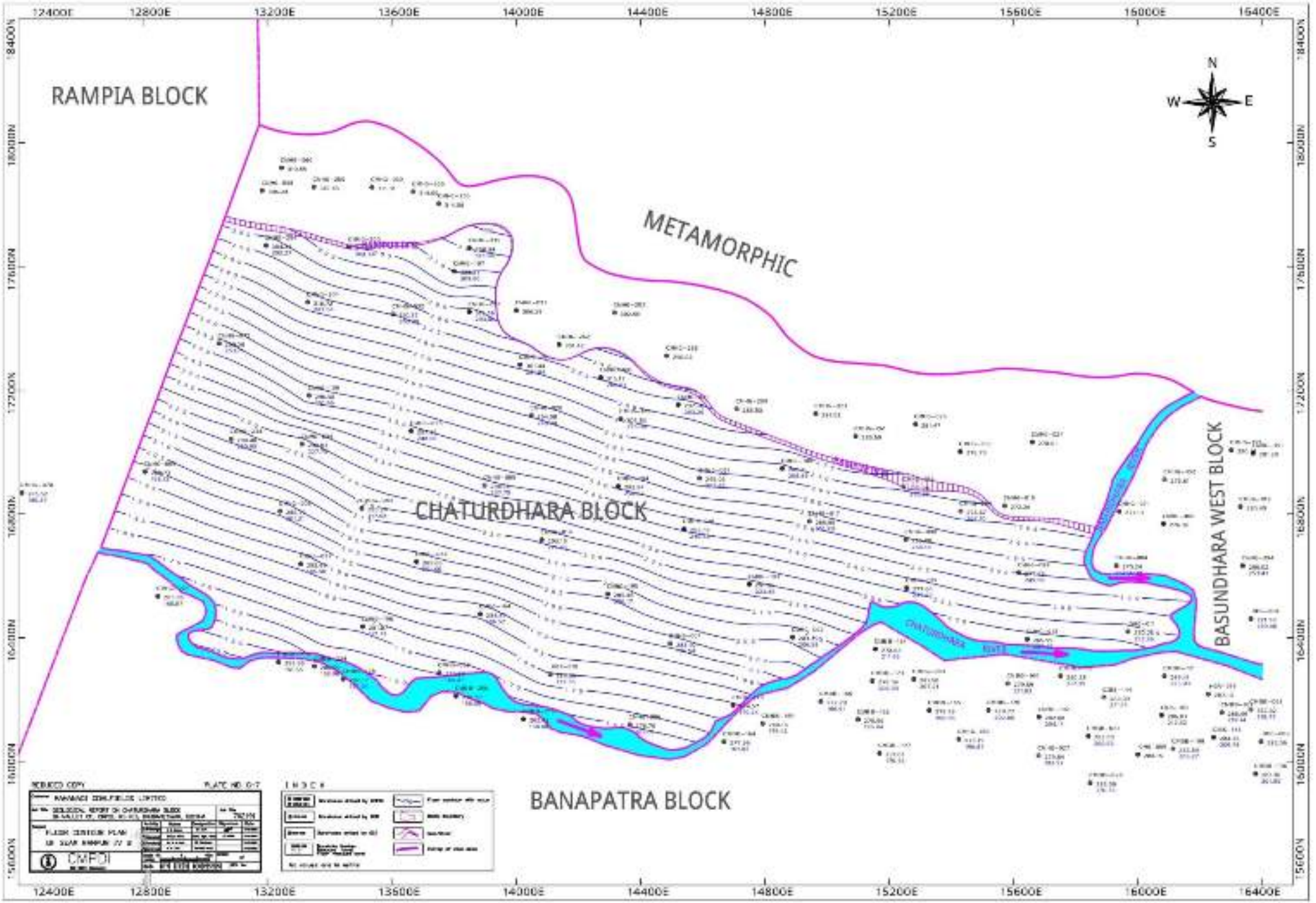
PLATE NO. D-13
CMPDI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CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
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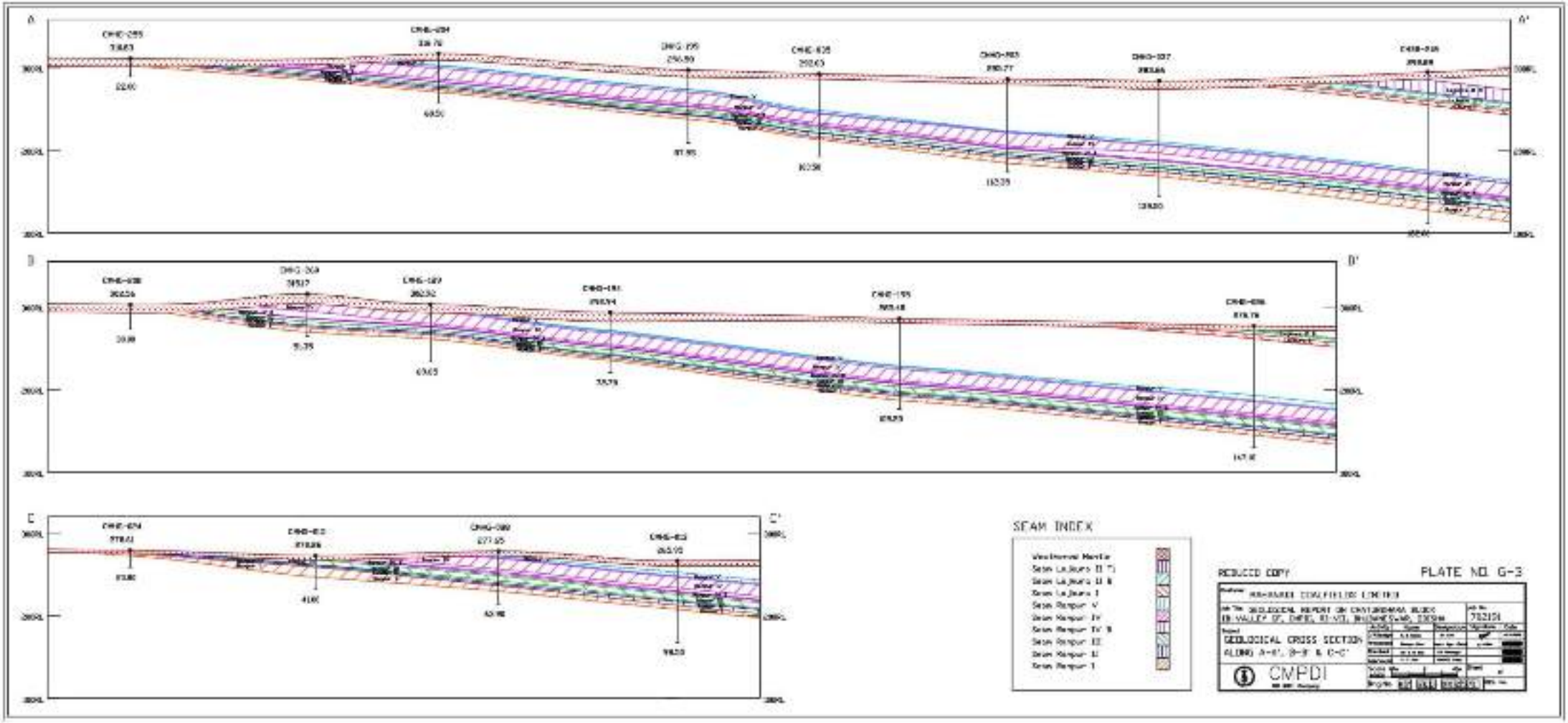
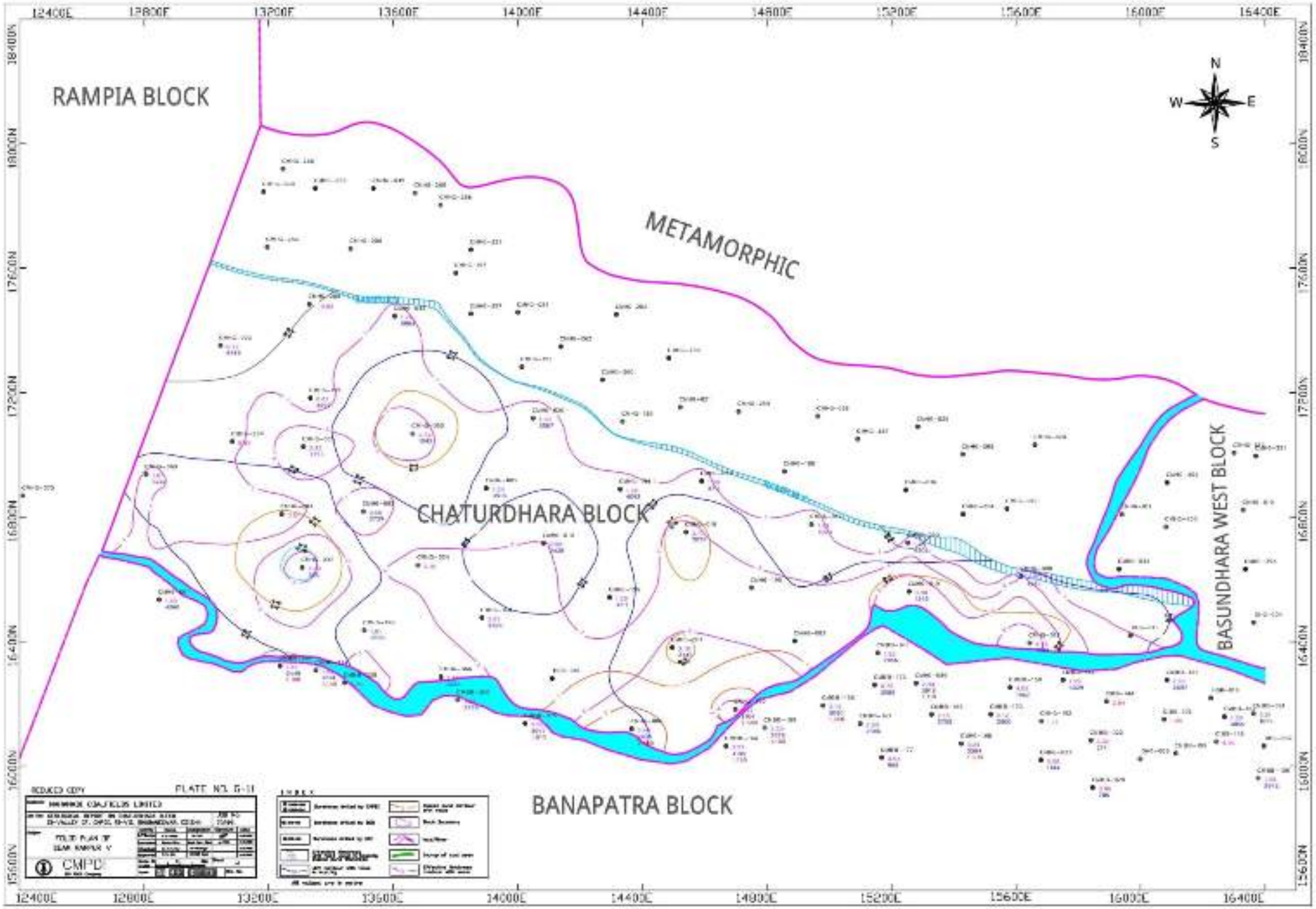
CMPDI


A
A'
B
B'
C
C'
SEAM INDEX
REDUCED COPY
PLATE NO. G-3
GEOLOGICAL CROSS SECTION
ALONG A-A', B-B' & C-C'
CMPDI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CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
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PLATE NO. G-II
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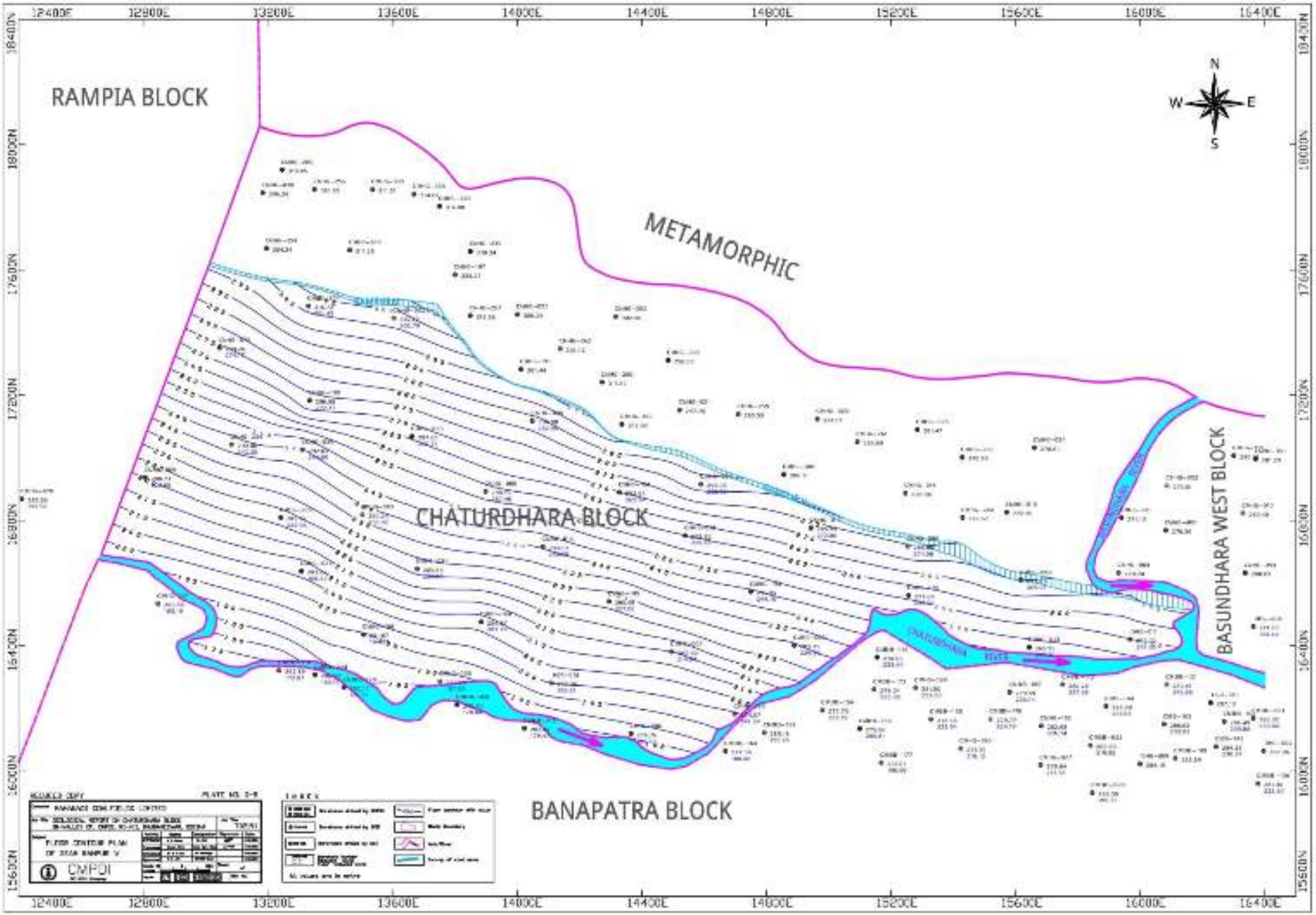
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METAMORPHIC
CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
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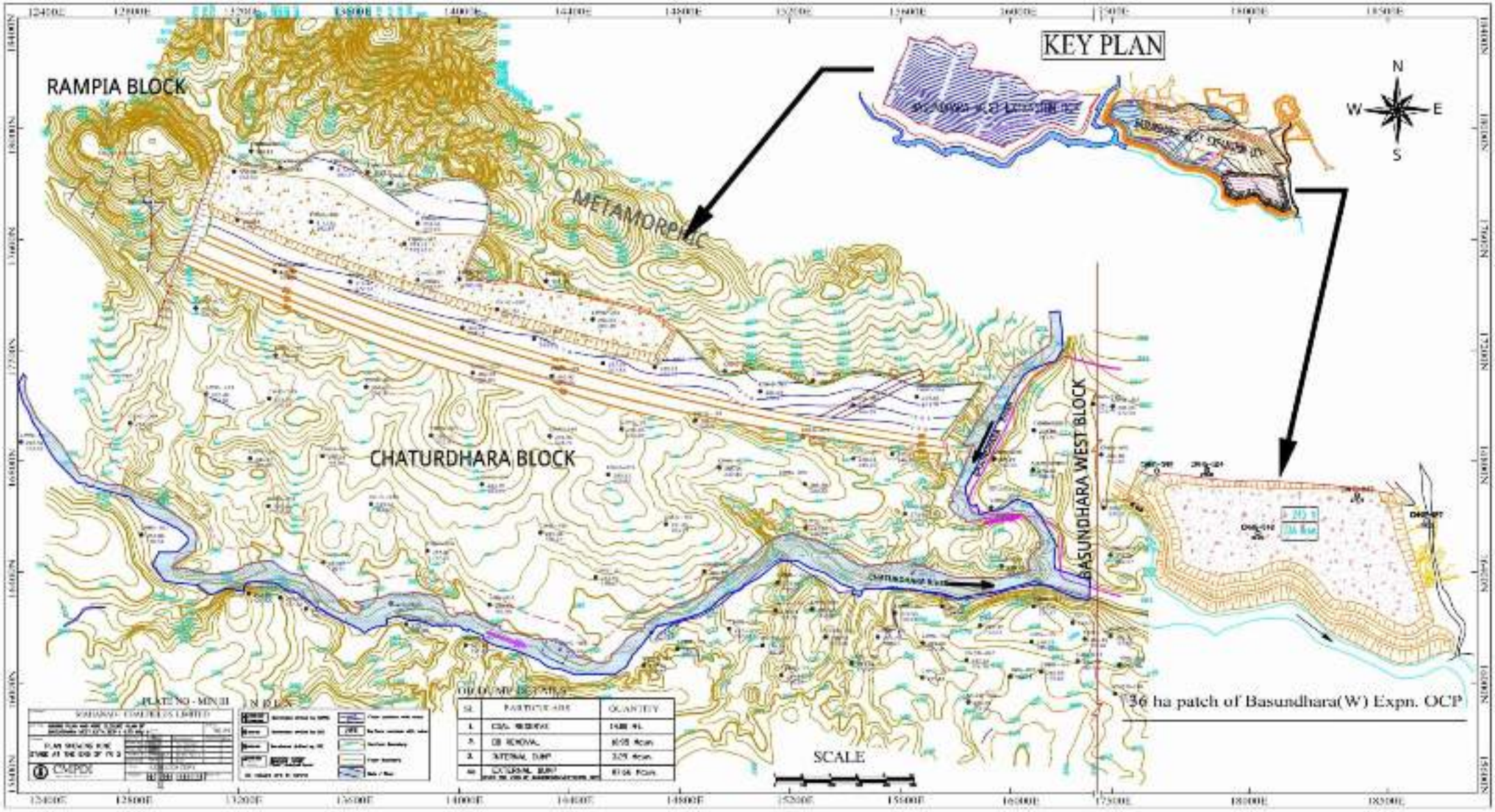
CMPDI


KEY PLAN
RAMPIA BLOCK
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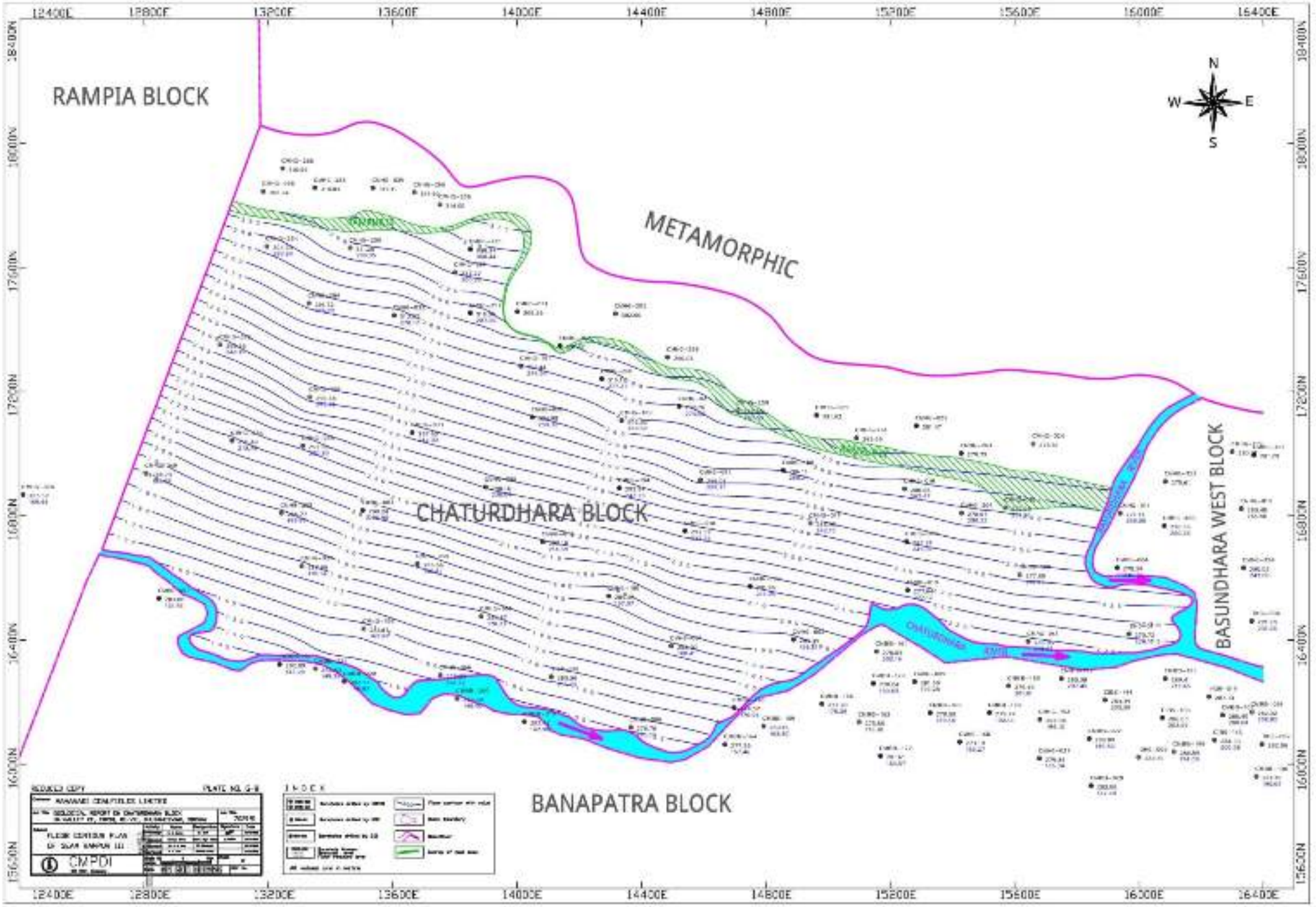
CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
N
S
E
W
SCALE
136 ha patch of Basundhara(W) Expn. OCP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CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
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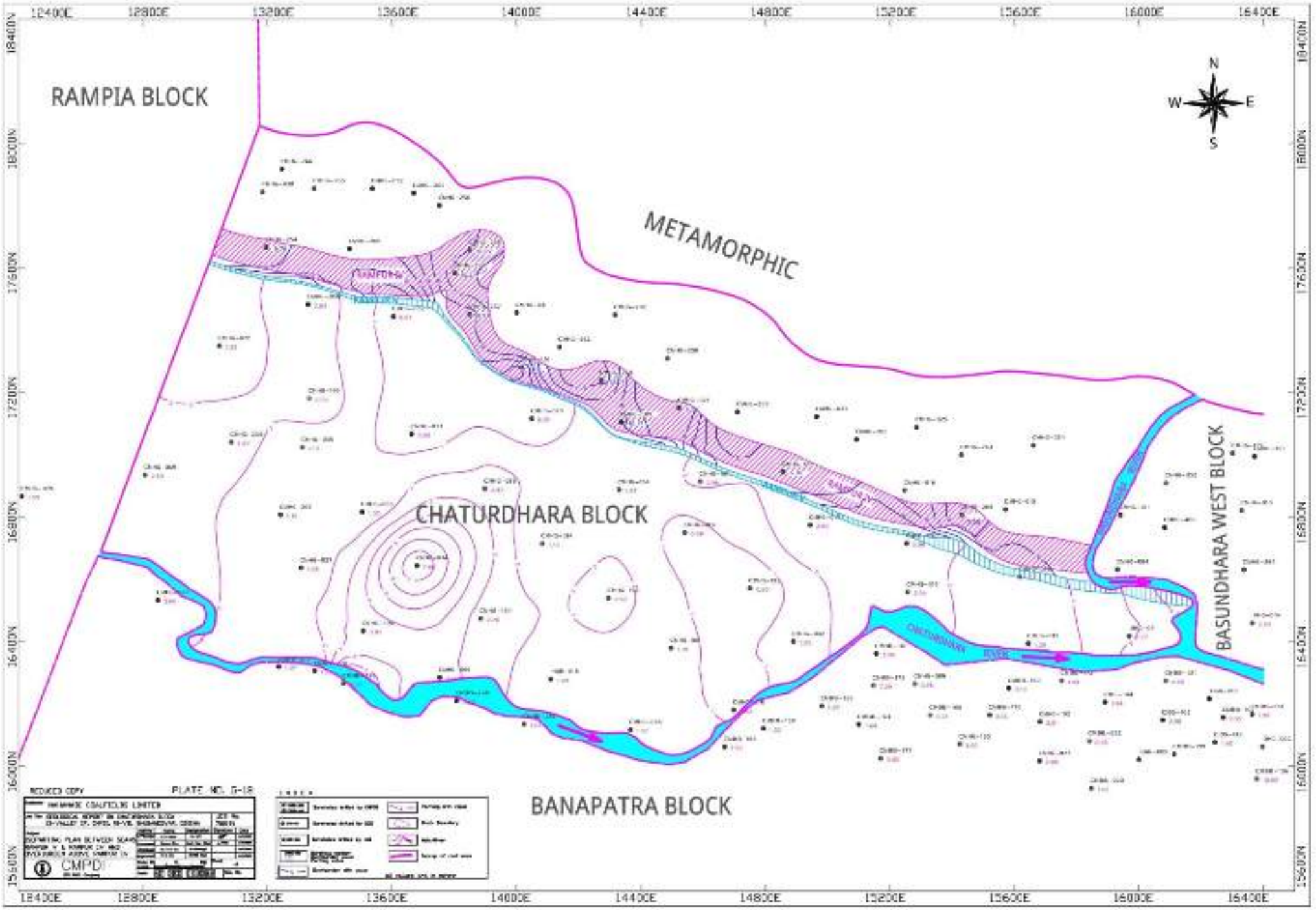
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CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
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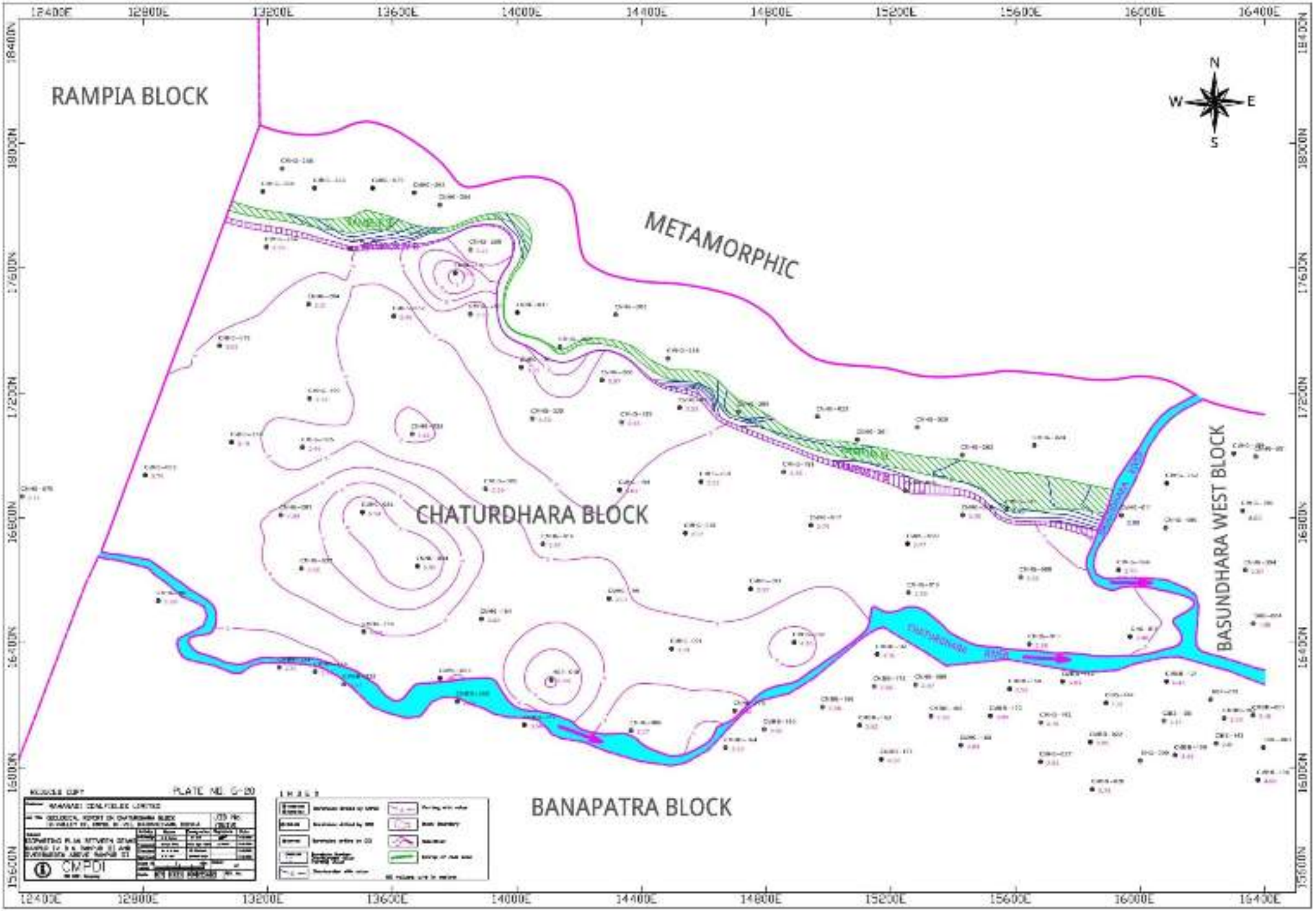
E
W
REDUCED COPY
PLATE NO. G-18
CMPDI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CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
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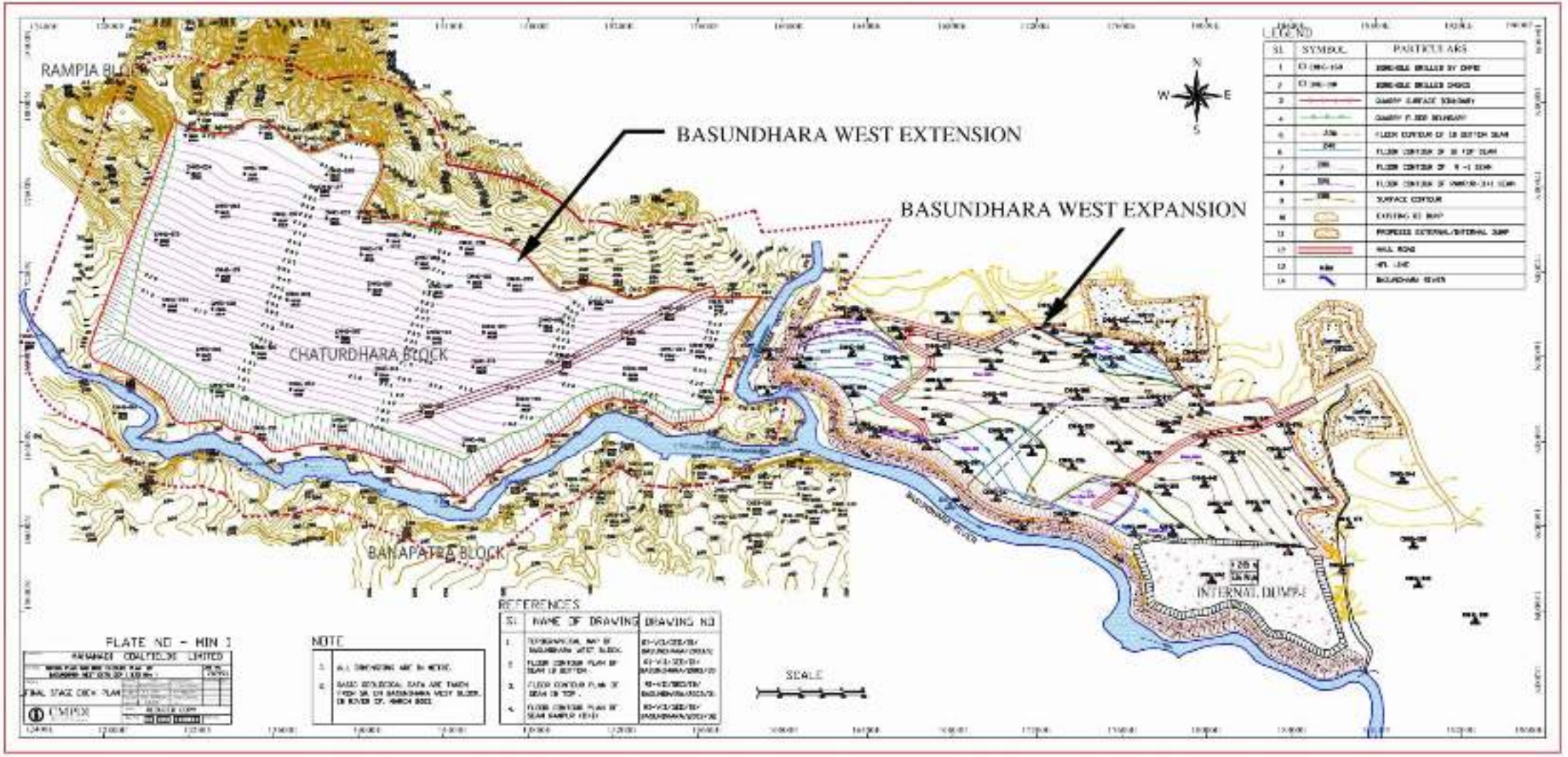
PLATE NO. G-20
CMPDI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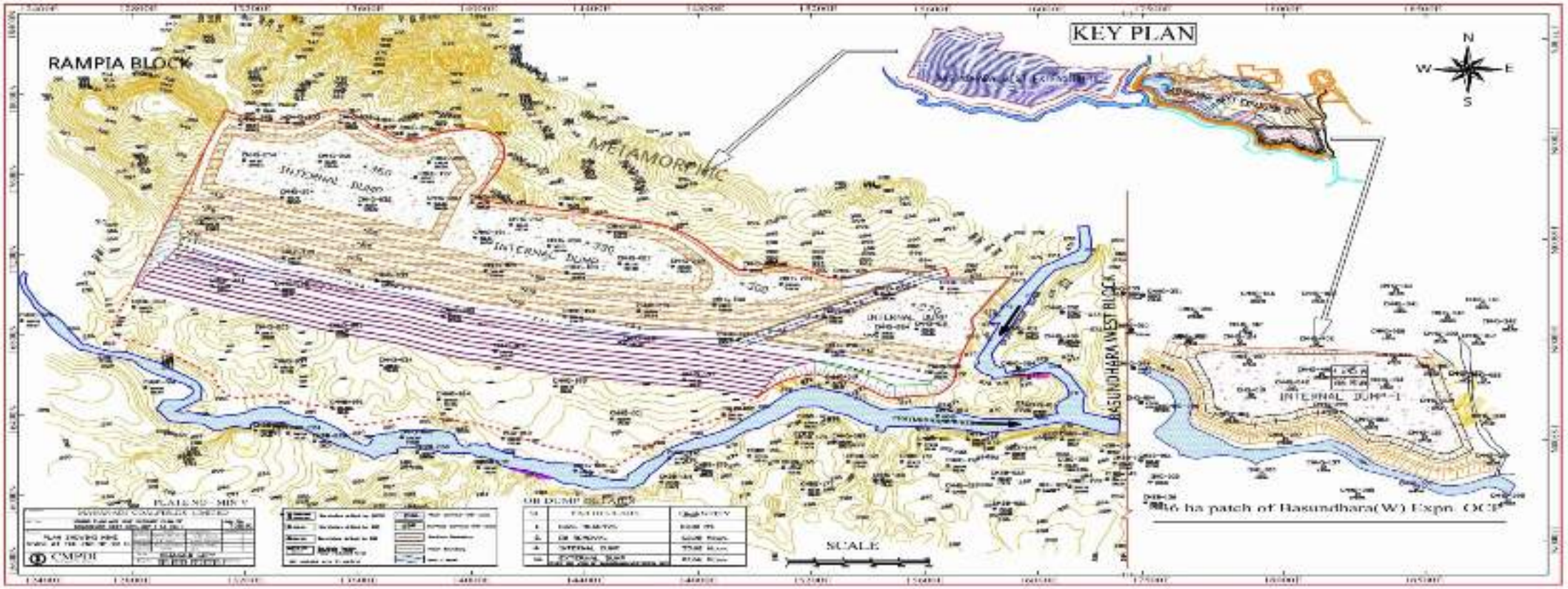
BASUNDHARA WEST EXTENSION
BASUNDHARA WEST EXPANSION
CHATURDHARA BLOCK
BANAPATRA BLOCK
INTERNAL DUMP-I
LEGEND
SL
SYMBOL
PARTICULARS
SURFACE CONTOUR
EXISTING ICI MINE
PROPOSED EXTERNAL/INTERNAL DUMP
HAUL ROAD
BASUNDHARA RIVER
N
S
E
W
SCALE
REFERENCES
SL
NAME OF DRAWING
DRAWING NO
NOTE
PLATE NO - MIN 1
FINAL STAGE OBOR PLAN
CMPDI


KEY PLAN
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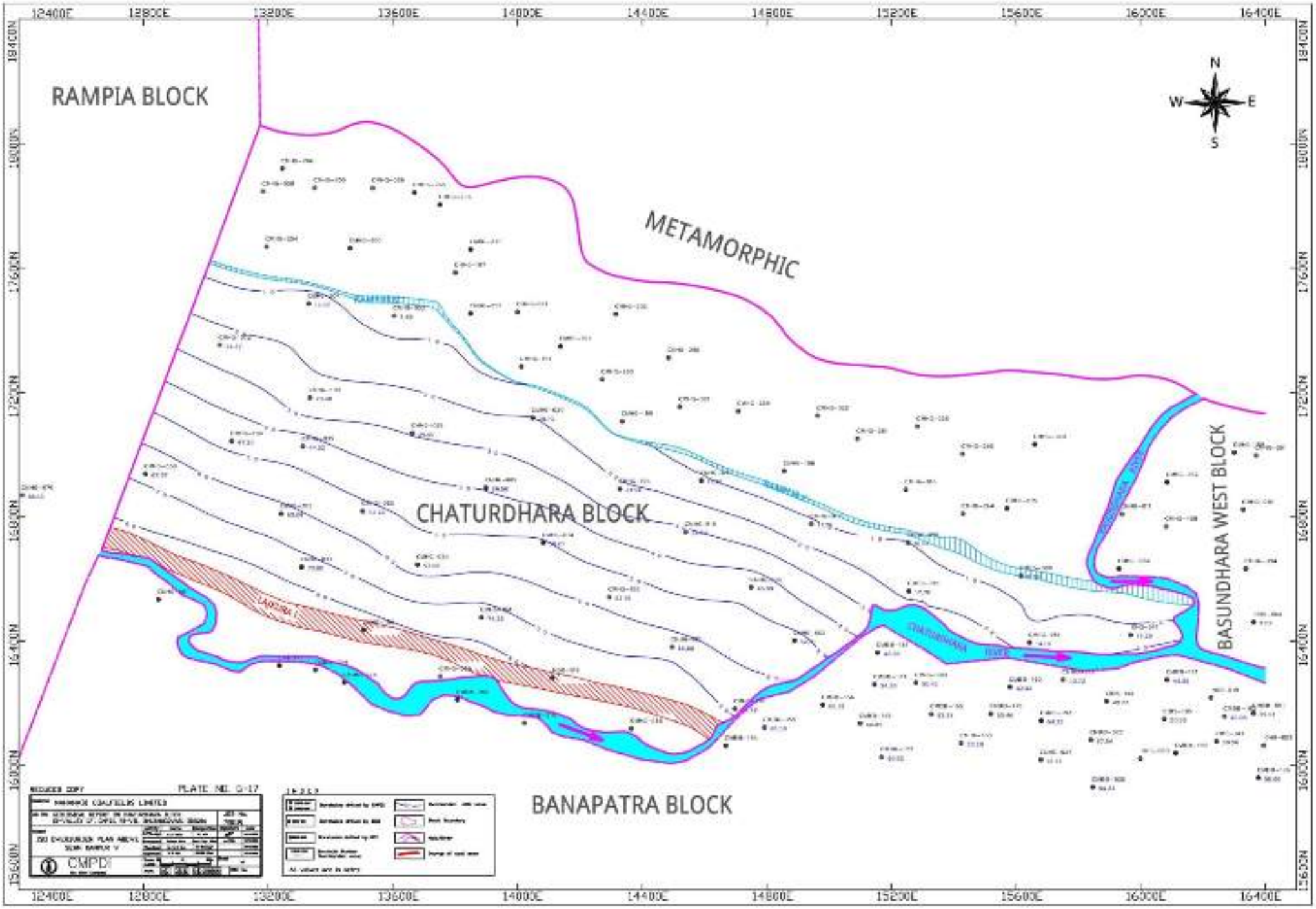
METAMORPHIC
INTERNAL DUMP
INTERNAL DUMP-1
BASUNDHARA WEST BLOCK
N
S
E
W
SCALE
CMPDI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CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
LAJKURA
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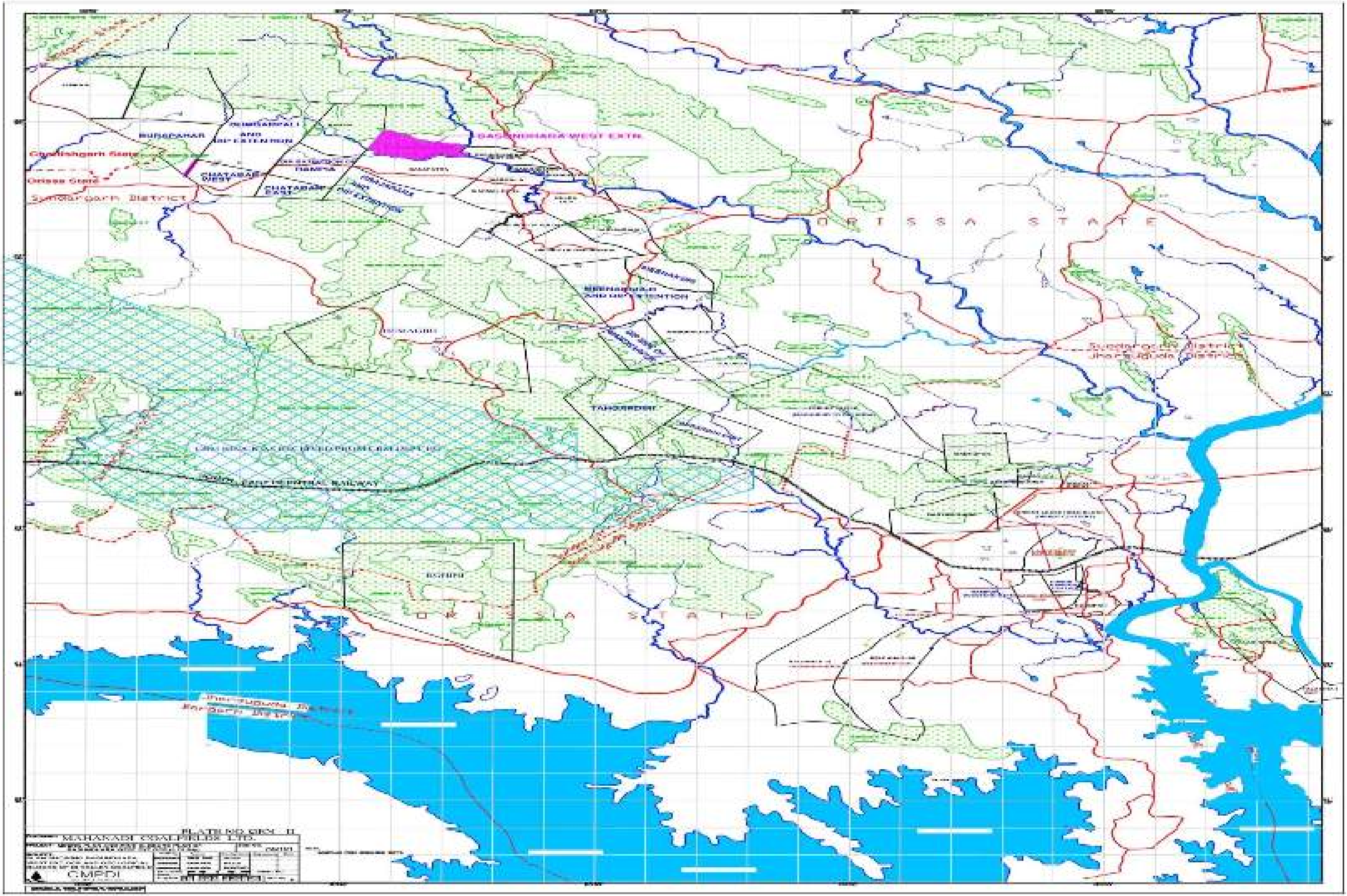
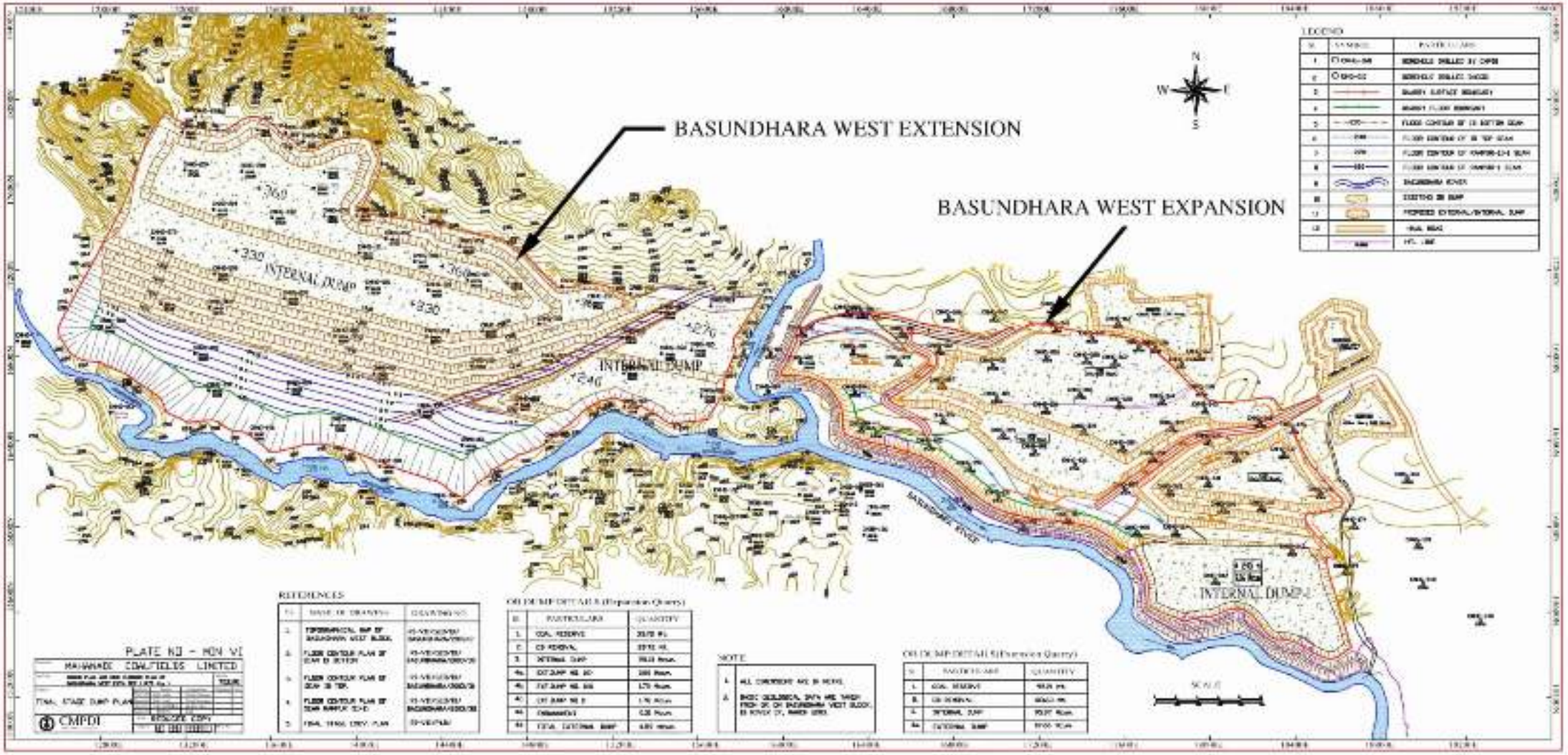
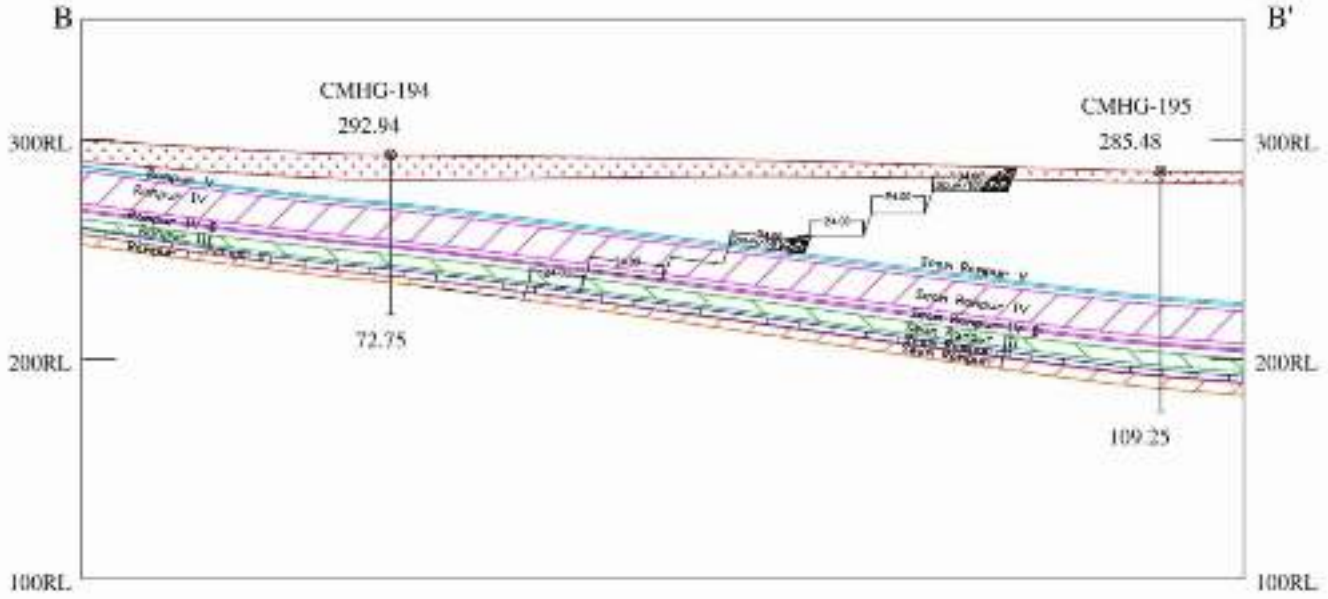
PLATE NO. G-17
CMPDI



GARJANBAHAL WEST EXTN
Chhattisgarh State
Orissa State
Sundargarh District
BURAPAHAR
KULDA
AND
DIP EXTENSION
CHATABAR WEST
CHATABAR EAST
TAMPA
AND
DIP EXTENSION
O R I S S A S T A T E
BASUNDHARA
AND DIP EXTENSION
TANGARDIHI
Sundargarh District
Jharsuguda District
SOUTH EAST CENTRAL RAILWAY
O R I S S A S T A T E
PLATE NO GEN - II
MAHANADI COALFIELDS LTD.
CMPDI


BASUNDHARA WEST EXTENSION
BASUNDHARA WEST EXPANSION
INTERNAL DUMP
INTERNAL DUMP-I
INTERNAL DUMP-II
BASUNDHARA RIVER
LEGEND
REFERENCES
OB DUMP DETAILS (Expansion Quarry)
OB DUMP DETAILS (Existing Quarry)
NOTE
SCALE
PLATE NO - MON VI
MAHANADI COALFIELDS LIMITED
FINAL STAGE DUMP PLAN
CMPDI



SEAM INDEX

- Weathered Mantle
- Seam Rampur V
- Seam Rampur IV
- Seam Rampur IV B
- Seam Rampur III
- Seam Rampur II
- Seam Rampur I

PLATE NO - MIN VII

Customer: MAHANADI COALFIELDS LIMITED

Job Title: MINING PLAN AND MINE CLOSURE PLAN OF BASUNDHARA WEST EXTN. OCP (8.75 Mty)

Job No. 702191

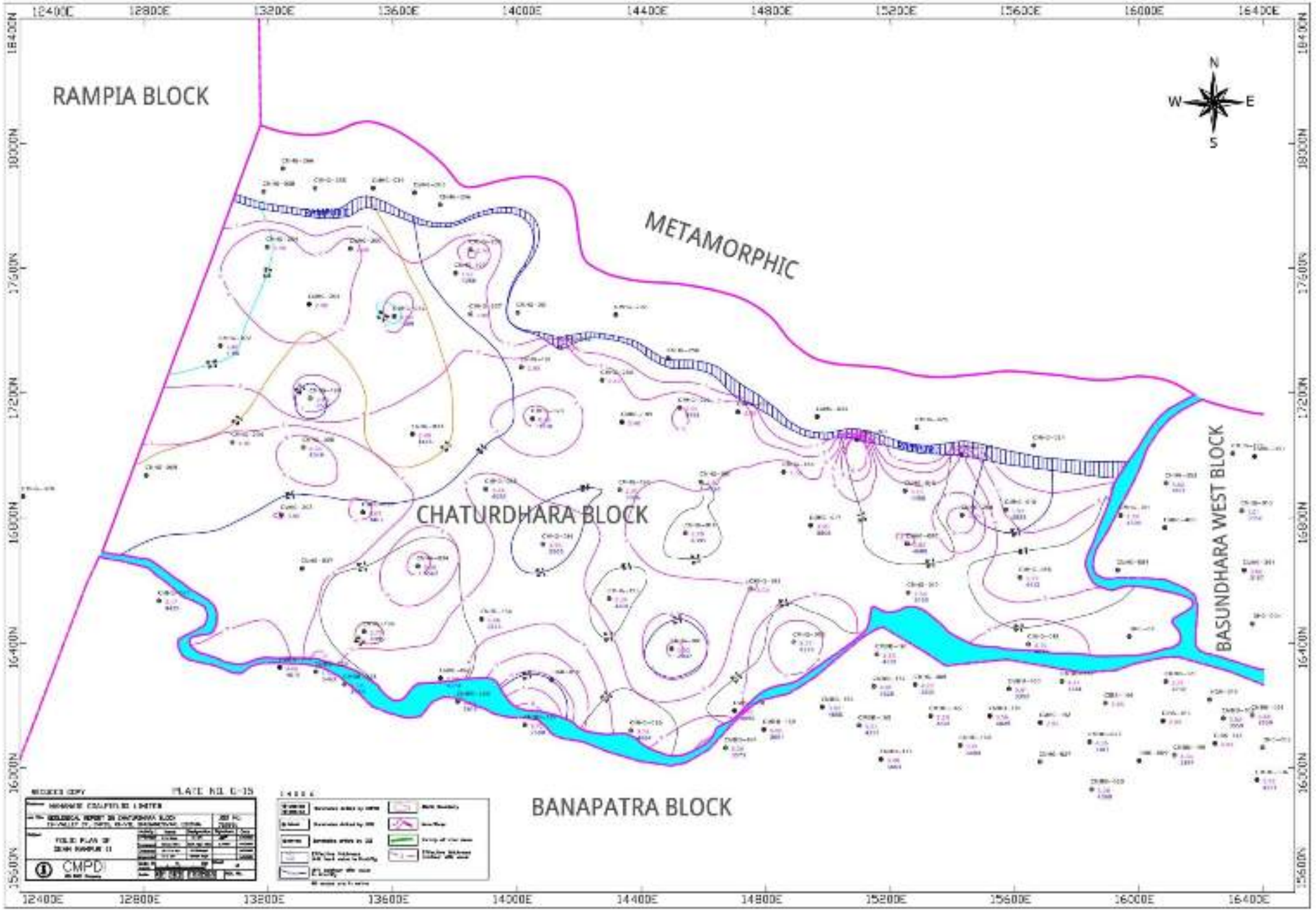
Subject: ELEMENTS OF MINING SYSTEM AND CROSS SECTIONS

Activity	Name	Designation	Signature	Date
Drawn by	R.K. DAS	Chief Manager		
Design by	R.K. DAS	Chief Manager		
Checked	G.K. MISHRA	HOD (P&D)		
Approved	D.BASU	ED		

CMPDI (ISO 9001 Company)

Scale: REDUCED COPY

Drg.No. R-T-P&D-01558 REV.No.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METAMORPHIC
CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
N
S
E
W
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13200E
13600E
14000E
14400E
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15200E
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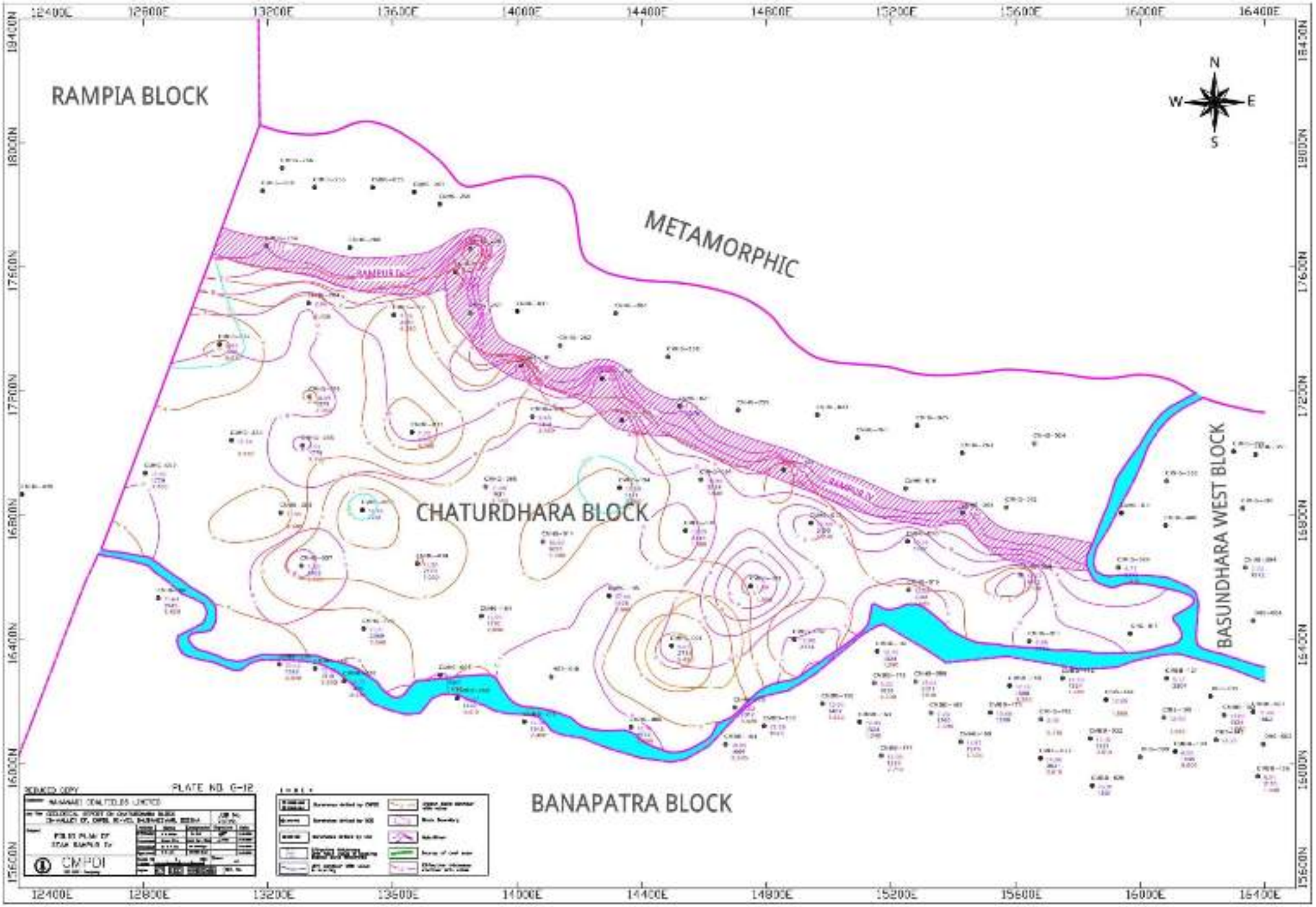
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METAMORPHIC
CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
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W
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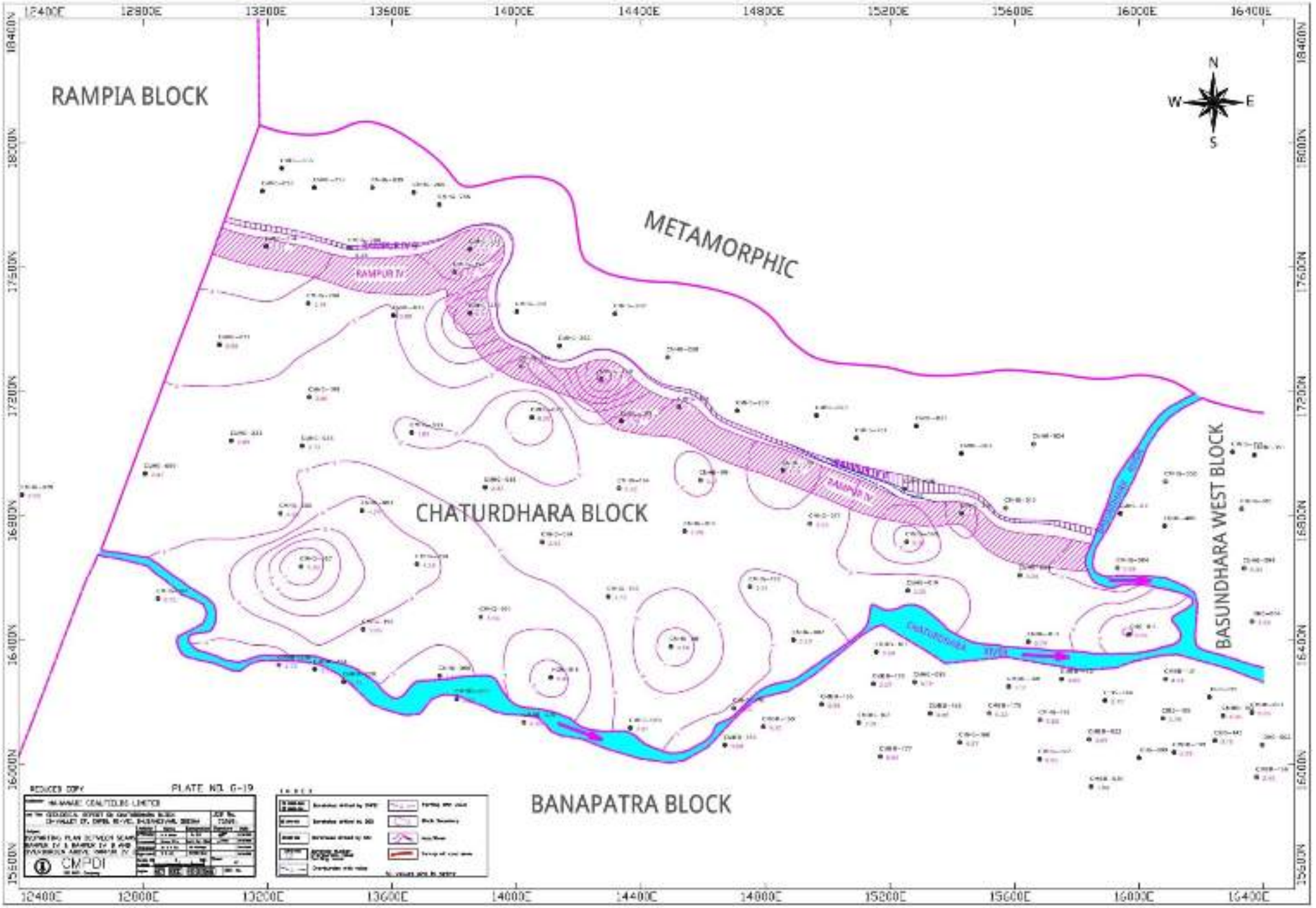
PLATE NO. G-12
CMPDI


RAMPIA BLOCK
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CHATURDHARA BLOCK
BASUNDHARA WEST BLOCK
BANAPATRA BLOCK
RAMPUR IV
N
S
E
W
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PLATE NO. G-19
CMPDI

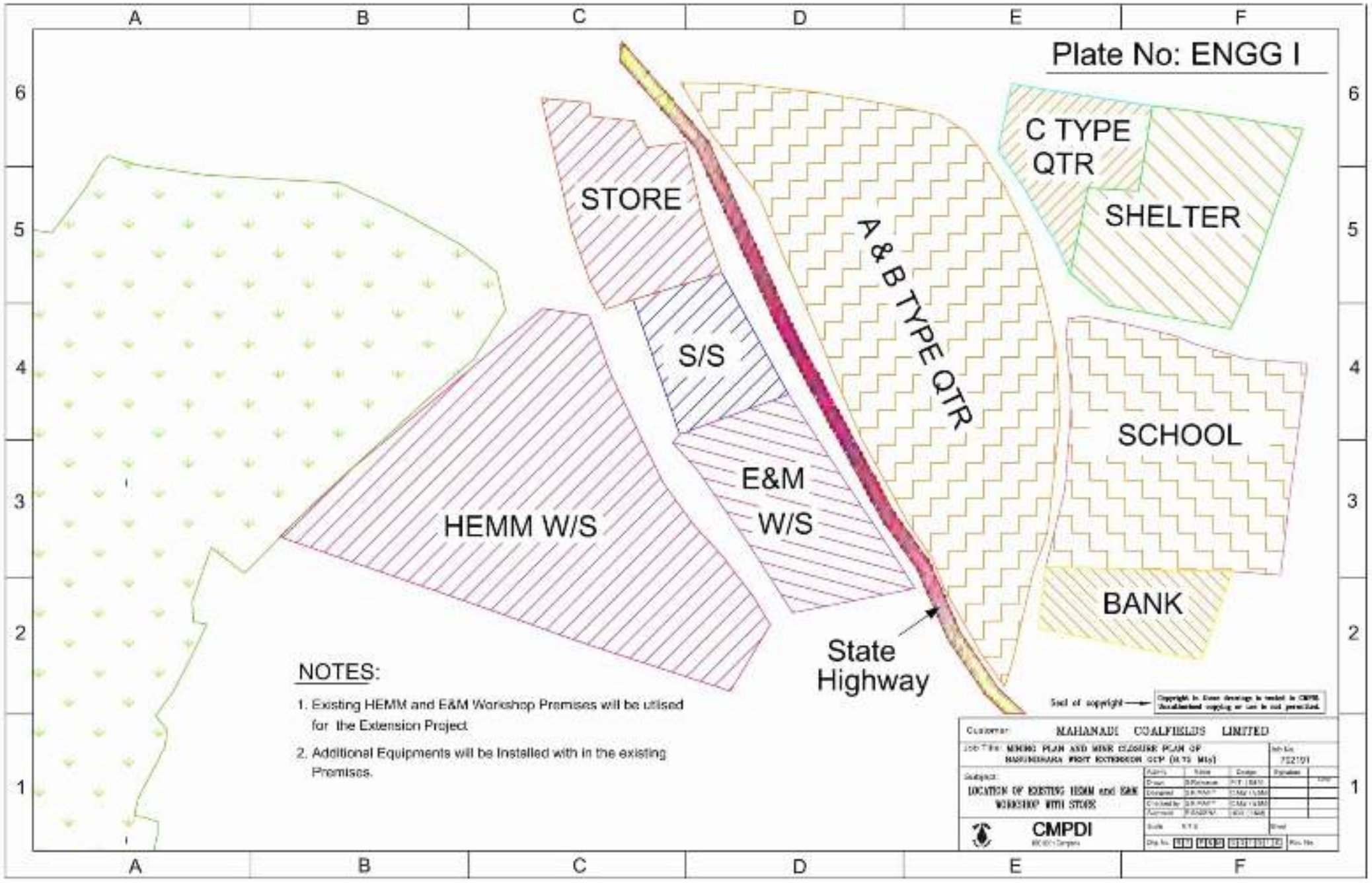
Plate No: ENGG I
STORE
S/S
HEMM W/S
E&M
W/S
A & B TYPE QTR
C TYPE
QTR
SHELTER
SCHOOL
BANK
State
Highway
NOTES:
1. Existing HEMM and E&M Workshop Premises will be utilised for the Extension Project.
2. Additional Equipments will be Installed with in the existing Premises.
Customer: MAHANADI COALFIELDS LIMITED
LOCATION OF EXISTING HEMM and E&M WORKSHOP WITH STORE
CMPDI