Satellite Surveillance: A tool for Land Reclamation Monitoring of OC coal mines of Coal India Ltd.

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Ranchi

PRESENTATION OUTLINE

- Fundamental of Remote Sensing
- Remote Sensing Satellites
- Mining leases
- Status of Land & Forest vis-à-vis coal mining
- Satellite surveillance for Land Reclamation
- Objective
- Methodology
- Company wise Land reclamation status
- Challenges
- Best Practices- Field photographs
- Land reclamation monitoring in USA- A case study of Knight Hauk Coal Mine

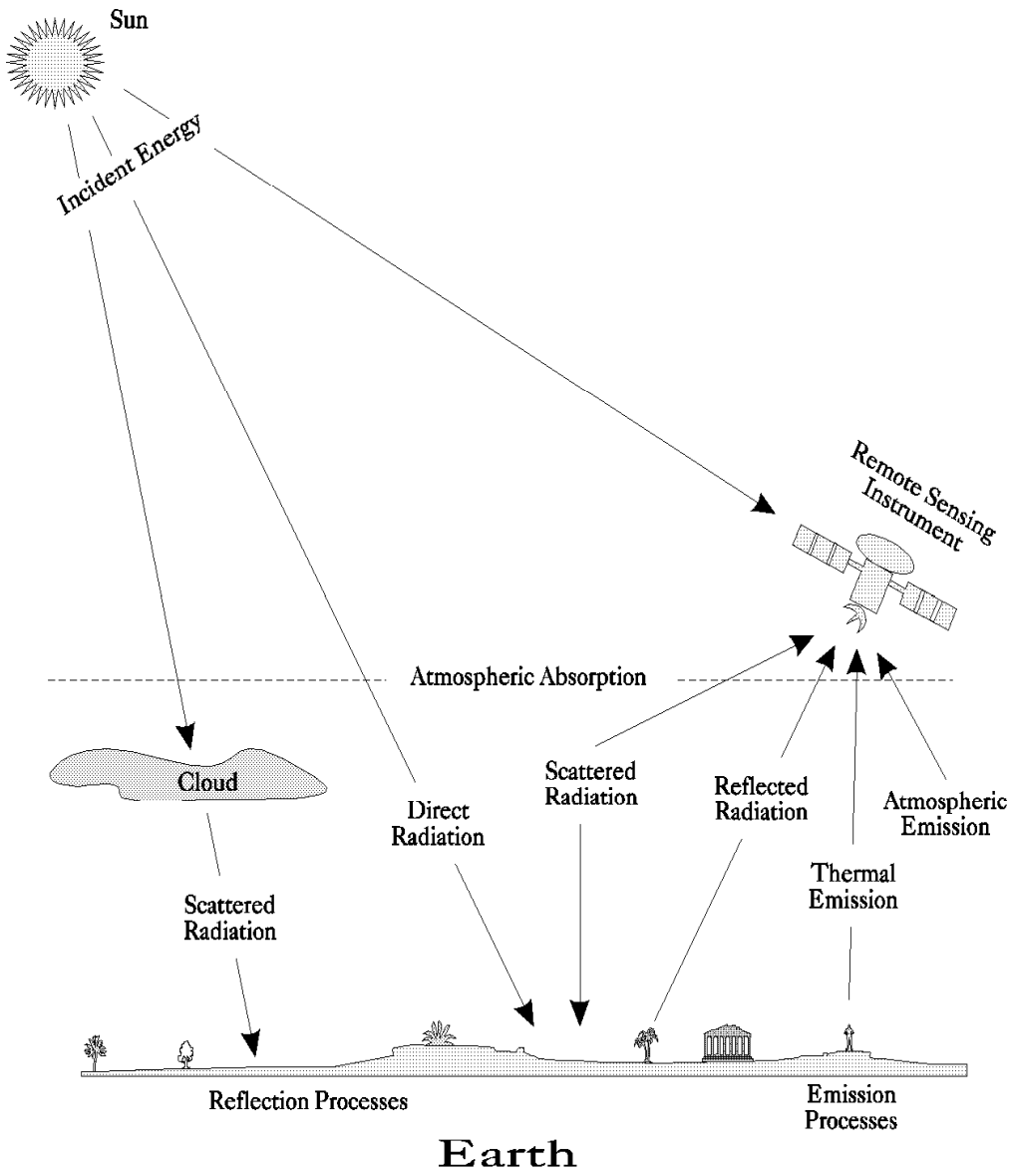


Figure 2.1 Remote sensing radiation system

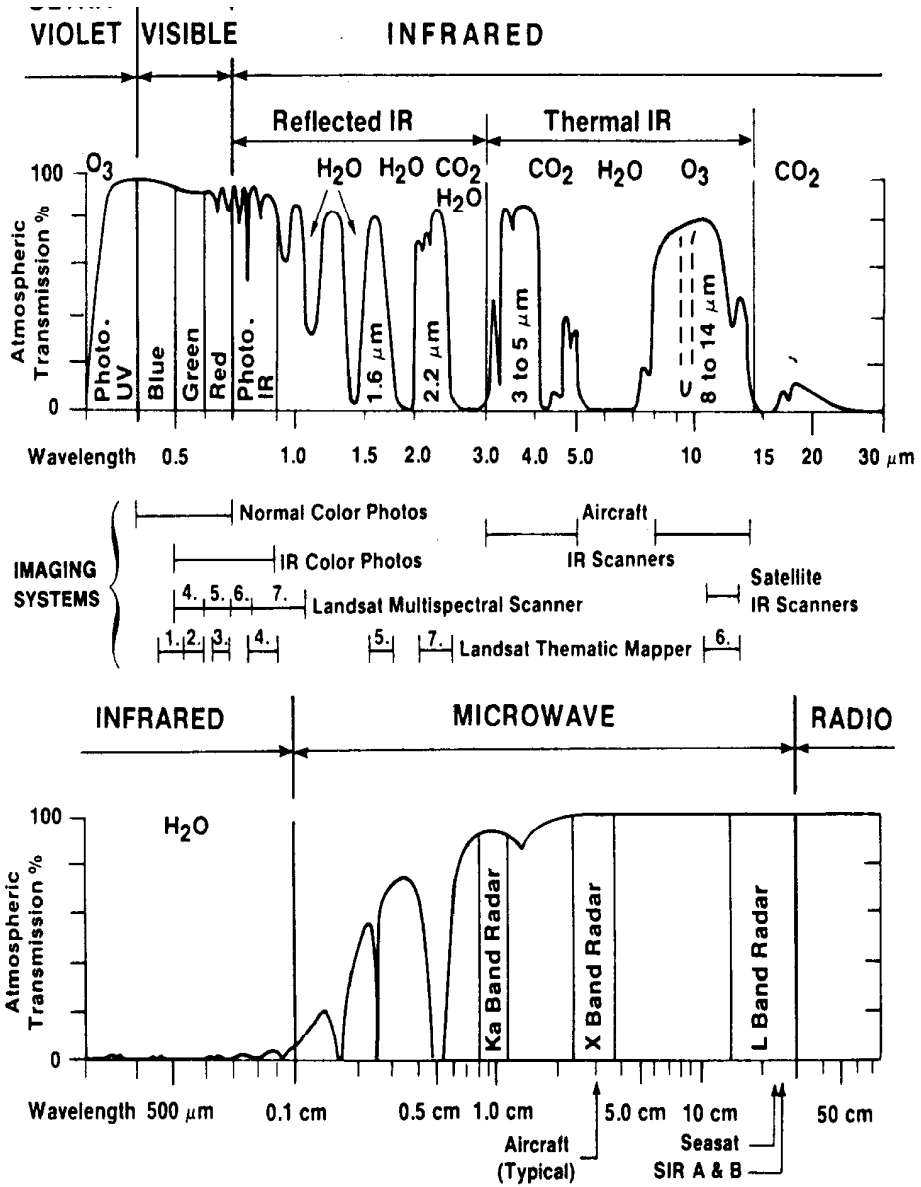
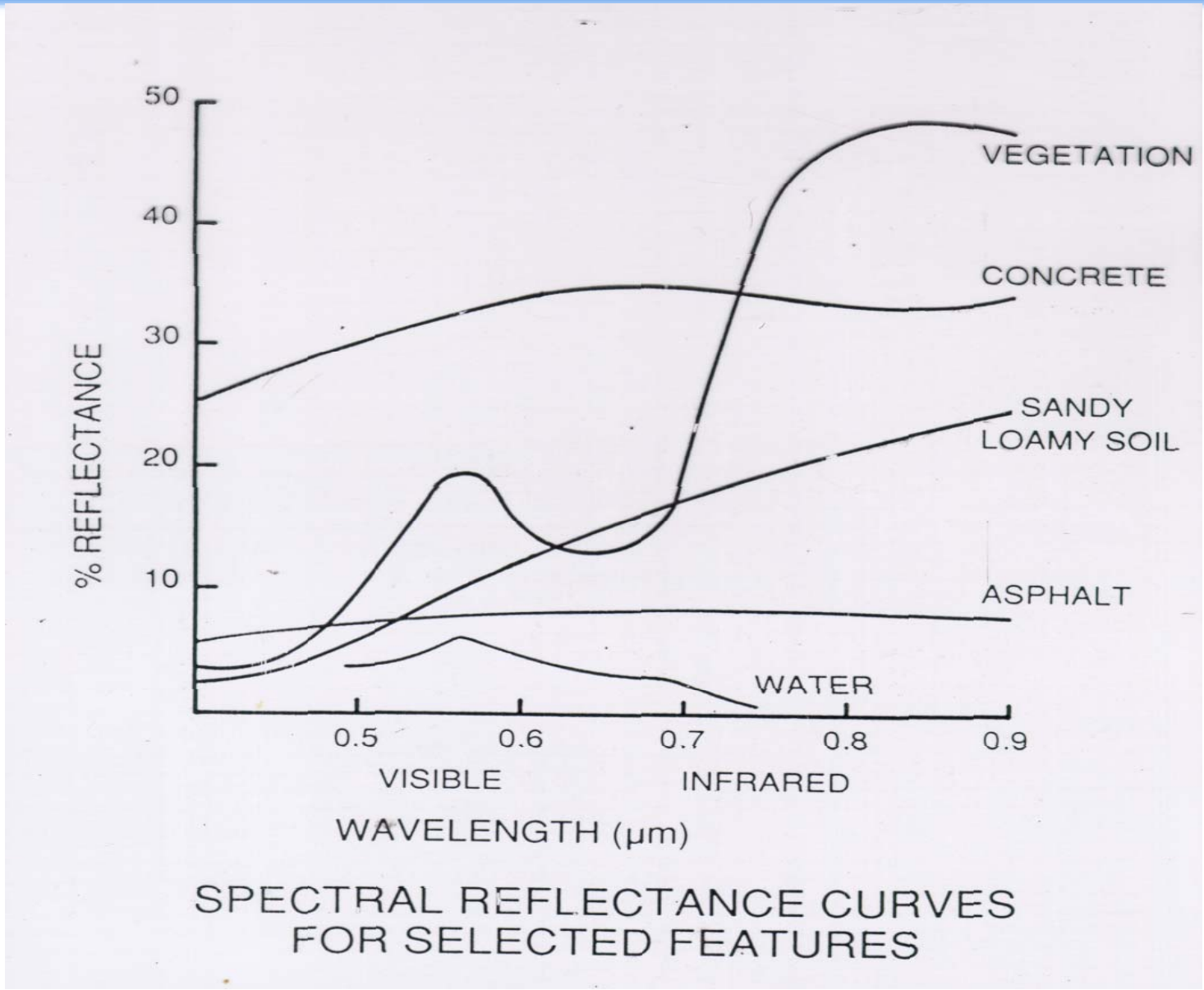


Figure 2.3 Expanded diagrams of the visible and infrared regions (upper) and the microwave regions (lower) showing atmospheric windows. Wavelength bands of commonly used remote sensing systems are indicated. Gases responsible for atmospheric absorption are shown.



SPECTRAL REFLECTANCE CURVES
FOR SELECTED FEATURES

Application of Spectral Bands

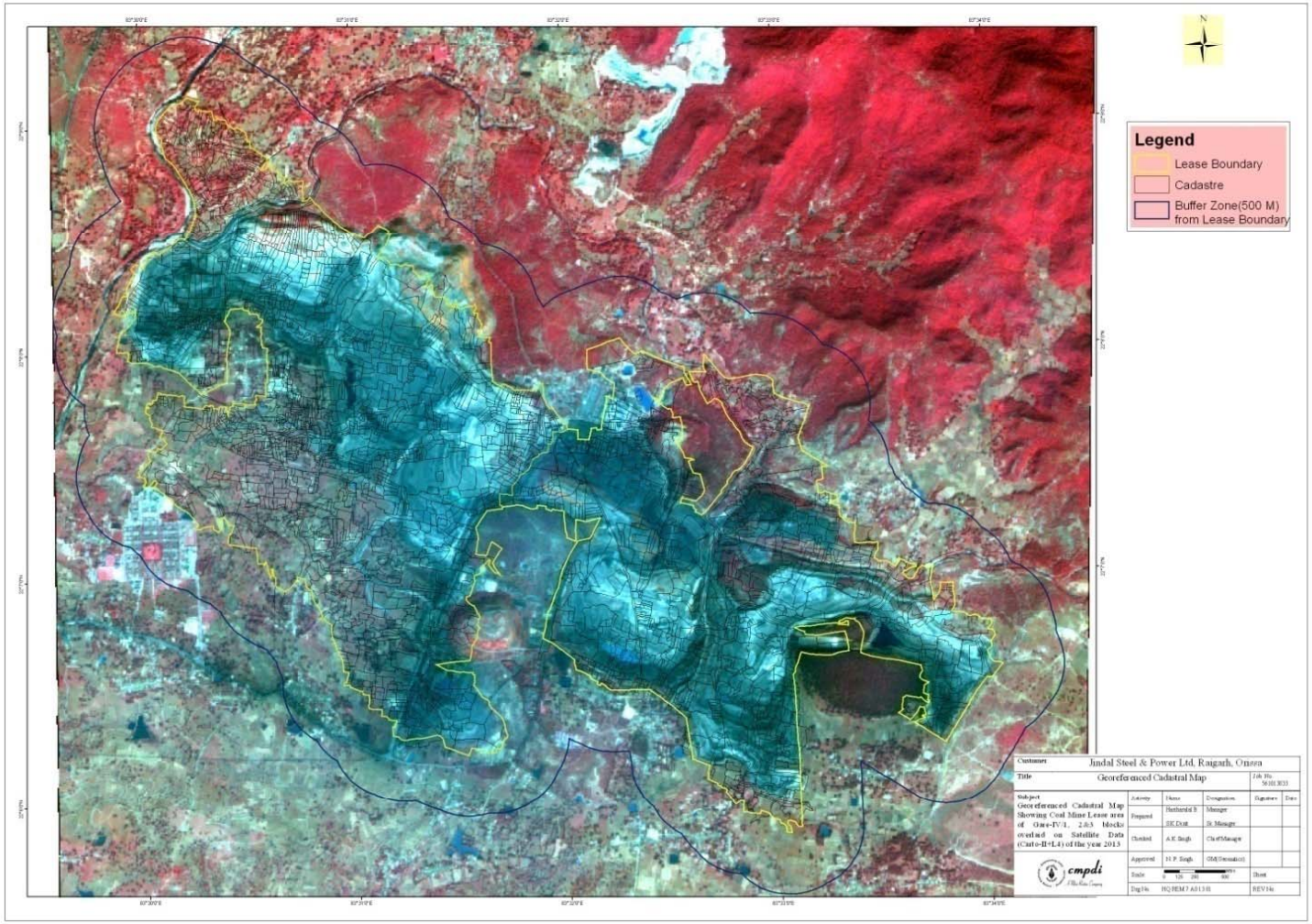
Spectral Region (μm)	Principal Application
0.45-0.52	**Vegetation species differentiation, coastal environmental study**
0.52-0.59	**Rock/Soil boundary differentiation, vegetation vigour & turbidity assessment**
0.62-0.69	**Forest Type & cultural feature mapping,**
0.77-0.86	**Delineation of surface water features, landform/geological studies, mapping of transport network and settlement.**
1.55-1.75	**Moisture content of soil and vegetation. Useful for differentiation of snow from cloud.**
2.08-2.35	**For mapping of different rock types and hydrothermally altered rocks associated with mineral deposits.**
10.40-12.50	**Thermal mapping & vegetation stress analysis,**

Resolution in Remote Sensing

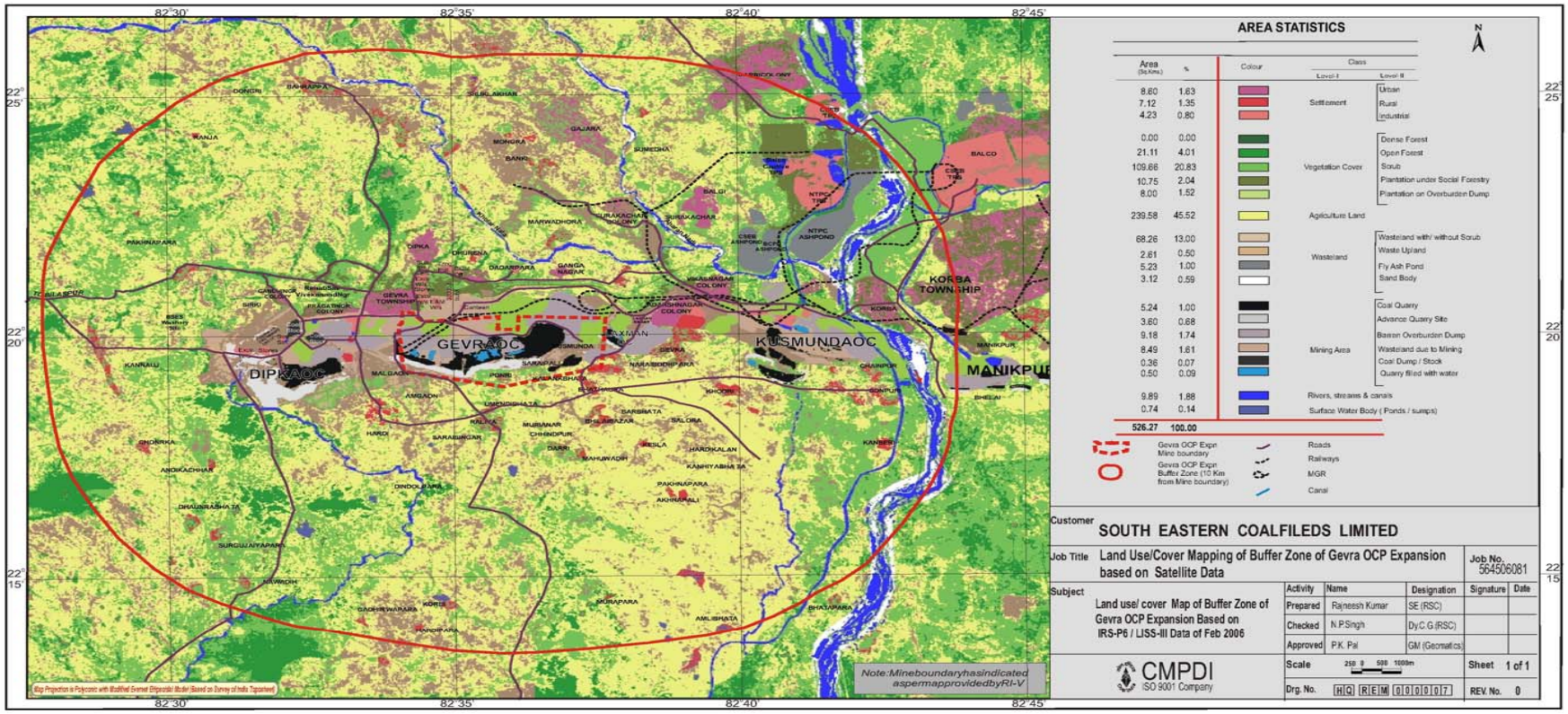
- Spatial Resolution
- Spectral Resolution
- Temporal Resolution
- Radiometric Resolution

Geo-referencing of Mining lease over Carto-II +LIV Data

- IBM has issued guidelines for overlaying mining leases on satellite data (CartoII+LIV) for monitoring of illegal mining.



Baseline Data for Land Environment



Land Status of India

- **Total Land Area – *297 MHA (Million Hectare) 8th Rank***
- **Per capita land availability** - 0.237 Hectare (302Rank)
- **Waste land – 46.07 MHA (15.70%)**
- **Potential Coal Bearing Area- *1.73 MHA (0.58%)***
- **Land Area Under Coal Mining - *0.36MHA (0.001%)***

(meets 52% commercial energy needs and 66% of Power generation)

- **Forest Land degraded due to Coal Mining**

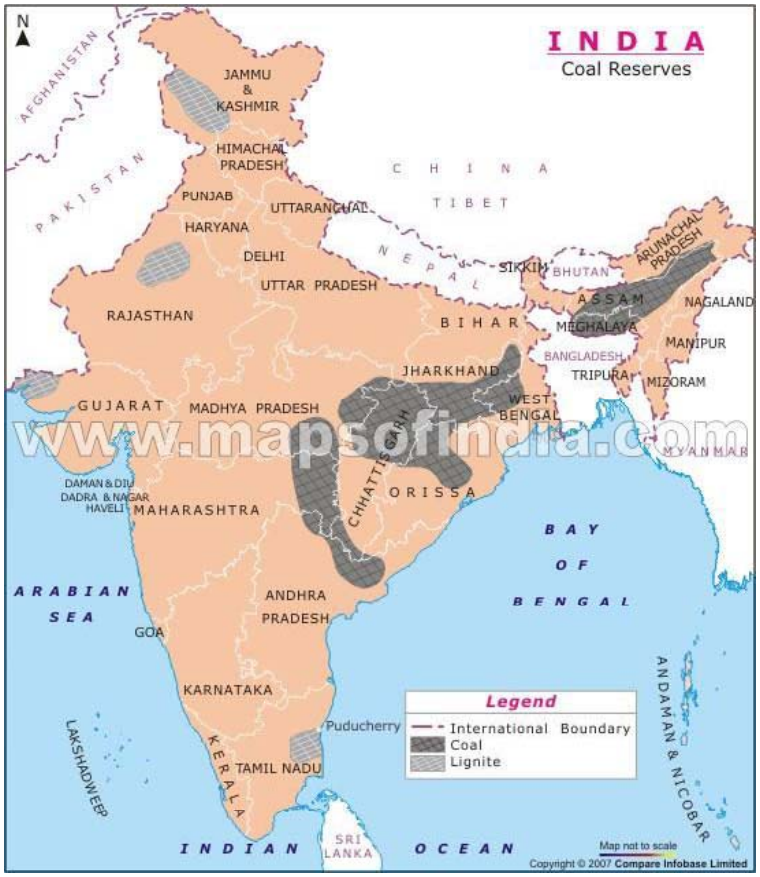
- *0.12 MHA*

Status of Forest of India

- **Total Area under Forest – 69.202 MHA(21.05%)**
- **Forest Cover on Potential Coal Bearing Area - 0.301MHA** *(0.004 % of total forest area is under potential coal bearing area)*
- **Forest Land Diverted for Mining – 0.0140 MHA**
- **Revegetated Area – 73 million tress- 0.0292 MHA (Ratio 1:2.4)**

Coal India Limited at a glance

- CIL is the **single largest coal producer company in the world**.
- Operates in 8 states through 7 coal producing companies and CMPDI
- Total 470 are under operation
  - 164 OC
  - 275 UG
  - 31 Mixed
- Produces around 80% of India's overall coal production
- Meet 52% of primary commercial energy demands
- Feeds 82 out of 86 coal based thermal power plants in India
- Accounts for 76% of total thermal power generating capacity of the Utility sector



Land Reclamation

- Process of converting degraded and mined out land in to Self-Sustaining productive land use
- MoEF has made mandatory to monitor the progress of mine land reclamation

- High Resolution, temporal satellite data used for land Reclamation monitoring of all the opencast mines of CIL
- Total 164 OC mines are operating in CIL

- 50 OC producing > 5m.cu.m.(Coal+OB) monitored on annual basis.

- 114 OC producing < 5 m.cu.m.(Coal+OB) monitored at interval of 3 years.

Objective

❖ To monitor

✓ Plantation / Social forestry area

✓Backfilled /Reclaimed area

✓ Position of OB dumps- External and internal

✓Active mining area

✓ Water bodies

✓ Landuse class viz. Agriculture, Wasteland, forest

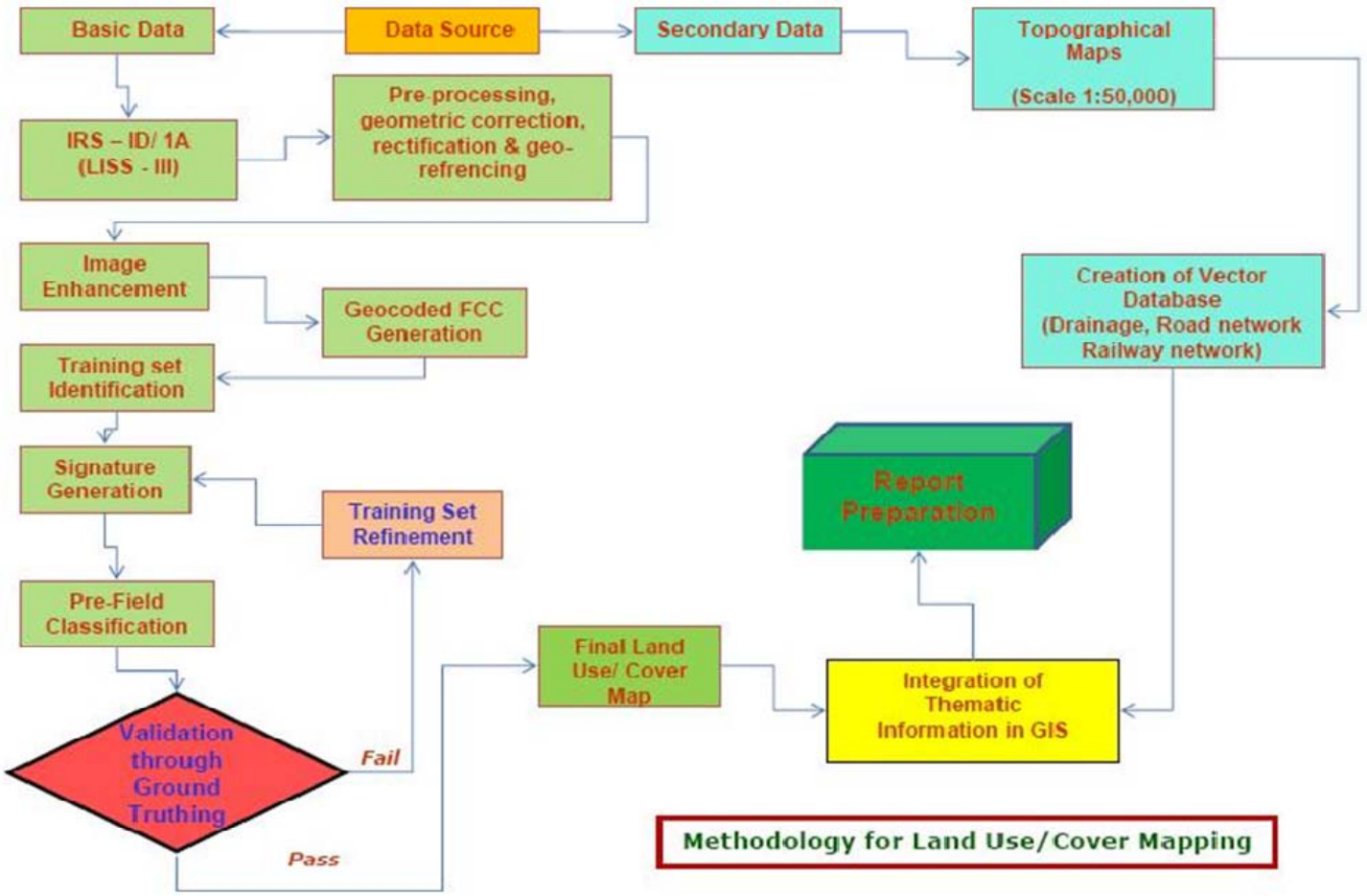
✓ Performance Evaluation of Project Officers

❖ **Above objectives will help in**

✓ Assessing the remedial measures to be taken up for land reclamation/restoration

✓ Utilizing the reclaimed land for larger socioeconomic activities in a planned way

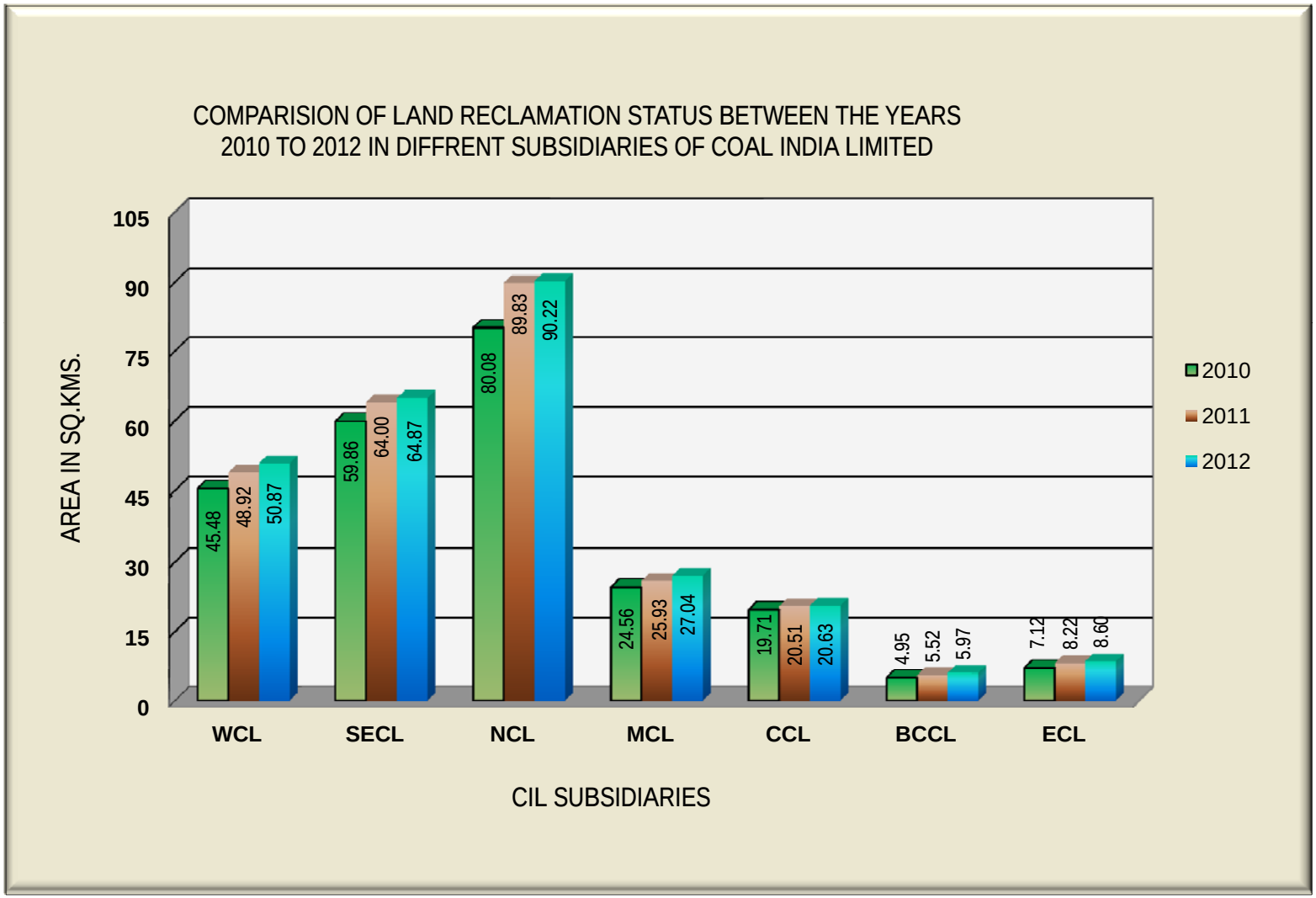
METHODOOLOGY



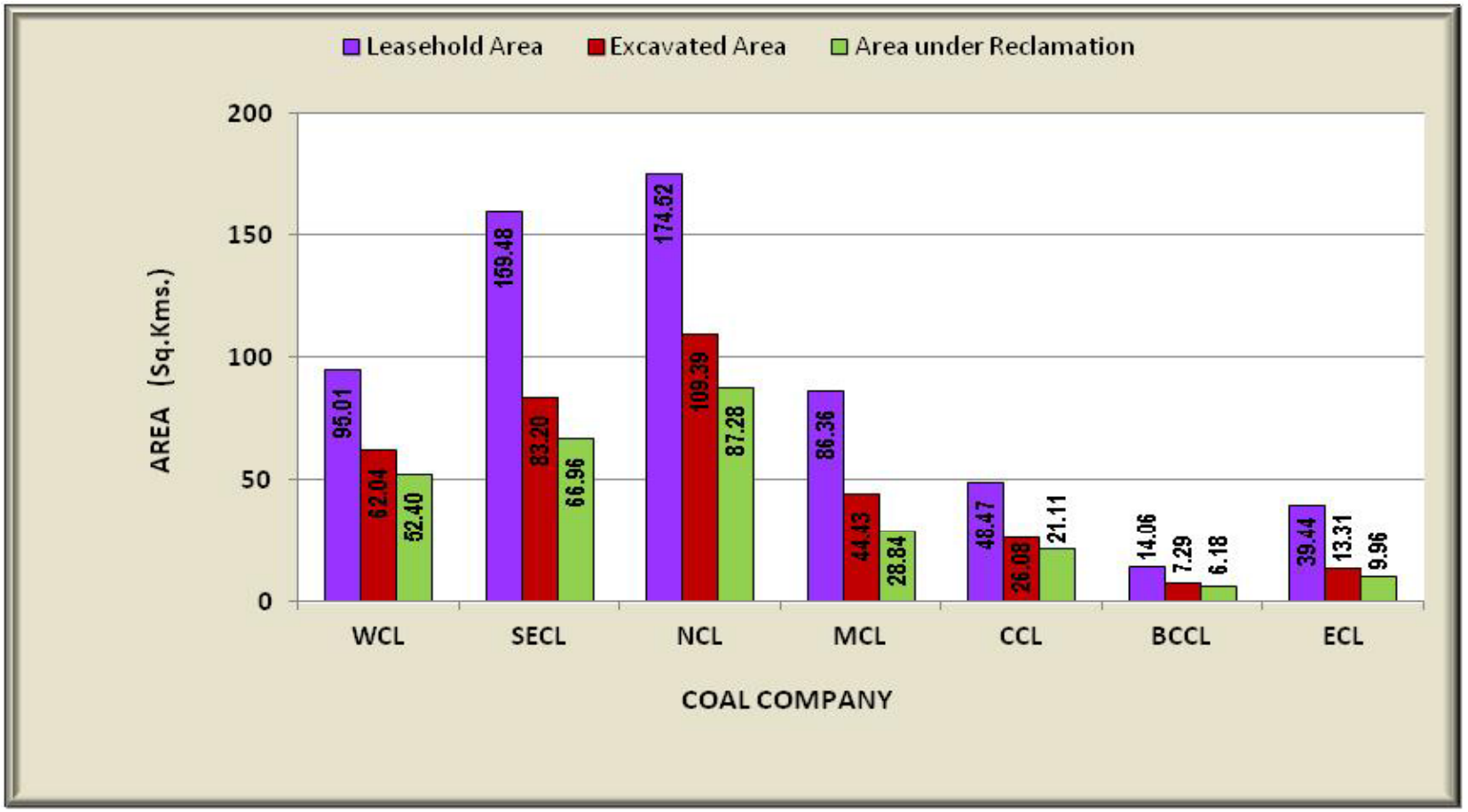
Methodology for Land Use/Cover Mapping

Land Reclamation Status in 50 OC projects Year-2012-13

Sl. No.	Coal Company (No. of OC Projects)	Area in Sq. Kms. (% calculated in respect of total excavated area)										
		Leasehold	Plantation		Under Backfilling		Area under Active Mining		Total Excavated Area		Total Reclaimed Area	
			2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
		(i)		(ii)		(iii)		(iv)	(ii+iii+iv)		(ii+iii)	
1	**WCL (10)**	77.94	26.82	27.44	22.10	23.43	8.19	7.95	57.11	58.82	48.92	50.87
			46.96	**46.65**	**38.70**	**39.83**	**14.34**	**13.52**			**85.66**	**86.48**
2	**SECL (10)**	159.48	42.90	42.66	21.10	22.21	17.08	18.74	81.08	83.61	64.00	64.87
			52.91	**51.02**	**26.03**	**26.55**	**21.07**	**22.41**			**78.93**	**77.59**
3	**NCL (10)**	179.40	59.94	61.70	29.89	28.52	15.90	17.61	105.73	107.83	89.83	90.22
			56.69	**57.22**	**28.27**	**26.45**	**15.04**	**16.33**			**84.96**	**83.67**
4	**MCL (11)**	86.36	14.37	14.41	11.56	12.63	14.55	14.58	40.48	41.62	25.93	27.04
			35.50	**34.62**	**28.56**	**30.35**	**35.94**	**35.03**			**64.06**	**64.97**
5	**CCL (05)**	47.14	15.95	16.33	4.56	4.30	4.60	4.70	25.11	25.33	20.51	20.63
			63.53	**64.47**	**18.17**	**16.98**	**18.31**	**18.55**			**81.69**	**81.45**
6	**BCCL (02)**	14.06	1.32	1.34	4.20	4.63	1.33	1.24	6.85	7.21	5.52	5.97
			19.27	**18.59**	**61.31**	**64.22**	**19.42**	**17.20**			**80.58**	**82.80**
7	**ECL (02)**	39.44	3.82	3.83	4.40	4.77	3.37	3.59	11.59	12.19	8.22	8.60
			32.96	**31.42**	**37.96**	**39.13**	**29.08**	**29.45**			**70.92**	**70.55**
TOTAL CIL (50)		**603.82**	**165.12**	**167.71**	**97.81**	**100.49**	**65.02**	**68.41**	**327.95**	**336.61**	**262.93**	**268.20**
			50.35	**49.82**	**29.82**	**29.85**	**19.83**	**20.32**	**54.31**	**55.75**	**80.17**	**79.68**

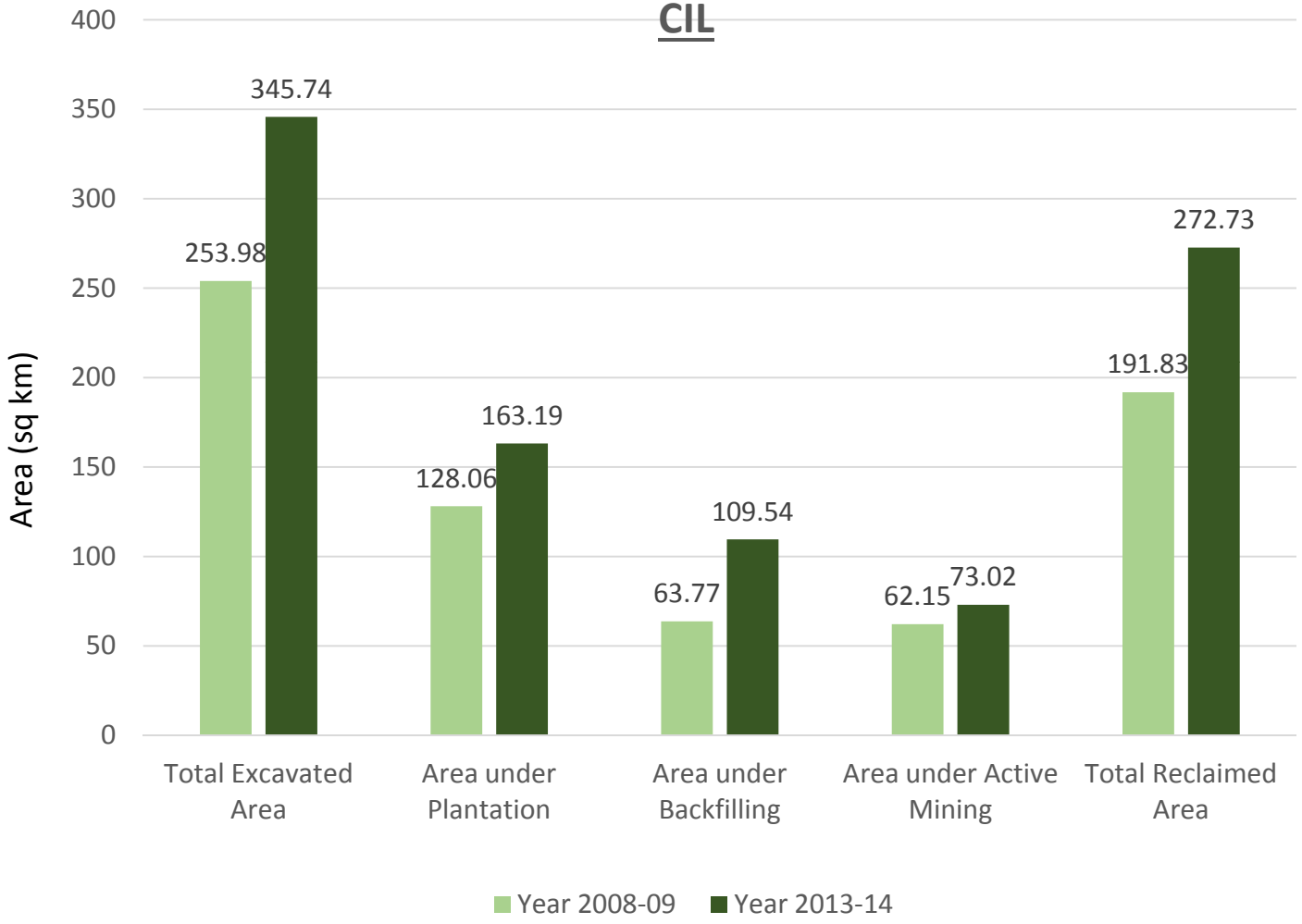


Year wise comparision of Land Reclamation in CIL Subsidiaries

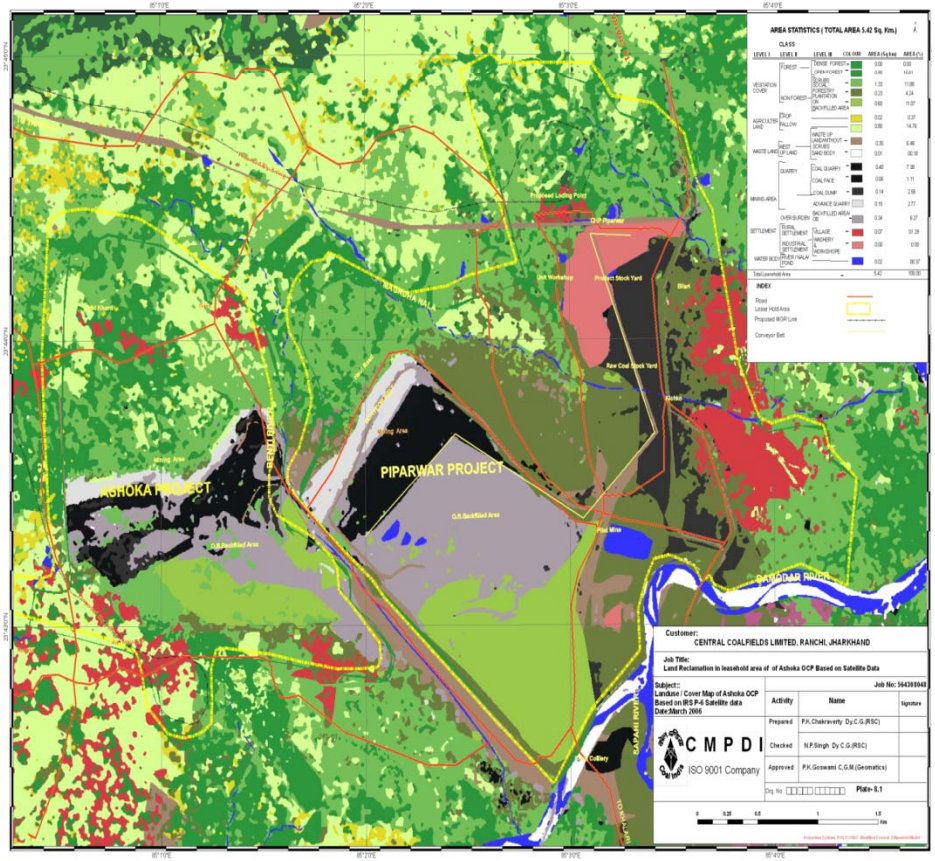


Company wise Land Reclamation Status in the Year 2012-13

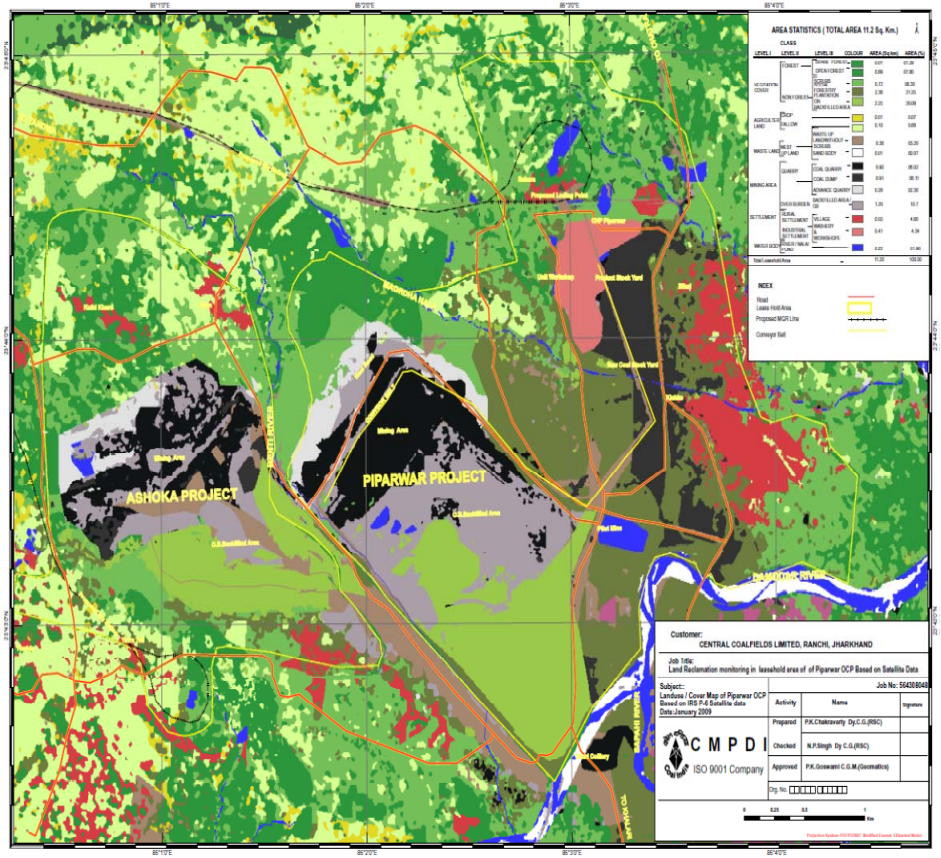
STATUS OF LAND RECLAMATION IN OC MINES OF CIL



Land Reclamation Monitoring in Piparwar & Ashoka Mining Area



Year2011

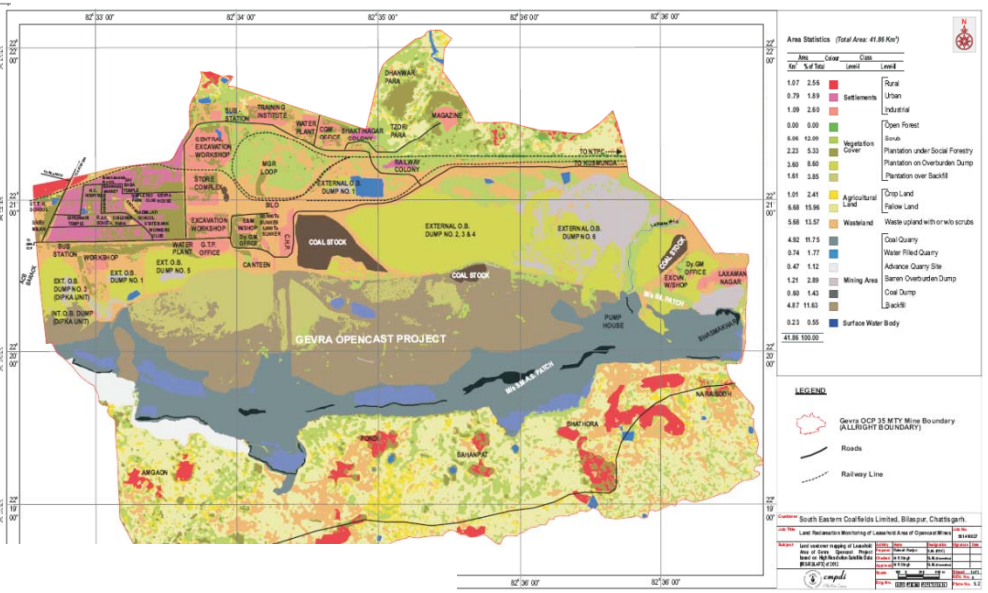


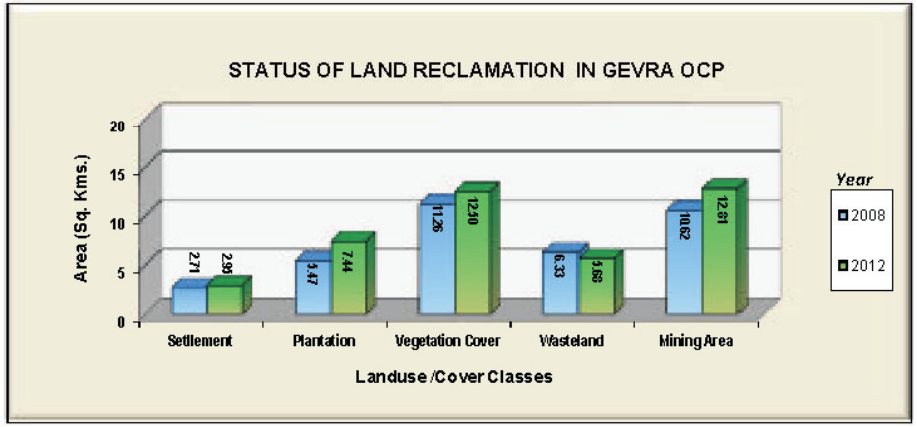
Year2012

Land Reclamation in Gevra OCP

Year 2008

Year 2012





Conclusion

- High resolution satellite data is very useful for land reclamation monitoring

- Till 2012-13, out of total 336.61sq km excavated area in 50 OC projects:
  - Biological Reclamation (Plantation) : 167.71sqkm (49.82%)
  - Technical Reclamation (Under Backfilling): 100.49sqkm (29.85%)
  - Under active mining: 68.41sqKm (20.32%)

- In 109 OC (<5mcm) capacity, out of total 128sq.km excavated area:
  - Biological Reclamation is 45.07sq. Km (35.20%)
  - Technical reclamation is 47.23sq.km (36.89%)
  - Under active mining is 35.74sq.km (27.91%)

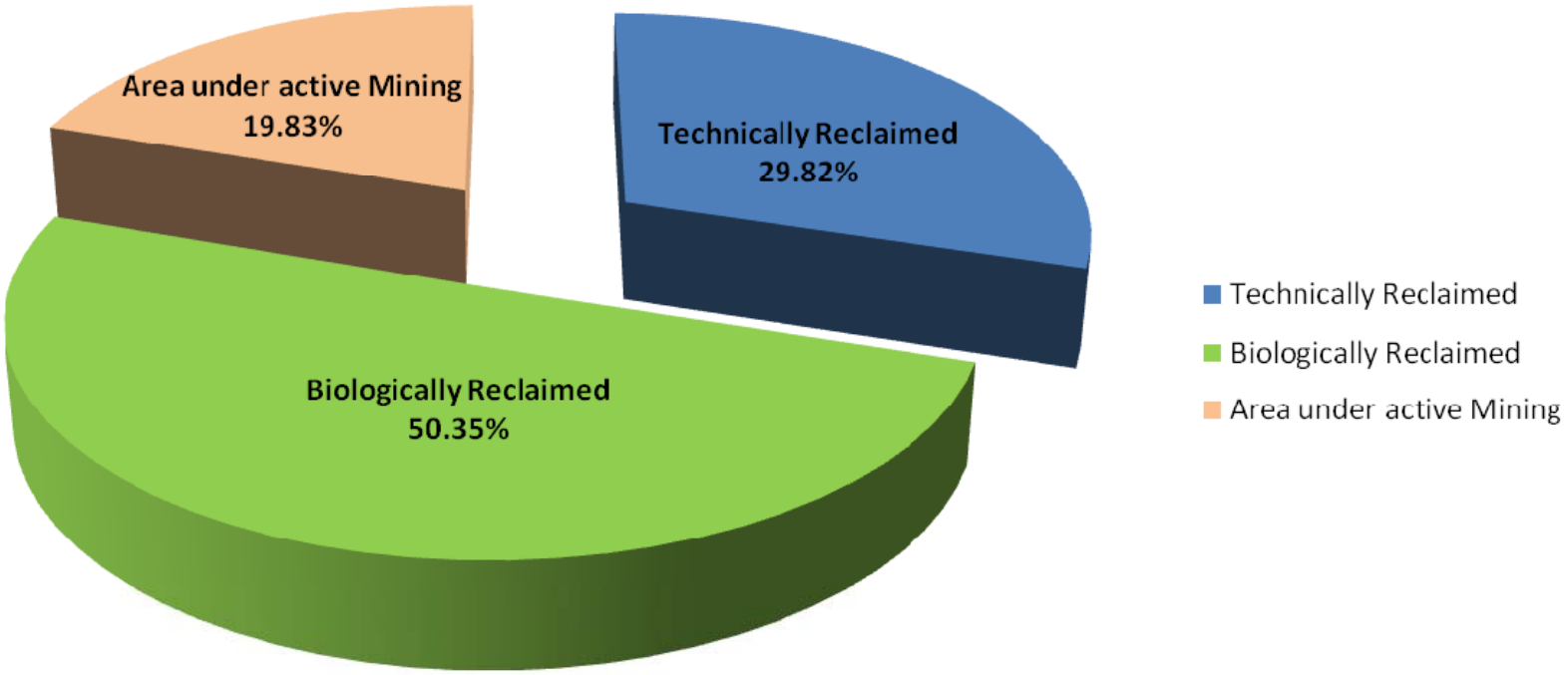
- Coal India has created 2.4 hectare of vegetation cover against each hectare of forest land used for coal mining so far..

- Suitable Wasteland area identified based on satellite data, being used for plantation.

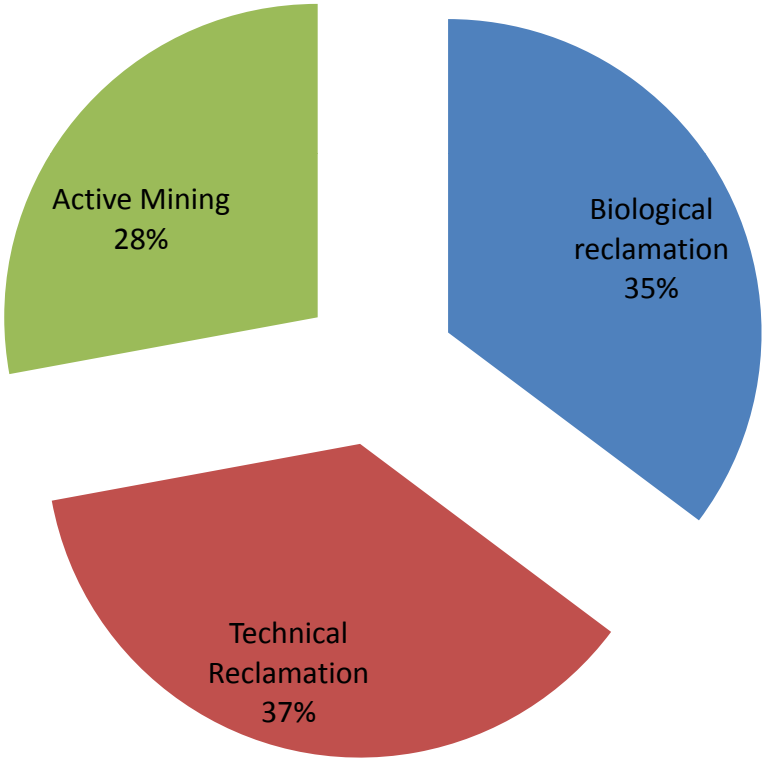
- Coal India is committed for eco-friendly mining.

Conclusion

STATUS OF LAND RESTORATION / RECLAMATION IN THE LEASEHOLD OF 50 OPENCAST MINES UNDER MONITORING



Land Reclamation Status in < 5 mcm (Coal+OB) coal mines



Impact of Land Reclamation on Forest Cover

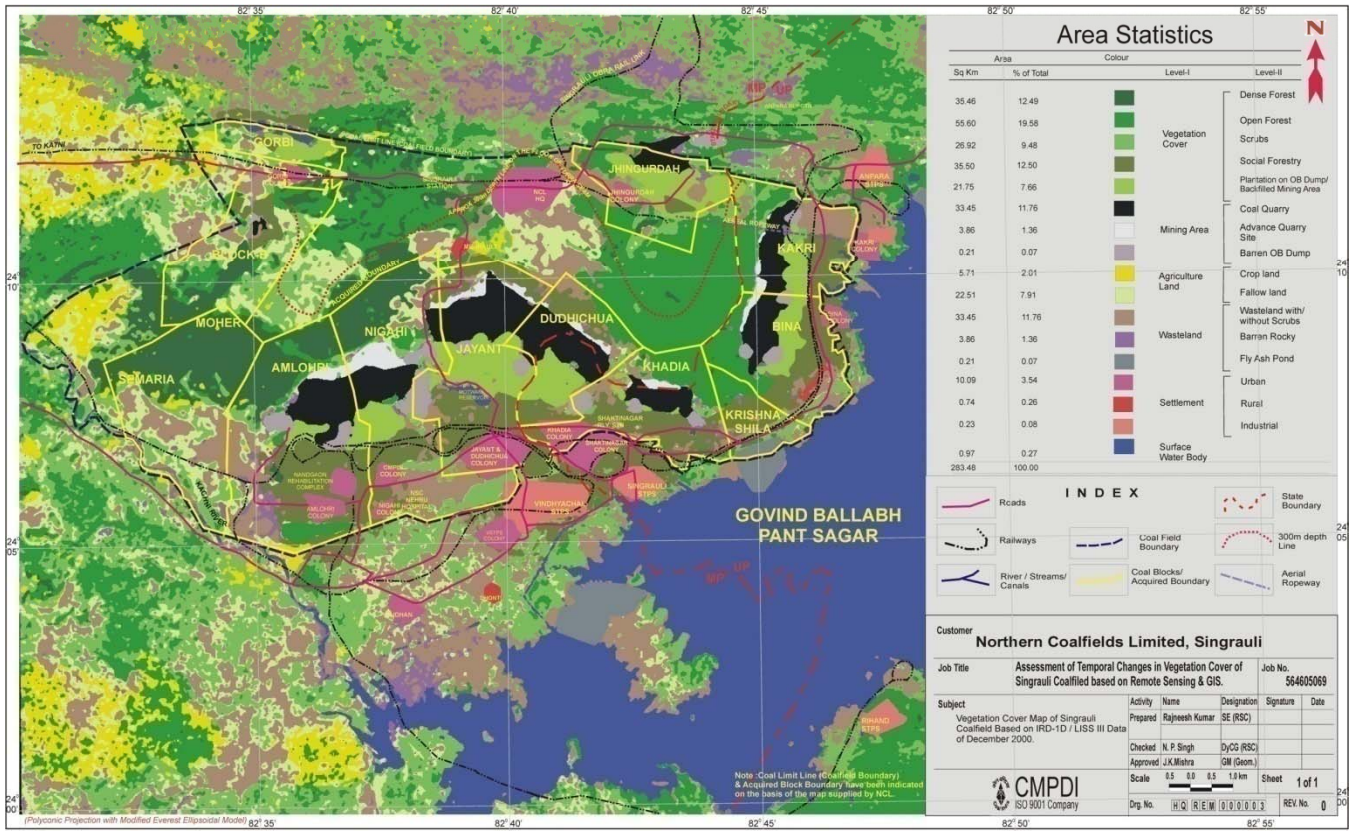
- As per SFR-2011 forest area has increased in last two years in coal mining states like:
  - Orissa (+48 Km^2)
  - Jharkhand (+83 Km^2)
  - Chhattisgarh (- 4 Km^2)
  - Maharashtra (- 4 Km^2)
  - M.P. (Nil)

- Contribution of CIL mines in these states are:
  - Orissa (4.90 Km^2)
  - Jharkhand (1.36 Km^2)
  - Chhattisgarh (5.56 Km^2)
  - Maharashtra (4.09 Km^2)
  - M.P. (5.49 Km^2)

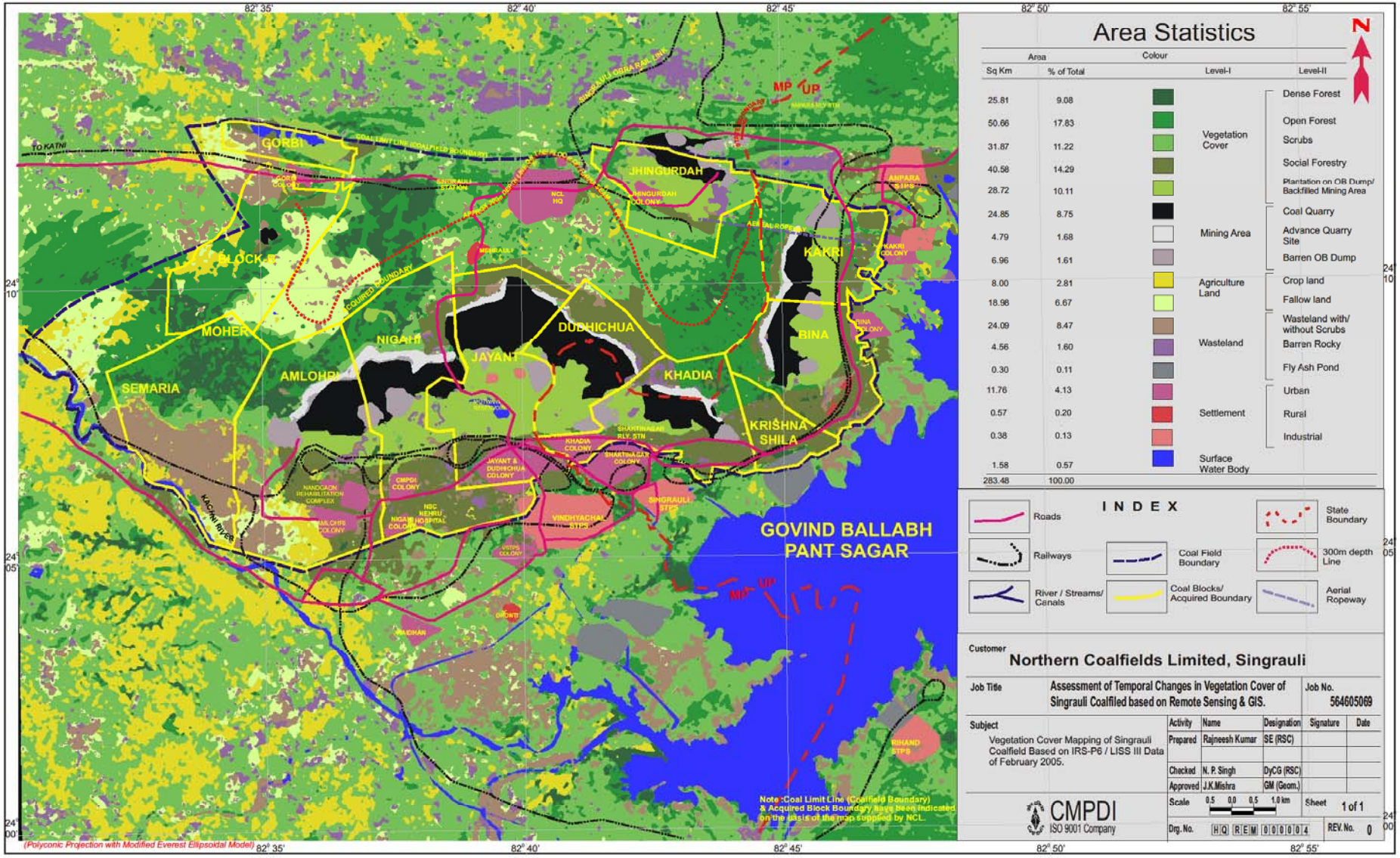
✓*Land use/Vegetation Cover Monitoring in Coalfield*

Geo-environmental dada base for all the coalfields are created using geospatial technology and monitored at regular interval of three years to assess the impact of coal mining on land use/vegetation cover in the coalfield.

Year 2000



VEGETATION COVER MAP OF SINGRAULI COALFIELD BASED ON RESOURCESAT, L-III SATELLITE DATA OF THE YEAR 2005



Area Statistics

N

Area Sq Km	Area % of Total	Colour	Level-I	Level-II
25.81	9.08		Vegetation Cover	Dense Forest
50.66	17.83			Open Forest
31.87	11.22			Scrubs
40.58	14.29			Social Forestry
28.72	10.11			Plantation on OB Dump/ Backfilled Mining Area
24.85	8.75		Mining Area	Coal Quarry
4.79	1.68			Advance Quarry Site
6.96	1.61			Barren OB Dump
8.00	2.81		Agriculture Land	Crop land
18.98	6.67			Fallow land
24.09	8.47		Wasteland	Wasteland with/ without Scrubs
4.56	1.60			Barren Rocky
0.30	0.11			Fly Ash Pond
11.76	4.13		Settlement	Urban
0.57	0.20			Rural
0.38	0.13			Industrial
1.58	0.57		Surface Water Body	
283.48	100.00			

INDEX

- Roads
- Railways
- River / Streams/ Canals
- State Boundary
- 300m depth Line
- Coal Field Boundary
- Coal Blocks/ Acquired Boundary
- Aerial Ropeway

Customer

Northern Coalfields Limited, Singrauli

Job Title	Job No.
Assessment of Temporal Changes in Vegetation Cover of Singrauli Coalfiled based on Remote Sensing & GIS.	564605069

Subject

Vegetation Cover Mapping of Singrauli Coalfield Based on IRS-P6 / LISS III Data of February 2005.

Activity	Name	Designation	Signature	Date
Prepared	Rajneesh Kumar	SE (RSC)		
Checked	N. P. Singh	DyCG (RSC)		
Approved	J.K.Mishra	GM (Geom.)		

CMPDI
ISO 9001 Company

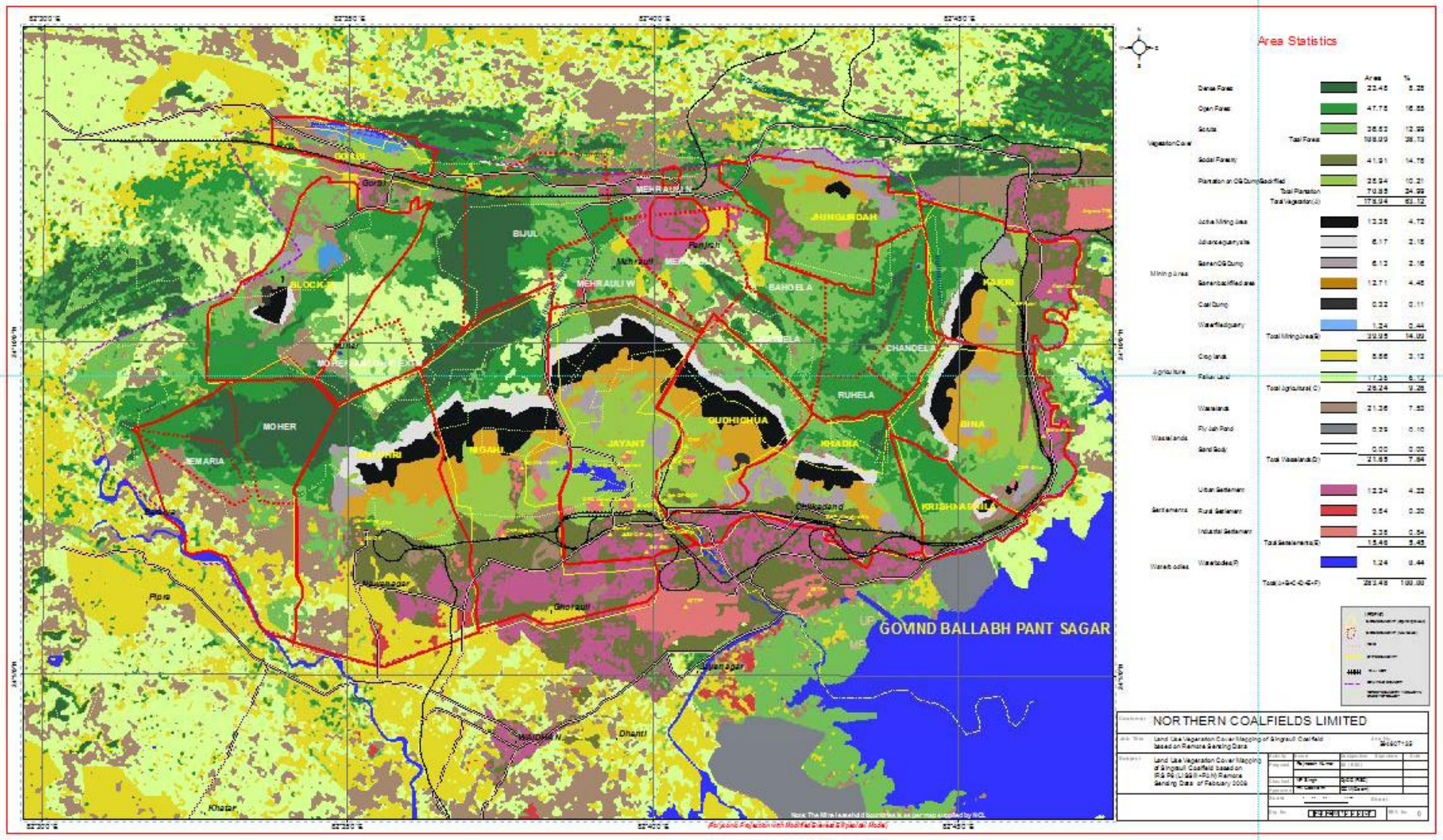
Scale 0.5 0.0 0.5 1.0 km

Sheet 1 of 1

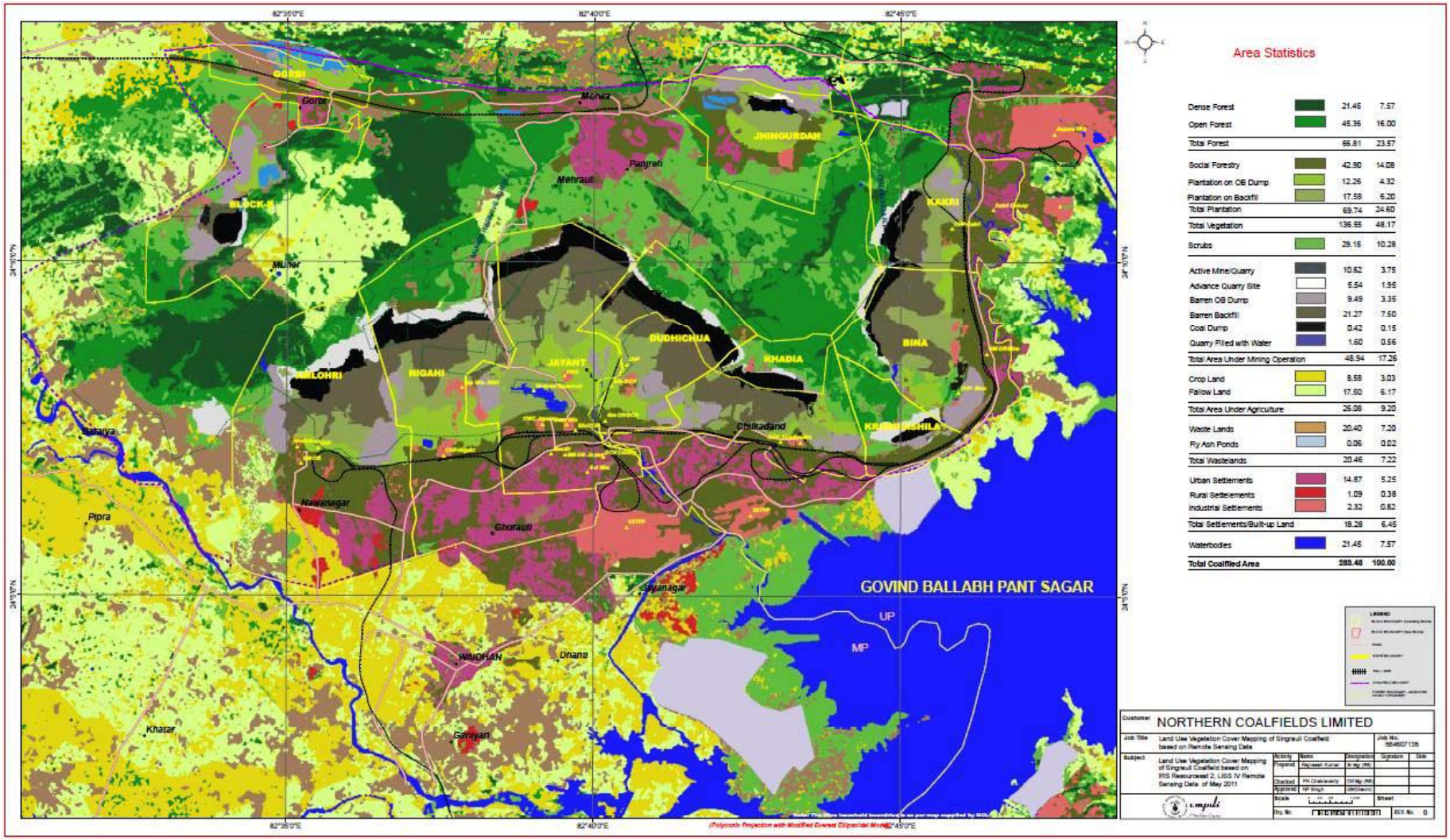
Drg. No. HQ REM 000004

REV. No. 0

VEGETATION COVER MAP OF SINGRAULI COALFIELD BASED RESOURCESAR/LIII DATA OF THE YEAR 2008



VEGETATION COVER MAPPING OF SINGRAULI COALFIELD -2011



Limitation of Satellite Surveillance

- ✓ Availability of High Resolution Satellite data
- ✓ Species Identification
- ✓ To distinguished between plantation and natural vegetation
- ✓ Identification of new plantation

❖ **These limitation may overcome by**

- **World View 3 satellite, 8 band data having 30 cm. spatial resolution**
- **NDVI for chlorophyll content**
- **Using 1cm. GSD airborne digital photographs using camera onboard UAV**

❑ **CPCB should very strictly monitor the compliance like USEPA.**

Backfilling

Terracing


OB DUMP STABILISATION BY JUTE NETTING

TERRACING & GRASS BEDDING

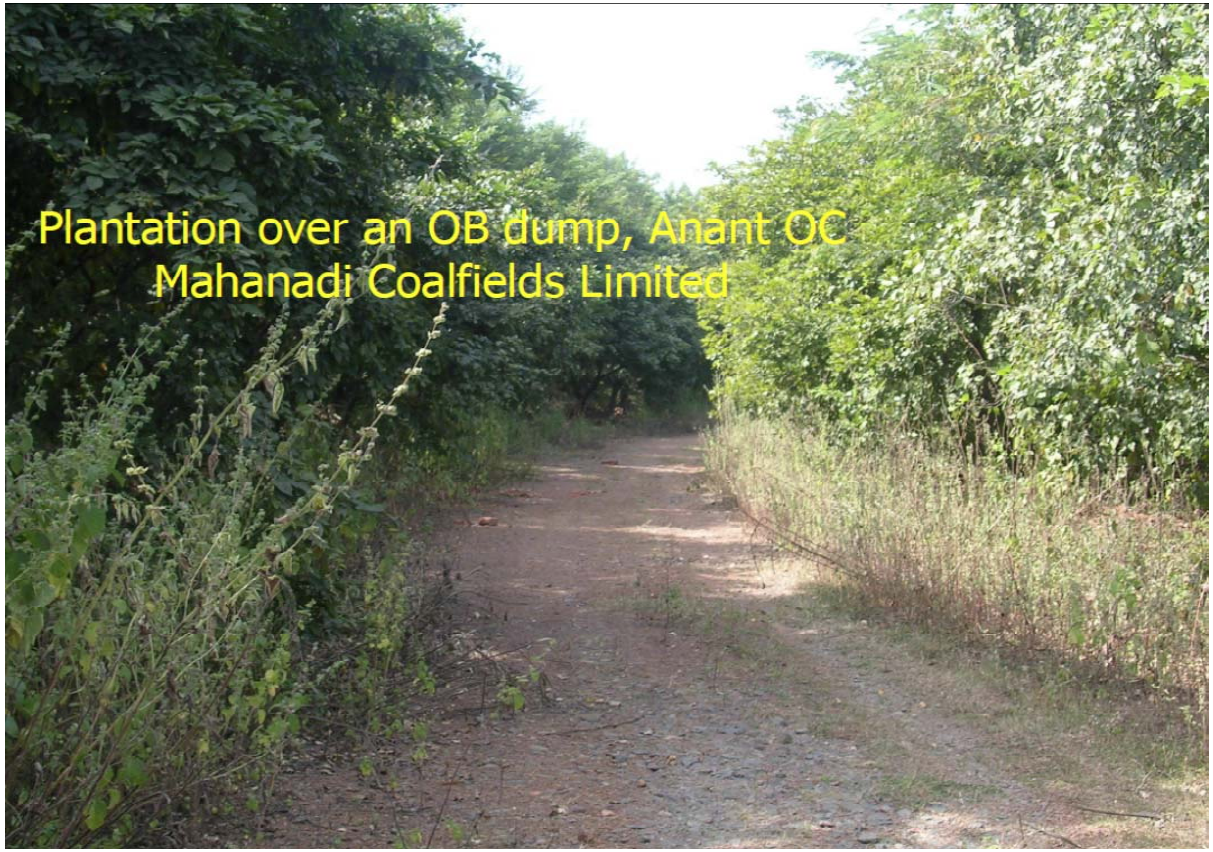
Gunjan Ecological Park on Reclaimed OB Dump, ECL

Reclaimed OB dump at Jayant OC, Northern Coalfields Limited


Reclaimed OC converted into a park at Umrer
Western Coalfields Limited

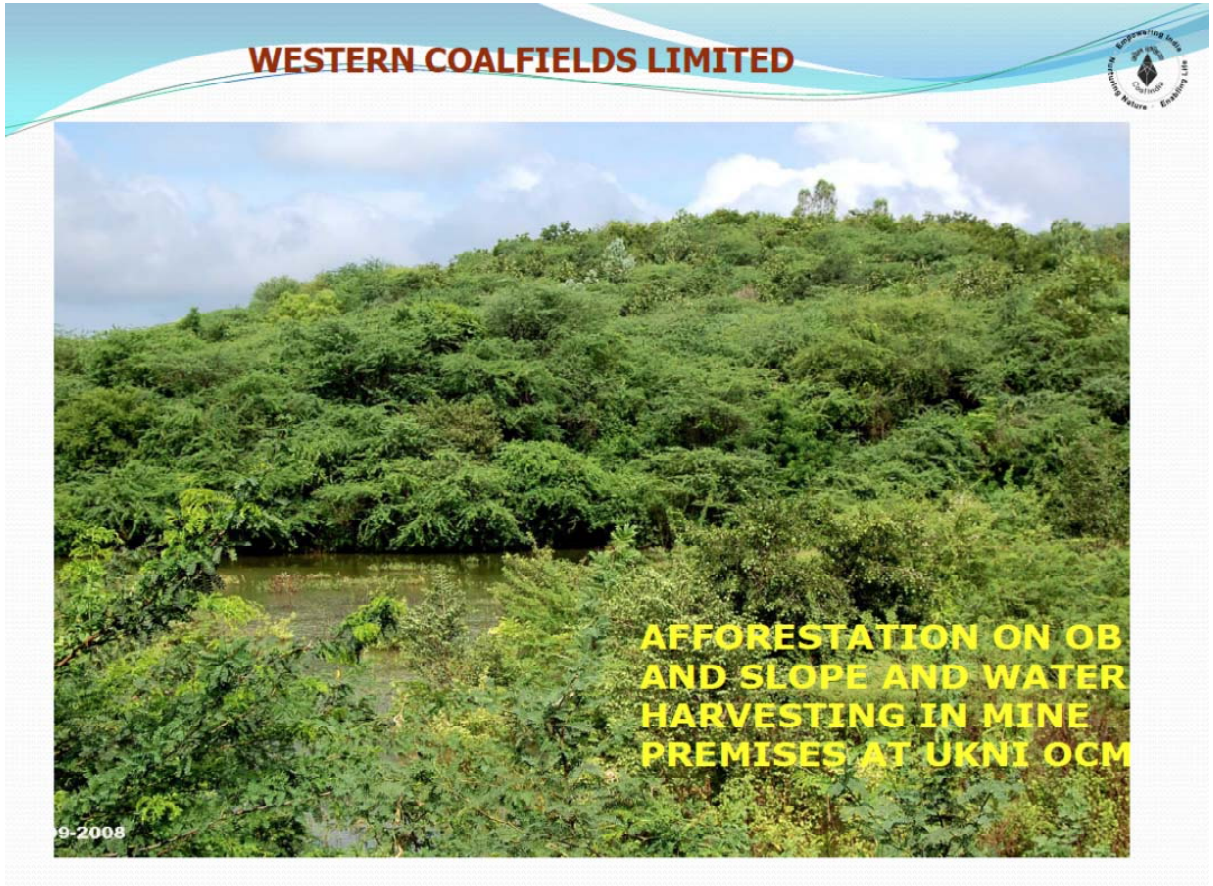
Plantation over reclaimed OB Dump, Anant OC
Mahanadi Coalfields Limited


Social Forestry in Sonepur Bazari OCP, ECL

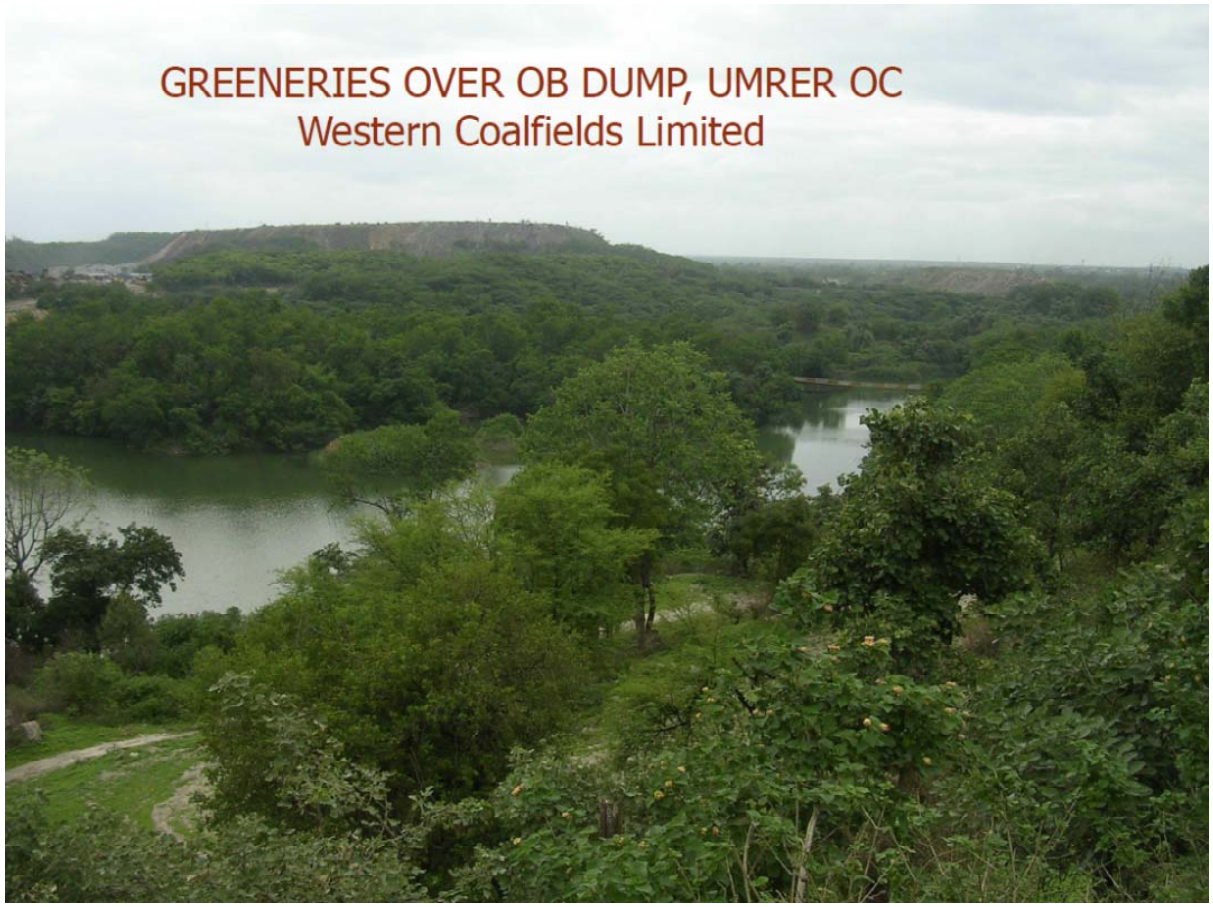

Plantation over an OB dump, Anant OC
Mahanadi Coalfields Limited

OB dump after Biological Reclamation, Gevra OC, SECL

Afforested O.B Dump


WESTERN COALFIELDS LIMITED
AFFORESTATION ON OB
AND SLOPE AND WATER
HARVESTING IN MINE
PREMISES AT UKNI OCM
9-2008

GREENER JAYANT EVERYWHERE


GREENERIES OVER OB DUMP, UMRER OC
Western Coalfields Limited


Social Forestry in Sonepur Bazari OCP, ECL

Land Reclamation in Knight Hauk mine in USA


Thanks!