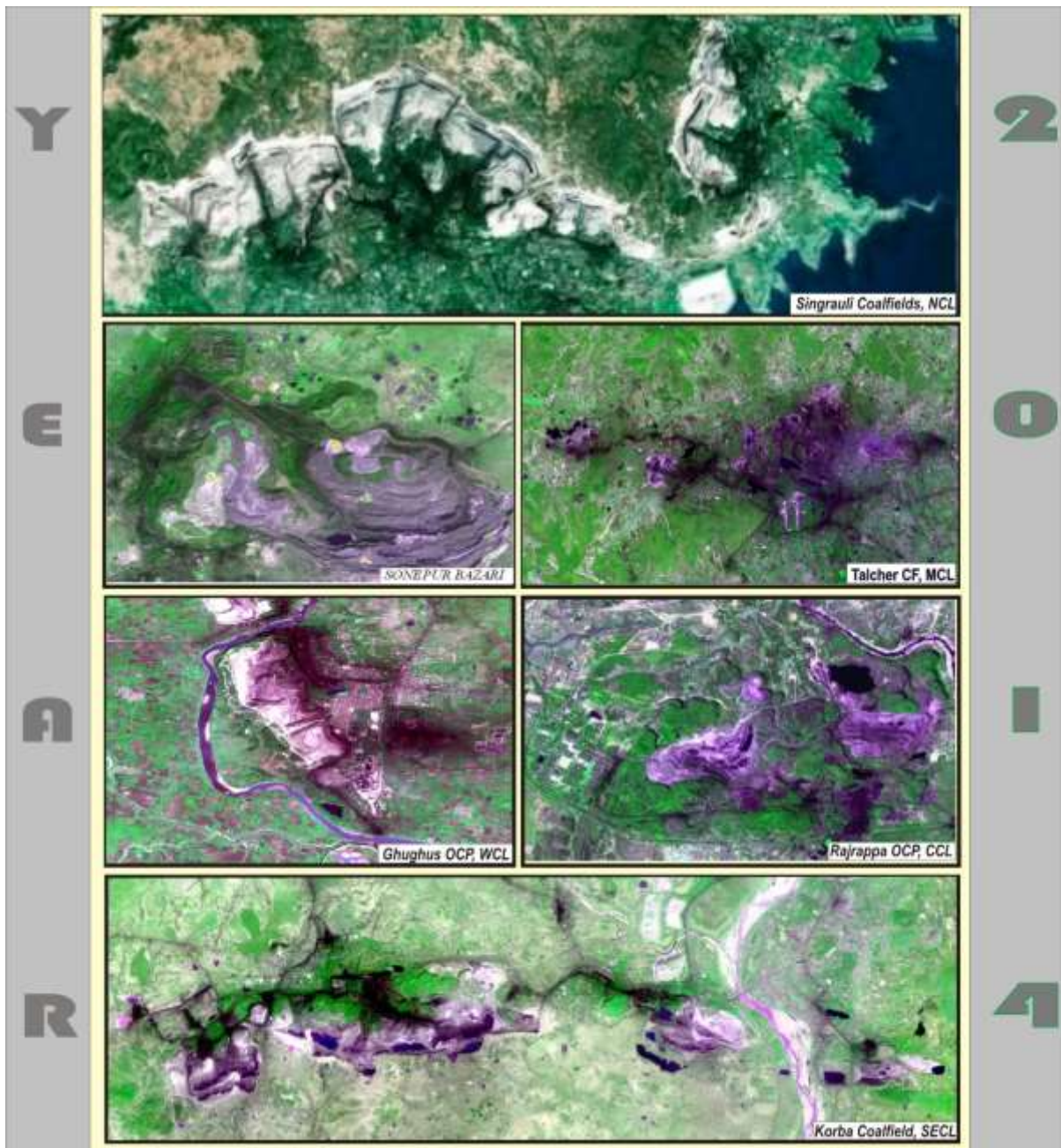


Land Restoration / Reclamation Monitoring of 50 Opencast Coal Mines of CIL producing more than 5 mcm (Coal+OB) based on Satellite Data for the Year 2014-15



**Land Restoration / Reclamation Monitoring of 50 Opencast
Coal Mines of CIL producing more than 5 mcm (Coal+OB)
based on Satellite Data for the Year 2014-15**

March- 2015



**Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi**

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Executive Summary

1.0 Project Land restoration / reclamation monitoring of 50 opencast coal mines of Coal India Ltd. (CIL) producing 5 million cu.m. and more (Coal+OB) per year based on satellite data on annual basis.

2.0 Objective Objective of the land restoration / reclamation monitoring is to assess the area under backfilling, plantation, social forestry, active mining area, water bodies, distribution of wasteland, agricultural land and forest in the leasehold area of the project. This will help in assessing the progressive status of mined land reclamation and to take up remedial measures, if any, required for environmental protection.

3.0 Salient Findings

- Out of the total mine leasehold area of 617.34 Km² of the 50 OC projects considered for monitoring during 2014-15; total excavated area is 356.37 Km² (57.73%);out of which 165.46 Km² area (46.43%) has been planted (Biologically Reclaimed), 115.69 Km² area (32.46%) is under backfilling (Technical Reclamation) and 75.26 Km² area (21.12%) is under active mining. It is evident from the analysis that 281.15 Km² (78.89%) areas of the OC projects are already under reclamation and balance 75.26 Km² (21.12%) area is under active mining. Company wise details are given in Table-1& Fig-1.
- On comparing the status of land reclamation carried out in year 2014-15 with respect to years 2013-14 in the 50 Opencast projects of different coal companies, it is evident from the analysis that area under land reclamation has increased from 274.30 Km² (Yr. 2013) to 281.15 Km² (Yr. 2014) which includes both plantation and areas under backfilling. This increase of 6.85 Km² area of land reclamation in one year is the result of the efforts made by CIL's subsidiary companies. Year wise comparison in land reclamation in different subsidiaries is given in Fig.2.

- It has been observed that in some projects, overall vegetation cover has been reduced marginally in the leasehold area in spite of increase in the total area under reclamation. This is primarily because of cutting of vegetation due to mine advancement.

Table-1

**Company wise Land Reclamation Status in OC projects
(5 million cu.m. and more Coal +OB) based on Satellite Data of year 2014**

Sl. No.	Coal Company (No. of OC Projects)	Area in Sq. Kms. (% calculated in respect of total excavated area)										
		Leasehold	Plantation		Under Backfilling		Under Active Mining		Total Excavated Area		Total Area under Reclamation	
			2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
		(i)	(ii)	(iii)	(iv)	(ii+iii+iv)		(ii+iii)				
1	WCL (10)	95.01	27.88	28.44	24.52	25.22	9.64	10.79	62.04	64.45	52.40	53.66
			44.94	44.13	39.52	39.13	15.54	16.74			84.46	83.26
2	SECL (10)	159.48	42.29	43.78	24.67	26.21	16.24	14.66	83.20	84.65	66.96	69.99
			50.83	51.72	29.65	30.96	19.52	17.32			80.48	82.68
3	NCL (10)	174.52	59.07	57.68	29.78	30.50	21.95	24.60	110.80	112.78	88.85	88.18
			53.31	51.14	26.88	27.04	19.81	21.81			80.19	78.19
4	MCL (11)	86.36	14.50	14.57	14.34	16.05	15.59	15.93	44.43	46.55	28.84	30.62
			32.64	31.30	32.28	34.48	35.09	34.22			64.91	65.78
5	CCL (05)	48.47	15.68	15.70	5.43	6.00	4.97	4.91	26.08	26.61	21.11	21.70
			60.12	59.00	20.82	22.55	19.06	18.45			80.94	81.55
6	BCCL (02)	14.06	1.36	1.44	4.82	4.79	1.12	1.10	7.30	7.29	6.18	6.23
			18.63	19.75	66.03	65.71	15.34	15.09			84.66	85.46
7	ECL (02)	39.44	3.83	3.85	6.13	6.92	3.35	3.27	13.31	14.04	9.96	10.77
			28.78	27.42	46.06	49.29	25.17	23.29			74.83	76.71
TOTAL CIL (50)	(50)	617.34	164.61	165.46	109.69	115.69	72.86	75.26	347.16	356.37	274.30	281.15
			47.42	46.43	31.60	32.46	20.99	21.12	56.23	57.73	79.01	78.89

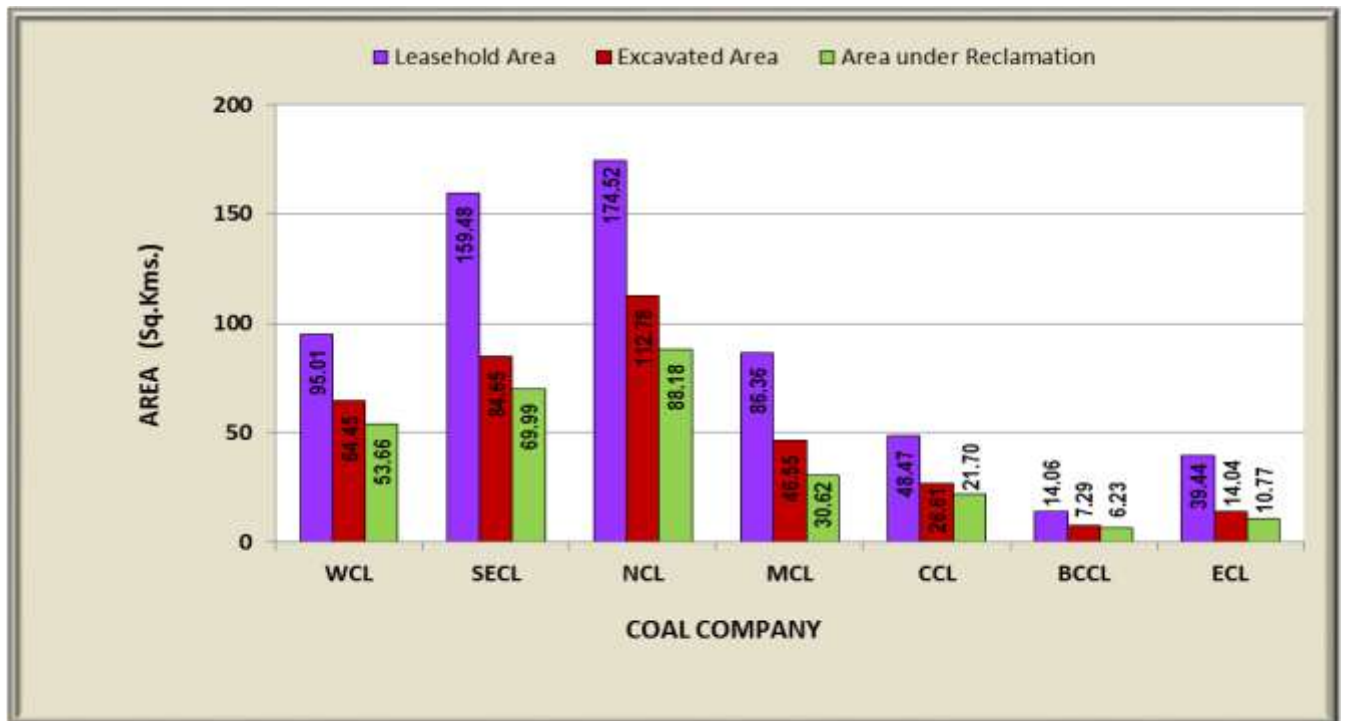


Fig. 1 : Company wise Land Reclamation Status in the Year 2014

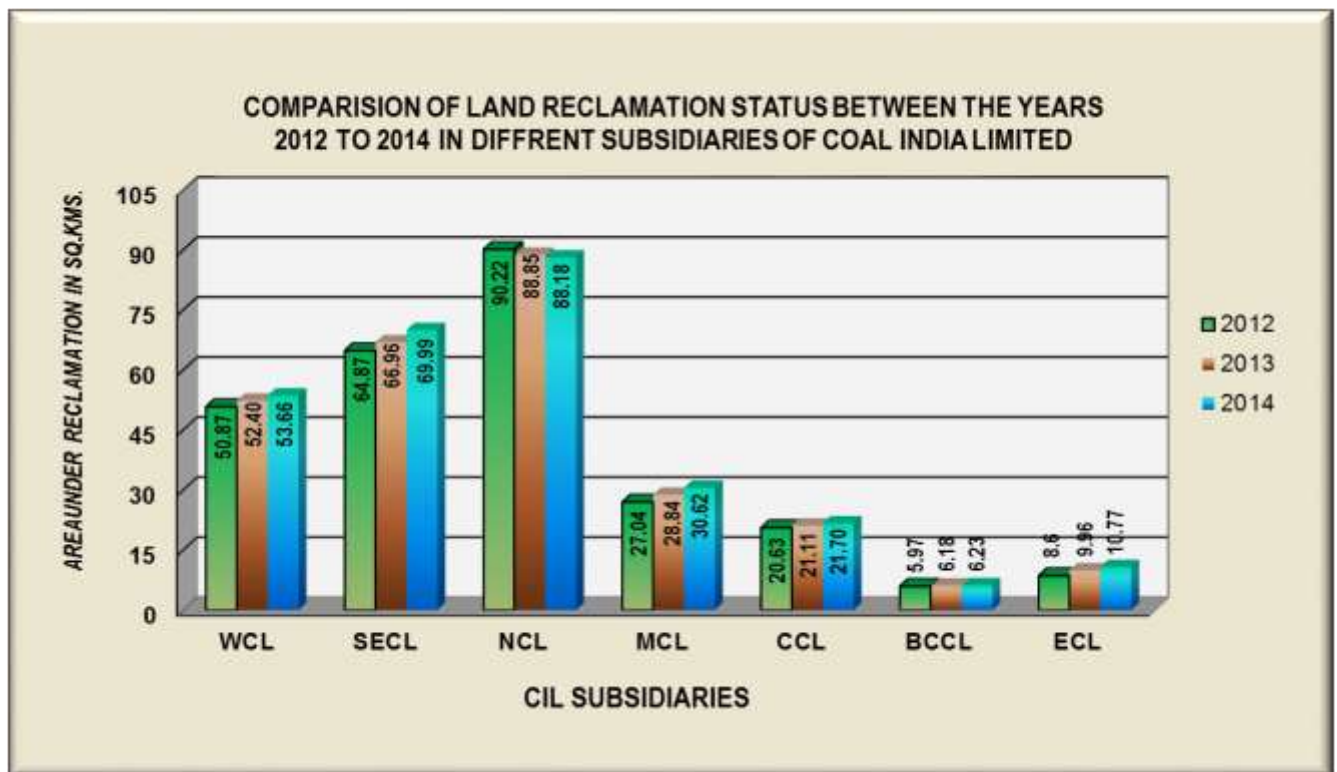


Fig.2 : Yearwise comparison of Land Reclamation in CIL Subsidiaries

1.0 Background

1.1 Land is the most important natural resource which embodies soil, water, flora, fauna and total ecosystem. All human activities are based on the land which is the most scarce natural resource in our country. Mining is a site specific industry and it could not be shifted anywhere else from the location where mineral occurs. It is a fact that surface mining activities do effect the land environment due to ground breaking. Therefore, there is an urgent need to reclaim and restore the mined out land for its productive use for sustainable development of mining. This will not only mitigate environmental degradation, but would also help in creating a more congenial environment for land acquisition by coal companies in future.

1.2 Keeping above in view, Coal India Ltd. (CIL) issued a work order vide letter no. CIL/WBP/Env/2009/2428 dated 29.12.2009 to Central Mine Planning & Design Institute (CMPDI), Ranchi, for monitoring land reclamation. status of all the opencast coal mines having production of more than 5 million m³ per annum (coal + OB taken together per annum) based on remote sensing satellite data, regularly on annual basis for sustainable development of mining. Another work order vide letter no. CIL/WBP/ENV./2011dated23/08/11was issued by CIL for monitoring of less than 5 million m³ per annum capacity (Coal +OB) projects from the year 2011 at interval of three years. Further, a revised work order was issued vide letter no. CIL/WBP/Env/2011/4706 dated 12.10.2012 from Coal India Limited for the period 2012-13 to 2016-17. According to this work order, all mines in CIL with output capacity of 5 million cu. m (coal +OB) shall be monitored every year and all mines below this capacity shall be monitored at an interval of 3 yrs. All coalfields in CIL shall also be monitored at an interval of 3 years as per a defined plan. The result of land reclamation status of all such mines to be put on the website of CIL, (www.coalindia.in), CMPDI (www.cmpdi.co.in) and the concerned coal companies in public domain. Detail report to be submitted to Coal India and respective subsidiaries.

- 1.3** Land reclamation monitoring of all opencast coal mining projects would also comply the statutory requirements of Ministry of Environment & Forest (MoEF). Such monitoring would not only facilitate in taking timely mitigation measures against environmental degradation but would also enable coal companies to utilize the reclaimed land for larger socio-economic benefits in a planned way.
- 1.4** CMPDI undertook the above study and the present report is embodying the findings in nutshell carrying out for the 50 opencast projects of different subsidiaries producing 5 million cubic m. coal +OB or more in the year 2014-15. This study is being carried out in since year 2008 on annual basis and progressive changes in the status of land reclamation have been assessed.

2.0 Objective

Objective of the land reclamation/restoration monitoring is to assess the area of backfilled, plantation, OB dumps, social forestry, active mining area, settlements and water bodies, distribution of wasteland, agricultural land and forest land in the leasehold area of the project. This is an important step taken up for assessing the progressive status of mined land reclamation and for taking up remedial measures, if any, required for environmental protection.

3.0 Methodology

There are number of steps involved between raw satellite data procurement and preparation of final map. National Remote Sensing Centre (NRSC) Hyderabad, being the nodal agency for satellite data supply in India, provides only raw digital satellite data, which needs further digital image processing for extracting the information and map

preparation before uploading the same in the website. Methodology for land reclamation monitoring is given in fig 3. Following steps are involved in land reclamation /restoration monitoring:

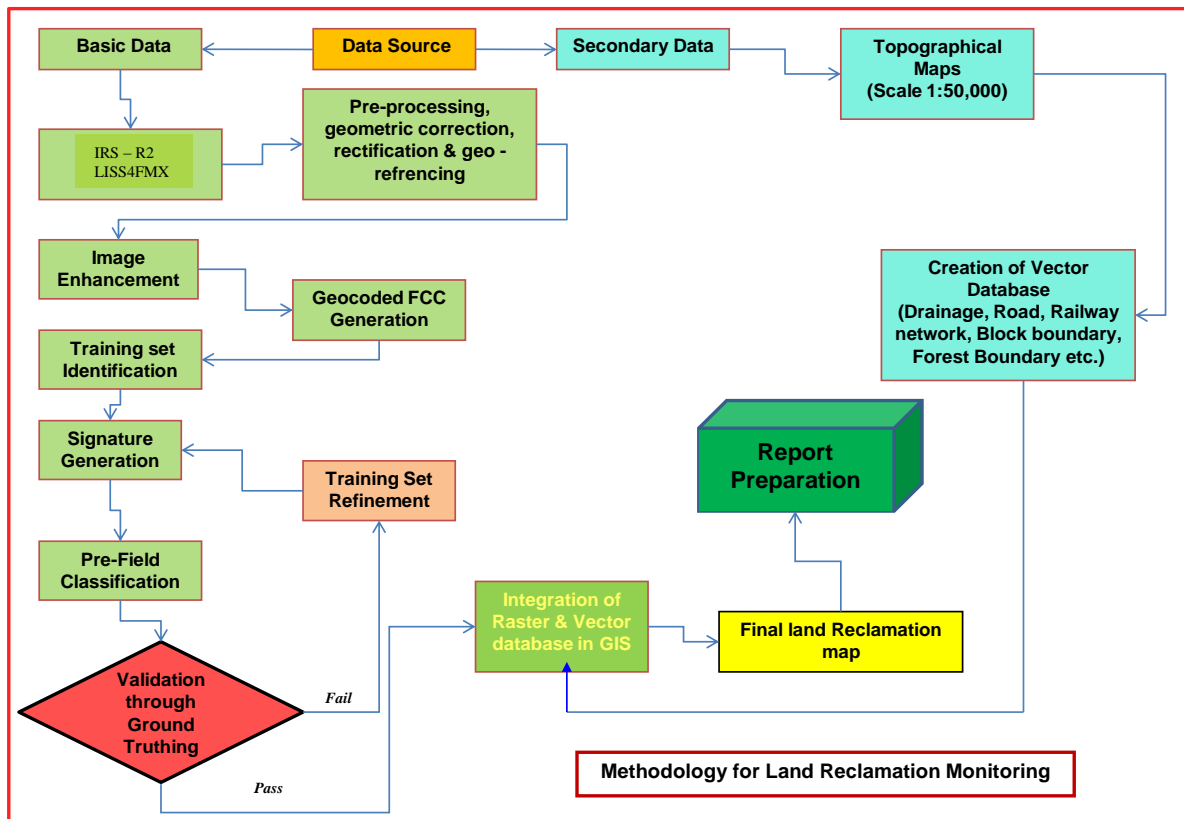


Fig.3 : Methodology for Land Reclamation Monitoring

- 3.1 **Data Procurement:** After browsing the data quality and date of pass on internet, supply order for data is placed to NRSC. Secondary data like leasehold boundary, topo sheets are procured for creation of vector database.
- 3.2 **Satellite Data Processing:** Satellite data are processed using ERDAS IMAGINE Professional v2014 s/w / PCI Geomatica v10.1 digital image processing s/w. Methodology involves the following major steps:

- **Rectification & Geo-referencing:** Inaccuracies in digital imagery may occur due to 'systematic errors' attributed to earth curvature and rotation as well as 'non-systematic errors' attributed to satellite receiving station itself. Raw digital images contain geometric distortions, which make them unusable as maps. Therefore, geo-referencing is required for correction of image data using ground control points (GCP) to make it compatible to Sol topo-sheet.
- **Image enhancement:**

To improve the interpretability of the raw data, image enhancement is necessary. Local operations modify the value of each pixel based on brightness value of neighbouring pixels using ERDAS IMAGINE Professional v2014 s/w / PCI Geomatica v10.1 digital image processing s/w and enhance the image quality for proper interpretation.
- **Training set selection**

Training set requires to be selected, so that software can classify the image data accurately. The image data are analysed based on the interpretation keys. These keys are evolved from certain fundamental image-elements such as tone/colour, size, shape, texture, pattern, location, association and shadow. Based on the image-elements and other geo-technical elements like land form, drainage pattern and physiography; training sets were selected/identified for each land use/cover class. Field survey was carried out by taking selective traverses in order to collect the ground information (or reference data) so that training sets are selected accurately in the image. This was intended to serve as an aid for classification.
- **Classification and Accuracy assessment**

Image classification is carried out using the maximum likelihood algorithm. The classification proceeds through the following steps: (a) calculation of statistics [i.e.

signature generation] for the identified training areas, and (b) the decision boundary of maximum probability based on the mean vector, variance, covariance and correlation matrix of the pixels. After evaluating the statistical parameters of the training sets, reliability test of training sets is conducted by measuring the statistical separation between the classes that resulted from computing divergence matrix. The overall accuracy of the classification was finally assessed with reference to ground truth data.

- **Area calculation**

The area of each land use class in the leasehold is determined using ERDAS IMAGINE Professional v2014/ PCI Geomatica v10.1 digital image processing s/w.

- **Overlay of Vector data base**

Vector data base created based on secondary data. Vector layer like drainage, railway line, leasehold boundary, forest boundary etc. are superimposed on the image as vector layer in the Arc GIS database.

- **Pre-field map preparation**

Pre-field map is prepared for validation of the classification result

3.3 Ground Truthing:

Selective ground verification of the land use classes are carried out in the field and necessary corrections if required, are incorporated before map finalization.

3.4 Land reclamation database on GIS:

Land reclamation database is created on GIS platform to identify the temporal changes identified from satellite data of different cut-off dates.

4.0 Work Plan

- 4.1** Total 50 opencast projects producing 5 million cubic m. and more (Coal + OB together) during the year 2014-15 were taken up for the study. Based on the *RESOURCESAT-2* satellite data, land reclamation / mine closure monitoring was carried out using ERDAS IMAGINE digital image processing s/w and Arc-Info GIS. Baseline data on reclamation of these OC projects of CIL's subsidiaries have been also done during the year 2008, 2009, 2010, 2011, 2012 and 2013.
- 4.2** Besides project wise land reclamation monitoring, coalfield wise vegetation cover monitoring on regional scale has also been planned for the major 28 coalfields of India at regular interval of three years using remote sensing satellite data to assess the regional impact of coal mining and associated industrialization on the land use and vegetation cover in the coalfield. Geo-environmental baseline data for Raniganj, Jharia , East Bokaro, West Bokaro, Karanpura, Singrauli (Moher Sub-basin), Korba, Bistrampur, Shoagpur, Mand-Raigarh, Talcher, Ib Valley , Wardha Valley, Bander , Kamptee, Umrer, PENCH Kanhan and Makum coalfields based on the satellite data have been generated and will be monitored regularly at three years interval.
- 4.3** The list of subsidiary wise 50 opencast projects taken up based on satellite data of year 2014-15 is given in table below :

Subsidiary (No. of Projects)	Opencast Projects (5 million Cu.m. Coal +OB or more per annum)
WCL (10)	Sasti, Padmapur, Durgapur, Mugoli, Umrer, Ukni, Niljai, New Majri (IIA), Pimpalgaon & Ghugus
SECL (10)	Dipka, Gevra, Kusmunda, Manikpur, Bishrampur, Dugga, Jamuna, Rajnagar, Dhanpuri & Chirimiri
NCL (10)	Amlohri, Nigahi, Jayant, Dudhichua, Khadia, Krishnashila, Bina, Kakri, Jhingurdah, Block-B
MCL (11)	Ananta, Balram, Lingraj, Bharatpur, Bhubaneswari, Jagannath, Hingula, Belpahar, Lakhapur, Samleswari, & Lajkura
CCL (05)	Ashoka, Piparwar, K.D. Hesalong, Parej & Rajrappa
BCCL (02)	Block-II, Muraidih
ECL (02)	Sonpur-Bazari, Rajmahal
TOTAL (50)	

4.4 Subsidiary wise land reclamation status of the above mentioned 50 OC projects derived from satellite data for the year 2014 are given in the following pages:

WESTERN COALFIELDS LIMITED

5.0 Land Reclamation Status in Western Coalfields Ltd.

5.1 Following 10 OC projects producing more than 5 million cubic m. (Coal + OB together) of Western Coalfields Ltd. have been taken up for land reclamation monitoring during the year 2014-15:

- Sasti
- Padmapur
- Durgapur
- Mugoli
- Umrer
- Ukni
- Niljai
- New Majri
- Pimpalgaon
- Ghugus

5.2 Project wise Land Reclamation status in WCL for the year 2014 is given in Table 5.1 and also shown graphically in Fig 5.1. Area statistics of different land use class present in the mine leasehold of the above projects for the year 2014 are shown in the Table –5.2. Land use maps derived from satellite data are shown in Plate 5.1-5.10. Land reclamation monitoring of the above mentioned 10 projects is being done since 2009 on annual basis. Year wise changes in the different land use classes based on satellite data are depicted in Bar Charts in Fig.5.2–5.11 for the last three years only.

5.3 Study reveals that 83.26% of mining area has been under reclamation by WCL out of which 44.13% area has been revegetated and 39.13% area is under backfilling. There is an increase of 1.26 Km² in area under reclamation in WCL in the year 2014 with respect to the year 2013, out of which 0.56 Km² increase in area under

biological reclamation (Plantation) and 0.70 Km² increase in area under technical reclamation (Barren Backfilling).

- 5.4** After analyzing the satellite data of year 2014 vs. 2013, it is evident that plantation carried out on backfilled area, OB dumps as well as under social forestry in all the mines of WCL has increased from 27.88 Km² to 28.44 Km² in span of last one year. This increase of 0.56 Km² area of plantation in one year time is due to the efforts of WCL towards mine land reclamation.
- 5.5** Out of 10 projects of WCL, maximum land reclamation has been carried out in Durgapur project (89.67%) followed by Sasti (89.46%) and Ghugus OCP (89.37%).

Table 5.1
Projectwise Land Reclamation Status in Opencast Projects of WCL
based on Satellite Data of the year 2014

(% Calculated in terms of Total Excavated Area)

(Area in Km²)

Sl. No.	Project		Plantation/Vegetation		Under Backfilling		Active Mining		Total Excavated Area		Total Area under Reclamation	
	Name	Leasehold	ii		iii		iv		ii+iii+iv		ii+iii	
		2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1	SASTI	12.69	3.33	3.38	2.43	2.39	0.58	0.68	6.34	6.45	5.76	5.77
			52.52	52.40	38.33	37.05	9.15	10.54			90.85	89.46
2	PADMAPUR	7.34	2.15	2.17	2.99	3.03	0.74	0.86	5.88	6.06	5.14	5.20
			36.56	35.81	50.85	50.00	12.59	14.19			87.41	85.81
3	DURGAPUR	8.88	3.38	3.49	3.22	3.11	0.69	0.76	7.29	7.36	6.60	6.60
			46.36	47.42	44.17	42.26	9.47	10.33			90.53	89.67
4	MUGOLI	7.88	1.57	1.60	2.20	2.22	1.23	1.55	5.00	5.37	3.77	3.82
			31.40	29.80	44.00	41.34	24.60	28.86			75.40	71.14
5	UMRER	9.45	5.66	5.63	1.81	1.84	1.09	1.10	8.56	8.57	7.47	7.47
			66.12	65.69	21.14	21.47	12.73	12.84			87.27	87.16
6	UKNI	9.30	2.25	2.27	2.19	2.59	1.46	1.51	5.90	6.37	4.44	4.86
			38.14	35.64	37.12	40.66	24.75	23.70			75.25	76.30
7	NILJAI	15.30	2.03	2.35	2.25	2.59	2.22	2.36	6.50	7.30	4.28	4.94
			31.23	32.19	34.62	35.48	34.15	32.33			65.85	67.67
8	NEW MAJRI	9.05	3.70	3.70	3.06	3.06	0.66	0.85	7.42	7.61	6.76	6.76
			49.87	48.62	41.24	40.21	8.89	11.17			91.11	88.83
9	PIMPALGAON	4.92	1.64	1.68	1.58	1.60	0.49	0.53	3.71	3.81	3.22	3.28
			44.20	44.09	42.59	41.99	13.21	13.91			86.79	86.09
10	GHUGUS	10.20	2.17	2.17	2.79	2.79	0.48	0.59	5.44	5.55	4.96	4.96
			39.89	39.10	51.29	50.27	8.82	10.63			91.18	89.37
TOTAL (WCL)		95.01	27.88	28.44	24.52	25.22	9.64	10.79	62.04	64.45	52.40	53.66
			44.94	44.13	39.52	39.13	15.54	16.74	65.30	67.83	84.46	83.26

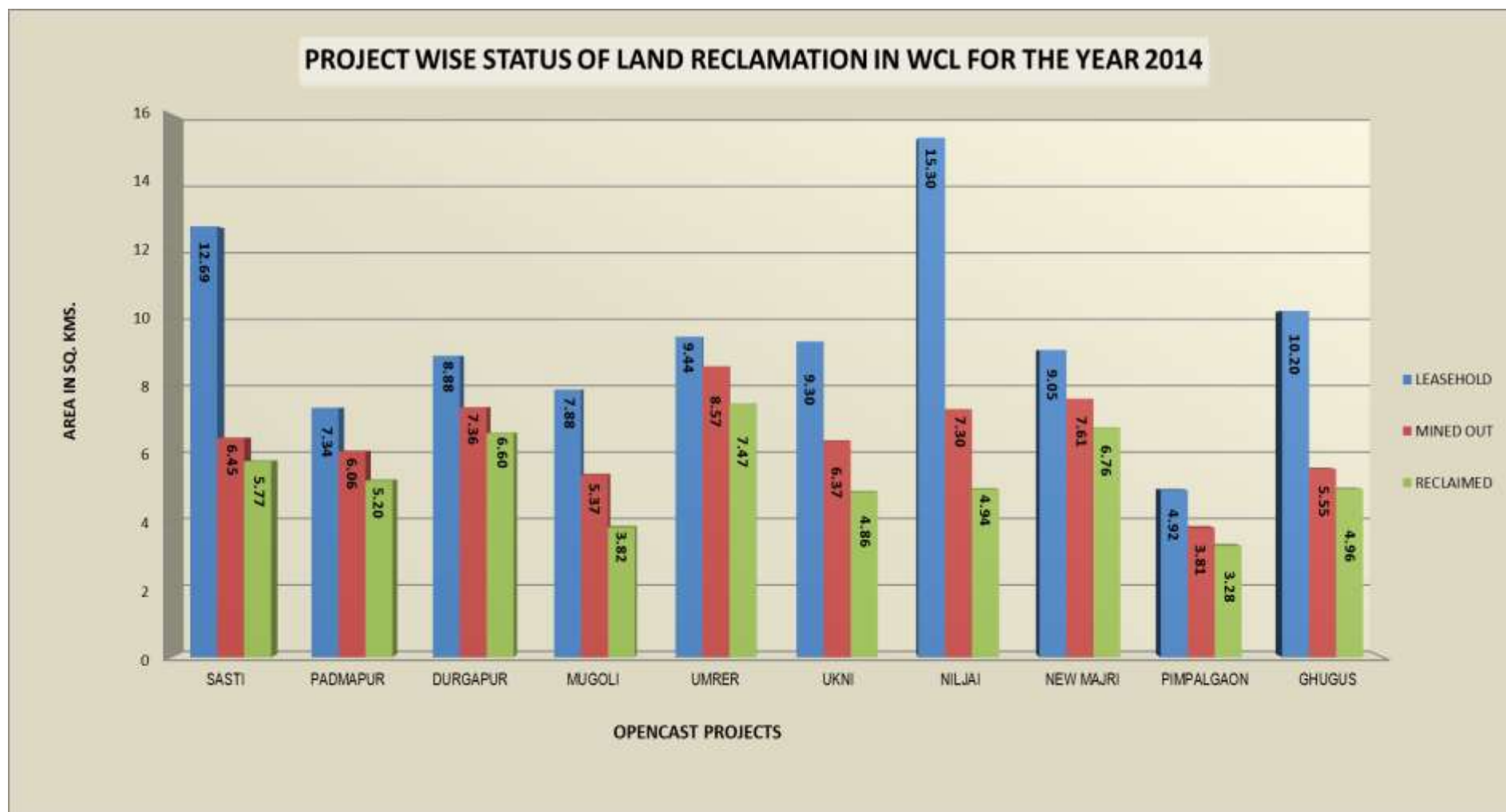


Figure : 5.1

Table 5.2

STATUS OF LAND USE / RECLAMATION IN OC MINES (>5mcu.m) OF WESTERN COALFIELDS LTD BASED ON SATELLITE DATA OF THE YEAR 2014

(Area in Sq Km)

	SASTI		PADMAPUR		DURGAPUR		MUGOLI		UMRER		UKNI		NILJAI		NEW MAJRI		PIMPALGAON		GHUGUS		TOTAL	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS																						
Dense Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCRUBS																						
Scrubs	0.54	4.26	0.69	9.40	0.45	5.07	1.13	14.34	0.00	0.00	1.53	17.42	1.31	8.56	0.25	2.76	0.36	7.32	0.68	6.67	6.94	8.21
Social Forestry	0.57	4.49	0.92	12.53	0.95	10.70	0.19	2.41	1.22	12.91	0.16	1.72	0.43	2.81	0.00	0.00	0.78	15.85	1.06	10.39	6.28	7.42
Plantation on OB Dump	2.44	19.23	1.25	17.03	2.54	28.60	1.03	13.07	2.57	27.20	0.97	10.43	0.86	5.62	2.39	26.41	0.90	18.29	0.81	7.94	15.76	18.63
Plantation on Backfill	0.37	2.92	0.00	0.00	0.00	0.00	0.38	4.82	1.84	19.47	1.14	12.26	1.06	6.93	1.31	14.48	0.00	0.00	0.30	2.94	6.40	7.57
Total Plantation (Biological Reclamation)	3.38	26.64	2.17	29.56	3.49	39.30	1.60	20.30	5.63	59.58	2.27	24.41	2.35	15.36	3.70	40.88	1.68	34.15	2.17	21.27	28.44	33.62
Total Vegetation	3.92	30.89	2.86	38.96	3.94	44.37	2.73	34.64	5.63	59.58	3.80	41.83	3.66	23.92	3.95	43.65	2.04	41.46	2.85	27.94	35.38	41.83
ACTIVE MINING																						
Coal Quarry	0.68	5.36	0.86	11.72	0.63	7.09	1.35	17.13	1.10	11.64	1.51	16.24	2.36	15.42	0.85	9.39	0.41	8.33	0.59	5.78	10.34	12.23
Advance Quarry Site	0.00	0.00	0.00	0.00	0.00	0.00	0.20	2.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.24
Quarry Filled With Water	0.00	0.00	0.05	0.68	0.13	1.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	1.42	0.00	0.00	0.25	0.30
Coal Dump	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Area Under Active Mining	0.68	5.36	0.91	12.40	0.76	8.56	1.55	19.67	1.10	11.64	1.51	16.24	2.36	15.42	0.85	9.39	0.48	9.76	0.59	5.78	10.79	12.76
Area under Backfilling	2.32	18.28	1.13	15.40	1.41	15.88	1.18	14.97	1.48	15.66	1.73	18.60	1.24	8.10	1.73	19.12	0.72	14.63	1.46	14.31	14.40	17.03
Barren OB Dump	0.07	0.55	1.90	25.89	1.70	19.14	1.04	13.20	0.36	3.81	0.86	9.25	1.35	8.82	1.33	14.70	1.04	21.14	1.33	13.04	10.98	12.98
Total Area Under Technical Reclamation	2.39	18.83	3.03	41.28	3.11	35.02	2.22	28.17	1.84	19.47	2.59	27.85	2.59	16.93	3.06	33.81	1.76	35.77	2.79	27.35	25.38	30.01
Total Area Under Mine Operation	3.07	24.19	3.94	53.68	3.87	43.58	3.77	47.84	2.94	31.11	4.10	44.09	4.95	32.35	3.91	43.20	2.24	45.53	3.38	33.14	36.17	42.76
WASTELANDS																						
Waste Lands	0.61	4.81	0.18	2.45	0.64	7.21	0.59	7.49	0.05	0.53	0.00	0.00	1.79	11.70	0.54	5.97	0.28	5.69	3.05	29.90	7.73	9.14
Sand Body	0.21	1.65	0.04	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.30
Total Wasteland	0.82	6.46	0.22	3.00	0.64	7.21	0.59	7.49	0.05	0.53	0.00	0.00	1.79	11.70	0.54	5.97	0.28	5.69	3.05	29.90	7.98	9.43
WATERBODIES																						
Reservoir, nallah, ponds	0.13	1.02	0.09	1.23	0.00	0.00	0.00	0.00	0.54	5.71	0.00	0.00	0.00	0.00	0.31	3.43	0.00	0.00	0.03	0.29	1.10	1.30
Total Waterbodies	0.13	1.02	0.09	1.23	0.00	0.00	0.00	0.00	0.54	5.71	0.00	0.00	0.00	0.00	0.31	3.43	0.00	0.00	0.03	0.29	1.10	1.30
AGRICULTURE																						
Crop Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.02	13.20	0.00	0.00	0.00	0.00	0.00	0.00	2.02	2.39
Fallow Lands	4.42	34.83	0.11	1.50	0.00	0.00	0.66	8.38	0.00	0.00	1.05	11.29	2.32	15.16	0.00	0.00	0.20	4.07	0.00	0.00	8.76	10.36
Total Agriculture	4.42	34.83	0.11	1.50	0.00	0.00	0.66	8.38	0.00	0.00	1.05	11.29	4.34	28.37	0.00	0.00	0.20	4.07	0.00	0.00	10.78	12.75
SETTLEMENTS																						
Urban Settlement	0.04	0.32	0.12	1.63	0.43	4.84	0.00	0.00	0.24	2.54	0.00	0.00	0.17	1.11	0.34	3.76	0.09	1.83	0.32	3.14	1.75	2.07
Rural Settlement	0.10	0.79	0.00	0.00	0.00	0.00	0.05	0.63	0.00	0.00	0.11	1.18	0.13	0.85	0.00	0.00	0.02	0.41	0.34	3.33	0.75	0.89
Industrial Settlement	0.19	1.50	0.04	0.57	0.00	0.00	0.08	1.02	0.05	0.53	0.24	2.58	0.26	1.70	0.00	0.00	0.05	1.02	0.23	2.25	1.14	2.96
Total Settlement	0.33	2.60	0.16	2.21	0.43	4.84	0.13	1.65	0.29	3.07	0.35	3.76	0.56	3.66	0.34	3.76	0.16	3.25	0.89	8.73	3.64	5.91
Grand Total	12.69	100.0	7.38	100.0	8.88	100.0	7.88	100.0	9.45	100.0	9.30	101.0	15.30	100.0	9.05	100.0	4.92	100.0	10.20	100.0	95.05	100.0

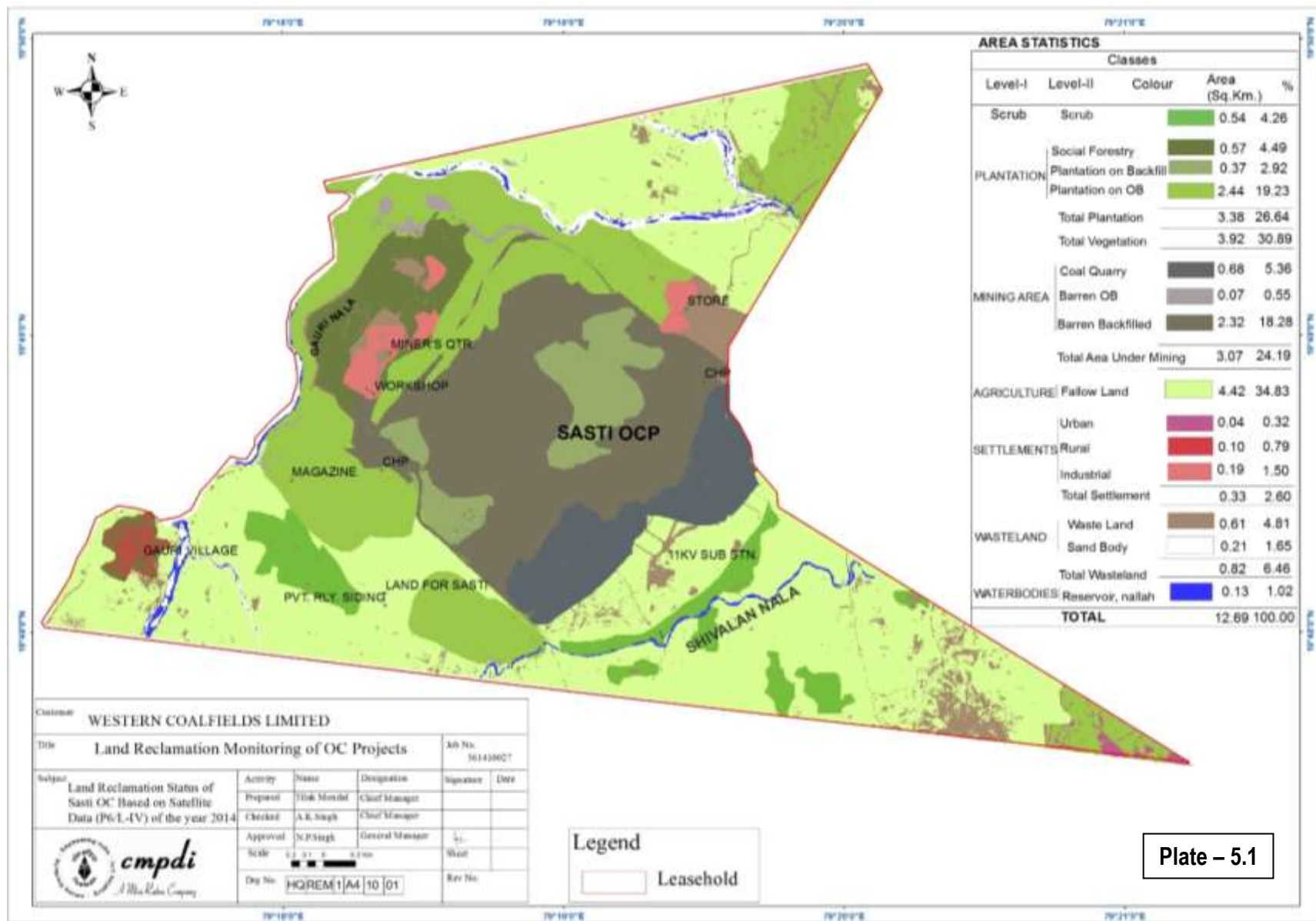
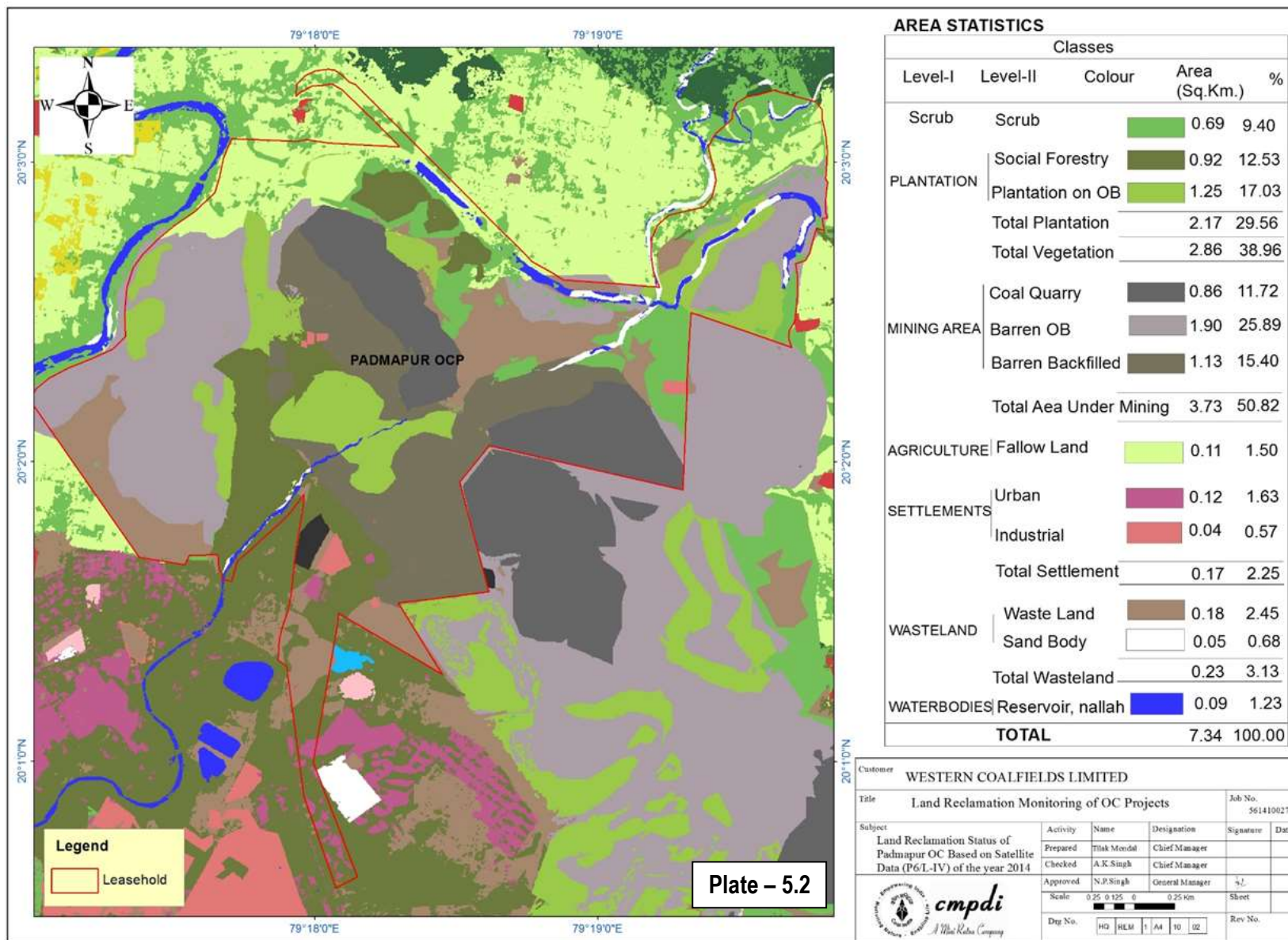


Plate - 5.1



AREA STATISTICS

Classes		Level-I	Level-II	Colour	Area (Sq.Km.)	%
PLANTATION	Scrub	Scrub			0.69	9.40
	Social Forestry				0.92	12.53
	Plantation on OB				1.25	17.03
	Total Plantation				2.17	29.56
	Total Vegetation				2.86	38.96
MINING AREA	Coal Quarry				0.86	11.72
	Barren OB				1.90	25.89
	Barren Backfilled				1.13	15.40
	Total Aea Under Mining				3.73	50.82
AGRICULTURE	Fallow Land				0.11	1.50
SETTLEMENTS	Urban				0.12	1.63
	Industrial				0.04	0.57
	Total Settlement				0.17	2.25
WASTELAND	Waste Land				0.18	2.45
	Sand Body				0.05	0.68
	Total Wasteland				0.23	3.13
WATERBODIES	Reservoir, nallah				0.09	1.23
TOTAL					7.34	100.00

Customer: WESTERN COALFIELDS LIMITED

Title: Land Reclamation Monitoring of OC Projects Job No. 561410027

Subject	Activity	Name	Designation	Signature	Date
Land Reclamation Status of Padmapur OC Based on Satellite Data (P6/L-IV) of the year 2014	Prepared	Thak Murali	Chief Manager		
	Checked	A.K.Singh	Chief Manager		
	Approved	N.P.Singh	General Manager		

Scale: 0 0.25 0.125 0 0.25 km

Dwg No. HG RLM 1/A4 10 02 Rev No.

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Plate - 5.2

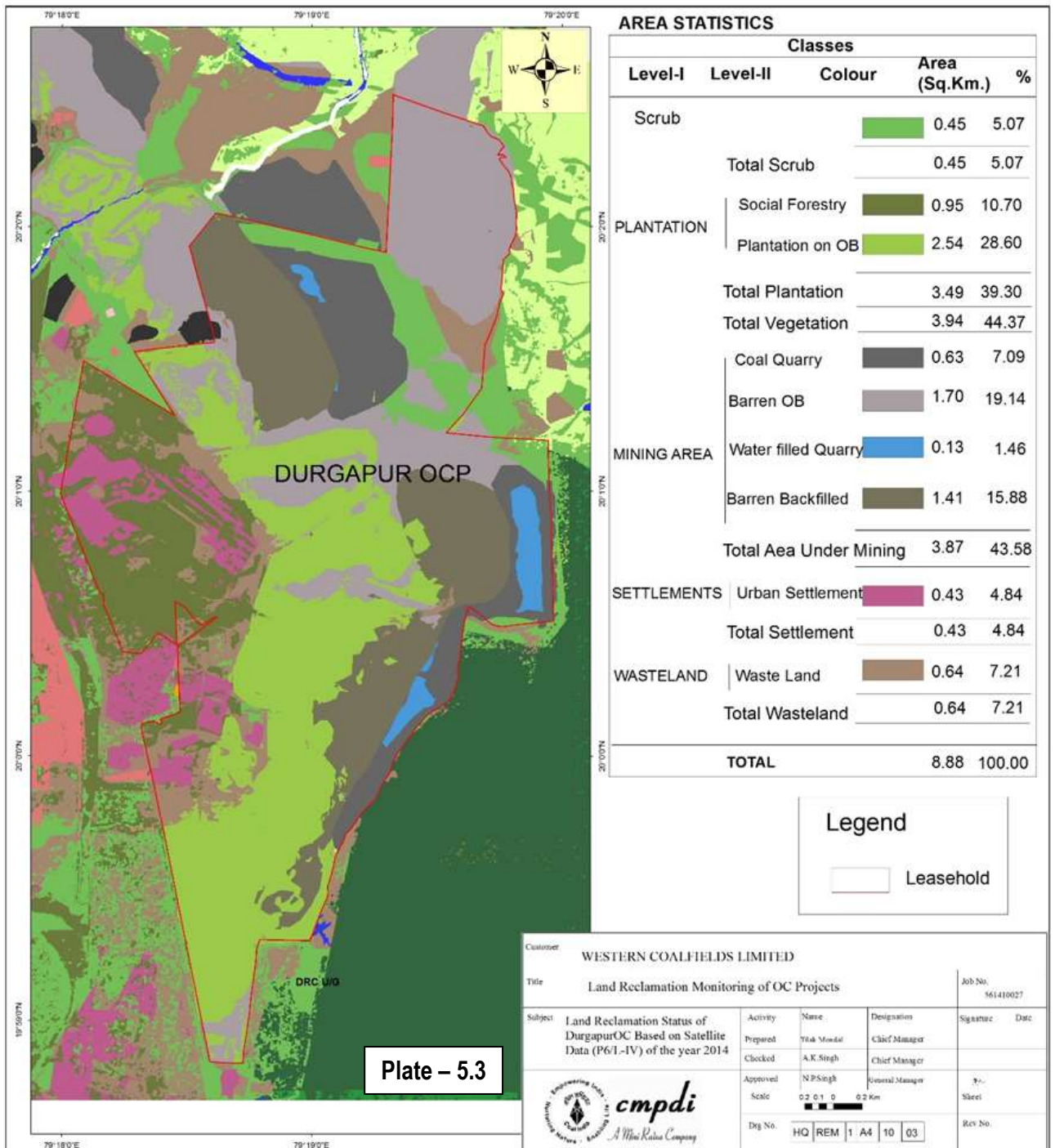
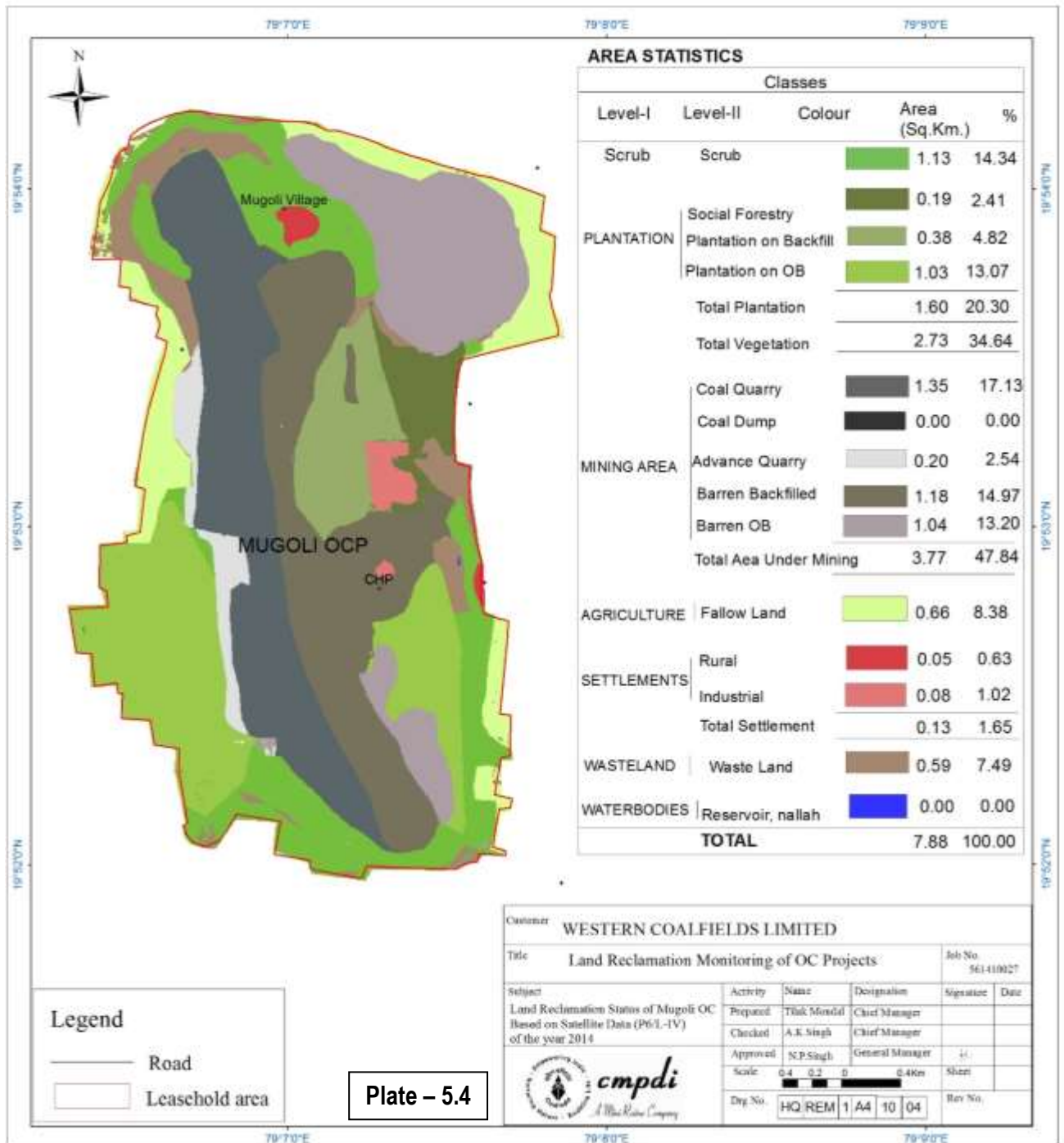
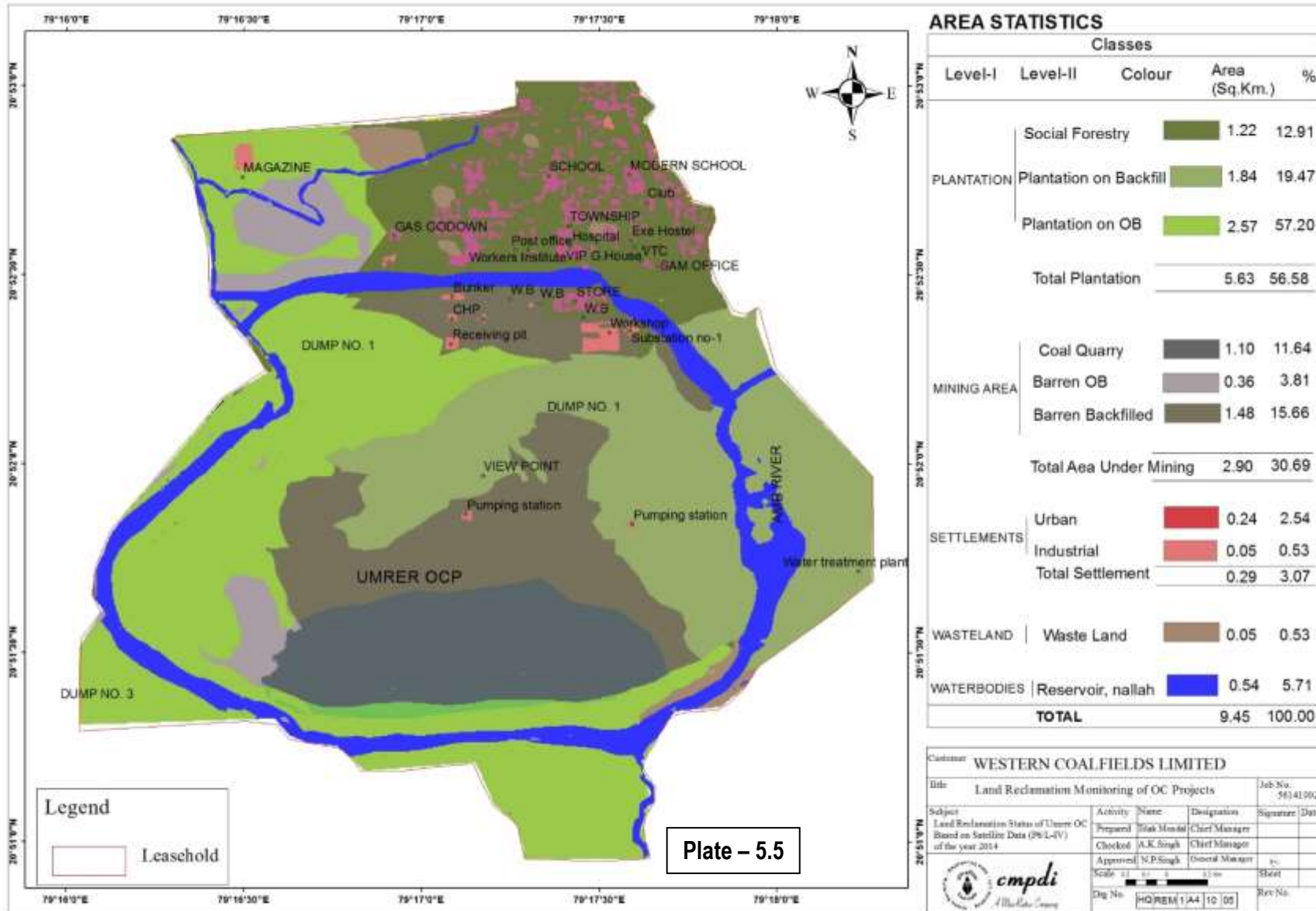
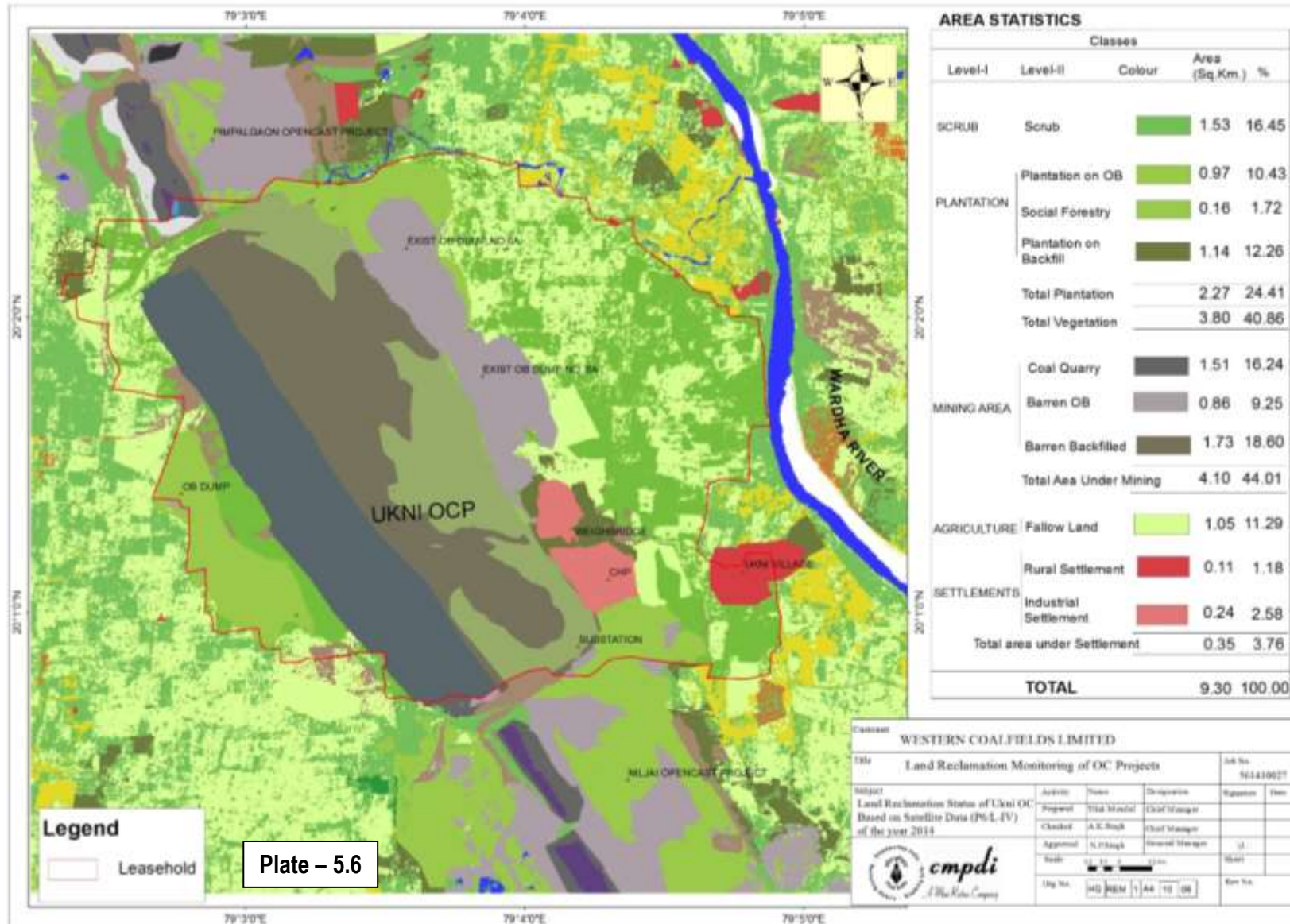


Plate - 5.3







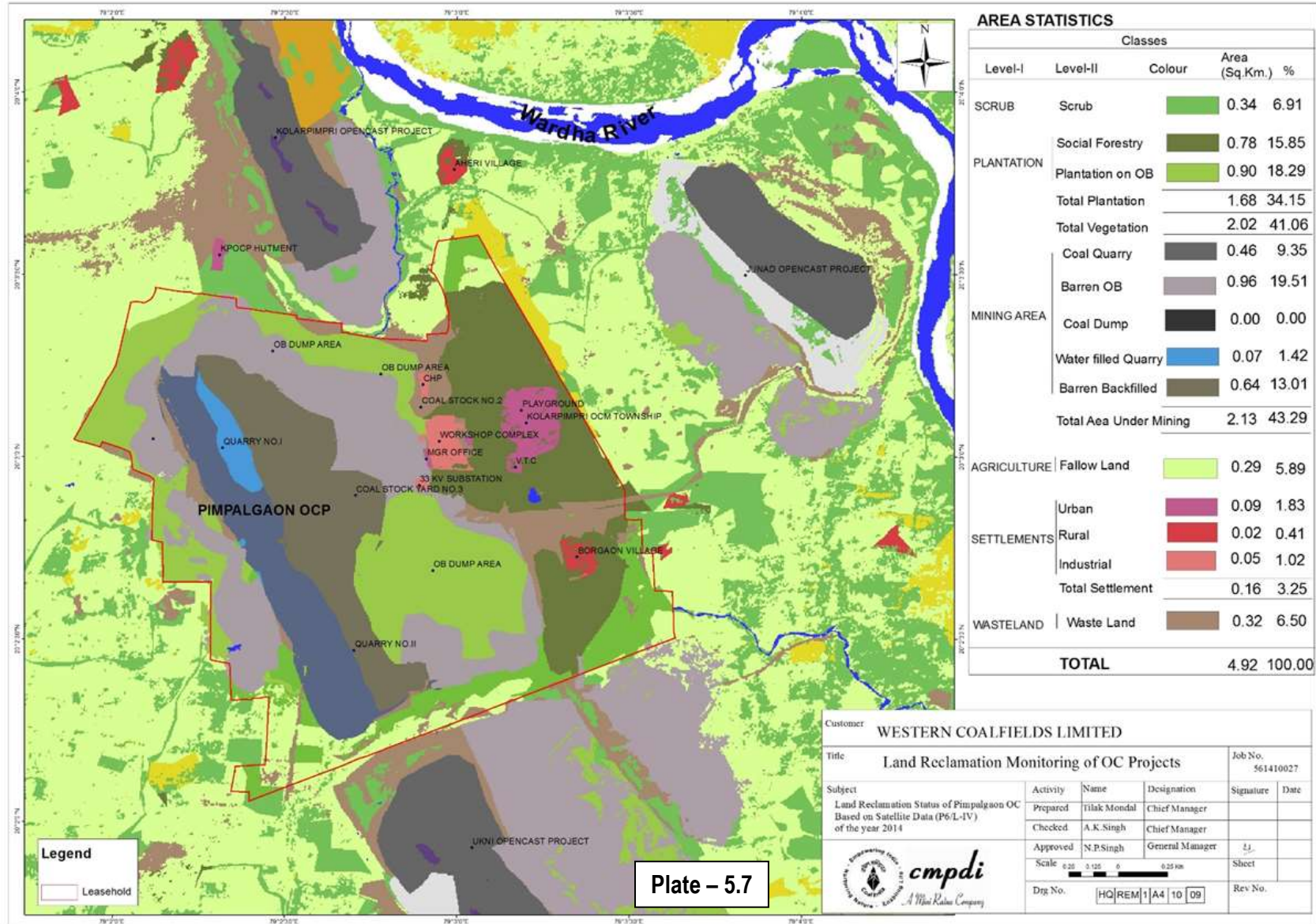


Plate - 5.7

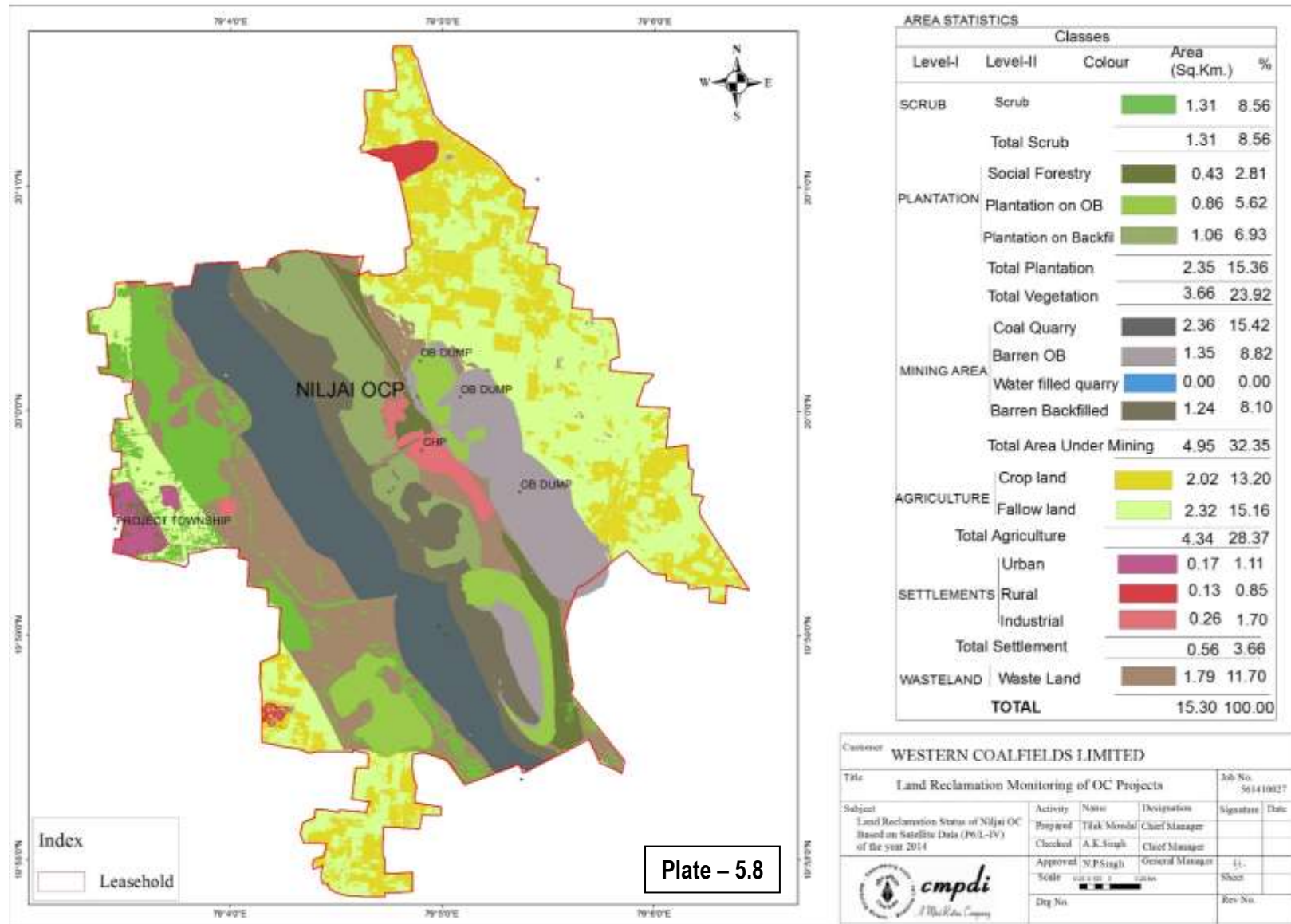
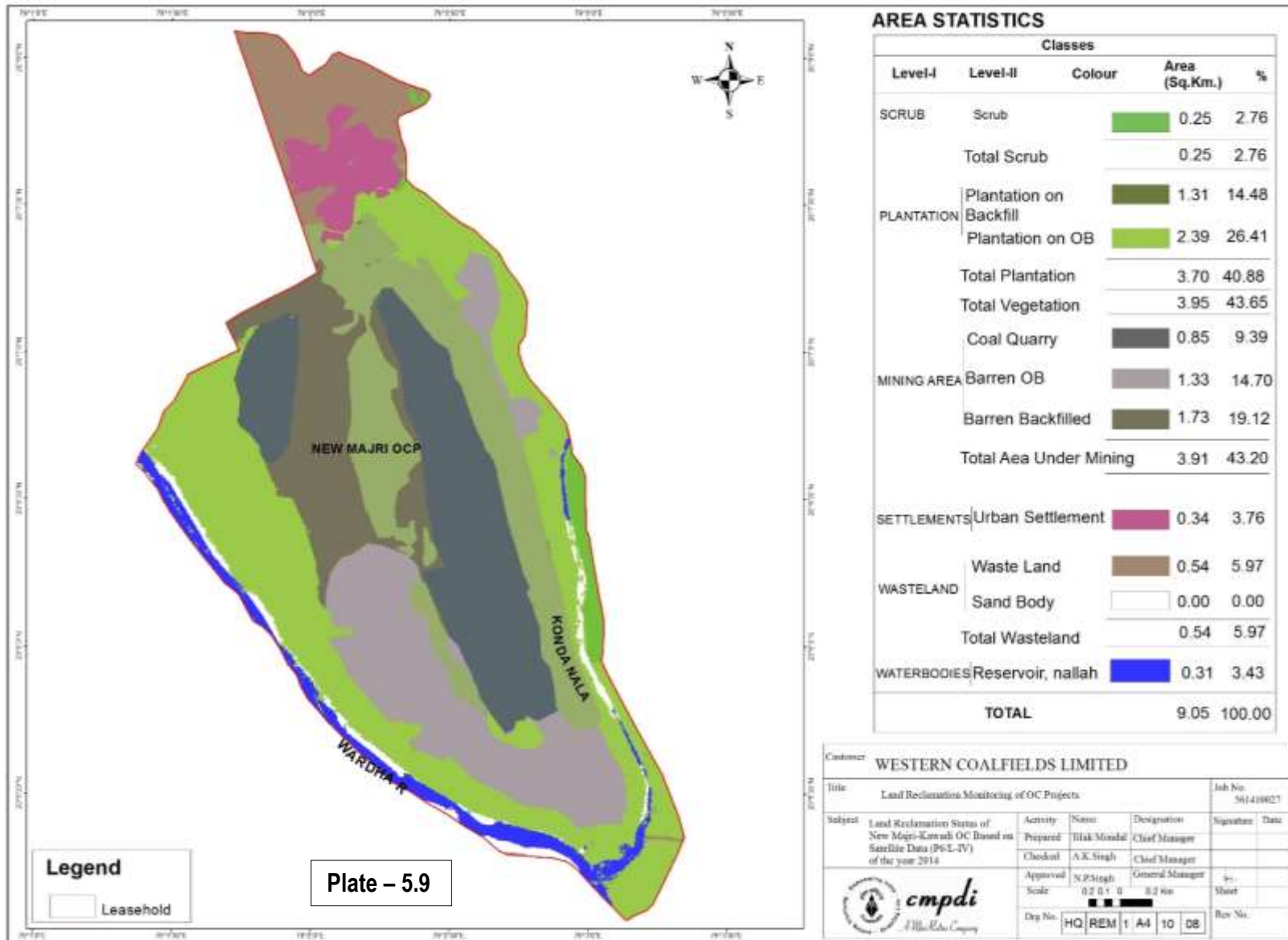


Plate – 5.8



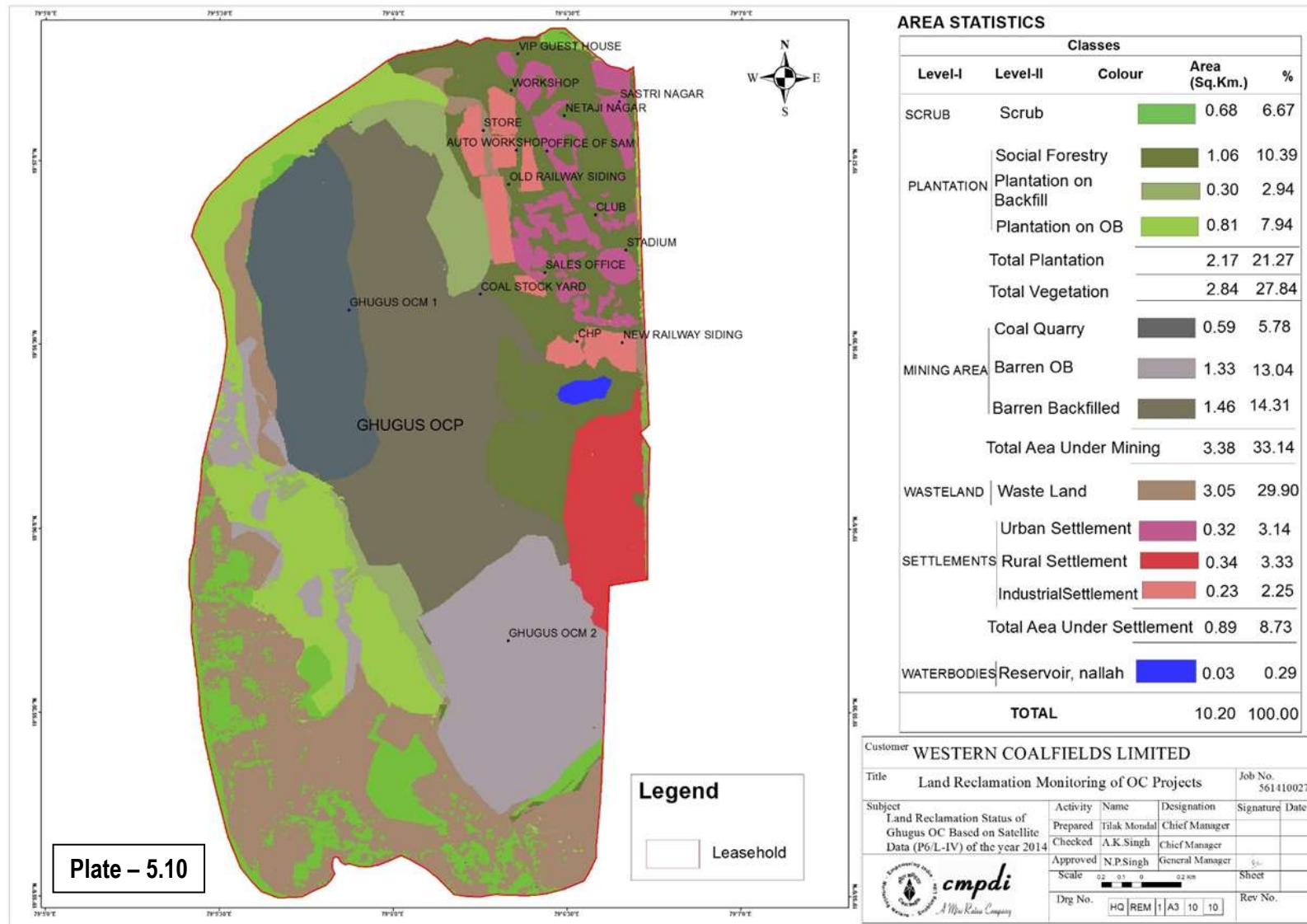


Plate - 5.10

AREA STATISTICS

Classes					
Level-I	Level-II	Colour	Area (Sq.Km.)	%	
SCRUB	Scrub		0.68	6.67	
	PLANTATION	Social Forestry		1.06	10.39
		Plantation on Backfill		0.30	2.94
		Plantation on OB		0.81	7.94
Total Plantation			2.17	21.27	
Total Vegetation			2.84	27.84	
MINING AREA	Coal Quarry		0.59	5.78	
	Barren OB		1.33	13.04	
	Barren Backfilled		1.46	14.31	
	Total Aea Under Mining			3.38	33.14
WASTELAND	Waste Land		3.05	29.90	
	Urban Settlement		0.32	3.14	
SETTLEMENTS	Rural Settlement		0.34	3.33	
	Industrial Settlement		0.23	2.25	
	Total Aea Under Settlement			0.89	8.73
WATERBODIES	Reservoir, nallah		0.03	0.29	
TOTAL			10.20	100.00	

Customer WESTERN COALFIELDS LIMITED					
Title Land Reclamation Monitoring of OC Projects			Job No. 561410027		
Subject	Activity	Name	Designation	Signature	Date
Land Reclamation Status of Ghugus OC Based on Satellite Data (P6/L-IV) of the year 2014	Prepared	Tilak Mondal	Chief Manager		
	Checked	A.K.Singh	Chief Manager		
	Approved	N.P.Singh	General Manager		
Scale		0 0.1 0.2 Km			
Dwg No.		HQ REM 1 A3 10 10			
		Rev No.			

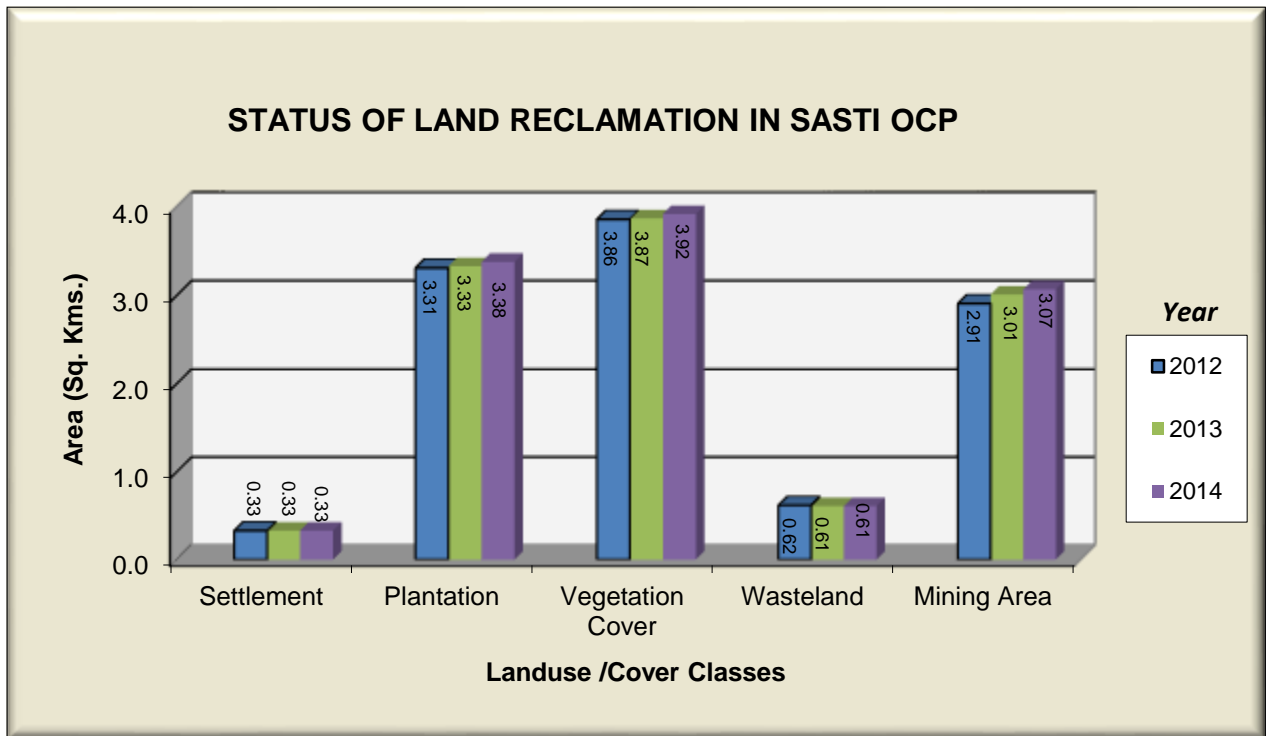


Figure - 5.2

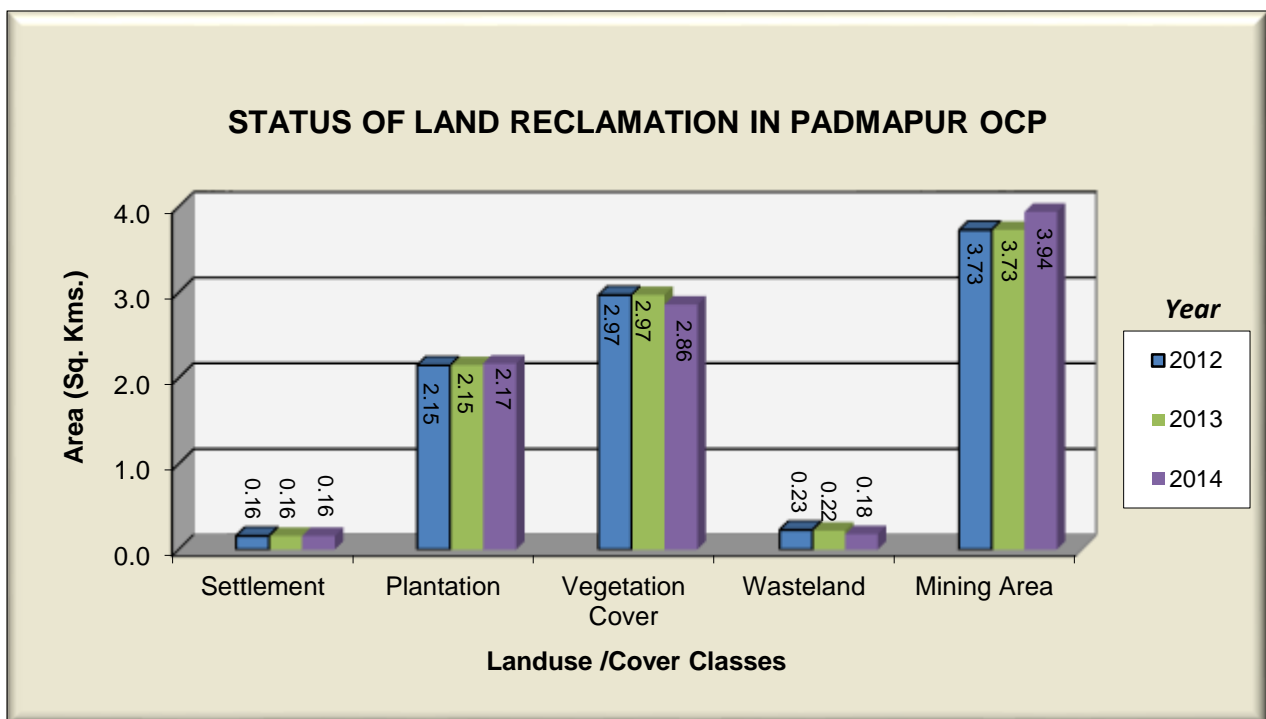


Figure - 5.3

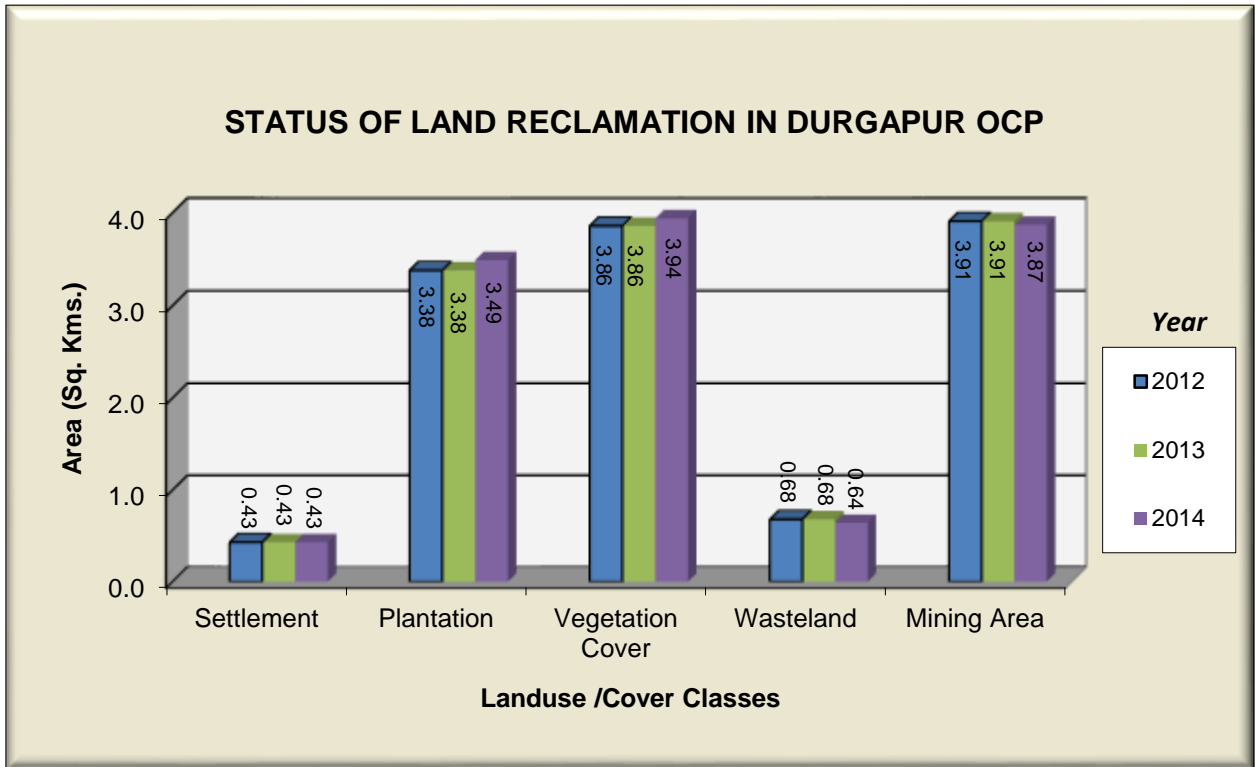


Figure - 5.4

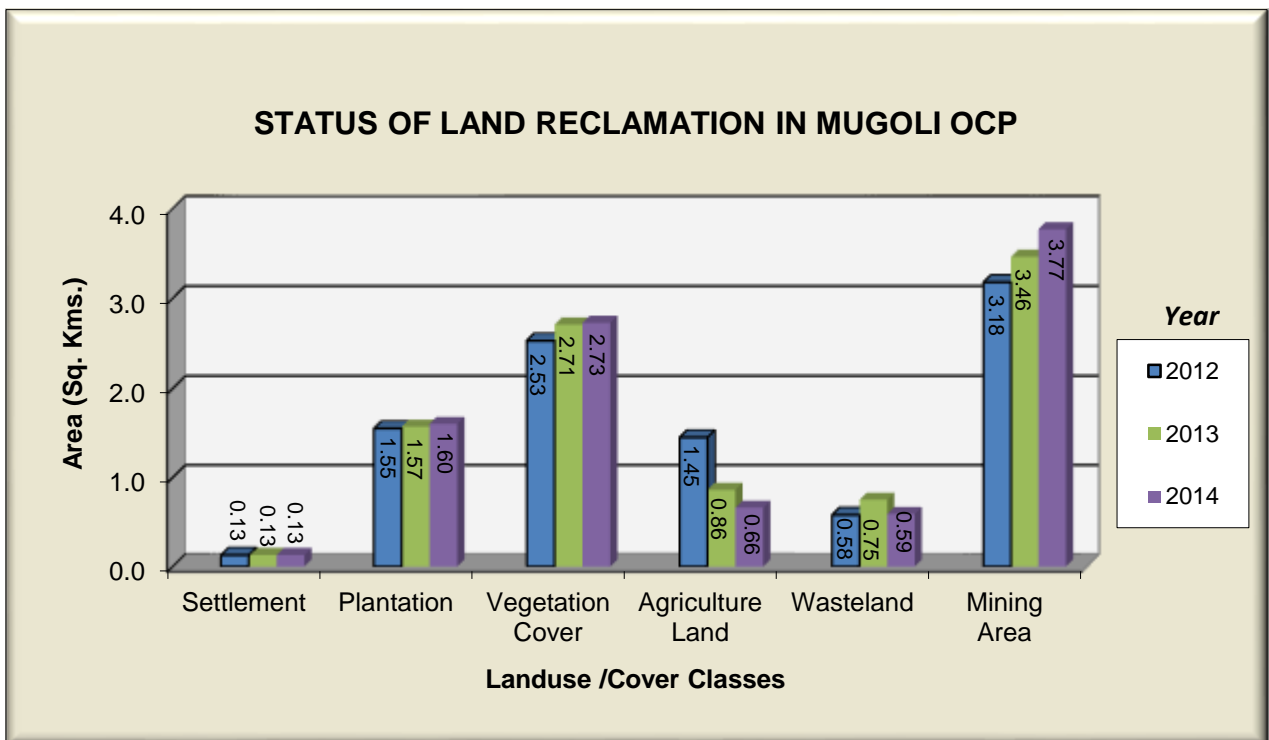


Figure - 5.5

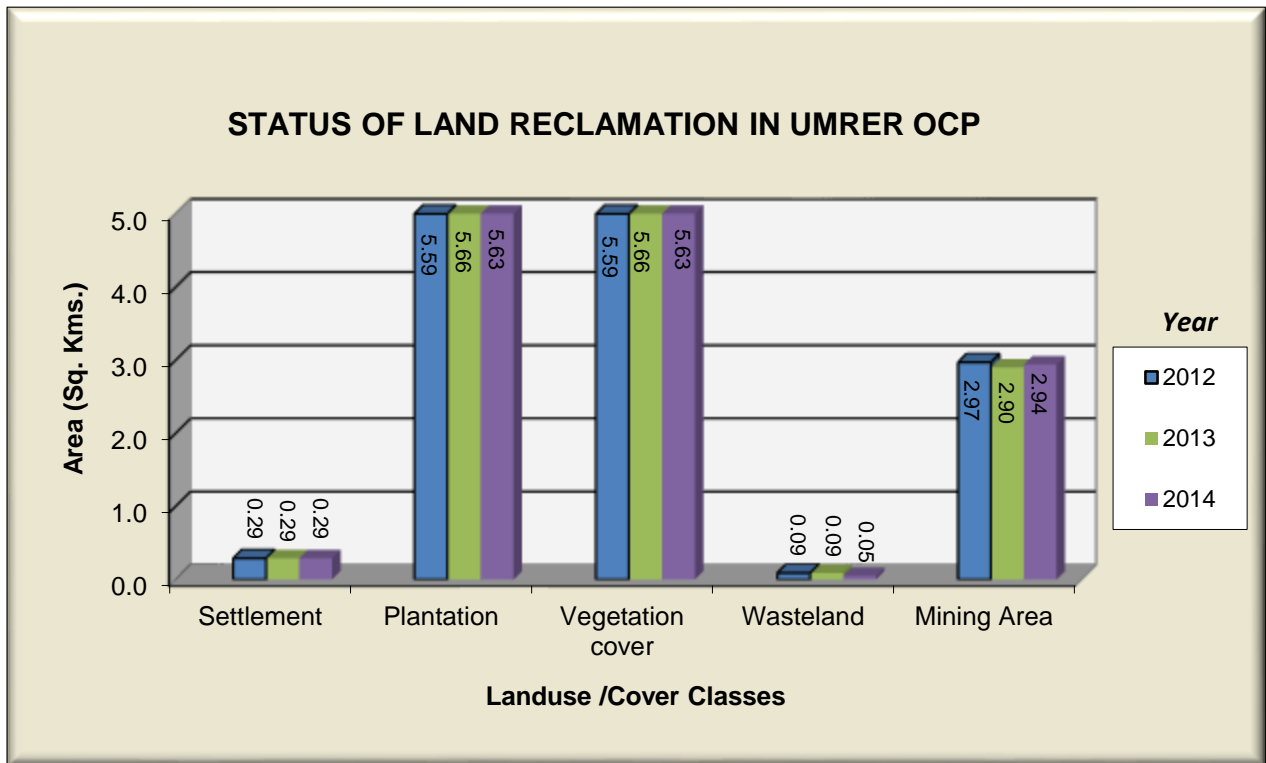


Figure - 5.6

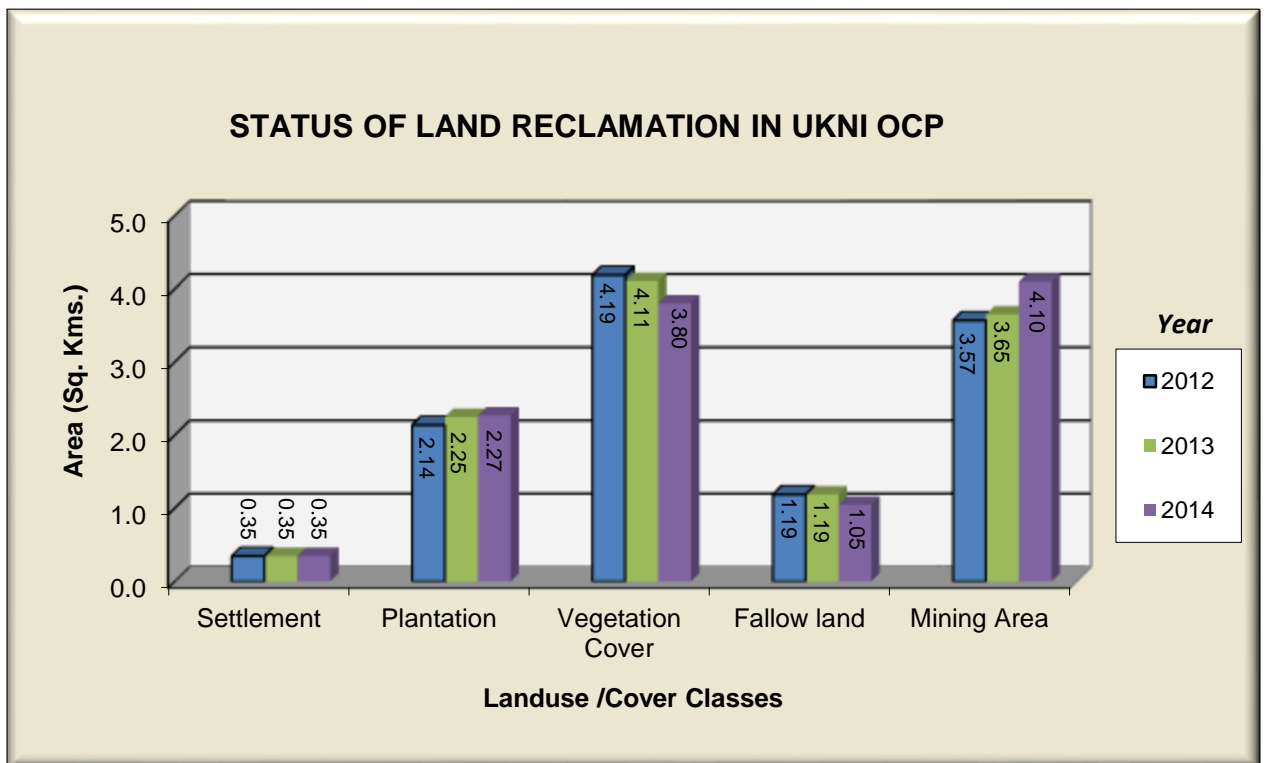


Figure - 5.7

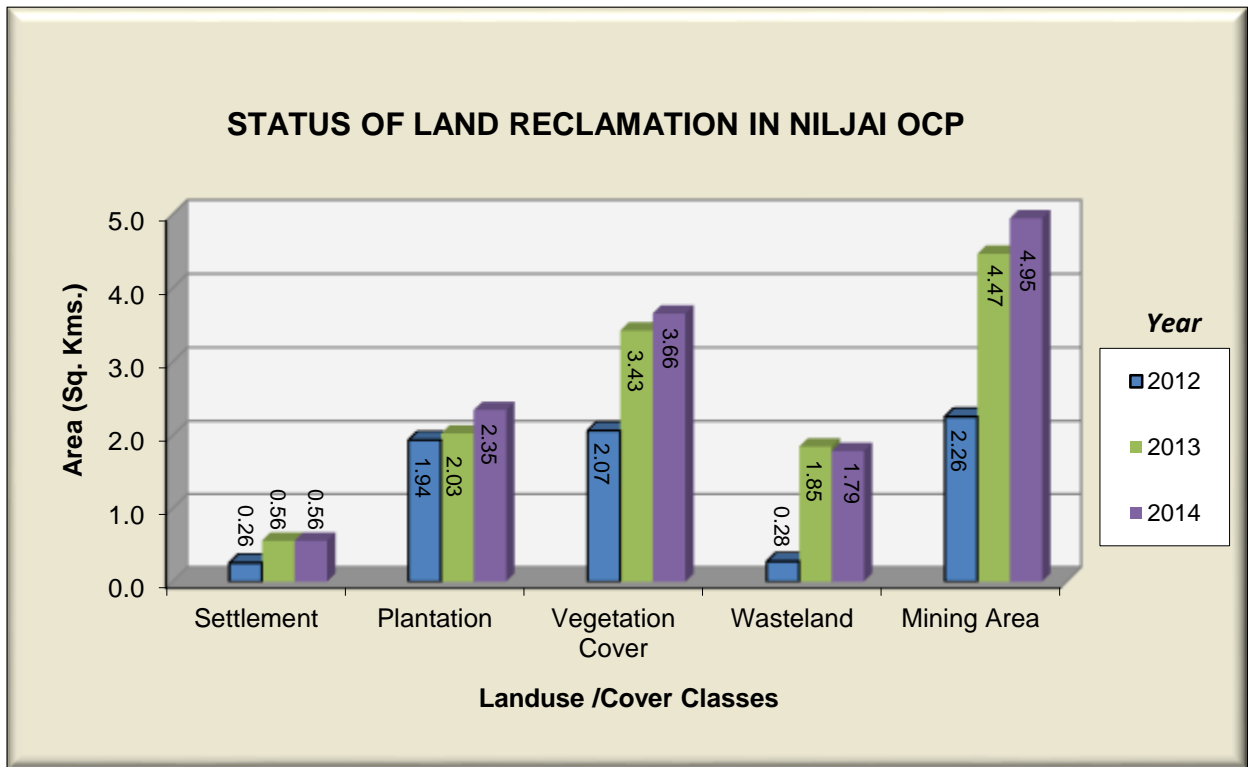


Figure - 5.8

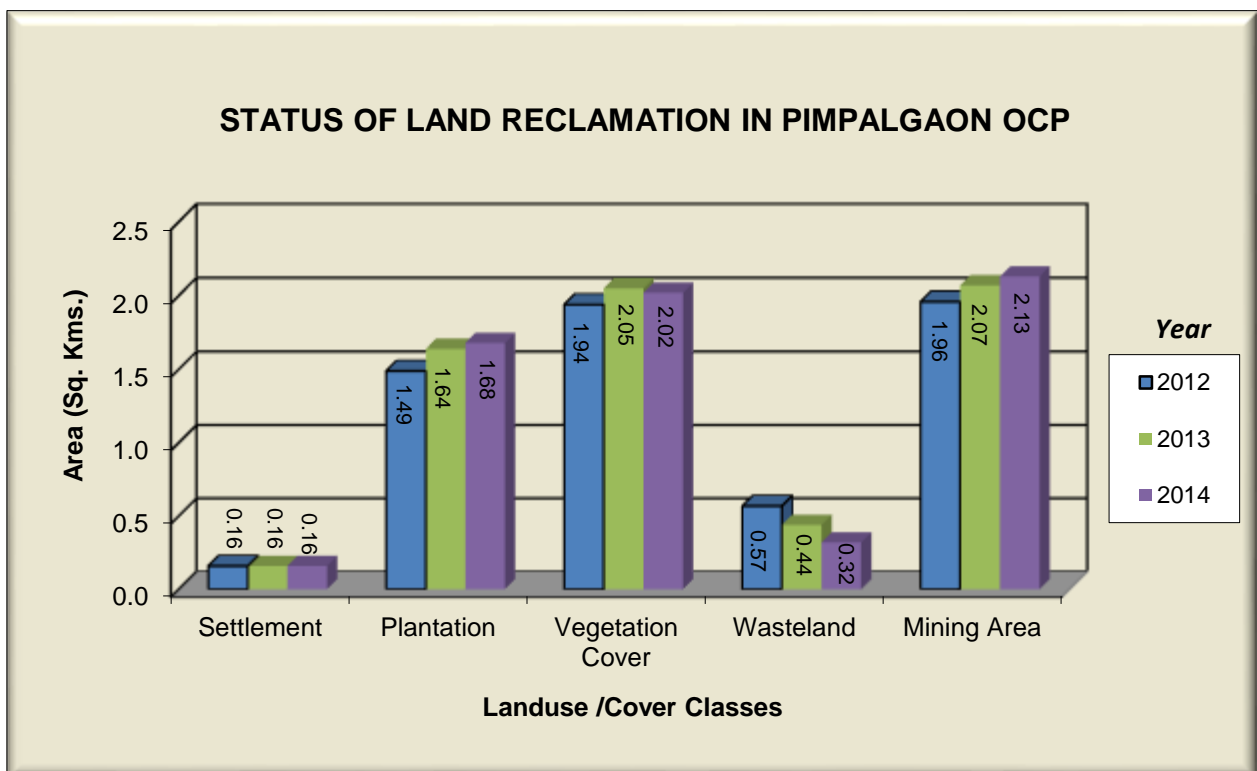


Figure - 5.9

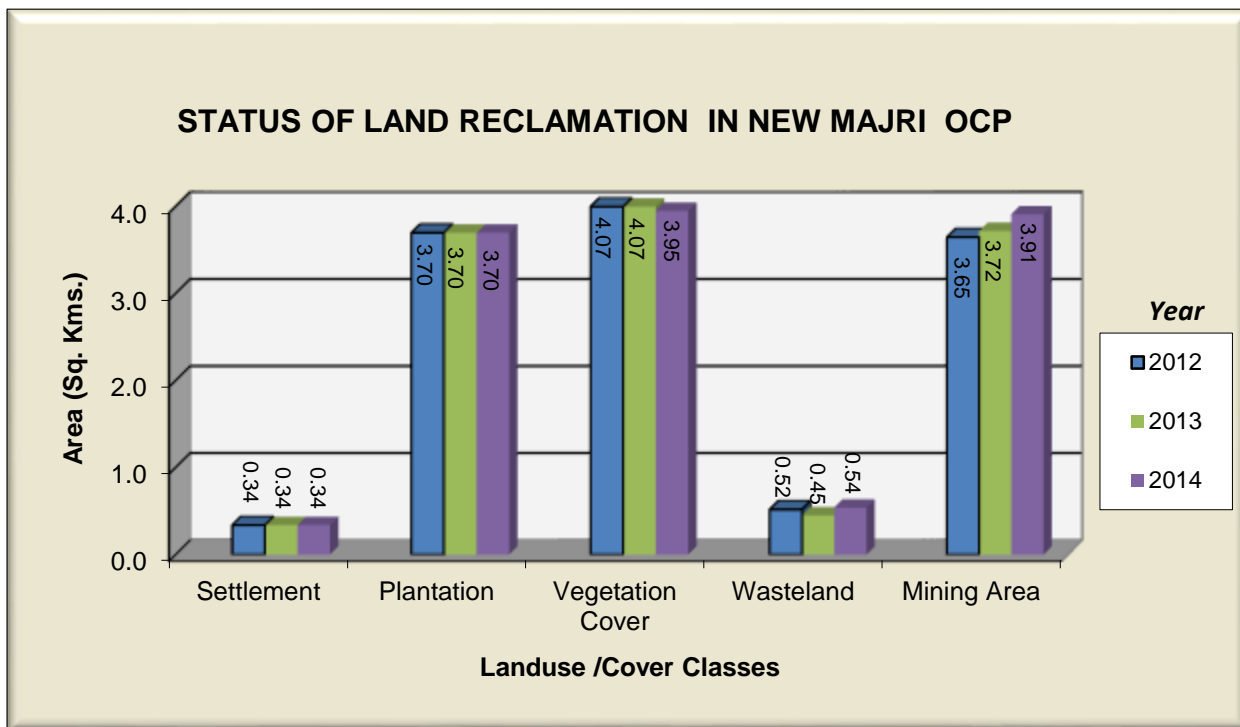


Figure – 5.10

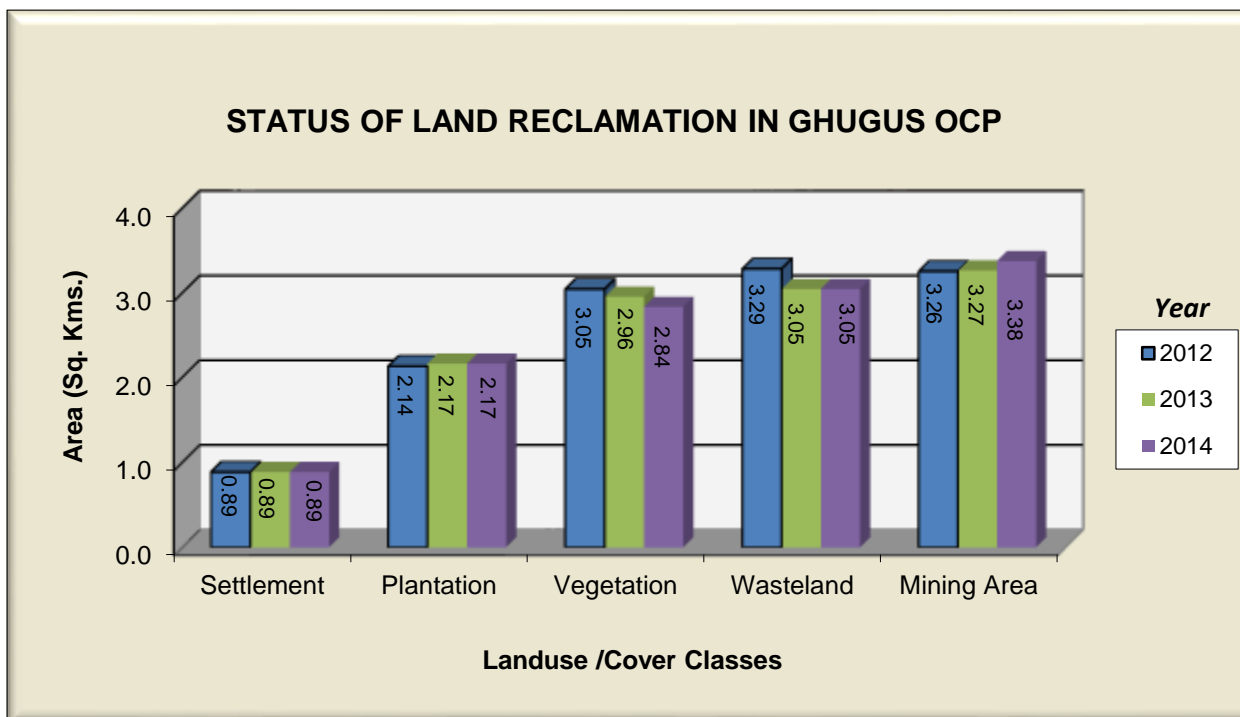


Figure - 5.11



Photograph -5.1: *Plantation on OB dump in Sasti OCP*



Photograph – 5.2 : *Plantation on OB dump in Ghugus OCP*



Photograph – 5.3 : *Plantation on OB dump in Mugoli OCP*



Photograph – 5.4: *Plantation on OB dump in New-Majri OCP*



Photograph – 5.5 : Plantation on backfilled area in Niljai OCP



Photograph – 5.6 : Plantation on backfilled area in Pimpalgaon OCP



Photograph – 5.7 : **Plantation on OB dump in Ukni OCP**



Photograph – 5.8 : **Plantation on backfilled area in Umrer OCP**



Photograph – 5.9 : Plantation on OB dump in Durgapur OCP



Photograph – 5.10 : Plantation on OB dump in Padmapur OCP

SOUTH EASTERN COALFIELDS LIMITED

6.0 Land Reclamation Status in South Eastern Coalfields Limited

6.1 Following ten opencast projects of SECL producing 5 million cubic m. or more (coal+OB) together were taken up for land reclamation monitoring during the year 2014-15:

- Dipka
- Gevra
- Kusmunda
- Manikpur
- Dugga
- Bishrampur
- Chirimiri
- Rajnagar
- Dhanpuri
- Jamuna

6.2 Project wise Land Reclamation status in SECL is given in Table 6.1 and also shown graphically in Fig 6.1. Area statistics of different land use class present in the mine leasehold area of the above projects for the year 2014 are shown in the Table –6.2. Land use maps derived from satellite data are shown in Plate 6.1 - 6.10. Land reclamation status of the above mentioned 10 projects, were also prepared for the year 2008, 2009, 2010, 2011, 2012 and 2013. Year wise changes in the different land use classes based on satellite data are depicted in Bar Charts in Fig.6.2-6.11.

6.3 Study reveals that out of total 84.65 Km² excavated area; 69.99 Km² area (82.68%) is under reclamation, out of which 43.78 Km² (51.72%) area has already been revegetated (Biologically Reclaimed) and 26.21 Km²(30.96%) area are under backfilling (under Technical Reclamation).

- 6.4** After analyzing the satellite data of the year 2013 and 2014, it is evident that area under land reclamation has increased from 66.96 Km² in the year 2013 to 69.99 Km² in the year 2014 in the above ten OC projects of SECL in a period of one year. There is an increase of 3.03Km² reclaimed area in SECL with respect to the year 2013, out of which there is an increase of 1.49 Km² in biological reclamation and 1.54 Km² increase in the areas under technical reclamation (barren backfilling) corresponding to the year 2013. This may be due to extensive plantation as well as more areas coming under technical reclamation.
- 6.5** Study indicates that in Chirimiri and Dhanpuri opencast projects, area of plantation have reduced marginally with respect to the year 2013 because of the OB dumping on vegetated backfilled / OB Dump area due to constrained of dumping space.
- 6.6** Overall, all the projects of SECL considered for this report indicate either an increase or static trend in biological reclamation (plantation) except for Chirimiri and Dhanpuri opencast projects and there has been increase in area under technical reclamation (backfilling) in all projects except for Bishrampur, Rajnagar and Jamuna as compared to the year 2013. The increase in area of plantation and area under backfilling in most of the projects of SECL taken up in this study indicates that SECL is committed for reclamation of mine land for maintaining the ecological balance in the region.
- 6.7** Out of 10 projects of SECL, Dugga OCP ranks on top for land reclamation (100%) followed by Bishrampur (99.38%) and Rajnagar (97.08%) in the year 2014-15.

Table – 6.1

**Project wise Land Reclamation Status in Opencast Project of SECL
(> 5 million Cu. M. of Coal+OB) based on Satellite Data of the Year 2014**

(% Calculated in terms of Total Excavated Area) *(Area in Km²)*

Sl. No.	Project		Plantation		Under Backfilling		Active Mining		Total Excavated Area		Total Area under Reclamation	
	Name	Leasehold (i)	(ii)		(iii)		(iv)		(ii+iii+iv)		(ii+iii)	
			2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1	DIPKA	22.26	3.01	3.12	3.11	3.35	3.52	3.49	9.64	9.96	6.12	6.47
			31.22	31.33	32.26	33.63	36.51	35.04			63.49	64.96
2	GEVRA	41.86	7.71	7.93	6.10	7.23	6.61	6.03	20.42	21.19	13.81	15.16
			37.76	37.42	29.87	34.12	32.37	28.46			67.63	71.54
3	KUSMUNDA	16.72	4.23	4.47	2.16	2.50	2.74	2.25	9.13	9.22	6.39	6.97
			46.33	48.48	23.66	27.11	30.01	24.40			69.99	75.60
4	MANIKPUR	19.44	2.55	2.66	2.04	2.14	1.82	1.98	6.41	6.78	4.59	4.80
			39.78	39.23	31.83	31.56	28.39	29.20			71.61	70.80
5	DUGGA *	5.41	1.83	1.83	1.38	1.39	0.00	0.00	3.21	3.22	3.21	3.22
			57.01	56.83	42.99	43.17	0.00	0.00			100.00	100.00
6	BISHRAMPUR	15.23	7.60	8.45	3.48	2.75	0.22	0.07	11.30	11.27	11.08	11.20
			67.26	74.98	30.80	24.40	1.95	0.62			98.05	99.38
7	CHIRIMIRI	6.51	2.78	2.59	0.43	0.79	0.23	0.12	3.44	3.50	3.21	3.38
			80.81	74.00	12.50	22.57	6.69	3.43			93.31	96.57
8	RAJNAGAR	8.61	4.23	4.37	1.97	1.62	0.14	0.18	6.34	6.17	6.20	5.99
			66.72	70.83	31.07	26.26	2.21	2.92			97.79	97.08
9	DHANPURI	14.59	4.07	3.69	2.27	2.78	0.46	0.33	6.80	6.80	6.34	6.47
			59.85	54.26	33.38	40.88	6.76	4.85			93.24	95.15
10	JAMUNA	8.85	4.28	4.67	1.73	1.66	0.50	0.21	6.51	6.54	6.01	6.33
			65.75	71.41	26.57	25.38	7.68	3.21			92.32	96.79
TOTAL		159.48	42.29	43.78	24.67	26.21	16.24	14.66	83.20	84.65	66.96	69.99
			50.83	51.72	29.65	30.96	19.52	17.32			80.48	82.68

Note : * In Dugga OCP no mining activity was observed during 2014-15

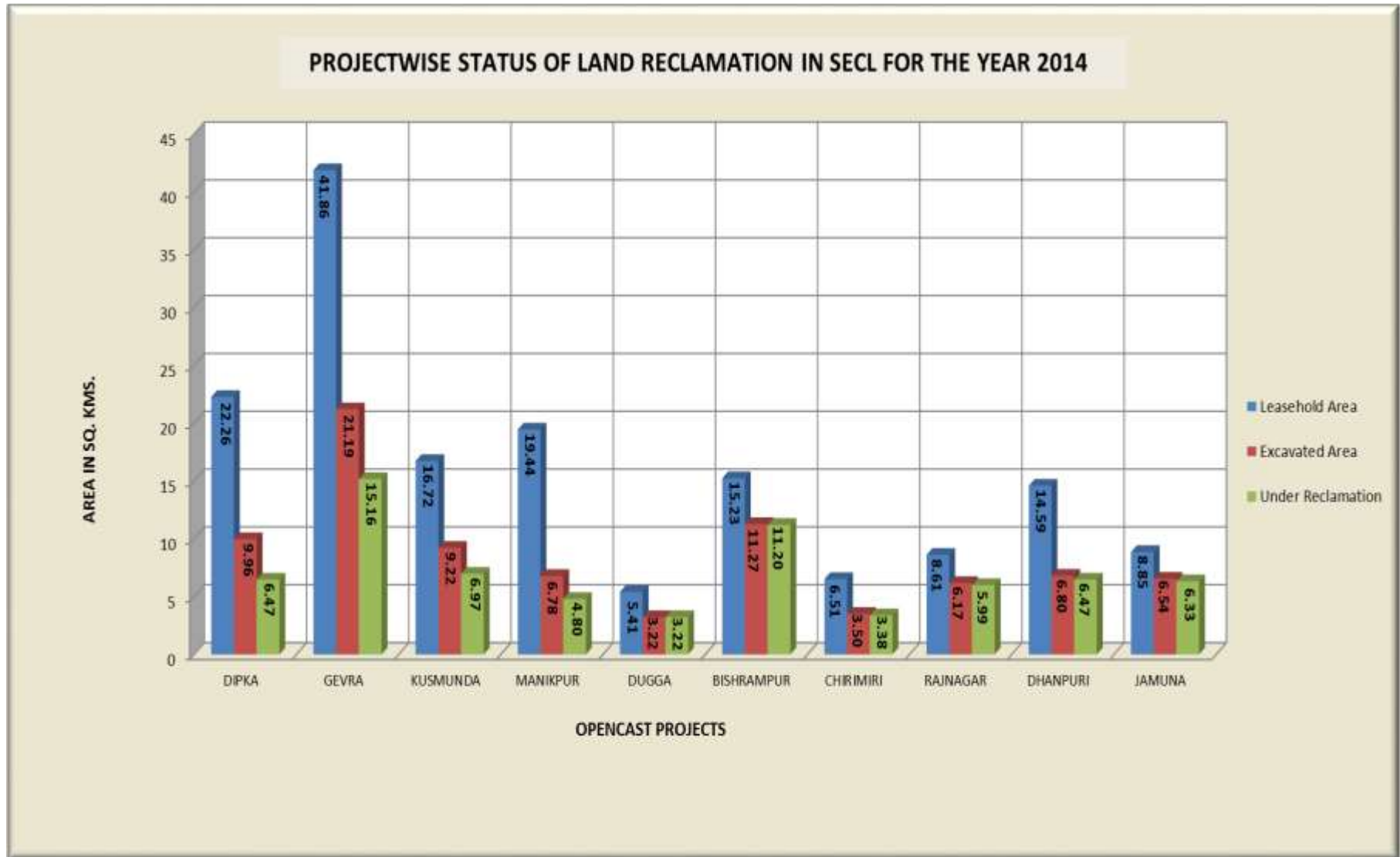


Fig.6.1: Land reclamation status in OC projects of SECL in the year-2014

Table 6.2

Status of Land Use / Reclamation in OC Mines(>5 mcu.m) of South Eastern Coalfields Ltd. based on Satellite data of the Year 2014

		(Area in Sq Km)																					
		DIPKA		GEVRA		KUSMUNDA		MANIKPUR		DUGGA		BISHRAMPUR		CHIRMIRI		RAJNAGAR		DHANPURI		JAMUNA		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest	0.01	0.07	0.01	0.03	0.00	0.00	0.93	4.80	0.00	0.00	0.00	0.00	0.39	5.99	0.02	0.23	2.77	18.98	0.00	0.00	4.13	2.59
	Total Forest	0.01	0.07	0.01	0.03	0.00	0.00	0.93	4.80	0.00	0.00	0.00	0.00	0.39	5.99	0.02	0.23	2.77	18.98	0.00	0.00	4.13	2.59
SCRUBS	Scrubs	3.49	15.68	4.45	10.64	1.84	11.00	2.91	14.96	0.85	15.71	1.34	8.78	1.83	28.11	1.36	15.80	2.80	19.19	0.66	7.46	21.53	13.50
	Total Scrubs	3.49	15.68	4.45	10.64	1.84	11.00	2.91	14.96	0.85	15.71	1.34	8.78	1.83	28.11	1.36	15.80	2.80	19.19	0.66	7.46	21.53	13.50
PLANTATION	Social Forestry	1.39	6.26	2.32	5.55	1.47	8.76	0.67	3.43	0.00	0.00	0.91	5.98	1.49	22.89	0.41	4.76	0.08	0.55	0.02	0.23	8.76	5.49
	Plantation on OB Dump	1.10	4.94	3.50	8.36	2.04	12.18	1.31	6.74	0.22	4.07	7.54	49.51	0.00	0.00	3.96	45.99	2.22	15.22	4.65	52.55	26.53	16.64
	Plantation on Backfill	0.63	2.83	2.11	5.03	0.96	5.77	0.68	3.49	1.61	29.76	0.00	0.00	1.10	16.90	0.00	0.00	1.39	9.53	0.00	0.00	8.48	5.32
	Total Plantation (Biological Reclamation)	3.12	14.03	7.93	18.94	4.47	26.71	2.66	13.66	1.83	33.83	8.45	55.49	2.59	39.79	4.37	50.75	3.69	25.30	4.67	52.78	43.76	27.44
Total Vegetation		6.63	29.78	12.39	29.61	6.30	37.71	6.50	33.42	2.68	49.54	9.79	64.27	4.81	73.89	5.75	66.78	9.26	63.47	5.33	60.24	69.44	43.54
ACTIVE MINING	Coal Quarry	3.00	13.49	4.72	11.28	1.40	8.36	1.50	7.71	0.00	0.00	0.01	0.07	0.03	0.46	0.15	1.74	0.26	1.78	0.00	0.00	11.07	6.94
	Coal Dump	0.33	1.46	0.18	0.42	0.24	1.41	0.08	0.40	0.00	0.00	0.06	0.39	0.09	1.37	0.03	0.35	0.07	0.48	0.21	2.37	1.28	0.80
	Advance Quarry Site	0.04	0.18	0.48	1.14	0.02	0.12	0.07	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.38
	Quarry Filled With Water	0.12	0.55	0.65	1.56	0.60	3.59	0.33	1.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.71	1.07
	Total Area under Active Mining	3.49	15.68	6.03	14.40	2.25	13.48	1.98	10.18	0.00	0.00	0.07	0.46	0.12	1.83	0.18	2.09	0.33	2.26	0.21	2.37	14.66	9.20
RECLAIMED	Barren OB Dump	1.26	5.67	1.58	3.77	0.48	2.88	0.93	4.80	0.38	7.02	2.75	18.06	0.79	12.14	1.62	18.80	2.78	19.05	1.66	18.76	14.23	8.92
	Barren Backfilled Area	2.09	9.37	5.66	13.51	2.02	12.05	1.21	6.22	1.01	18.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.98	7.51
	Total Area under Technical Reclamation	3.35	15.04	7.23	17.28	2.50	14.93	2.14	11.02	1.39	25.69	2.75	18.06	0.79	12.14	1.62	18.80	2.78	19.05	1.66	18.76	26.21	16.43
Total Area under Mining Operations		6.84	30.72	13.26	31.68	4.75	28.41	4.12	21.20	1.39	25.69	2.82	18.52	0.91	13.97	1.80	20.89	3.11	21.31	1.87	21.13	40.87	25.63
WASTELANDS	Waste Lands	3.93	17.65	5.79	13.83	1.43	8.53	1.02	5.25	0.15	2.77	0.12	0.79	0.42	6.45	0.00	0.00	0.84	5.76	0.33	3.73	14.03	8.79
	Fly Ash Pond / Sand Body	0.00	0.00	0.00	0.00	0.03	0.18	1.44	7.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47	0.92
Total Wasteland		3.93	17.65	5.79	13.83	1.46	8.71	2.46	12.66	0.15	2.77	0.12	0.79	0.42	6.45	0.00	0.00	0.84	5.76	0.33	3.73	15.50	9.72
WATERBODIES	Reservoir, nallah, ponds	0.36	1.60	0.27	0.65	0.19	1.12	0.82	4.22	0.35	6.47	1.57	10.31	0.08	1.23	0.58	6.74	0.22	1.51	0.49	5.54	4.92	3.09
	Total Waterbodies	0.36	1.60	0.27	0.65	0.19	1.12	0.82	4.22	0.35	6.47	1.57	10.31	0.08	1.23	0.58	6.74	0.22	1.51	0.49	5.54	4.92	3.09
AGRICULTURE	Crop Lands	0.35	1.55	0.96	2.28	0.79	4.71	0.20	1.03	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.63	0.00	0.00	0.05	0.56	2.48	1.55
	Fallow Lands	2.42	10.88	5.99	14.30	2.26	13.52	4.71	24.22	0.83	15.35	0.88	5.78	0.00	0.00	0.13	1.51	1.03	7.06	0.68	7.68	18.93	11.87
	Total Agriculture	2.77	12.43	6.942	16.58	3.05	18.23	4.91	25.25	0.83	15.35	0.88	5.78	0.00	0.00	0.27	3.14	1.03	7.06	0.73	8.24	21.41	13.42
SETTLEMENTS	Urban Settlement	0.39	1.74	0.79	1.88	0.17	1.00	0.01	0.06	0.00	0.00	0.00	0.00	0.27	4.15	0.14	1.63	0.00	0.00	0.00	0.00	1.76	1.11
	Rural Settlement	0.48	2.15	1.27	3.02	0.30	1.76	0.30	1.54	0.00	0.00	0.05	0.33	0.00	0.00	0.06	0.70	0.09	0.62	0.05	0.56	2.59	1.62
	Industrial Settlement	0.88	3.93	1.15	2.75	0.51	3.06	0.32	1.65	0.01	0.18	0.00	0.00	0.02	0.31	0.01	0.12	0.04	0.27	0.05	0.56	2.99	1.87
	Total Settlement	1.74	7.82	3.21	7.65	0.97	5.82	0.63	3.25	0.01	0.18	0.05	0.33	0.29	4.46	0.21	2.45	0.13	0.89	0.10	1.12	7.34	4.60
Grand Total		22.26	100.00	41.86	100.00	16.72	100.00	19.45	100.00	5.41	100.00	15.23	100.00	6.51	100.00	8.61	100.00	14.59	100.00	8.85	100.00	159.48	100.00

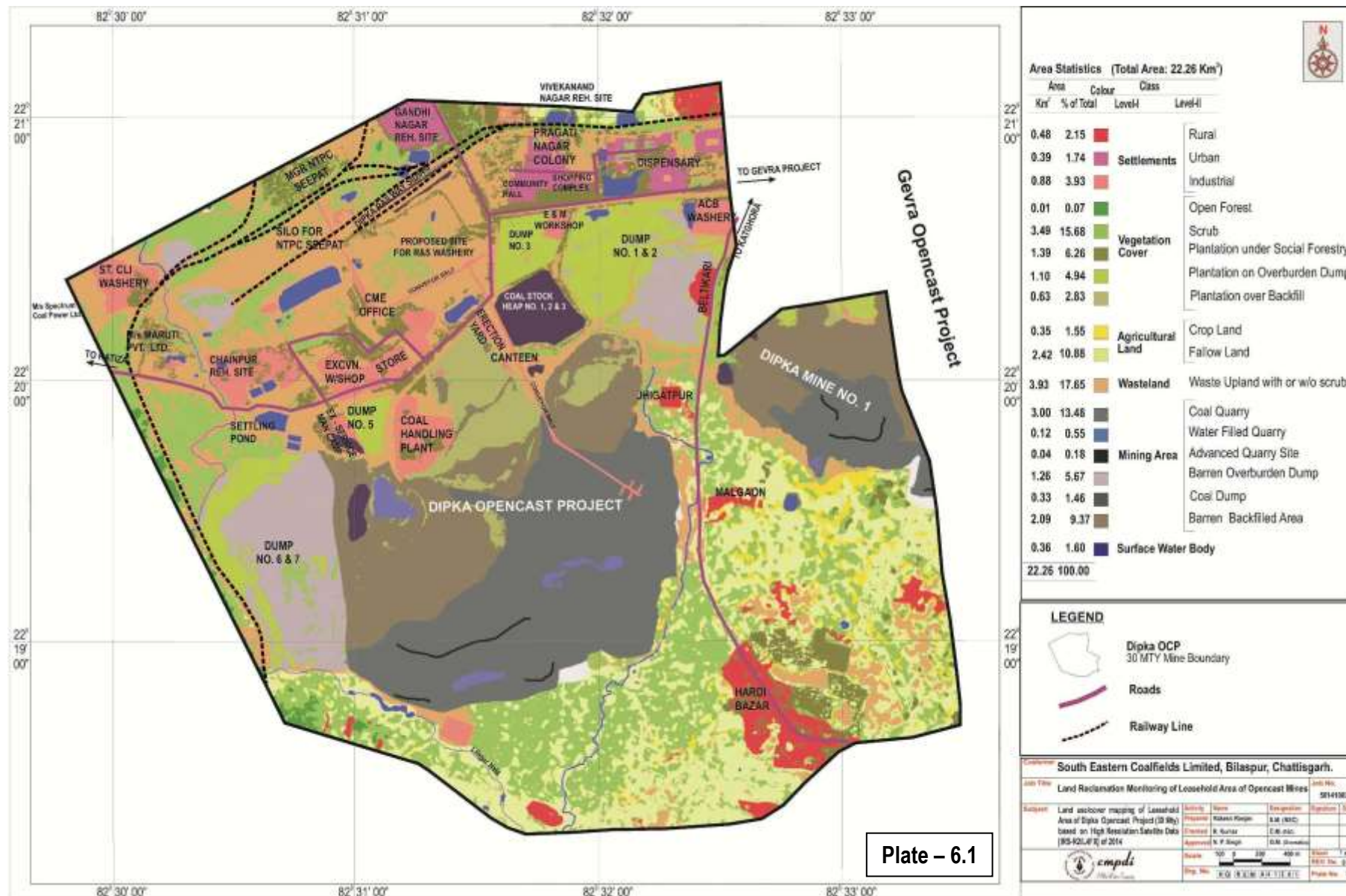
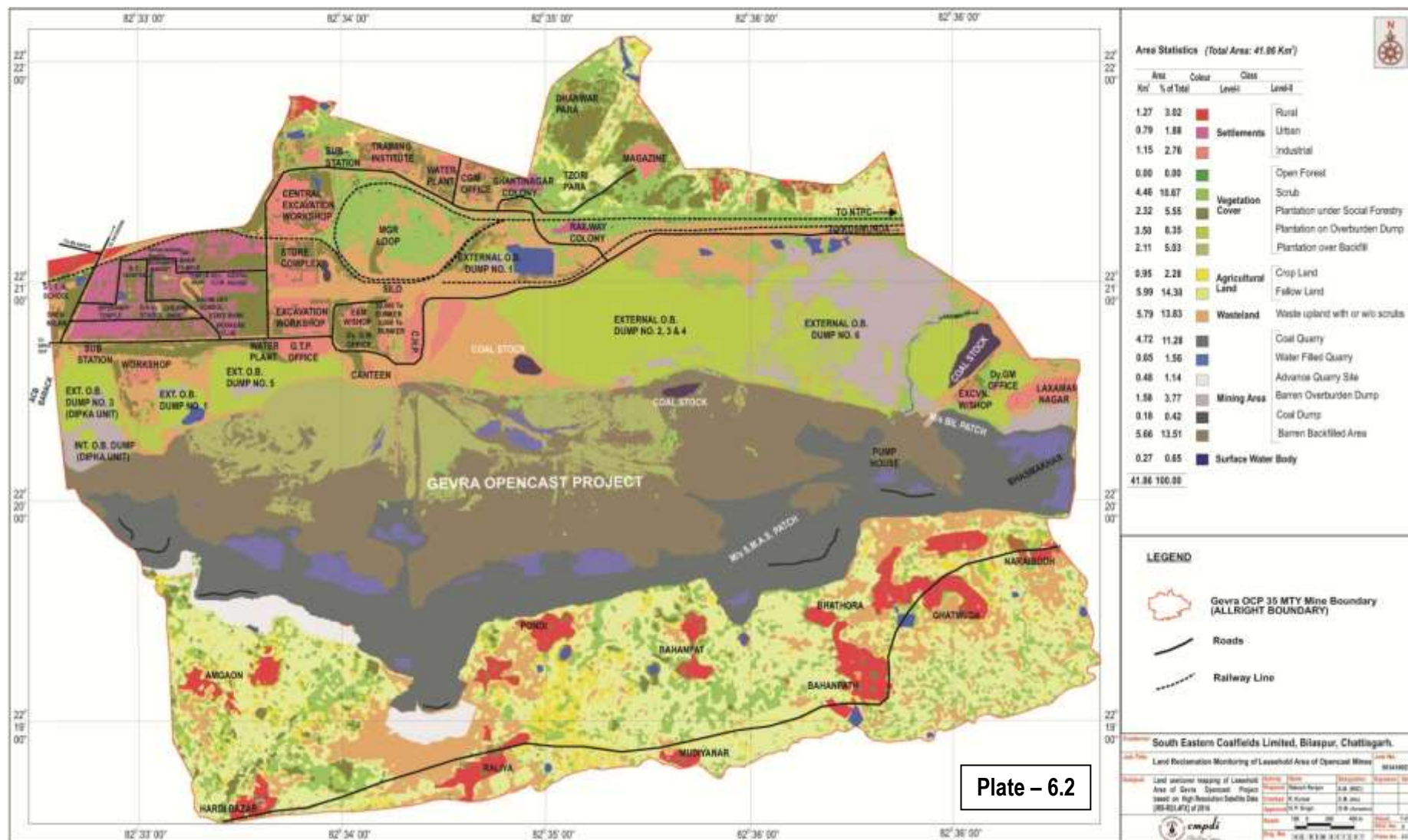


Plate - 6.1



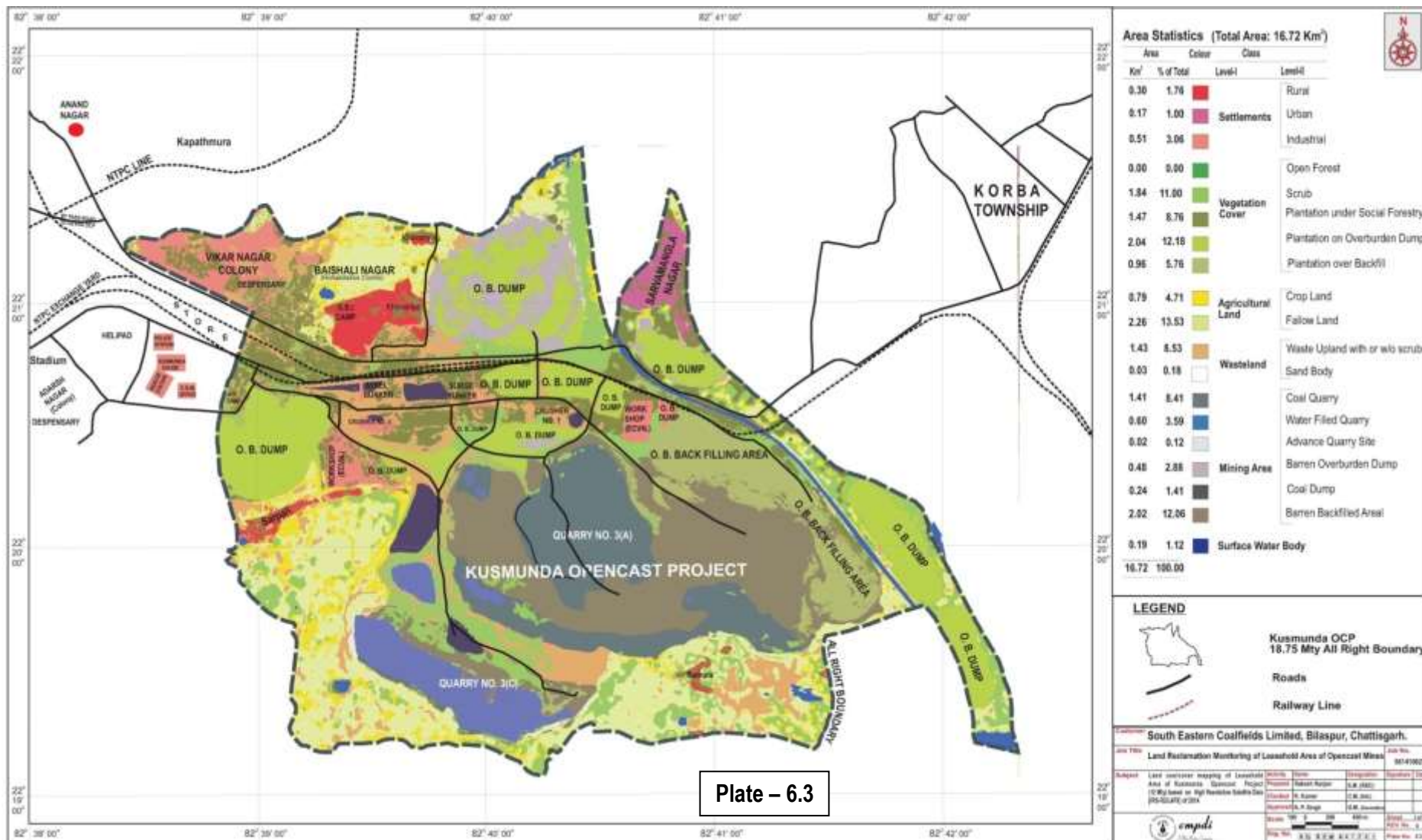


Plate - 6.3

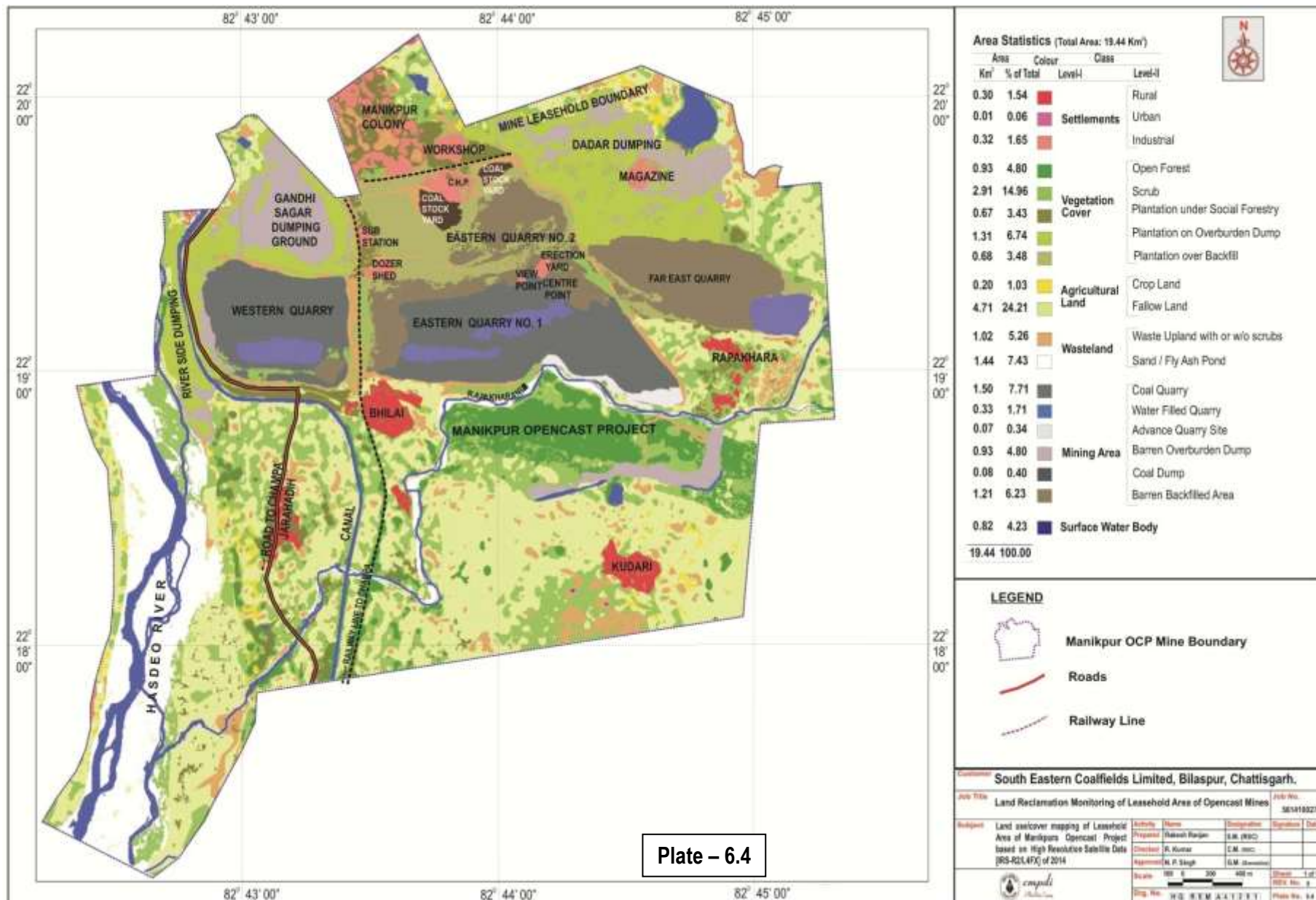


Plate - 6.4

Area Statistics (Total Area: 19.44 Km²)

Area Km ²	% of Total	Colour	Level-I	Level-II
0.30	1.54	[Red]	Settlements	Rural
0.01	0.06	[Pink]	Settlements	Urban
0.32	1.65	[Orange]	Settlements	Industrial
0.93	4.80	[Green]	Vegetation Cover	Open Forest
2.91	14.96	[Light Green]		Scrub
0.67	3.43	[Dark Green]		Plantation under Social Forestry
1.31	6.74	[Olive Green]		Plantation on Overburden Dump
0.68	3.48	[Yellow-Green]		Plantation over Backfill
0.20	1.03	[Yellow]	Agricultural Land	Crop Land
4.71	24.21	[Light Yellow]	Agricultural Land	Fallow Land
1.02	5.26	[Orange]	Wasteland	Waste Upland with or w/o scrubs
1.44	7.43	[White]		Sand / Fly Ash Pond
1.50	7.71	[Grey]	Mining Area	Coal Quarry
0.33	1.71	[Blue]		Water Filled Quarry
0.07	0.34	[Light Grey]		Advance Quarry Site
0.93	4.80	[Brown]		Barren Overburden Dump
0.08	0.40	[Dark Grey]	Mining Area	Coal Dump
1.21	6.23	[Dark Brown]		Barren Backfilled Area
0.82	4.23	[Blue]	Surface Water Body	
19.44	100.00			

LEGEND

- Manikpur OCP Mine Boundary
- Roads
- Railway Line

South Eastern Coalfields Limited, Bilaspur, Chattisgarh.

Job Title: Land Reclamation Monitoring of Leasehold Area of Opencast Mines **Job No.:** SE/18/027

Authority	Name	Designation	Signature	Date
Prepared	Rakesh Rajan	S.M. (WFO)		
Checked	R. Kumar	S.M. (WFO)		
Approved	N. P. Singh	S.M. (WFO)		

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Proj. No.: W.B. SEM A (11/11) **Plate No.:** 4

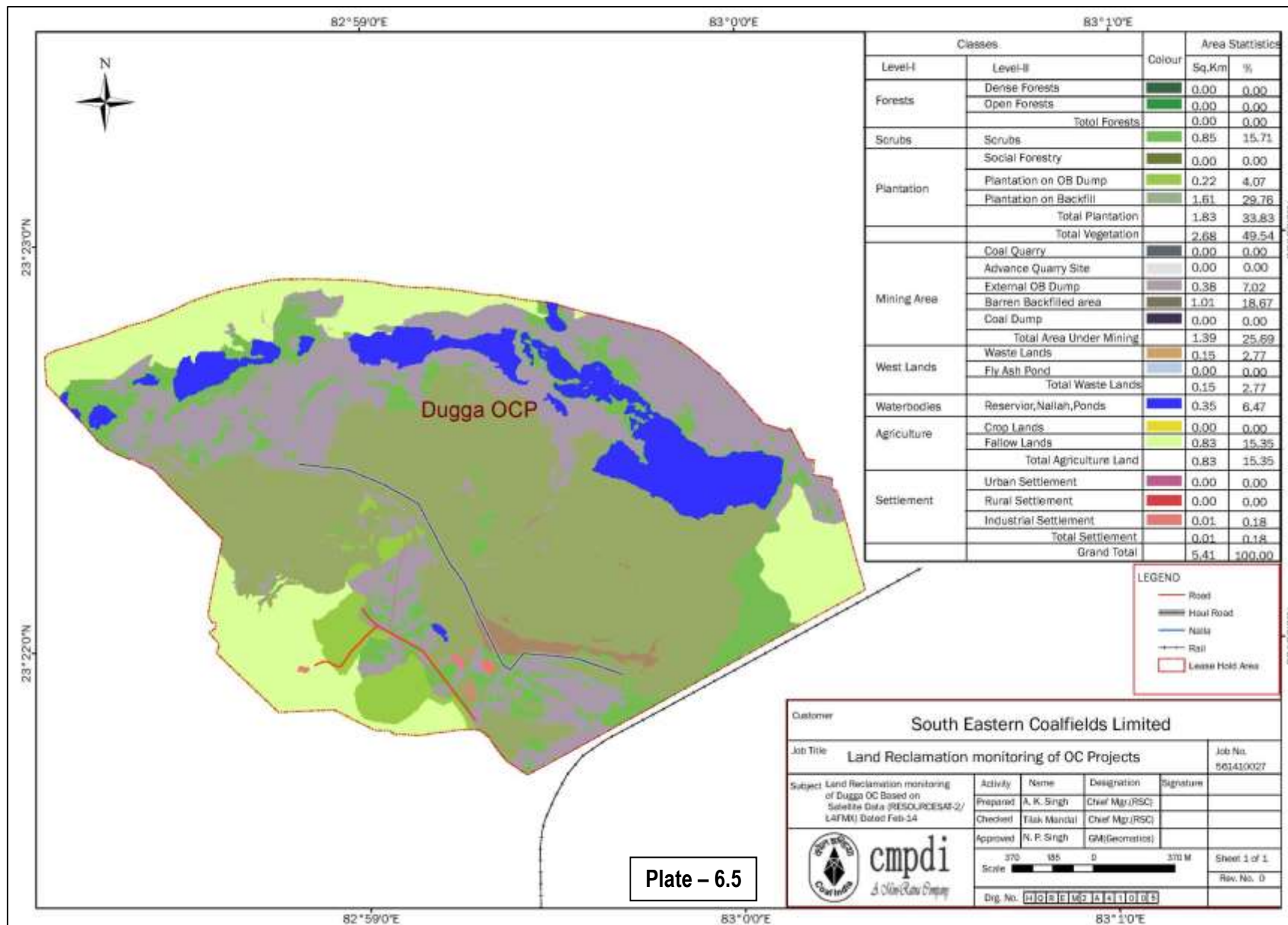
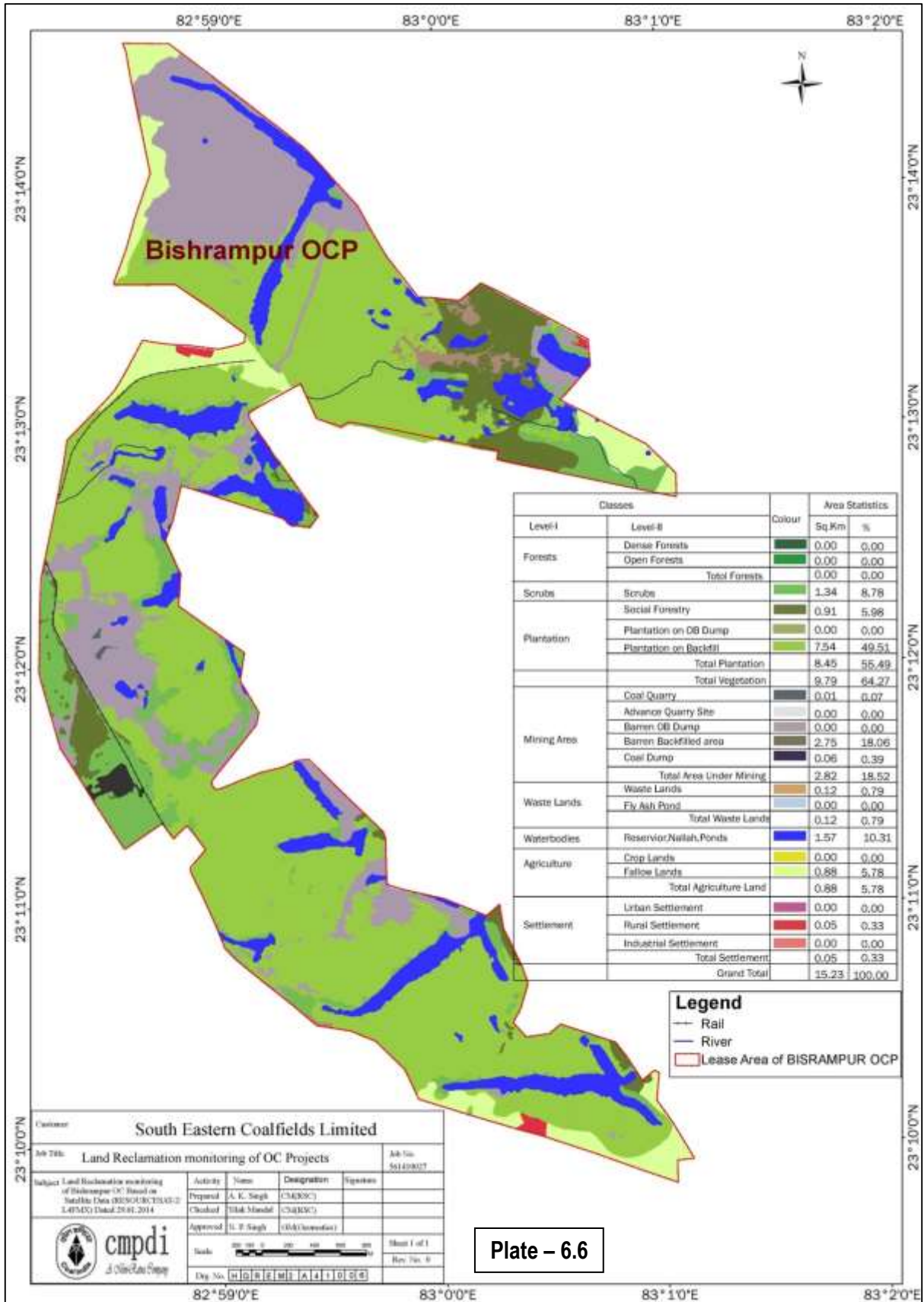


Plate - 6.5

Customer South Eastern Coalfields Limited				
Job Title Land Reclamation monitoring of OC Projects				Job No. 561410027
Subject: Land Reclamation monitoring of Dugga OC Based on Satellite Data (RESOURCE/SF-2/ LAFM) Dated Feb-14	Activity	Name	Designation	Signature
	Prepared	A. K. Singh	Chief Mgr (RSC)	
	Checked	Tilak Mandal	Chief Mgr (RSC)	
	Approved	N. P. Singh	GM(Geomatics)	
Scale 370 185 0 370 M		Sheet 1 of 1		Rev. No. 0
Dwg. No. HSR/EMD/A/110/05				



Customer: **South Eastern Coalfields Limited**

Job Title: **Land Reclamation monitoring of OC Projects**

Subject: Land Reclamation monitoring of Bishrampur OCP based on Satellite Data (IRS/SPOT/ISRO/2.405M) Dated: 28.01.2014

Activity	Name	Designation	Signature
Prepared	A. K. Singh	(S/ASOC)	
Checked	Tilak Mandal	(S/ASOC)	
Approved	H. P. Singh	(S/AC/Operations)	

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Sheet 1 of 1
Rev. No. 0

Plate - 6.6

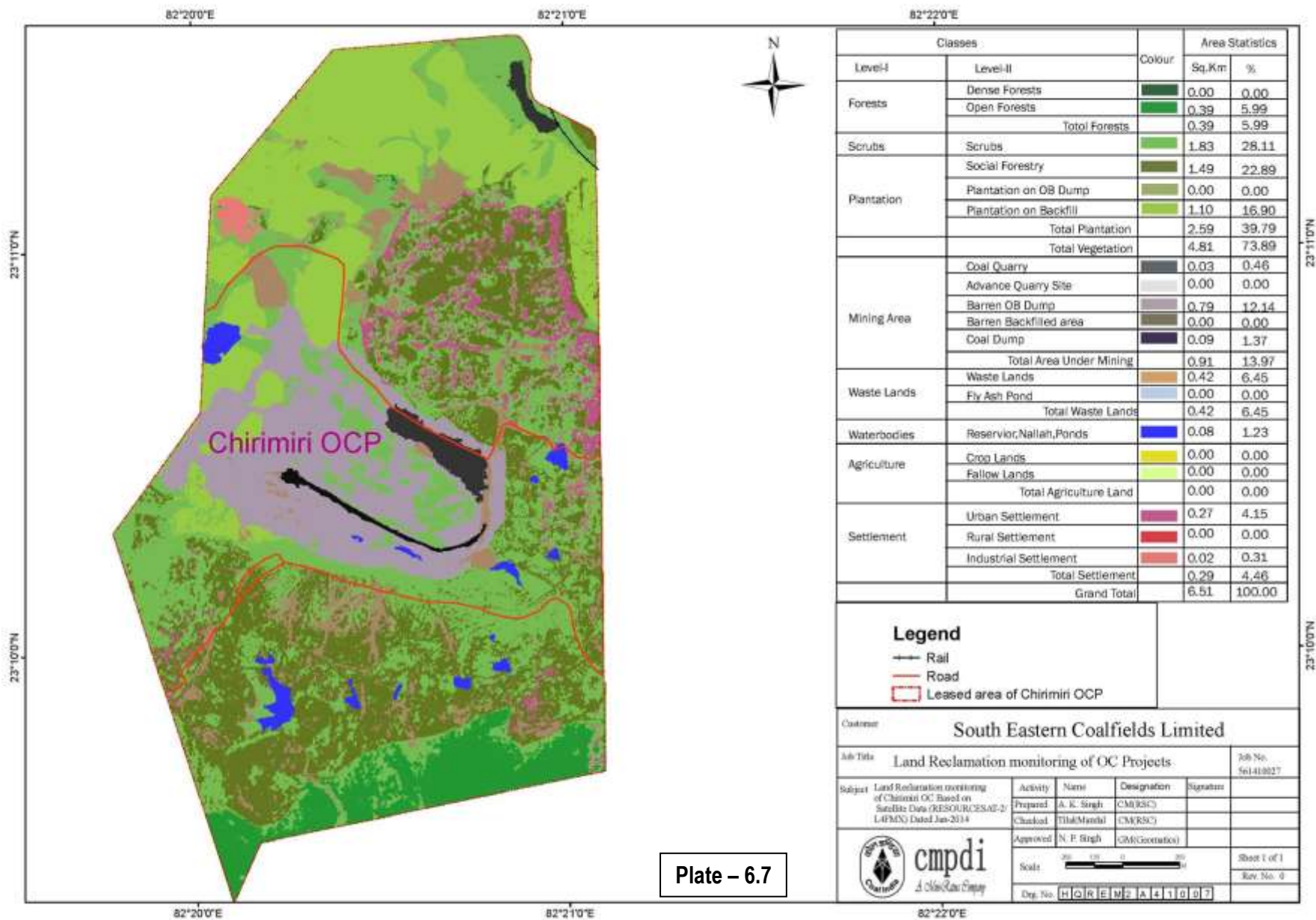


Plate – 6.7

Classes		Colour	Area Statistics	
Level-I	Level-II		Sq.Km	%
Forests	Dense Forests		0.00	0.00
	Open Forests		0.39	5.99
	Total Forests		0.39	5.99
Scrubs	Scrubs		1.83	28.11
Plantation	Social Forestry		1.49	22.89
	Plantation on OB Dump		0.00	0.00
	Plantation on Backfill		1.10	16.90
	Total Plantation		2.59	39.79
	Total Vegetation		4.81	73.89
Mining Area	Coal Quarry		0.03	0.46
	Advance Quarry Site		0.00	0.00
	Barren OB Dump		0.79	12.14
	Barren Backfilled area		0.00	0.00
	Coal Dump		0.09	1.37
		Total Area Under Mining		0.91
Waste Lands	Waste Lands		0.42	6.45
	Fly Ash Pond		0.00	0.00
	Total Waste Lands		0.42	6.45
Waterbodies	Reservoir,Nallah,Ponds		0.08	1.23
Agriculture	Crop Lands		0.00	0.00
	Fallow Lands		0.00	0.00
	Total Agriculture Land		0.00	0.00
Settlement	Urban Settlement		0.27	4.15
	Rural Settlement		0.00	0.00
	Industrial Settlement		0.02	0.31
	Total Settlement		0.29	4.46
	Grand Total		6.51	100.00

Legend	
	Rail
	Road
	Leased area of Chirimiri OCP

Customer	South Eastern Coalfields Limited			
Job Title	Land Reclamation monitoring of OC Projects			Job No. 561410027
Subject	Land Reclamation monitoring of Chirimiri OC Based on Satellite Data (RESOURCESAT-2) LRFMO Dated Jan-2014	Activity	Name	Designation
		Prepared	A. K. Singh	CM(RSC)
		Checked	Tilak/Mandil	CM(RSC)
		Approved	N. P. Singh	GM(Geomatics)
		Scale		
		Dep. No.	HOREW2A41007	

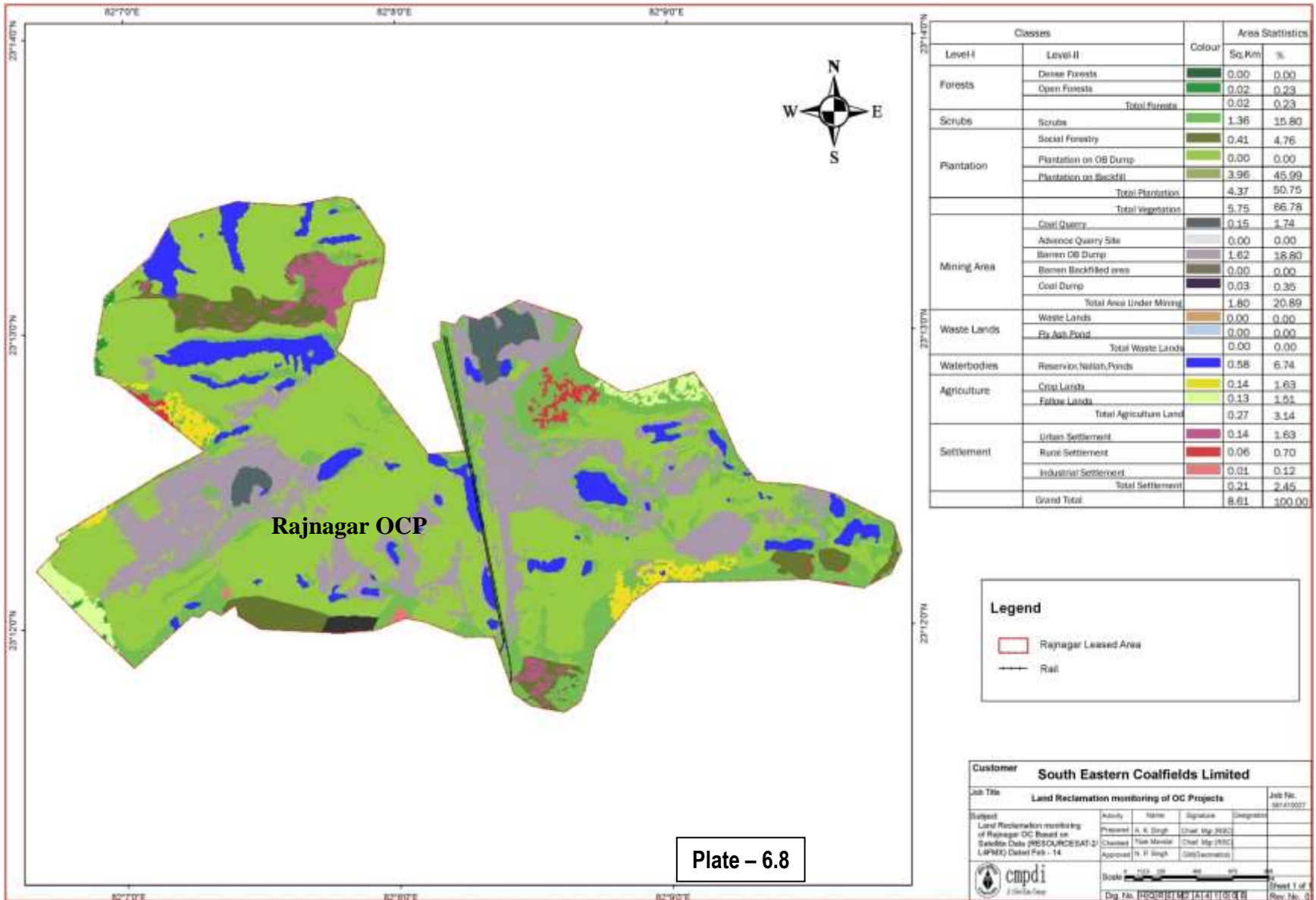


Plate - 6.8

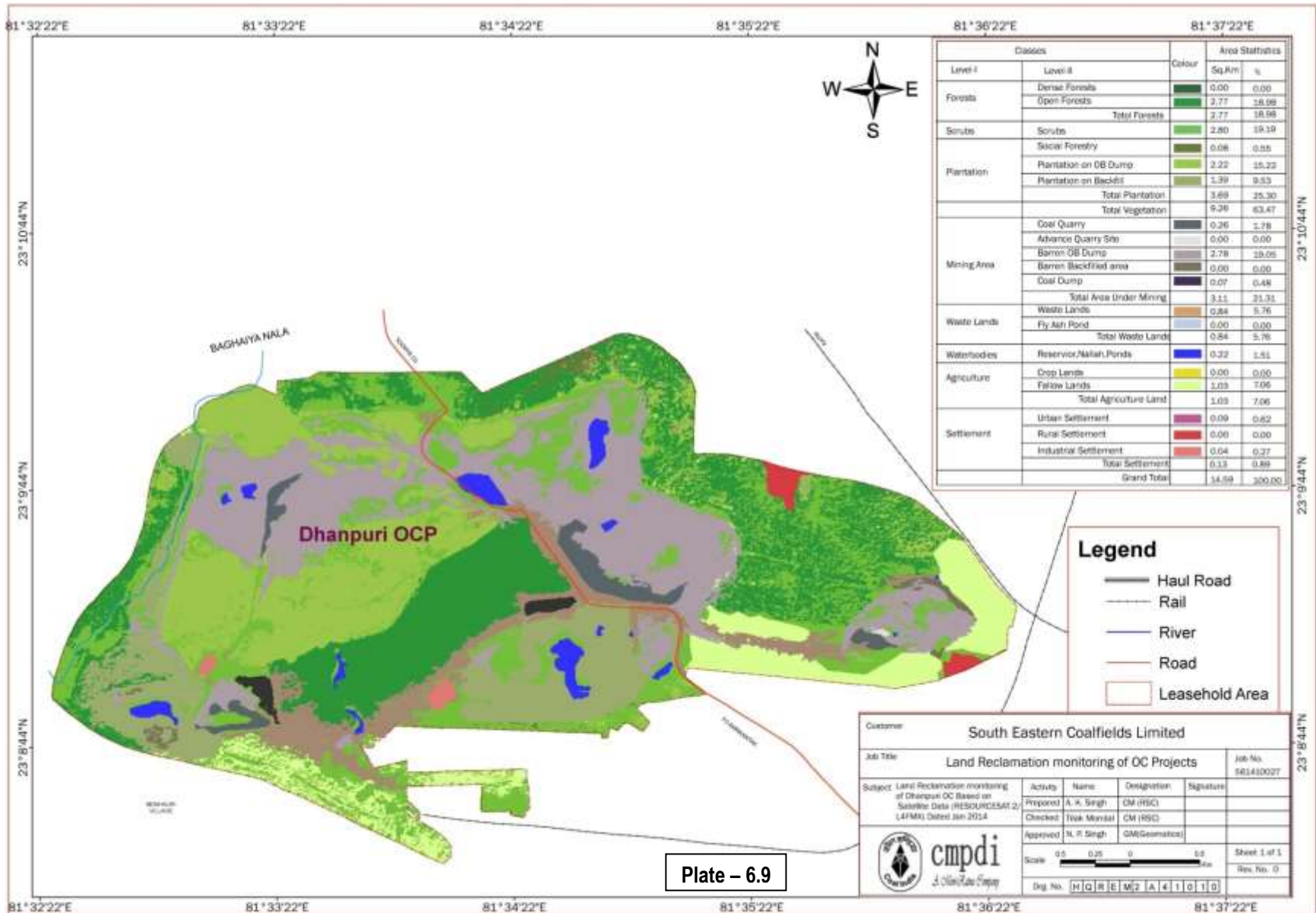


Plate - 6.9

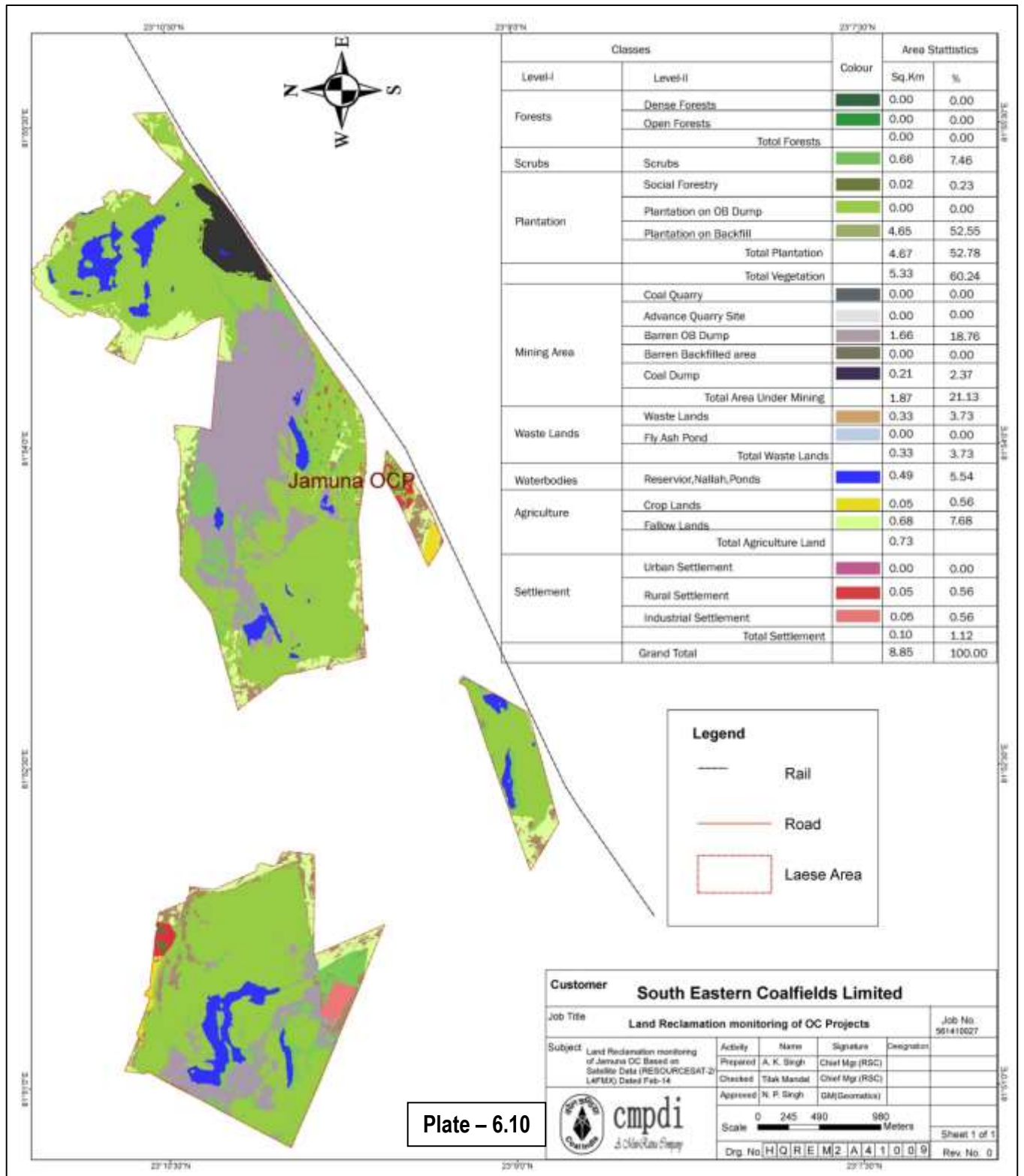


Plate - 6.10

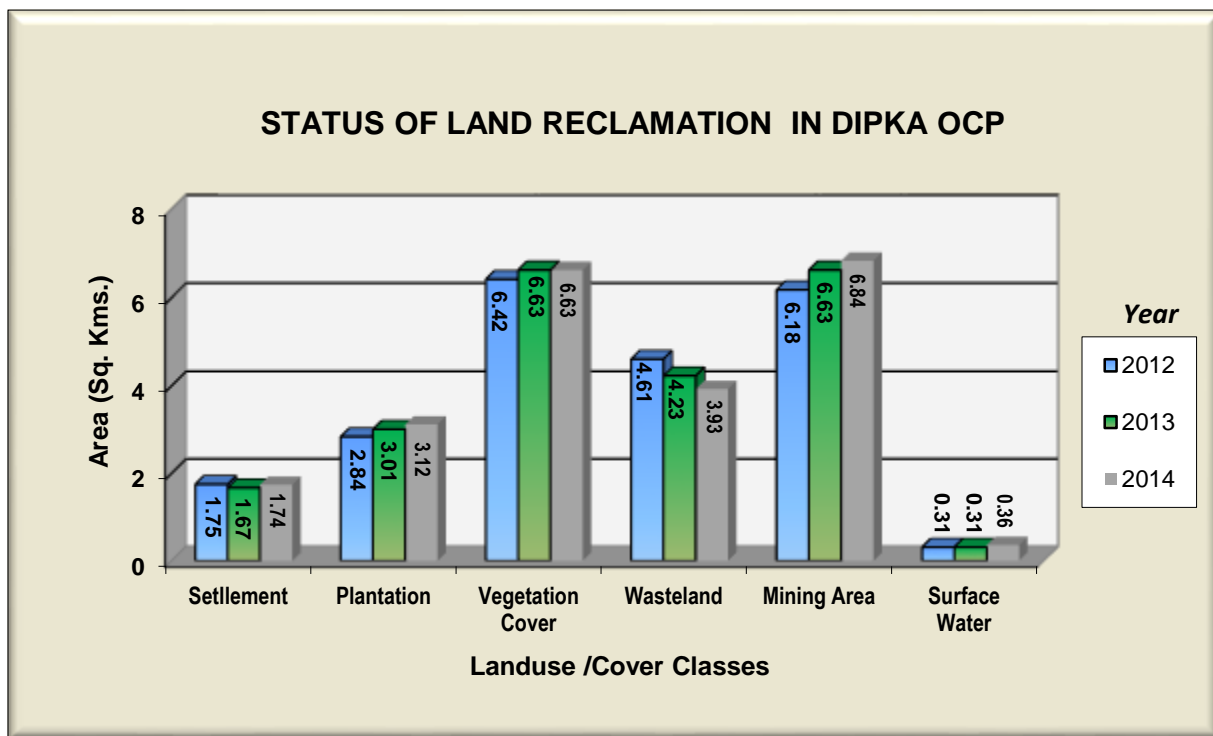


Figure 6.2

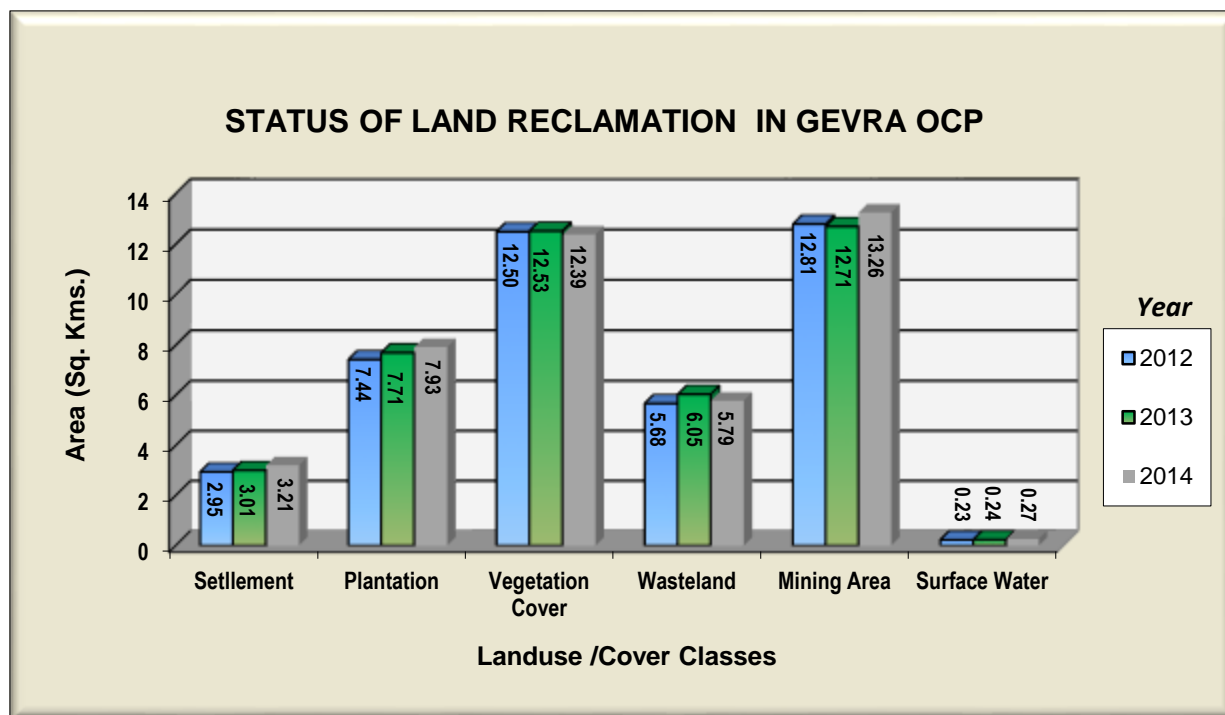


Figure 6.3

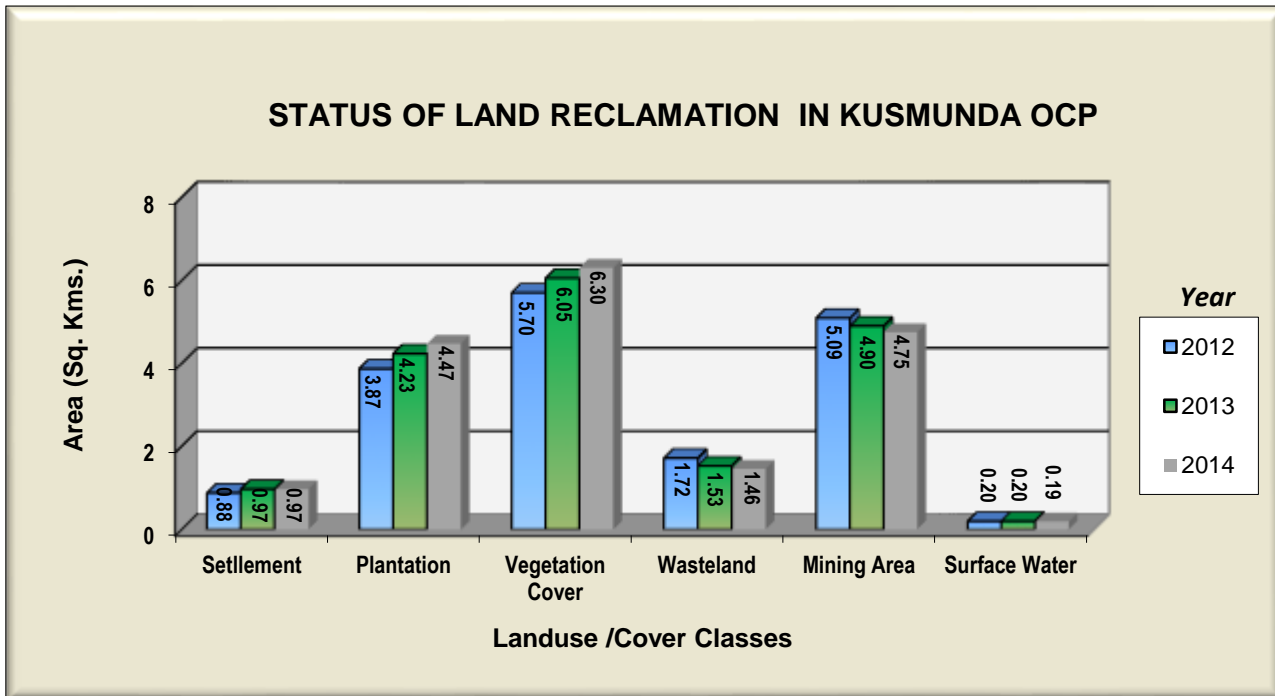


Figure 6.4

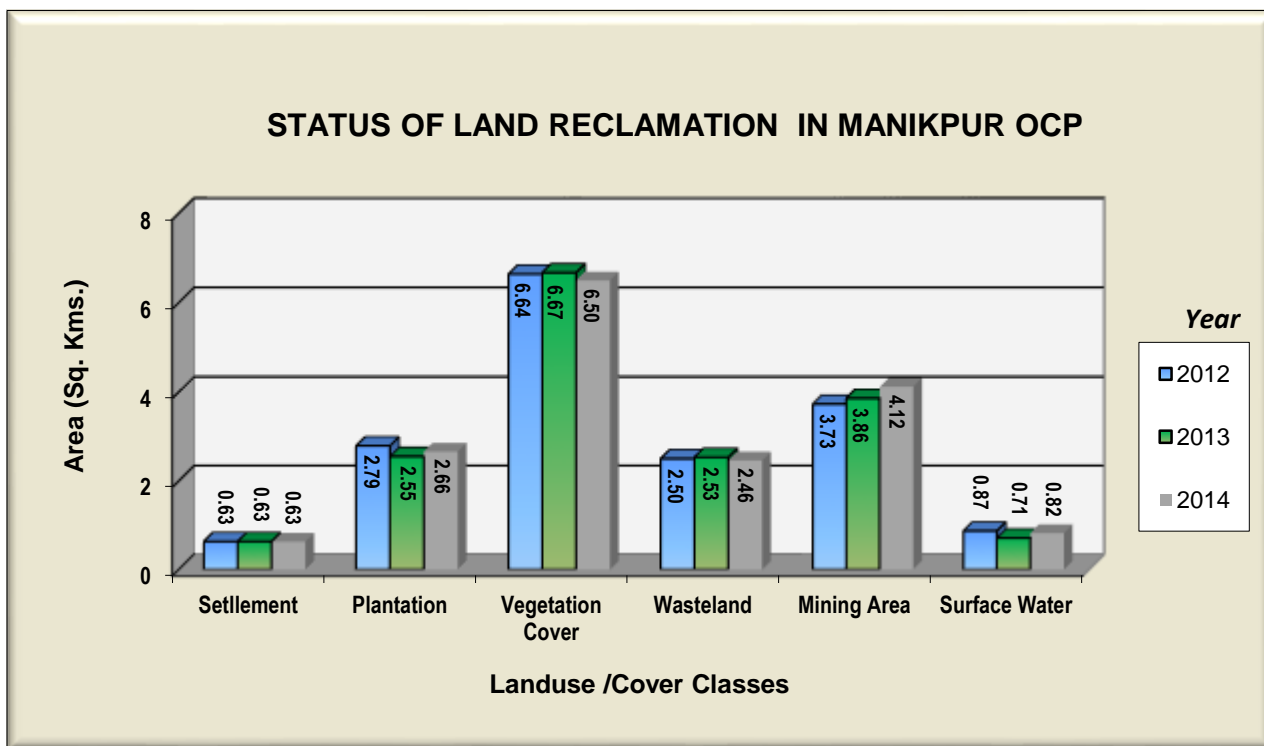


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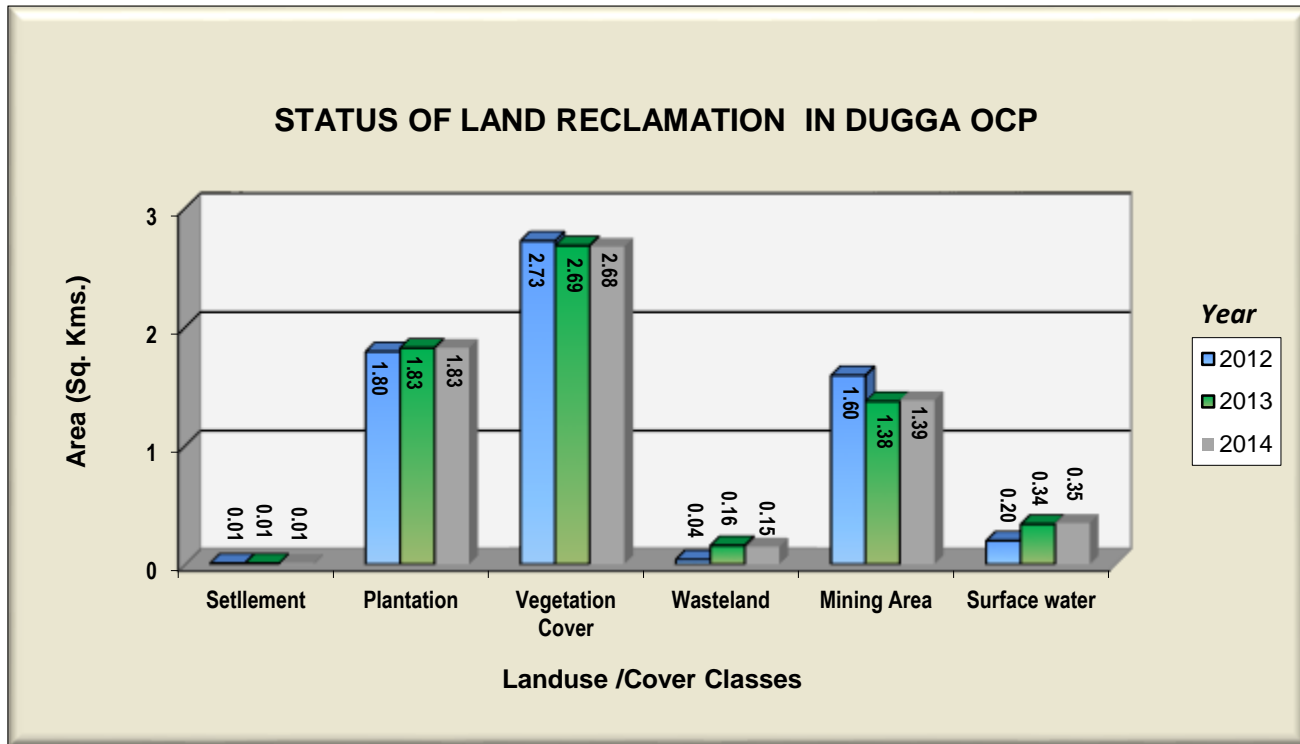


Figure 6.6

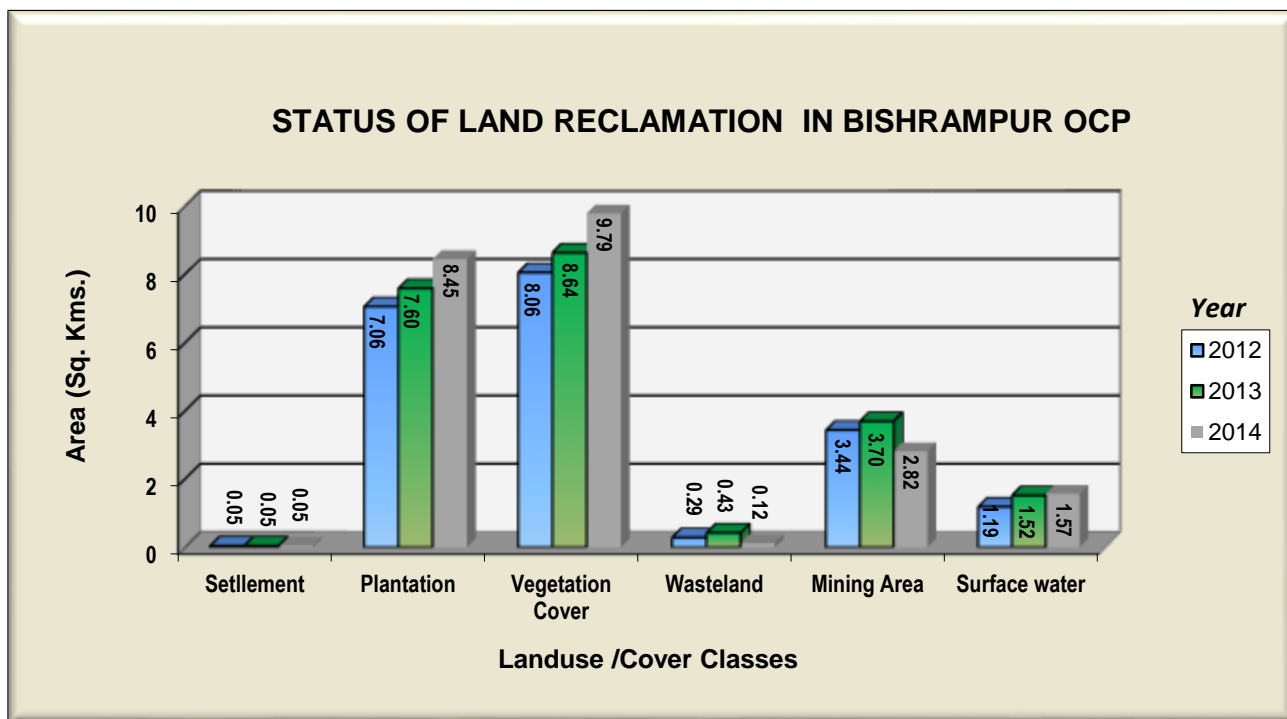


Figure 6.7

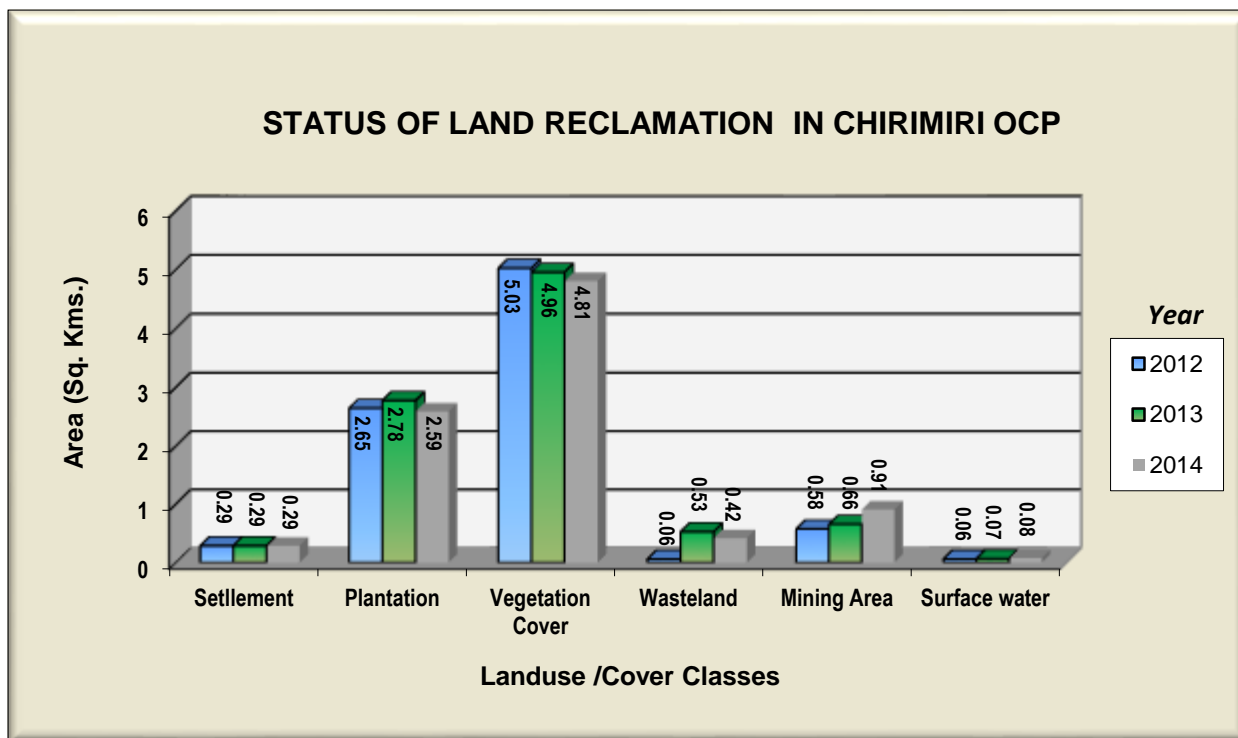


Figure 6.8

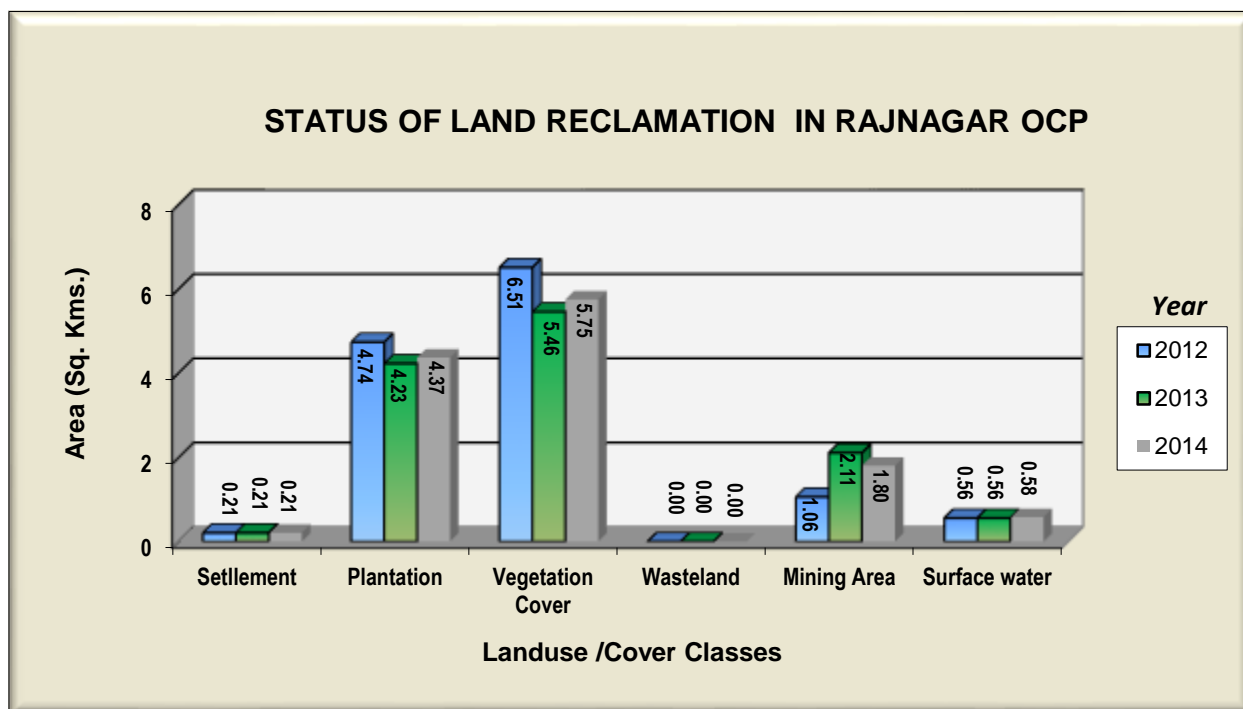


Figure 6.9

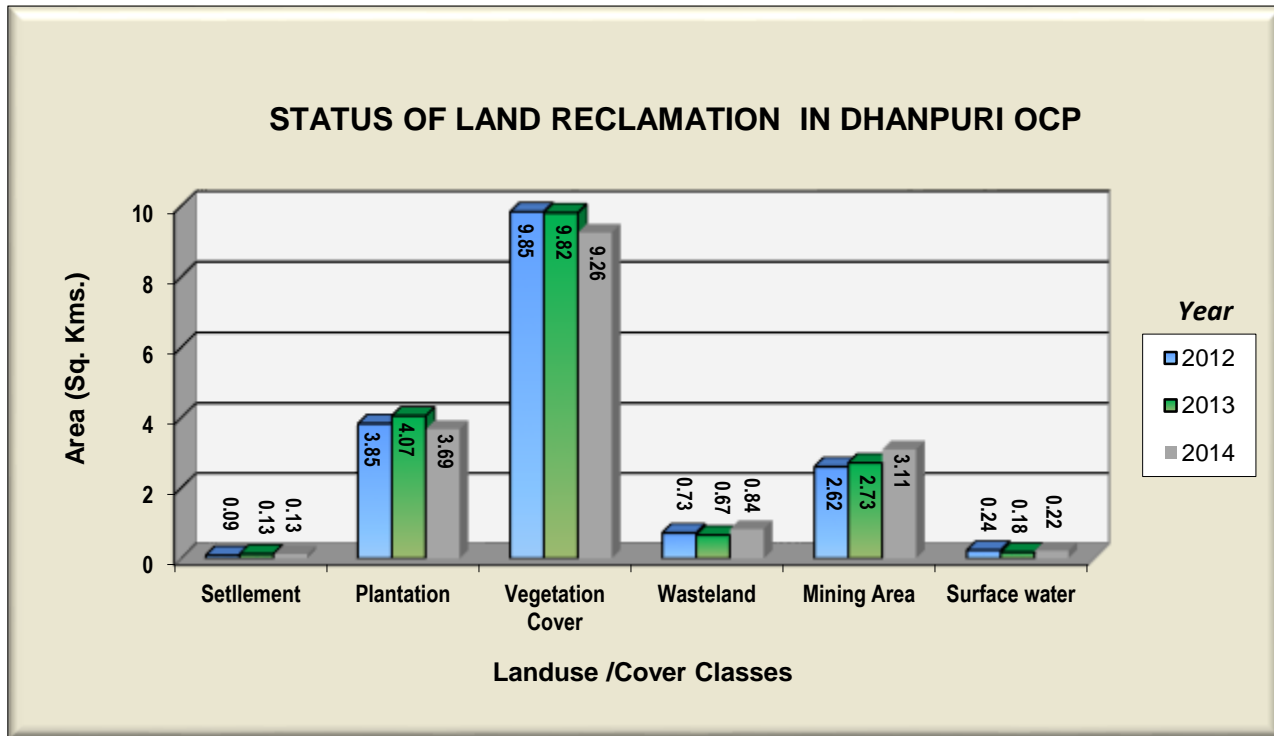


Figure 6.10

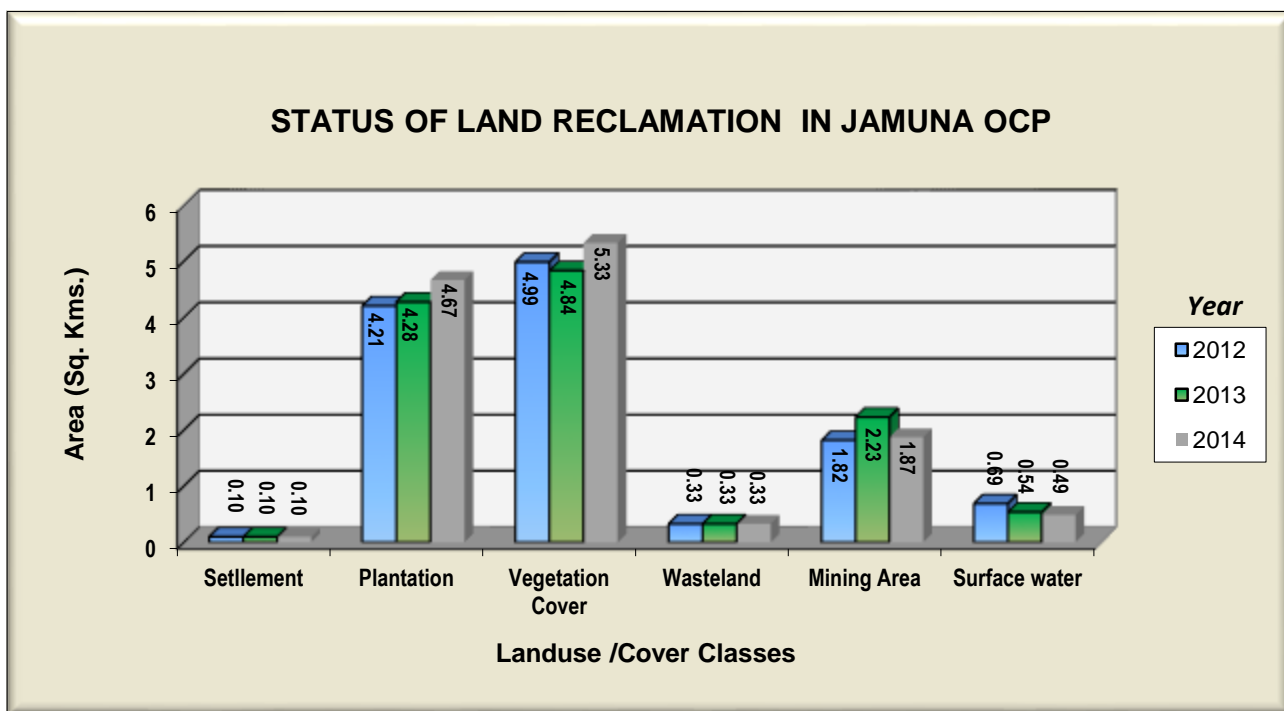


Figure 6.11



Photograph – 6.1: *Plantation in Dipka Opencast Project*



Photograph – 6.2: *Plantation in Gevra Opencast Project*



Photograph – 6.3: *Plantation in Kusmunda Opencast Project*



Photograph – 6.4: *Plantation in Manikpur Opencast Project*



Photograph – 6.5: *Plantation on OB Dump in Dugga Opencast Project*



Photograph – 6.6: *Plantation on OB Dump in Bishrampur Opencast Project*



Photograph – 6.7: *Plantation on OB Dump in Chirimiri Opencast Project*



Photograph – 6.8: *Plantation on OB Dump in Rajnagar Opencast Project*



Photograph – 6.9: *Plantation on OB Dump in Dhanpuri Opencast Project*



Photograph – 6.10: *Plantation on OB Dump in Jamuna Opencast Project*

NORTHERN COALFIELDS LIMITED

7.0 Land Reclamation Status in Northern Coalfields Ltd.

7.1 Following 10 OC projects producing more than 5 million cubic m. (Coal + OB together) of Northern Coalfields Ltd. have been taken up for land reclamation monitoring during the year 2013-14:

- Amlohri
- Nigahi
- Jayant
- Dudhichua
- Khadia
- Krishnashila
- Bina
- Kakri
- Jhingurdah
- Block-B

7.2 Project wise Land Reclamation status in NCL for the year 2014 is given in Table 7.1 and also shown graphically in Fig 7.1. Area statistics of different land use class present in the mine leasehold of the above projects for the year 2014 are shown in the Table – 7.2. Land use/cover maps derived from satellite data are shown in Plate 7.1 – 7.10. Land reclamation status of the above mentioned 10 projects, were also prepared for the year 2009, 2010, 2011, 2012 and 2013. Year wise changes in the different land use classes based on satellite data for the last three years are depicted in Bar Charts in Fig. 7.2 to 7.11.

7.3 Study reveals that 88.18 Km² of mining area has already been under reclamation in NCL out of which 57.68 Km² area has been revegetated and 30.50 Km² area is under backfilling. There is a decrease of 0.67 Km² area under reclamation in NCL with respect to the year 2013.

- 7.4** After analyzing the satellite data of year 2013 vs. 2014, it is evident that area under plantation has decreased due to dumping done on already vegetated areas due to space constraints arising out of high production of coal and in some cases dump heights were increased as per revised design. This has happened in Amlohri, Jayant, Dudhichua, Khadia, Krishnashila and Bina.
- 7.5** At Amlohri OCP, plantation loss due to OB dumping is 0.64 km². In Jayant, some plantation which was done on dip side of the mine long back was removed due to the mine advancement in that direction. Some plantation loss has occurred due to erosion of dumps at Khadia OC Project. Plantation in the OC projects of NCL has decreased from 59.07 km² in 2013 to 57.68 km² in 2014. Hence there is a decrease of 1.39 km² of plantations in the OCPs of NCL.
- 7.6** Out of 10 projects of NCL, maximum land reclamation has been carried out in Jhingurdah Project (93.94%) followed by Kakri (84.54%) and Khadia (81.32%).

Table 7.1

Summarised Land Reclamation Status in Opencast Projects of NCL based on Satellite Data of the year 2014

(% Calculated in terms of Total Area Excavated)

Sl. No.	Project		Plantation		Under Backfilling		Under Active Mining		Total Excavated Area		Area under Reclamation	
	Name	Leasehold (i)	ii		iii		iv		ii+iii+iv		ii+iii	
			2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1	AMLOHRI	31.23	8.67	8.03	4.93	5.35	3.74	3.74	17.34	17.12	13.60	13.38
			50.00	46.90	28.43	31.25	21.57	21.85			78.43	78.15
2	NIGAHI	30.16	9.75	9.94	4.23	4.07	3.50	3.79	17.48	17.80	13.98	14.01
			55.78	55.84	24.20	22.87	20.02	21.29			79.98	78.71
3	JAYANT #	29.11	12.65	12.50	3.78	3.92	3.73	4.10	20.16	20.52	16.43	16.42
			62.75	60.92	18.75	19.10	18.50	19.98			81.50	80.02
4	DUDHICHUA	14.00	4.07	3.75	4.62	4.92	2.34	2.92	11.03	11.59	8.69	8.67
			36.90	32.36	41.89	42.45	21.21	25.19			78.79	74.81
5	KHADIA	14.91	5.41	5.10	3.10	3.26	1.74	1.92	10.25	10.28	8.51	8.36
			52.78	49.61	30.24	31.71	16.98	18.68			83.02	81.32
6	KRISHNASHILA	5.94	1.13	1.11	0.57	0.82	0.63	0.95	2.33	2.88	1.70	1.93
			48.50	38.54	24.46	28.47	27.04	32.99			72.96	67.01
7	BINA #	17.98	6.18	5.92	3.18	3.06	2.72	3.31	12.08	12.29	9.36	8.98
			51.16	48.17	26.32	24.90	22.52	26.93			77.48	73.07
8	KAKRI	13.60	5.70	5.73	1.71	1.60	1.14	1.34	8.55	8.67	7.41	7.33
			66.67	66.09	20.00	18.45	13.33	15.46			86.67	84.54
9	JHINGURDAH	12.43	5.24	5.29	0.82	0.91	0.41	0.40	6.47	6.60	6.06	6.20
			80.99	80.15	12.67	13.79	6.34	6.06			93.66	93.94
10	BLOCK-B	14.64	0.27	0.31	2.84	2.59	2.00	2.13	5.11	5.03	3.11	2.90
			5.28	6.16	55.58	51.49	39.14	42.35			60.86	57.65
	TOTAL (NCL)	184.00	59.07	57.68	29.78	30.50	21.95	24.60	110.80	112.78	88.85	88.18
			53.31	51.14	26.88	27.04	19.81	21.81	60.22	61.29	80.19	78.19

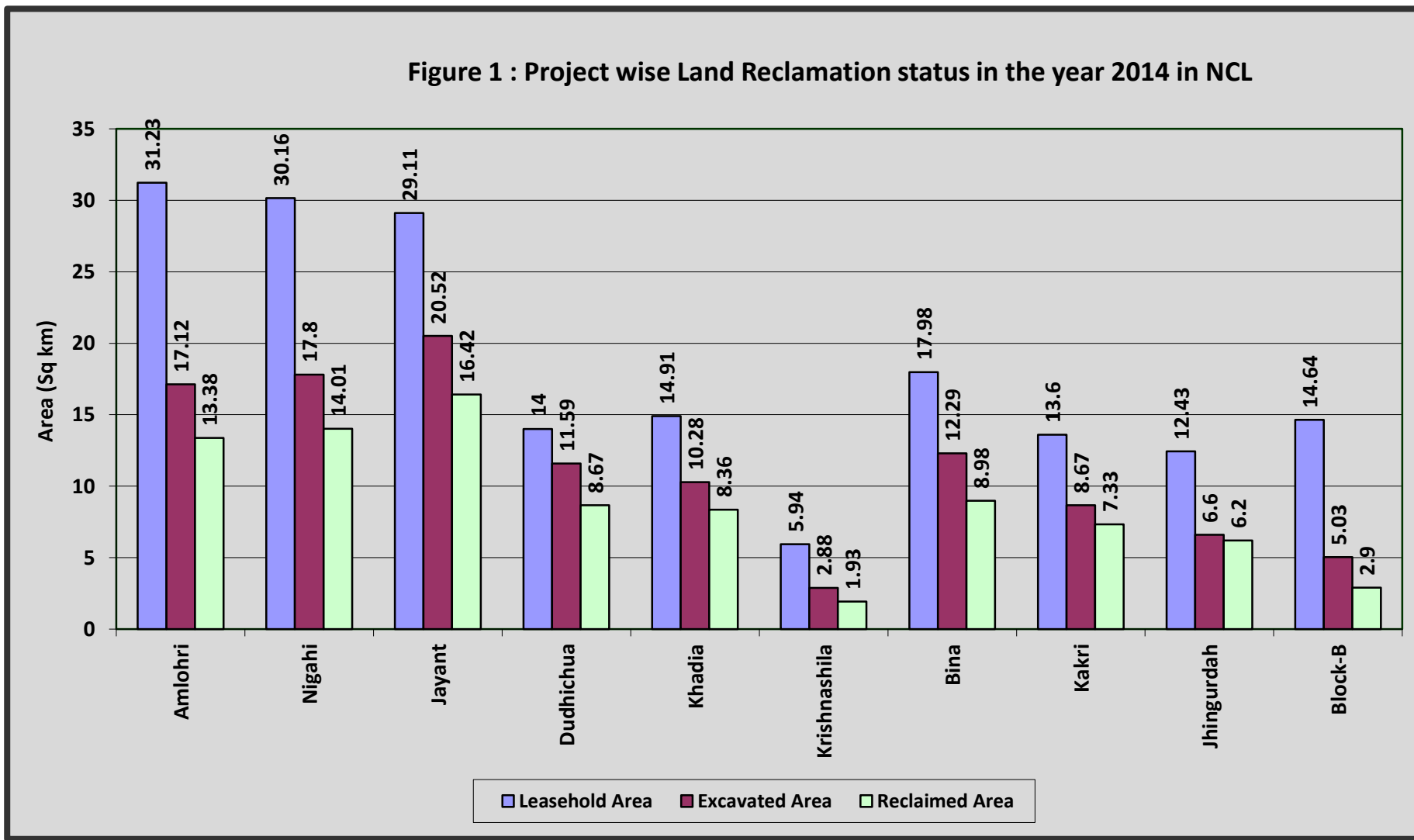


Fig.7.1: Land reclamation status in Opencast Projects of NCL in the Year 2014

Table 7.2

PROJECTWISE LAND USE/ RECLAMATION STATUS IN OC MINES (>5mcu.m) OF NORTHERN COALFIELDS LTD BASED ON SATELLITE DATA OF THE YEAR 2014

(Area in Sq.Km)

	AMLOHRI		NIGAH I		JAYANT		DUDHICHUA		KHADIA		KRISHNASHILA		BNA		KAKRI		JHINGURDAH		BLOCK-B		Overall Blockwise		
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	
FORESTS	Dense Forest	1.08	3.46	0.04	0.13	0.00	0.00	0.00	0.00	0.00	0.01	0.17	0.00	0.00	0.02	0.15	0.01	0.08	1.03	7.04	2.19	1.19	
	Open Forest	0.93	2.98	3.30	10.94	1.14	3.92	0.72	5.14	1.67	11.20	1.43	24.07	2.21	12.29	1.81	13.31	0.89	7.16	1.23	8.40	15.33	8.33
	Total Forest	2.01	6.44	3.34	11.07	1.14	3.92	0.72	5.14	1.67	11.20	1.44	24.24	2.49	13.85	1.83	13.46	0.90	7.24	2.26	15.44	17.80	9.67
SCRUBS	1.82	5.83	2.06	6.83	3.23	11.10	0.85	6.07	1.25	8.38	1.08	18.18	1.74	9.68	1.81	13.31	3.71	29.85	3.14	21.45	20.69	11.24	
PLANTATION	Social Forestry	6.17	19.76	4.91	16.28	3.92	13.47	0.82	5.86	3.25	21.80	1.00	16.84	3.52	19.58	3.85	28.31	1.80	14.48	0.17	1.16	29.41	15.98
	Plantation on OB Dump	0.84	2.69	2.66	8.82	2.86	9.82	1.21	8.64	0.54	3.62	0.10	1.68	0.75	4.17	0.37	2.72	1.85	14.88	0.14	0.96	11.32	6.15
	Plantation on Backfill	1.02	3.27	2.37	7.86	5.72	19.65	1.72	12.29	1.31	8.79	0.01	0.17	1.65	9.18	1.51	11.10	1.64	13.19	0.00	0.00	16.95	9.21
Total Plantation (Biological Reclamation)	8.03	25.71	9.94	32.96	12.50	42.94	3.75	26.79	5.10	34.21	1.11	18.69	5.92	32.93	5.73	42.13	5.29	42.56	0.31	2.12	57.68	31.35	
Total Vegetation	11.86	37.98	15.34	50.86	18.87	57.95	5.32	38.00	8.02	53.79	3.63	61.11	10.15	56.45	9.37	68.90	9.90	79.65	5.71	39.00	96.17	52.27	
ACTIVE MINING	Coal Quarry	2.12	6.79	2.76	9.15	2.85	9.79	1.92	13.71	1.16	7.78	0.29	4.88	2.18	12.12	0.98	7.21	0.26	2.09	1.05	7.17	15.57	8.46
	Advance Quarry Site	1.51	4.84	0.99	3.28	0.90	3.09	0.81	5.79	0.61	4.09	0.59	9.93	0.89	4.95	0.31	2.28	0.00	0.00	0.44	3.01	7.05	3.83
	Coal Dump	0.06	0.19	0.01	0.03	0.24	0.82	0.03	0.21	0.05	0.34	0.00	0.00	0.20	1.11	0.00	0.00	0.00	0.00	0.15	1.02	0.74	0.40
	Quarry Filled With Water	0.05	0.16	0.03	0.10	0.11	0.38	0.16	1.14	0.10	0.67	0.07	1.18	0.04	0.22	0.05	0.37	0.14	1.13	0.49	3.35	1.24	0.67
	Total Area Under Active Mining	3.74	11.98	3.79	12.57	4.10	14.08	2.92	20.86	1.92	12.88	0.95	15.99	3.31	18.41	1.34	9.85	0.40	3.22	2.13	14.55	24.60	13.37
RECLAIMED	Barren OB Dump	3.72	11.91	1.48	4.91	0.15	0.52	0.64	4.57	0.89	5.97	0.60	10.10	0.28	1.56	0.74	5.44	0.70	5.63	2.28	15.57	11.48	6.24
	Barren Backfilled Area	1.63	5.22	2.59	8.59	3.77	12.95	4.28	30.57	2.37	15.90	0.22	3.70	2.78	15.46	0.86	6.32	0.21	1.69	0.31	2.12	19.02	10.34
	Total Area Under Technical Reclamation	5.35	17.13	4.07	13.49	3.92	13.47	4.92	35.14	3.26	21.88	0.82	13.80	3.06	17.02	1.60	11.78	0.91	7.32	2.59	17.69	30.50	16.58
Total Area Under Mine Operations	9.09	29.11	7.86	26.06	8.02	27.55	7.84	56.00	5.18	34.74	1.77	29.80	6.37	35.43	2.94	21.62	1.31	10.54	4.72	32.24	55.10	29.95	
WASTELANDS	Waste Lands	2.40	7.68	0.88	2.92	0.62	2.13	0.33	2.36	0.37	2.48	0.19	3.20	0.05	0.28	0.15	1.10	0.29	2.33	2.88	19.67	8.16	4.43
	Fly Ash Pond	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	3.03	0.04	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.12
	Total Wasteland	2.40	7.68	0.88	2.92	0.62	2.13	0.33	2.36	0.37	2.48	0.37	6.23	0.09	0.50	0.15	1.10	0.29	2.33	2.88	19.67	8.38	4.55
WATERBODIES	Reservoir, nallah, ponds	0.14	0.45	0.13	0.43	0.49	1.68	0.01	0.07	0.06	0.40	0.03	0.51	0.13	0.72	0.21	1.54	0.03	0.24	0.22	1.50	1.45	0.79
	Total Waterbodies	0.05	0.16	0.09	0.30	0.49	1.68	0.01	0.07	0.07	0.47	0.03	0.51	0.13	0.72	0.21	1.54	0.03	0.24	0.22	1.50	1.33	0.72
	Total Agriculture	4.53	14.51	0.24	0.80	0.61	2.10	0.36	2.57	0.00	0.00	0.04	0.67	0.04	0.22	0.00	0.00	0.24	1.93	0.73	4.99	6.79	3.69
SETTLEMENTS	Urban Settlement	2.30	7.36	4.82	15.98	1.45	4.98	0.00	0.00	1.11	7.44	0.10	1.68	0.44	2.45	0.90	6.62	0.47	3.78	0.19	1.30	11.78	6.40
	Rural Settlement	0.68	2.18	0.01	0.03	0.64	2.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.82	1.45	0.79
	Industrial Settlement	0.32	1.02	0.92	3.05	0.41	1.41	0.14	1.00	0.16	1.07	0.00	0.00	0.76	4.23	0.03	0.22	0.19	1.53	0.07	0.48	3.00	1.63
	Total Settlement	3.30	10.57	5.75	19.06	2.50	8.59	0.14	1.00	1.27	8.52	0.10	1.68	1.20	6.67	0.93	6.84	0.66	5.31	0.38	2.60	16.23	8.82
Grand Total	31.23	100.00	30.16	100.00	29.11	100.00	14.00	100.00	14.91	100.00	5.94	100.00	17.98	100.00	13.60	100.00	12.43	100.00	14.64	100.00	184.00	100.00	

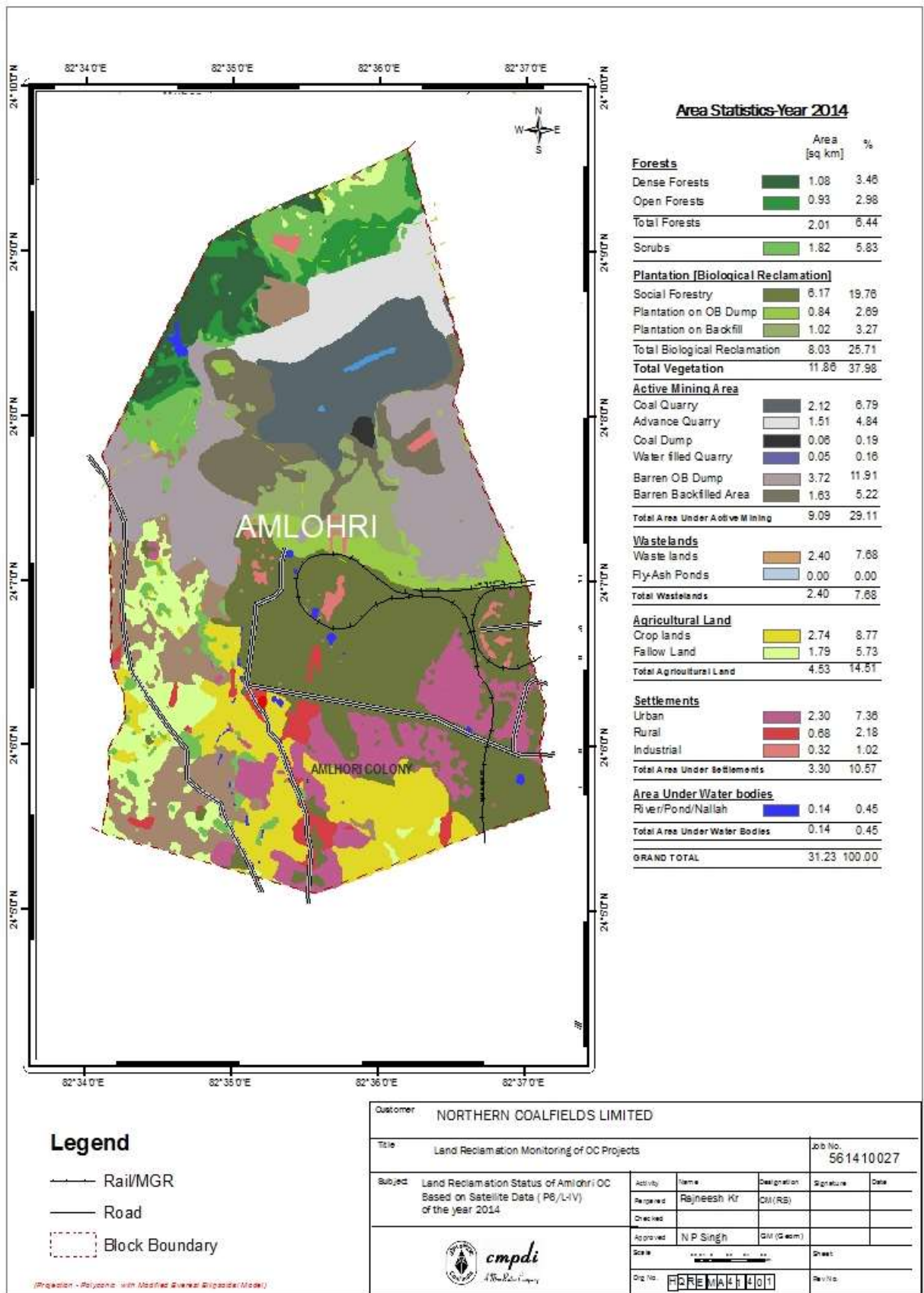
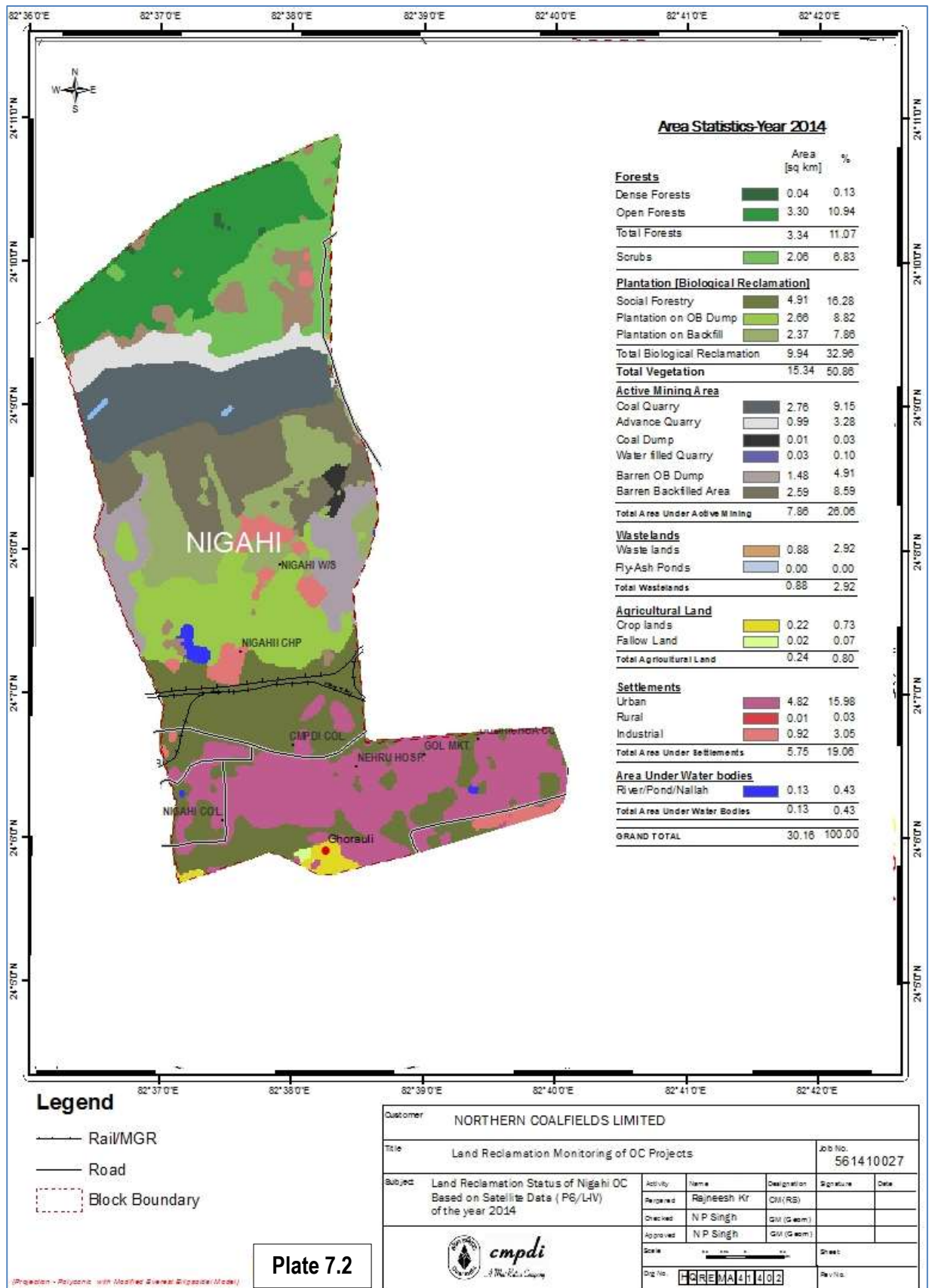


Plate 7.1



Legend

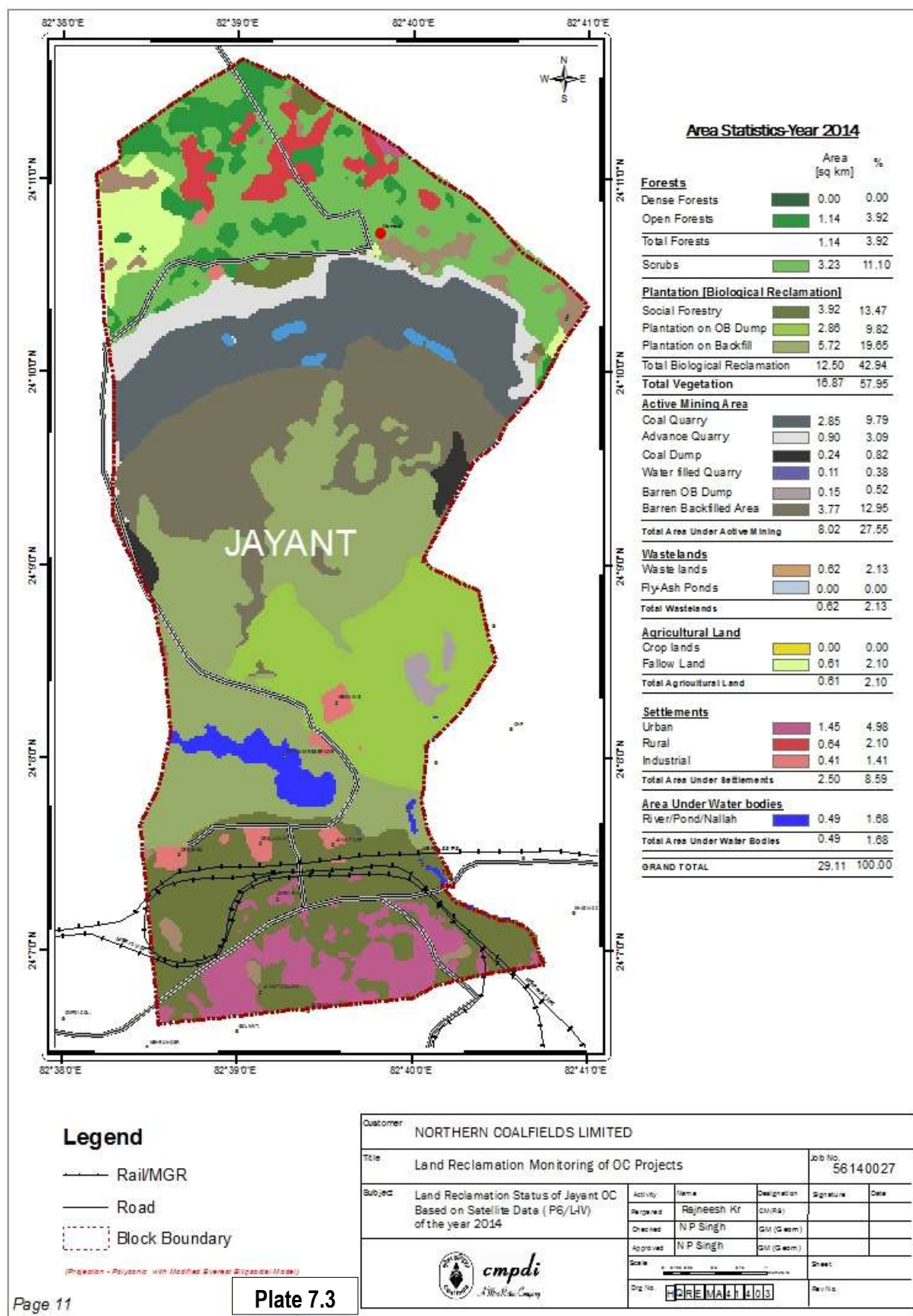
- Rail/MGR
- Road
- ⋯ Block Boundary

Plate 7.2

(Projection - Polyconic with Modified Universal Transverse Mercator)

Customer		NORTHERN COALFIELDS LIMITED			
Title		Land Reclamation Monitoring of OC Projects		Job No. 561410027	
Subject		Activity	Name	Designation	Signature
Land Reclamation Status of Nigahi OC Based on Satellite Data (P6/LIV) of the year 2014		Prepared	Rajneesh Kr	GM(RS)	
		Checked	N P Singh	GM (Gadm)	
		Approved	N P Singh	GM (Gadm)	
Scale		1:10000		Sheet	
Dwg No.		HERE MAT 102		Rev/No.	





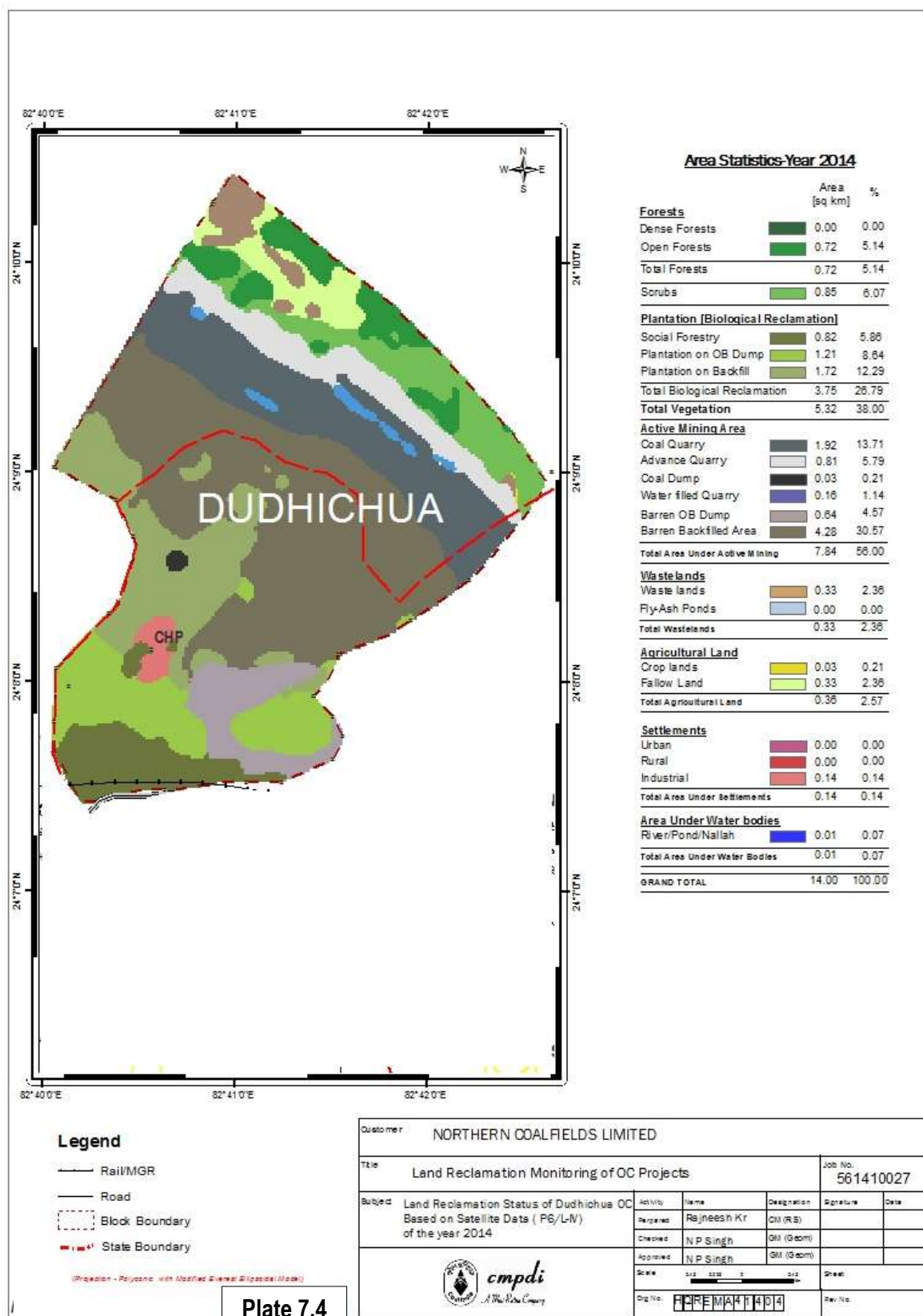
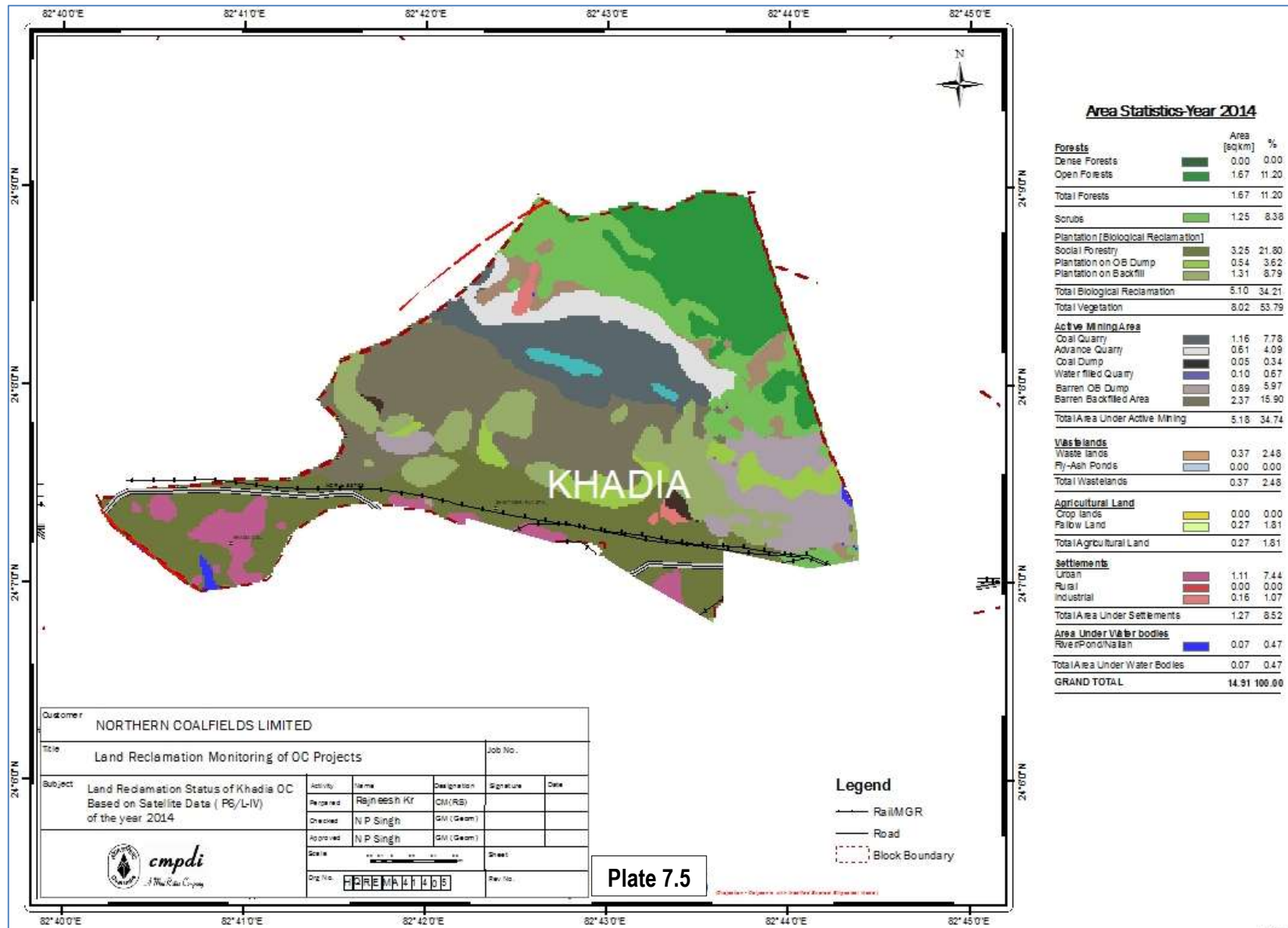
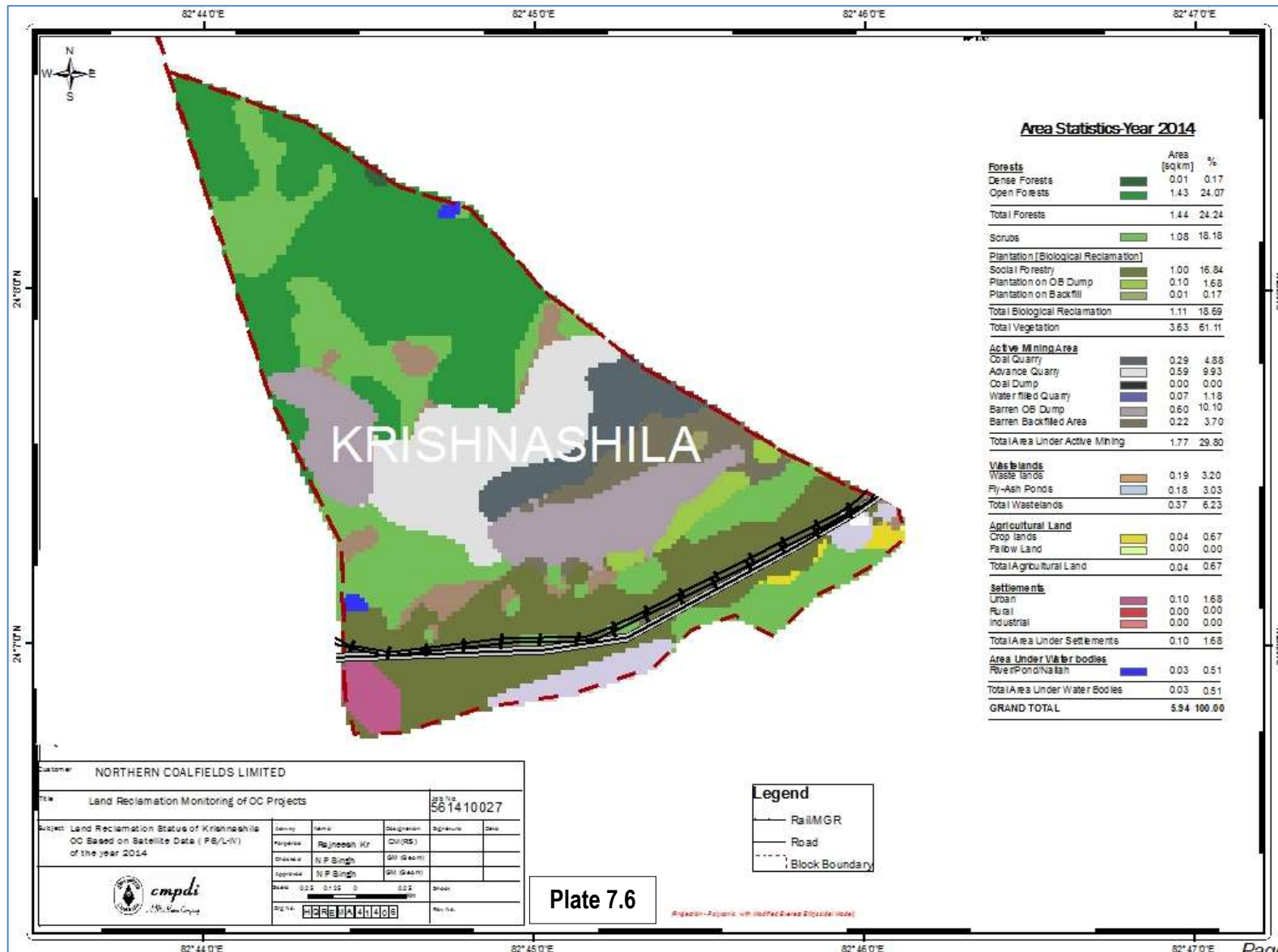
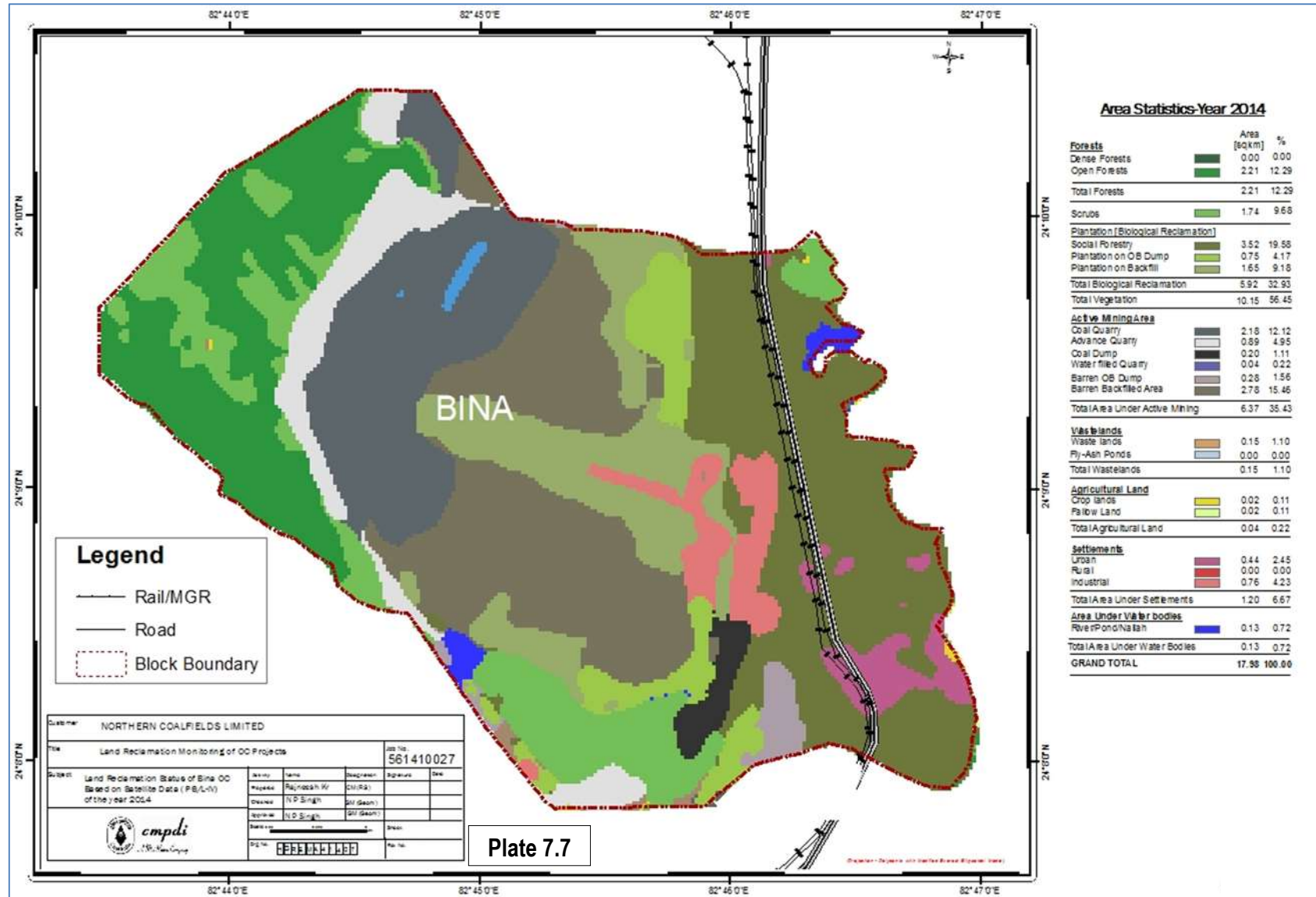


Plate 7.4







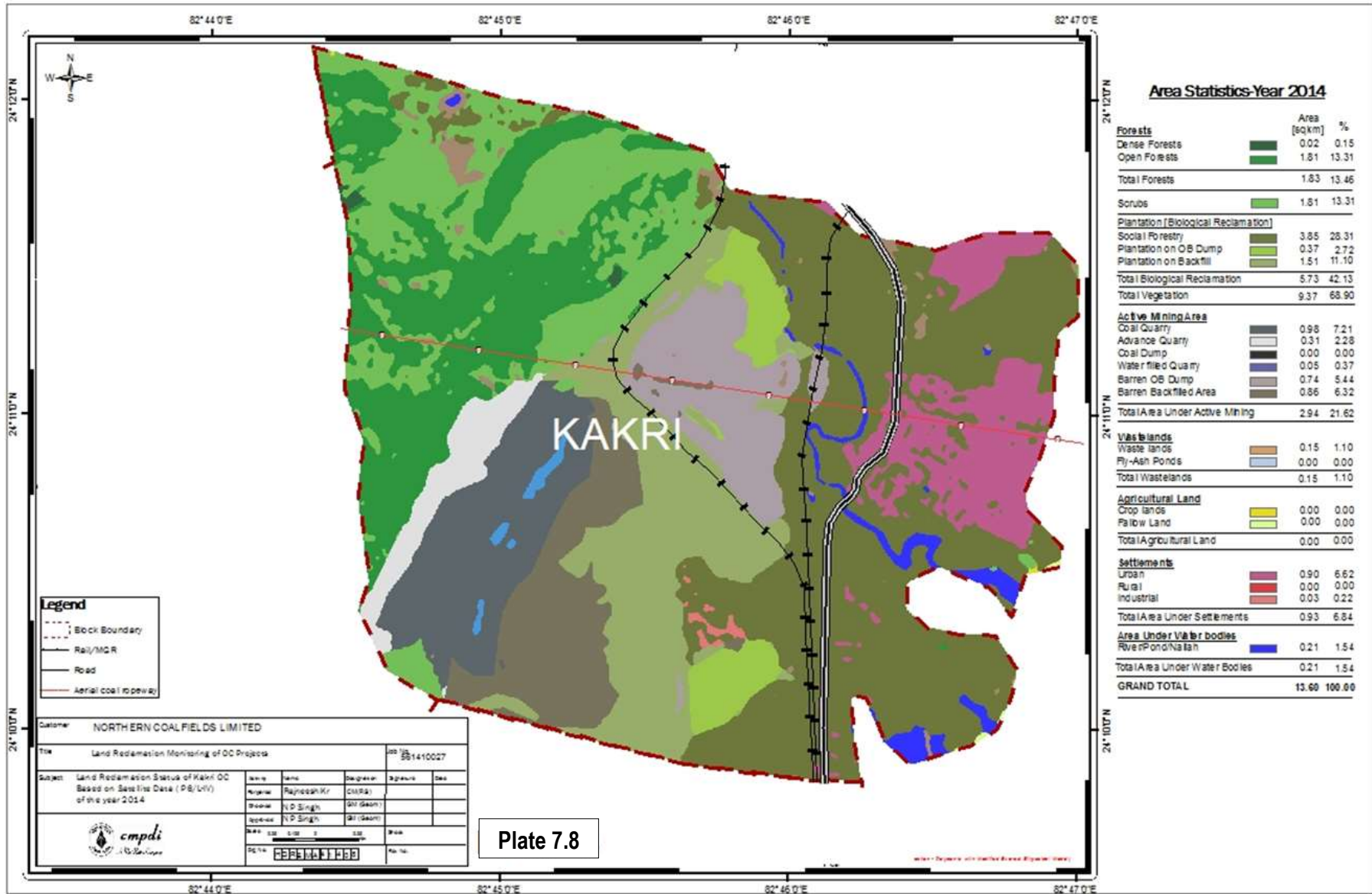
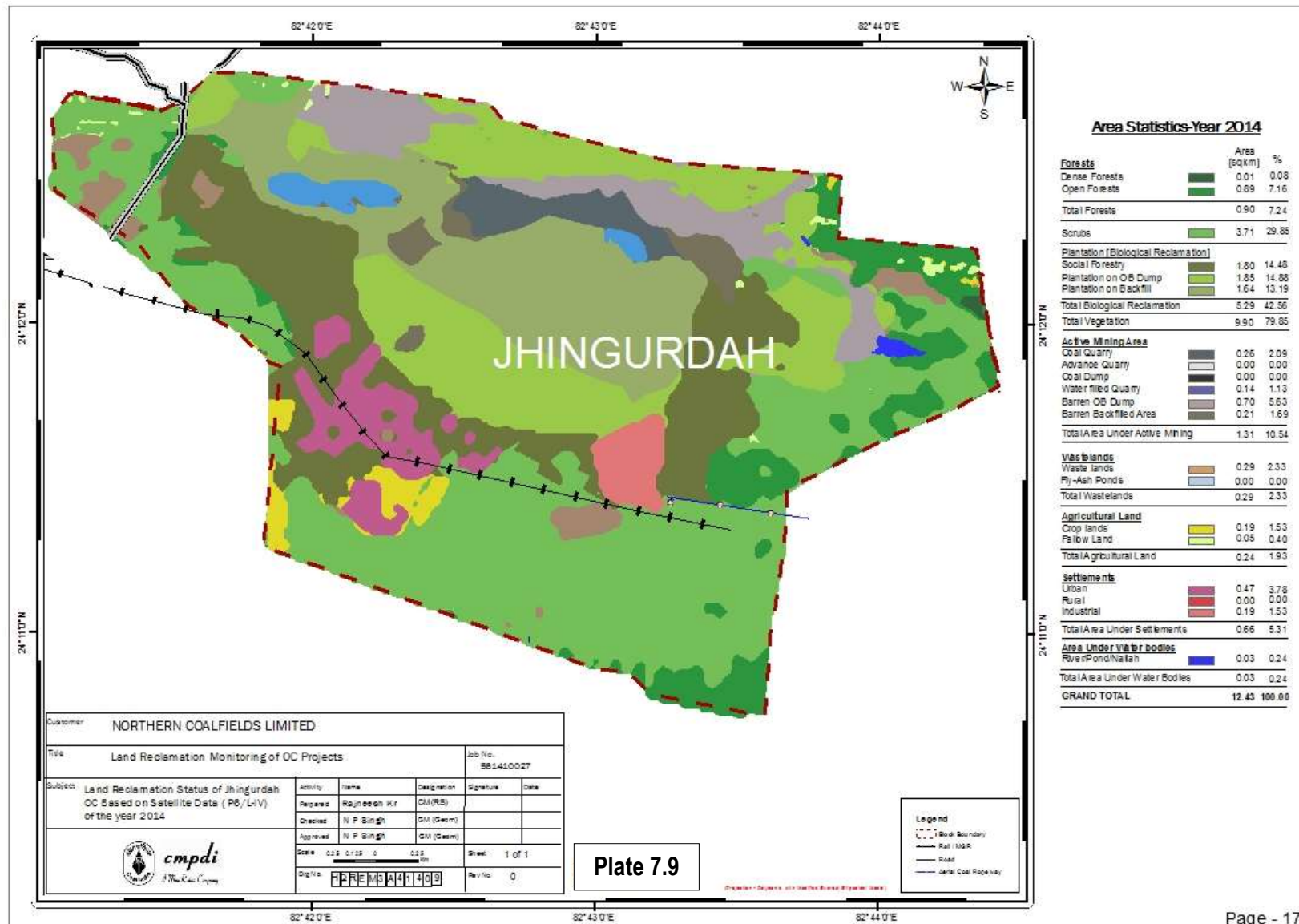
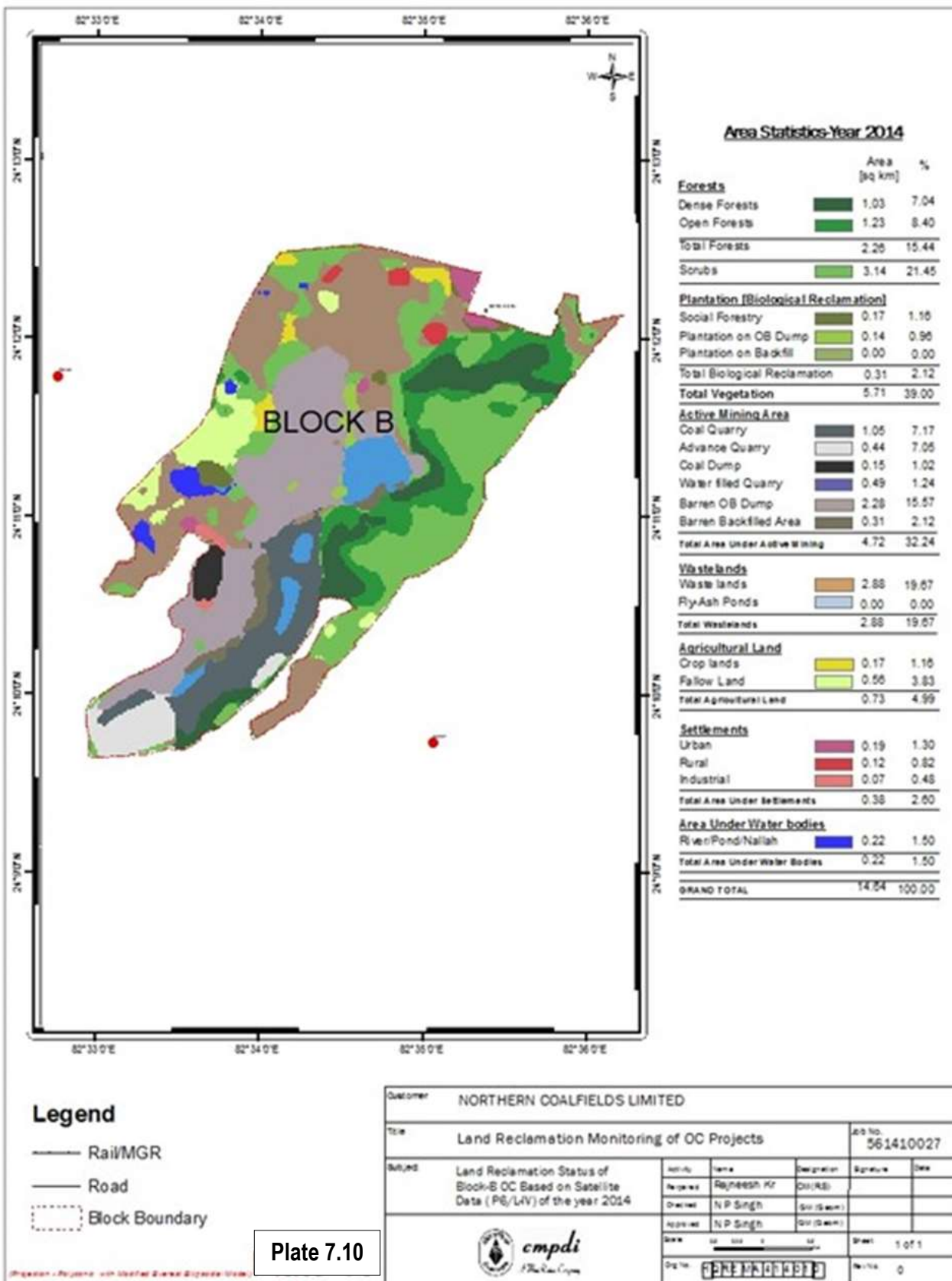


Plate 7.8





Legend

- Rail/MGR
- Road
- - - Block Boundary

Plate 7.10

Customer	NORTHERN COALFIELDS LIMITED				
Title	Land Reclamation Monitoring of OC Projects			Proj No.	561410027
Subject	Land Reclamation Status of Block-B OC Based on Satellite Data (PE/LV) of the year 2014				
APPROVED	APPROVED	NAME	DESIGNATION	SIGNATURE	DATE
		REVISOR	REVISOR		
		DRAWN	DRAWN		
		CHECKED	CHECKED		
		DATE	DATE		
		SCALE	SCALE		
		SHEET	SHEET	1 OF 1	
		DATE	DATE		
		NO. OF SHEETS	NO. OF SHEETS	0	

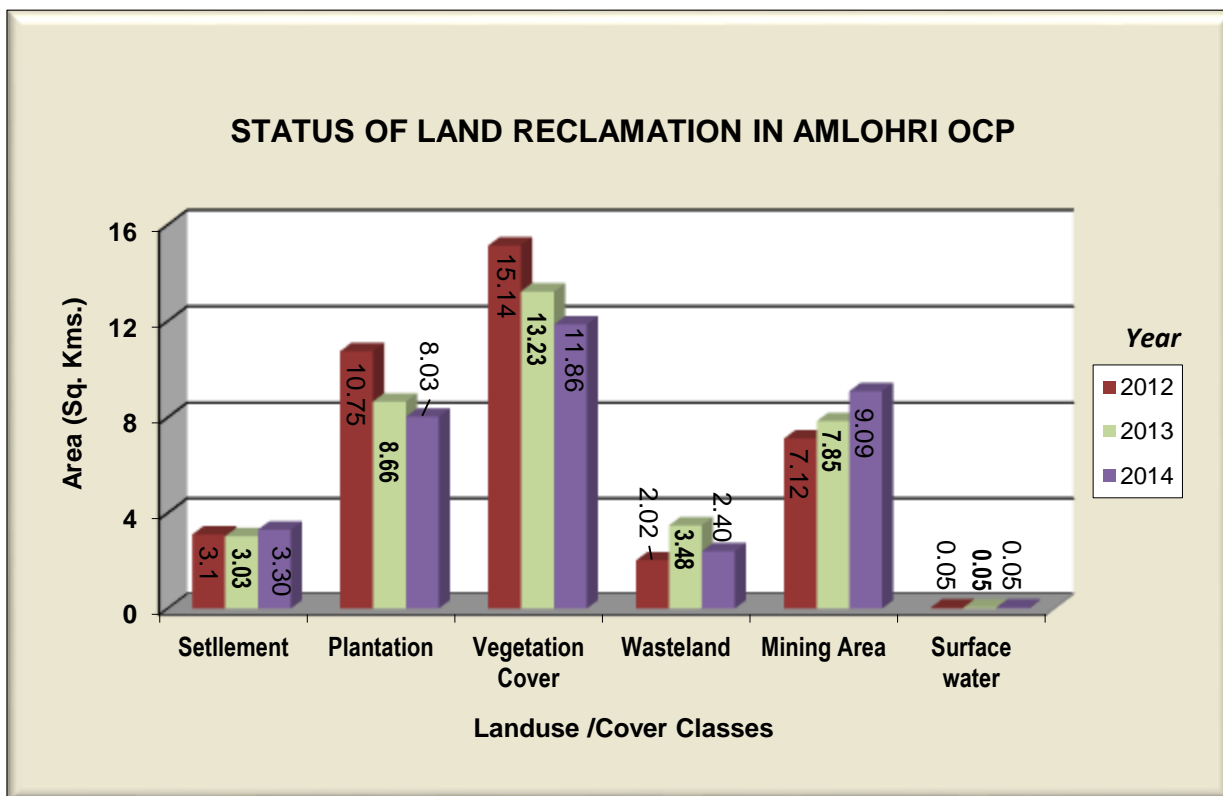


Figure 7.2

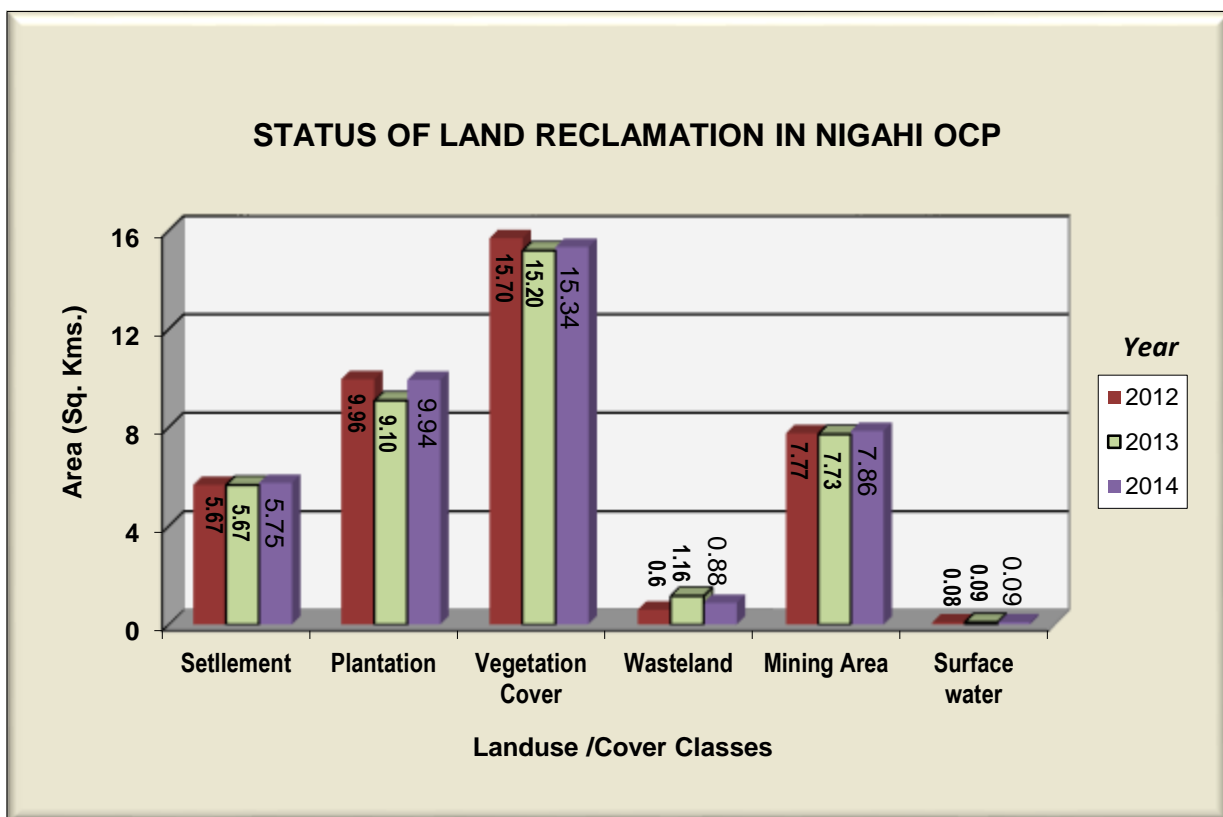


Figure 7.3

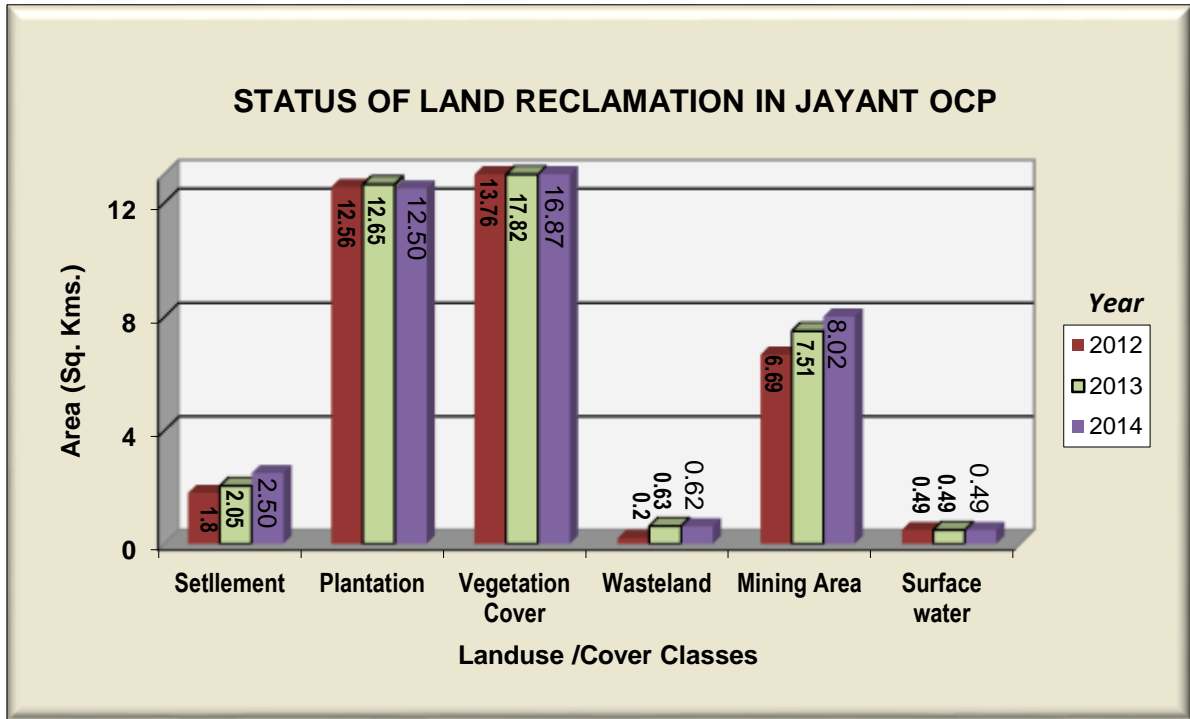


Figure 7.4

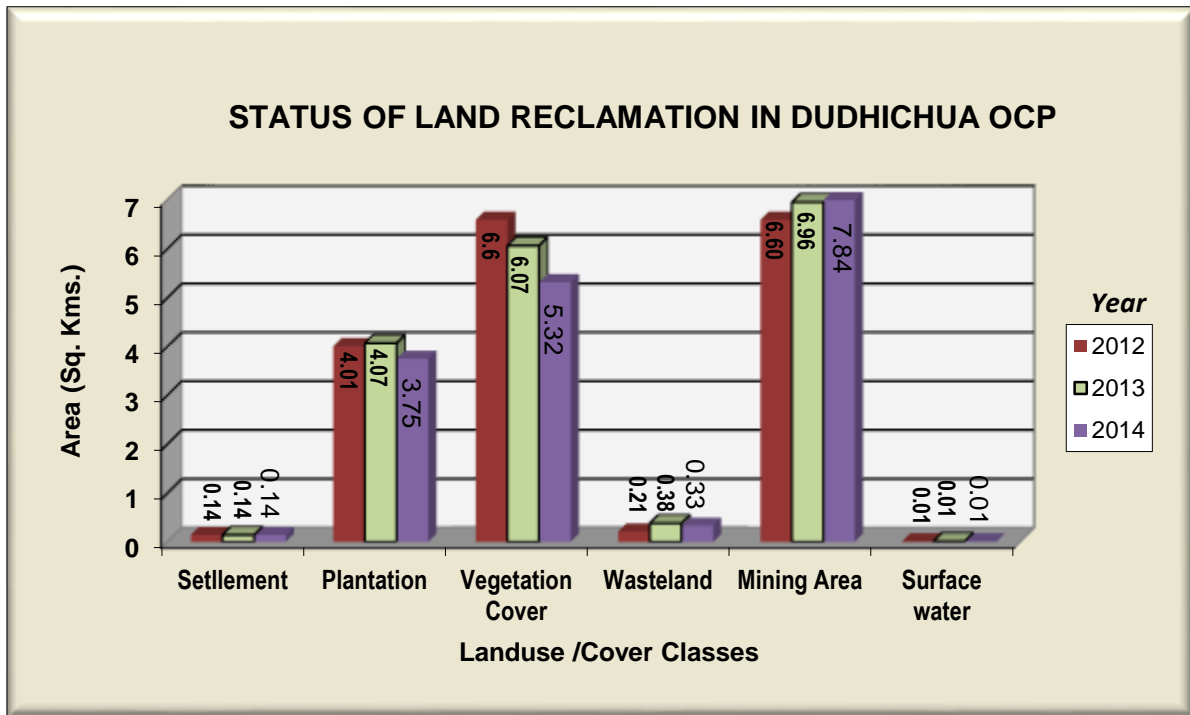


Figure 7.5

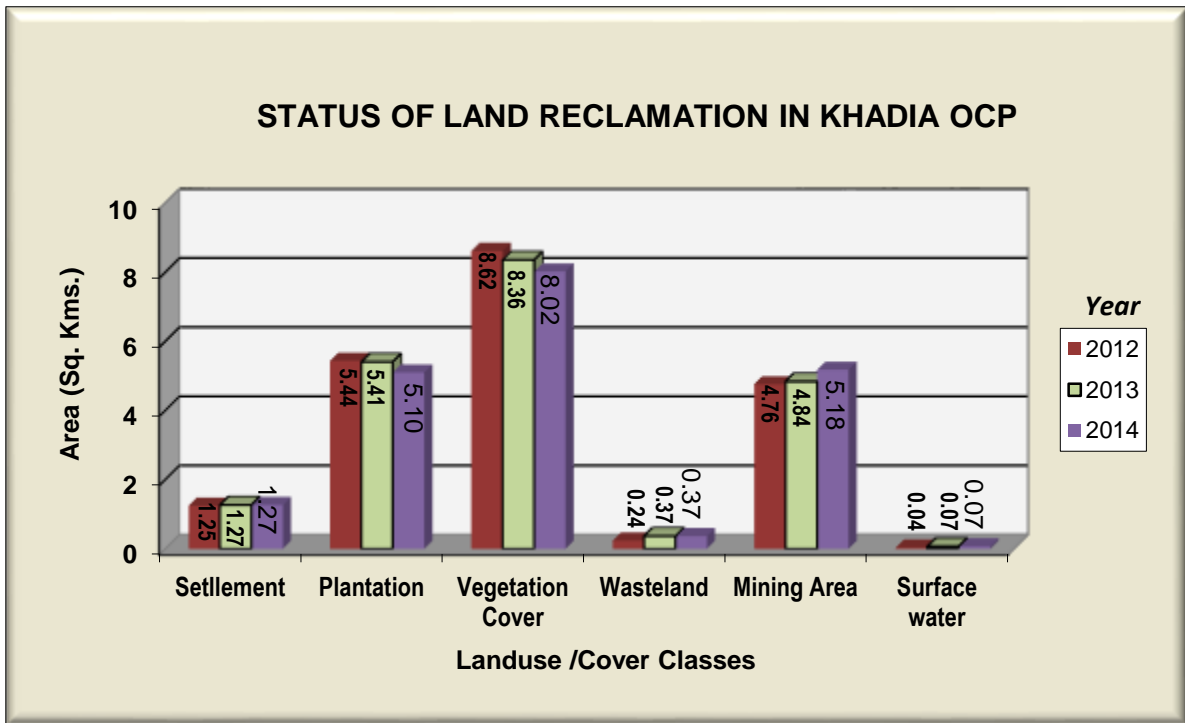


Figure 7.6

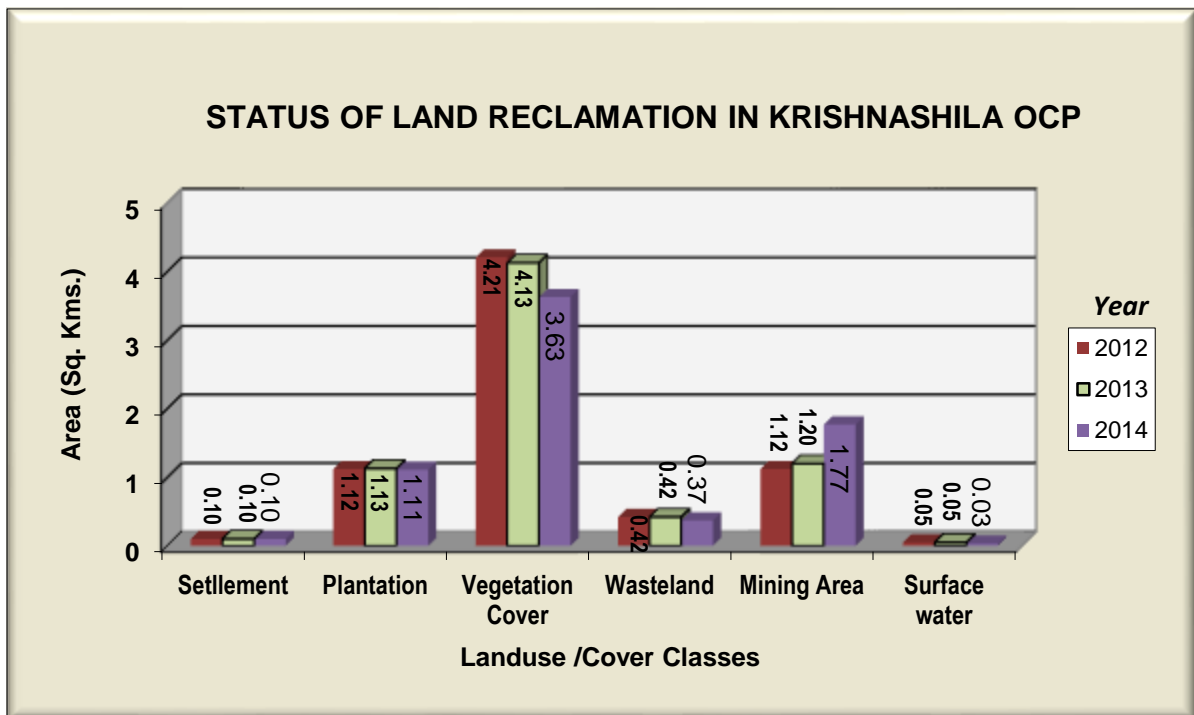


Figure 7.7

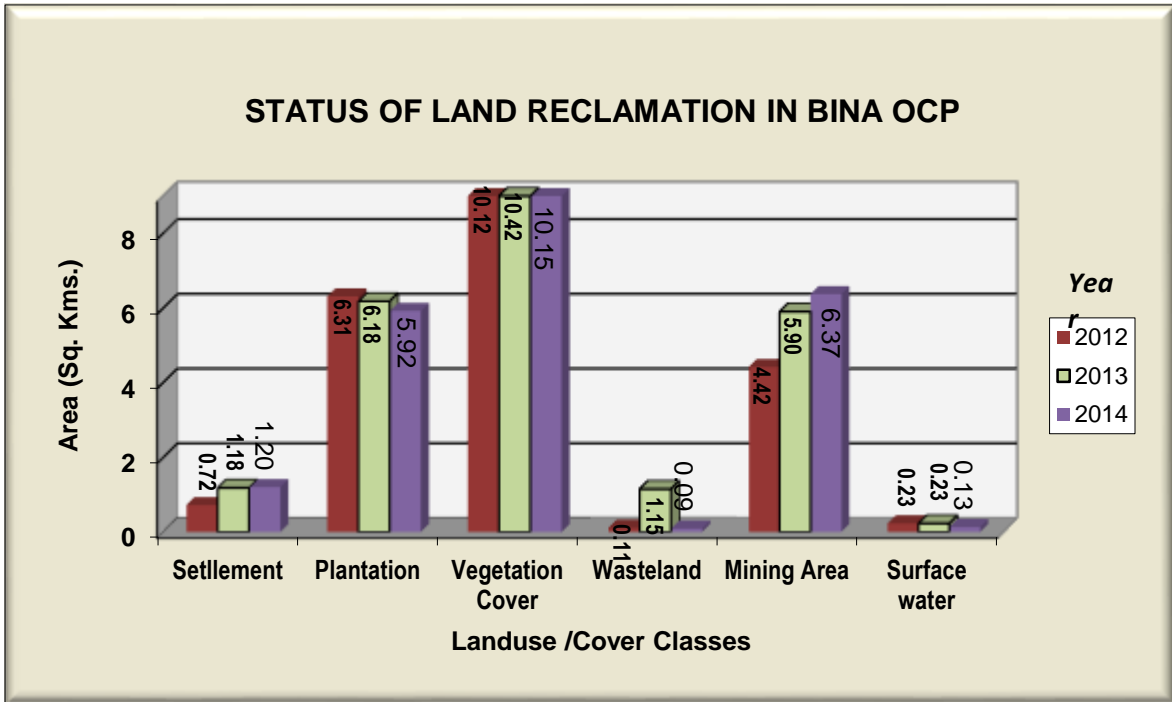


Figure 7.8

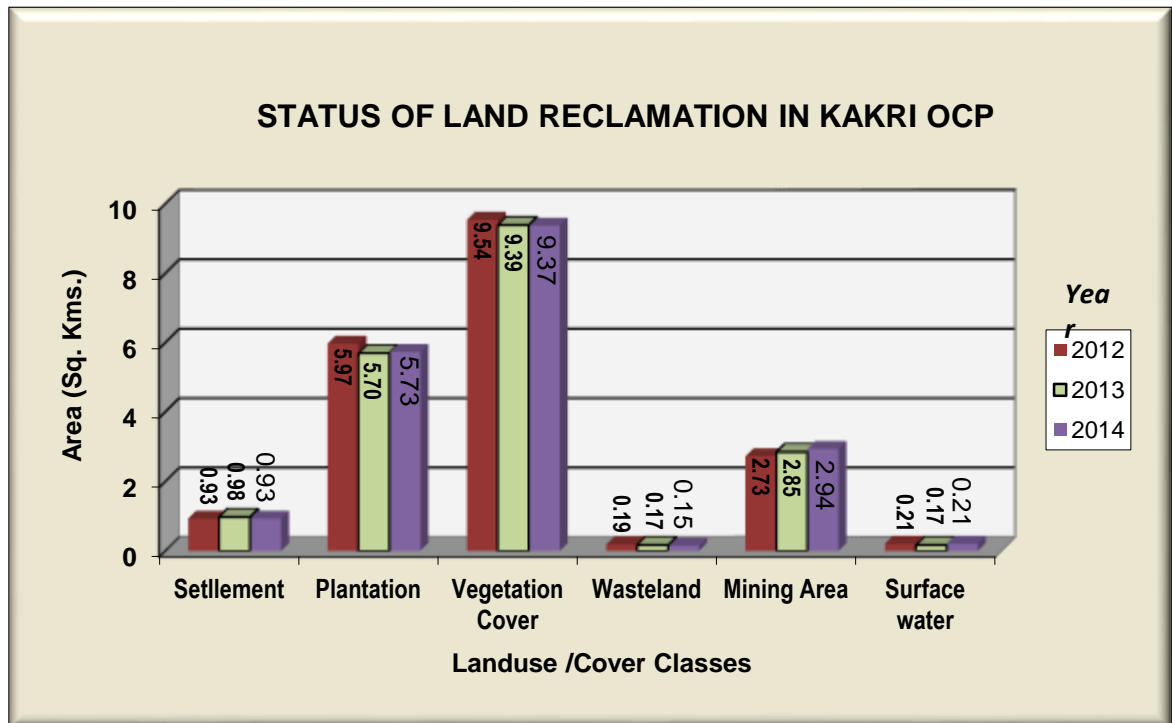


Figure 7.9

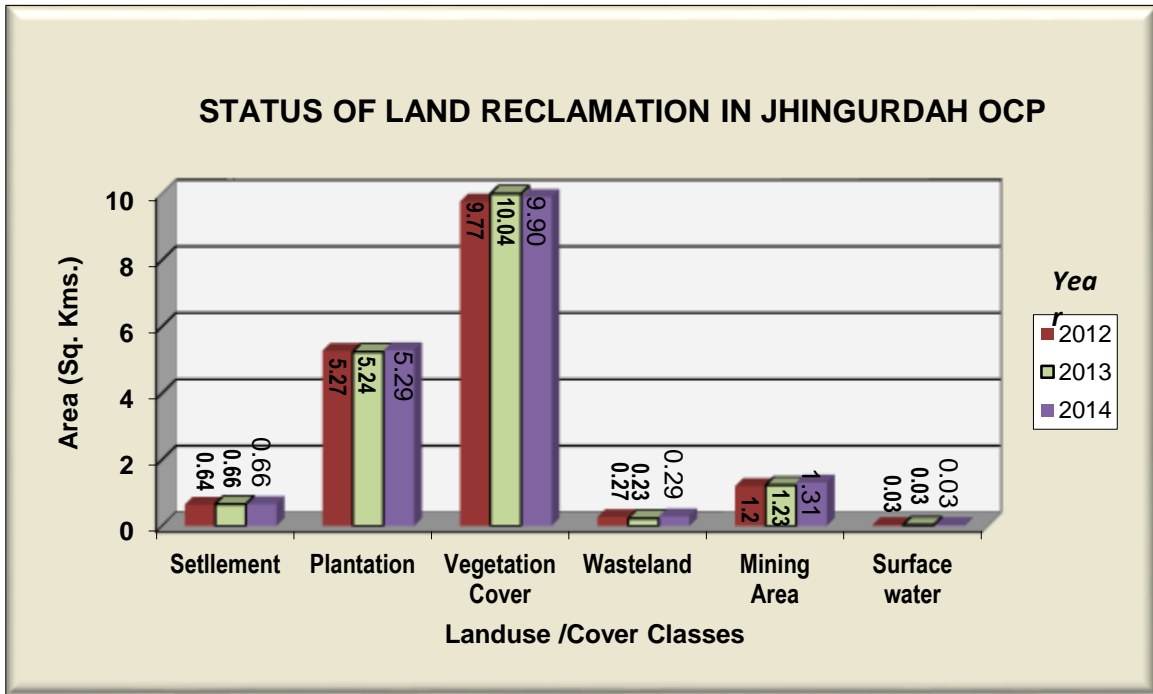


Figure 7.10

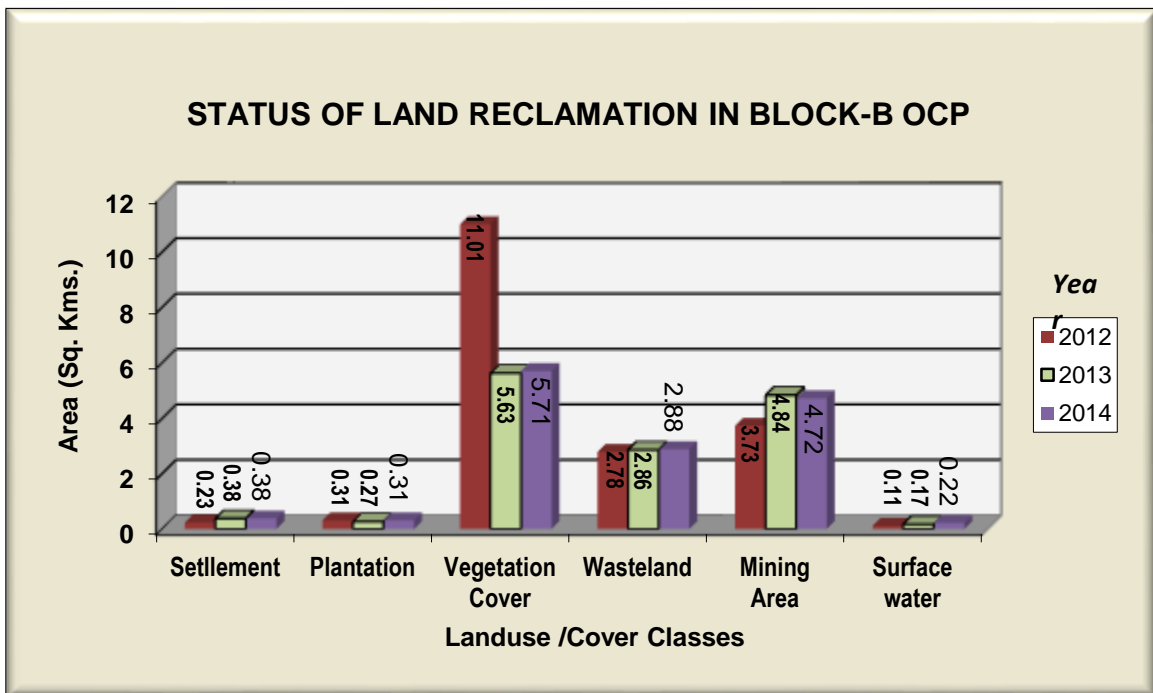


Figure 7.11



Photograph 7.1 :Plantation on OB Dump in Amlohri OCP



Photograph 7.2:Technical Reclamation in Nigahi OCP



Photograph 7.3 : View of fresh Dumps at Nigahi OCP



Photograph 7.4: Dense Plantation on the top of a Dump at Nigahi



Photograph 7.5 : View of Plantation at Jayant OCP



Photograph 7.6 : View of Reclamation & Plantation at Dudhichua OCP



Photograph 7.7 : Newly Planted samplings on Dump top at Krishnashila OCP



Photograph 7.8 :Plantation on OB Dump of Bina OCP



Photograph 7.9 : Plantation around OB Dump at Kakri OCP



Photograph 7.10 :Plantation around Block –B OCP Dumps

MAHANADI COALFIELDS LIMITED

8.0 Land Reclamation Status in Mahanadi Coalfields Limited

8.1 Following eleven opencast projects of MCL producing more than 5 million cubic meter and more (Coal + OB) were taken up for land reclamation monitoring during year 2014-15 :

- Ananta
- Balram
- Lingaraj
- Bharatpur
- Bhubaneswari
- Jagannath
- Hingula
- Belpahar
- Lakhanpur
- Samleswari
- Lajkura

8.2 Project wise Land Reclamation status in MCL for the year 2014 is given in Table 8.1 and also shown graphically in Fig 8.1. Area statistics of different land use class present in the mine leasehold of the above projects for the year 2014 are shown in the Table -8.2. Land use maps derived from satellite data are shown in Plate 8.1 – 8.11. Land reclamation status of the above mentioned 11 projects, were also prepared for the year 2009, 2010, 2011, 2012 and 2013. Year wise changes in the different land use classes based on satellite data are depicted in Bar Charts in Fig. 8.2–8.12.

8.3 Study reveals that out of total 46.55 Km² excavated / mined out area; 30.62 Km² area (65.78%) is under reclamation. Out of which 14.57 Km² (31.31%) area has been re-vegetated and 16.05 Km² (34.48%) area is under backfilling.

- 8.4** Analysis of satellite data indicates that area of plantation has increased from 14.50 Km² (2013) to 14.57 Km² (2014). This increase of 0.07 Km² plantation areas in one year indicates that MCL is committed for reclamation of mine land for maintaining the ecological balance in the region. It has been observed in some of the projects natural vegetation has also started growing on stabilized old backfilled areas and OB dumps due to high soil fertility.
- 8.5** On comparing the status of land reclamation for the year 2014 with respect to the year 2013 in different projects, it is evident from the analysis that area of land reclamation has increased from 28.84 Km² (Yr. 2013) to 30.62 Km² (Yr.2014).
- 8.6** Out of 11 projects of MCL, Bharatpur OCP ranks on top for land reclamation (78.38%) followed by Lajkura OCP (74.43%) and Balram OCP (74.01%).

Table – 8.1
Project wise Land Reclamation Status in
Opencast Projects of MCL based on Satellite Data of the year 2014

Sl. No.	Project		(% Calculated in terms of Total Excavated Area)						Area are in Km ²			
	Name	Leasehold i	Plantation/ Vegetation ii		Under Backfilling iii		Under Active Mining iv		Total Excavated Area ii+iii+iv		Area under Reclamation ii+iii	
			2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1	Ananta	4.56	1.04	1.05	1.30	1.62	1.38	1.09	3.72	3.76	2.34	2.67
			27.98	27.94	34.98	43.11	37.04	28.95			62.96	71.05
2	Balram	10.21	1.37	1.41	2.02	2.07	1.10	1.22	4.48	4.70	3.39	3.48
			30.44	30.06	45.13	43.95	24.44	25.99			75.56	74.01
3	Lingaraj	7.26	0.88	0.89	1.27	1.32	1.60	1.74	3.75	3.95	2.15	2.21
			23.43	22.53	33.98	33.45	42.59	44.02			57.41	55.98
4	Bharatpur	9.43	2.54	2.55	1.77	1.87	1.15	1.22	5.46	5.64	4.31	4.42
			46.60	45.18	32.38	33.20	21.01	21.62			78.99	78.38
5	Bhubaneswari	7.33	0.47	0.43	0.91	1.02	1.72	2.17	3.10	3.62	1.38	1.45
			15.18	11.89	29.39	28.25	55.43	59.87			44.57	40.13
6	Jagannath	4.99	2.16	2.17	0.85	0.89	1.17	1.12	4.18	4.18	3.01	3.06
			51.71	51.98	20.35	21.27	27.94	26.75			72.06	73.25
7	Hingula	4.83	0.57	0.57	0.94	0.98	1.54	1.64	3.06	3.19	1.51	1.55
			18.66	17.79	30.82	30.74	50.52	51.47			49.48	48.53
8	Belpahar	9.74	2.15	2.16	0.80	0.88	1.51	1.67	4.47	4.70	2.95	3.04
			48.17	45.81	17.94	18.73	33.89	35.46			66.11	64.54
9	Lakhanpur	16.20	1.49	1.50	1.91	2.52	2.20	1.99	5.60	6.01	3.41	4.02
			26.67	24.92	34.11	41.94	39.22	33.15			60.78	66.85
10	Samleswari	7.13	1.30	1.32	1.67	1.89	1.69	1.56	4.66	4.77	2.97	3.22
			27.83	27.70	35.95	39.69	36.22	32.61			63.78	67.39
11	Lajkura	4.68	0.53	0.53	0.88	0.98	0.55	0.52	1.96	2.03	1.41	1.51
			26.99	26.07	45.12	48.36	27.88	25.57			72.12	74.43
TOTAL (MCL)		86.36	14.50	14.57	14.34	16.05	15.59	15.93	44.43	46.55	28.84	30.62
			32.64	31.31	32.27	34.48	35.09	34.22	51.45	53.91	64.91	65.78

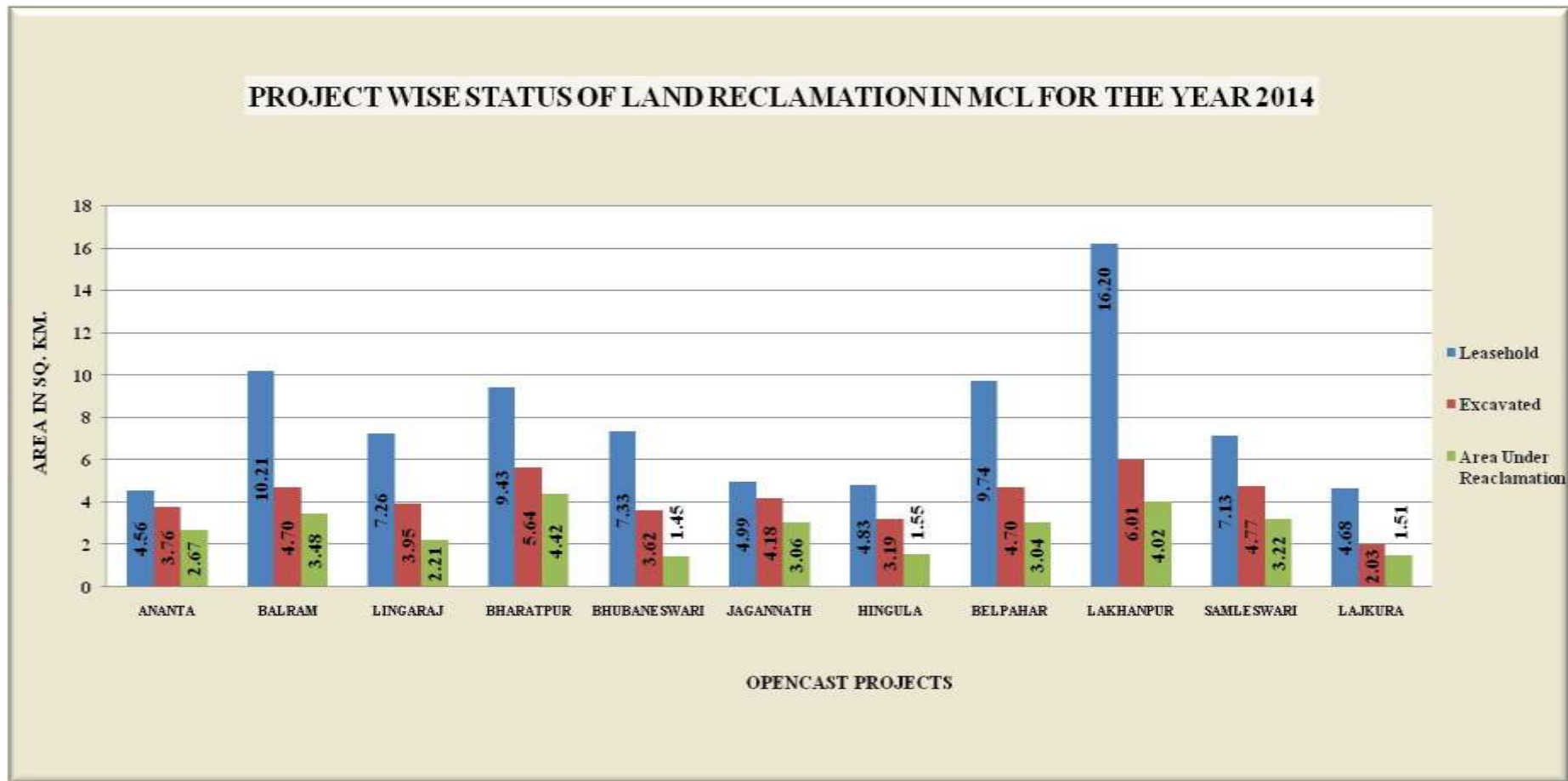


Fig.8.1: Land reclamation status in OC projects of MCL in the year 2013

Table 8.2: STATUS OF LAND RESTORATION / RECLAMATION IN MAHANADI COALFIELD LIMITED BASED ON SATELLITE DATA OF THE YEAR 2014

(Area in Sq. Kms.)

		ANANTA		BALRAM		LINGARAJ		BHARATPUR		BHUBANESHWARI		JAGANNATH		HINGULA		BELPAHAR		LAKHANPUR		SAMLESWARI		LAJKURA		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.65	10.18	0.07	1.05	1.19	25.39	2.95	3.41
	Open Forest	0.01	0.26	0.13	1.25	0.21	2.89	0.73	7.70	0.86	11.76	0.01	0.21	0.00	0.00	0.01	0.10	2.79	17.22	0.11	1.58	0.61	13.01	5.47	6.33
	Total Forest (A)	0.01	0.26	0.13	1.25	0.21	2.89	0.76	8.08	0.86	11.76	0.01	0.21	0.00	0.00	0.01	0.10	4.44	27.40	0.19	2.63	1.80	38.40	8.42	9.74
SCRUBS	Scrub (B)	0.21	4.53	2.00	19.63	1.14	15.68	1.10	11.67	0.71	9.68	0.23	4.61	0.25	5.15	2.33	23.90	2.20	13.58	0.64	8.93	0.35	7.53	11.16	12.92
PLANTATION	Social Forestry	0.10	2.20	0.21	2.09	0.43	5.86	0.36	3.82	0.42	5.73	0.14	2.86	0.25	5.17	0.40	4.11	0.43	2.64	0.18	2.47	0.07	1.57	2.99	3.46
	Plantation on OB Dump	0.11	2.41	0.27	2.63	0.33	4.53	0.43	4.53	0.00	0.00	0.00	0.00	0.23	4.72	0.70	7.19	0.30	1.85	0.48	6.74	0.28	5.91	3.12	3.61
	Plantation on Backfill	0.84	18.44	0.93	9.13	0.14	1.87	1.76	18.67	0.01	0.14	2.03	40.68	0.09	1.86	1.06	10.83	0.77	4.75	0.67	9.34	0.18	3.85	8.47	9.81
	Total Plantation (Biological Reclamation C)	1.05	23.05	1.41	13.85	0.89	12.25	2.55	27.02	0.43	5.86	2.17	43.54	0.57	11.76	2.16	22.12	1.50	9.24	1.32	18.55	0.53	11.33	14.57	16.88
	Total Vegetation (A+B+C)	1.27	27.84	3.55	34.72	2.24	30.83	4.41	46.78	2.00	27.30	2.41	48.36	0.82	16.91	4.49	46.12	8.14	50.22	2.15	30.11	2.68	57.26	34.15	39.54
ACTIVE MINING	Coal Quarry	0.67	14.69	0.52	5.09	1.18	16.19	0.38	3.99	1.51	20.59	0.25	5.01	0.55	11.37	1.24	12.73	1.45	8.95	1.26	17.71	0.42	8.98	9.42	10.92
	Coal Dump	0.13	2.86	0.19	1.89	0.22	3.00	0.17	1.82	0.29	3.96	0.22	4.46	0.35	7.14	0.09	0.94	0.20	1.26	0.07	0.95	0.06	1.18	1.99	2.30
	Advance Quarry Site	0.11	2.35	0.09	0.88	0.20	2.75	0.11	1.13	0.29	3.97	0.02	0.31	0.06	1.20	0.17	1.79	0.24	1.50	0.13	1.84	0.04	0.77	1.45	1.68
	Quarry Filled with Water	0.18	4.00	0.42	4.10	0.15	2.01	0.56	5.99	0.07	1.01	0.63	12.63	0.69	14.30	0.16	1.67	0.09	0.58	0.10	1.34	0.01	0.19	3.07	3.55
	Total Area under Active Mining	1.09	23.90	1.22	11.96	1.74	23.95	1.22	12.93	2.17	29.53	1.12	22.41	1.64	34.01	1.67	17.13	1.99	12.29	1.56	21.84	0.52	11.12	15.93	18.45
RECLAIMED	Barren OB dump	0.00	0.00	0.09	0.91	0.32	4.34	0.06	0.60	0.72	9.79	0.00	0.00	0.02	0.46	0.02	0.22	0.01	0.07	0.07	0.95	0.04	0.93	1.35	1.56
	Area Under Backfilling	1.62	35.56	1.97	19.32	1.01	13.85	1.81	19.25	0.30	4.14	0.89	17.82	0.96	19.85	0.86	8.83	2.51	15.48	1.83	25.64	0.94	20.09	14.70	17.02
	Total Area under Technical Reclamation	1.62	35.56	2.07	20.23	1.32	18.19	1.87	19.85	1.02	13.93	0.89	17.82	0.98	20.31	0.88	9.05	2.52	15.55	1.89	26.59	0.98	21.02	16.05	18.58
	Total Area under Mine Operation	2.71	59.44	3.29	32.19	3.06	42.14	3.09	32.79	3.19	43.45	2.01	40.23	2.63	54.32	2.55	26.17	4.51	27.84	3.45	48.43	1.50	32.13	31.98	37.03
WASTELANDS	Waste Lands	0.30	6.56	0.87	8.48	0.75	10.34	1.12	11.87	0.43	5.81	0.34	6.81	0.70	14.56	1.58	16.22	0.70	4.33	0.88	12.37	0.40	8.55	8.07	9.34
	Fly Ash Pond/Sand Body	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	
	Total Wastelands	0.30	6.56	0.87	8.48	0.75	10.34	1.12	11.87	0.43	5.81	0.34	6.81	0.73	15.13	1.58	16.22	0.70	4.33	0.88	12.37	0.40	8.55	8.09	9.37
WATER	Reservoir, nallah, ponds etc.	0.03	0.58	0.20	1.97	0.08	1.13	0.04	0.43	0.06	0.77	0.01	0.10	0.12	2.40	0.26	2.64	0.17	1.06	0.06	0.91	0.01	0.17	1.03	1.19
	Total Waterbodies	0.03	0.58	0.20	1.97	0.08	1.13	0.04	0.43	0.06	0.77	0.01	0.10	0.12	2.40	0.26	2.64	0.17	1.06	0.06	0.91	0.01	0.17	1.03	1.19
AGRICULTURE	Crop Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fallow Lands	0.15	3.39	1.75	17.18	0.87	11.93	0.47	4.97	1.48	20.18	0.03	0.62	0.47	9.72	0.50	5.15	2.51	15.51	0.38	5.29	0.04	0.91	8.66	10.03
	Total Agriculture	0.15	3.39	1.75	17.18	0.87	11.93	0.47	4.97	1.48	20.18	0.03	0.62	0.47	9.72	0.50	5.15	2.51	15.51	0.38	5.29	0.04	0.91	8.66	10.03
SETTLEMENTS	Urban Settlement	0.00	0.00	0.02	0.17	0.02	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.13	0.01	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.06
	Rural Settlement	0.005	0.10	0.11	1.08	0.10	1.38	0.12	1.22	0.15	2.05	0.00	0.00	0.05	0.93	0.11	1.13	0.09	0.59	0.03	0.39	0.00	0.00	0.76	0.88
	Industrial Settlement	0.09	2.08	0.43	4.21	0.15	2.01	0.18	1.95	0.03	0.43	0.19	3.88	0.02	0.46	0.24	2.44	0.07	0.46	0.18	2.48	0.05	0.99	1.64	1.90
	Total Settlements	0.10	2.19	0.56	5.47	0.26	3.64	0.30	3.17	0.18	2.48	0.19	3.88	0.07	1.52	0.36	3.70	0.17	1.05	0.21	2.88	0.05	0.99	2.45	2.84
	GRAND TOTAL	4.56	100.00	10.21	100.00	7.26	100.00	9.43	100.00	7.33	100.00	4.99	100.00	4.83	100.00	9.74	100.00	16.20	100.00	7.13	100.00	4.68	100.00	86.36	100.00



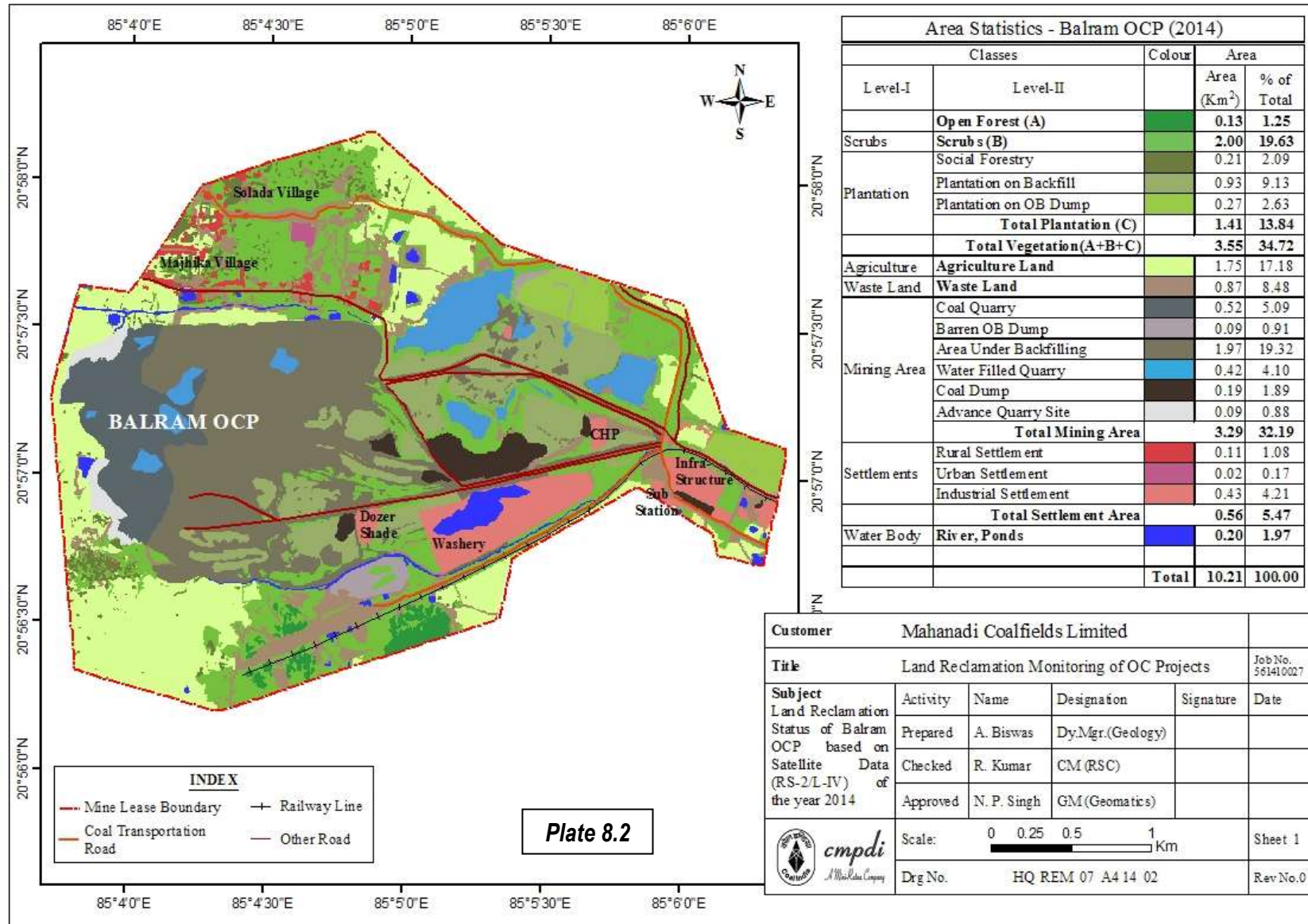
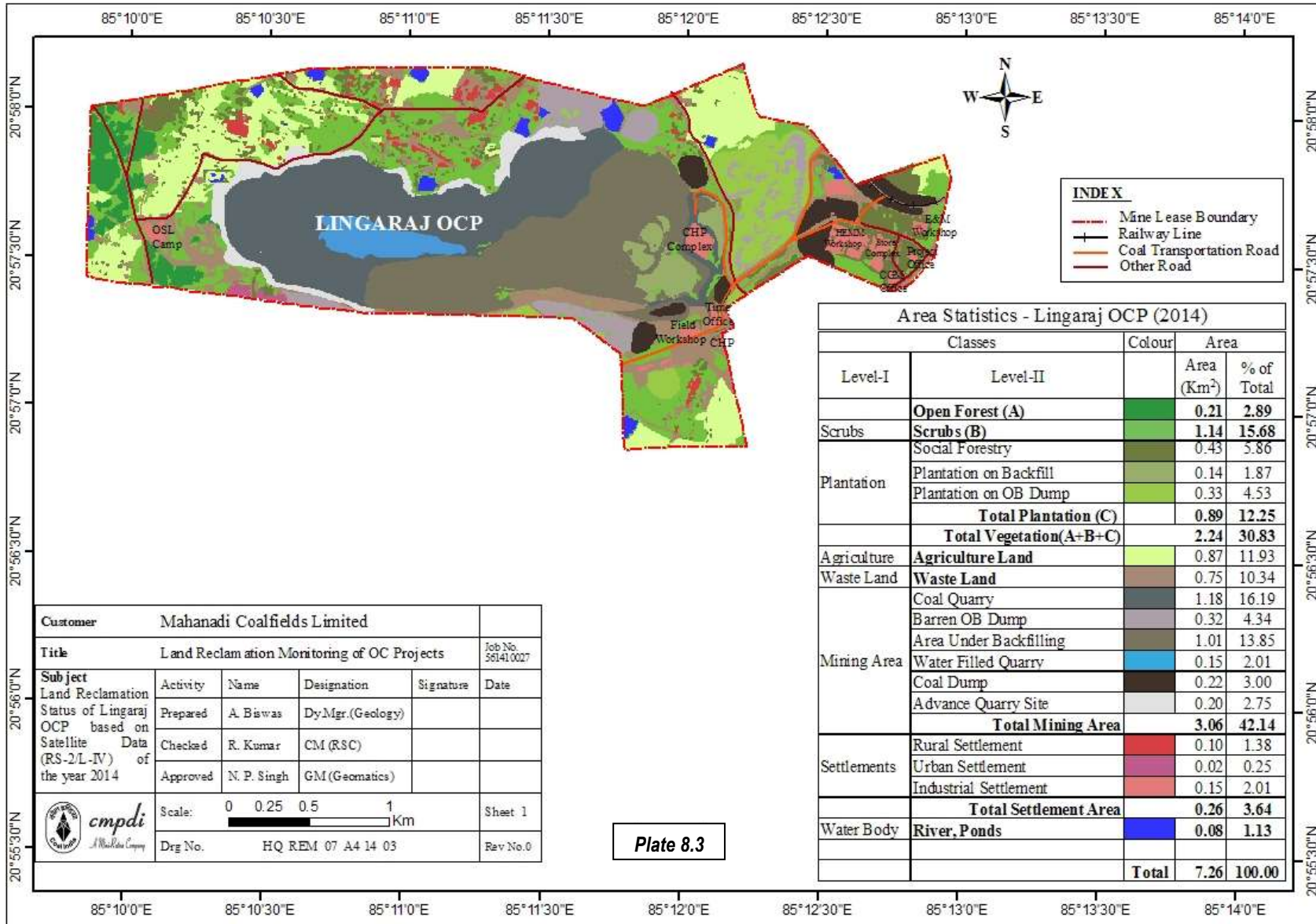
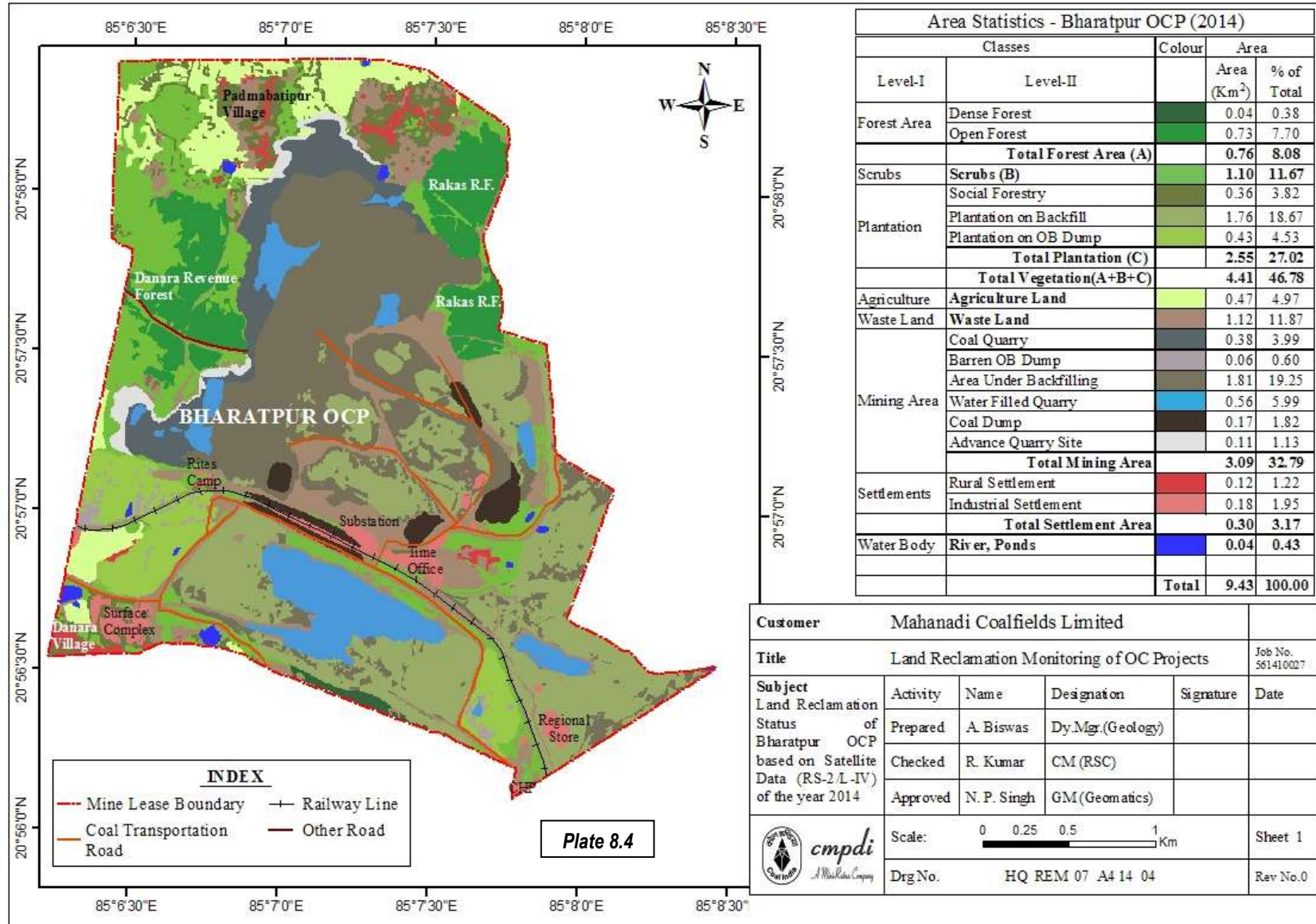


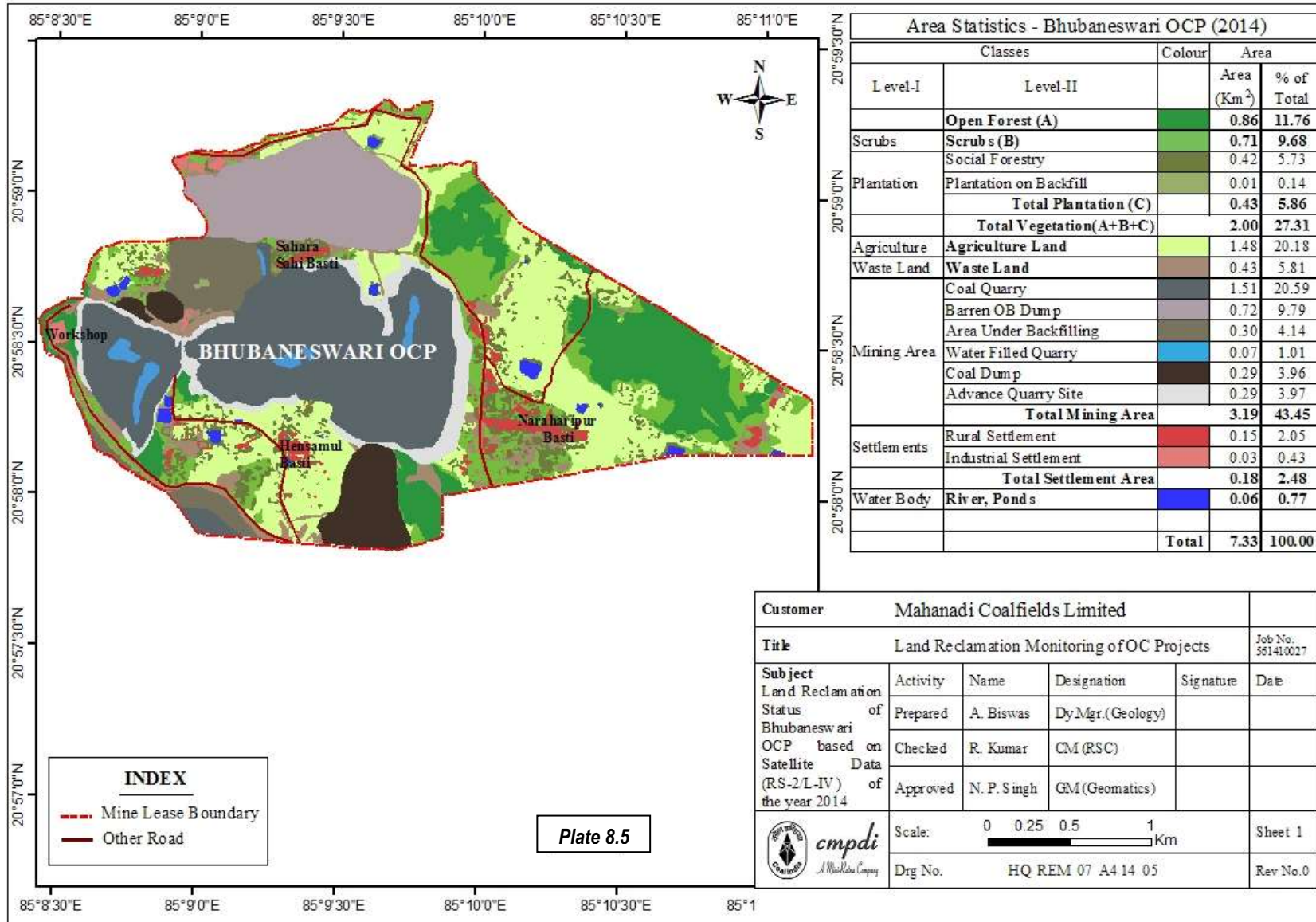
Plate 8.2



Customer Mahanadi Coalfields Limited					
Title Land Reclamation Monitoring of OC Projects					Job No. 561410027
Subject Land Reclamation Status of Lingaraj OCP based on Satellite Data (RS-2/L-IV) of the year 2014	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Dy.Mgr.(Geology)		
	Checked	R. Kumar	CM (RSC)		
	Approved	N. P. Singh	GM (Geomatics)		
Scale: 0 0.25 0.5 1 Km					Sheet 1
Drg No. HQ REM 07 A4 14 03					Rev No.0

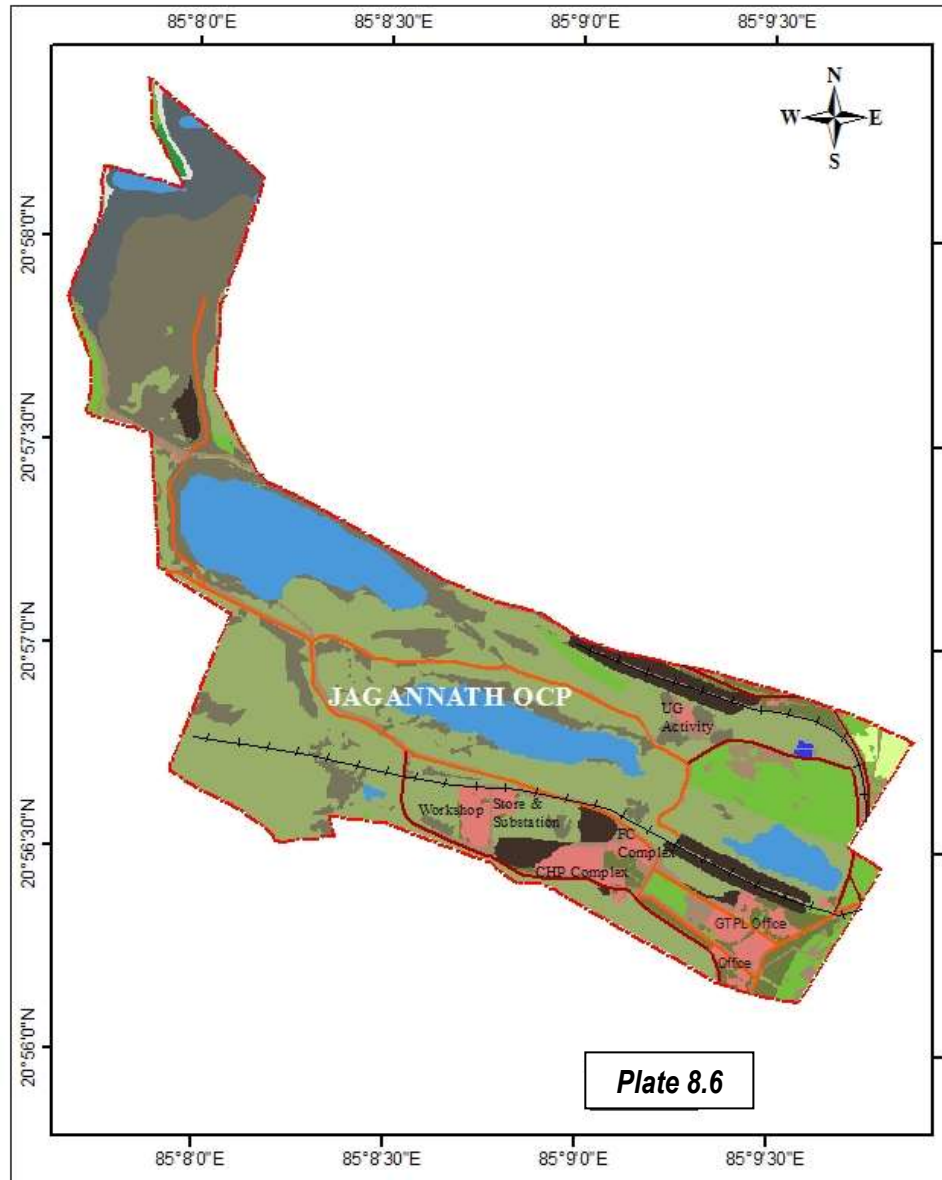
Plate 8.3





Classes		Colour	Area	
Level-I	Level-II		Area (Km ²)	% of Total
	Open Forest (A)		0.86	11.76
Scrubs	Scrubs (B)		0.71	9.68
	Social Forestry		0.42	5.73
Plantation	Plantation on Backfill		0.01	0.14
	Total Plantation (C)		0.43	5.86
	Total Vegetation(A+B+C)		2.00	27.31
Agriculture	Agriculture Land		1.48	20.18
Waste Land	Waste Land		0.43	5.81
	Coal Quarry		1.51	20.59
	Barren OB Dump		0.72	9.79
	Area Under Backfilling		0.30	4.14
Mining Area	Water Filled Quarry		0.07	1.01
	Coal Dump		0.29	3.96
	Advance Quarry Site		0.29	3.97
	Total Mining Area		3.19	43.45
Settlements	Rural Settlement		0.15	2.05
	Industrial Settlement		0.03	0.43
	Total Settlement Area		0.18	2.48
Water Body	River, Ponds		0.06	0.77
	Total		7.33	100.00

Customer		Mahanadi Coalfields Limited			
Title		Land Reclamation Monitoring of OC Projects			Job No. 561410027
Subject Land Reclamation Status of Bhubaneswari OCP based on Satellite Data (RS-2/L-IV) of the year 2014	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Dy Mgr.(Geology)		
	Checked	R. Kumar	CM (RSC)		
Approved	N. P. Singh	GM(Geomatics)			
Scale:		0 0.25 0.5 1 Km			Sheet 1
Drg No.		HQ REM 07 A4 14 05			Rev No.0



Area Statistics - Jagannath OCP (2014)				
Classes		Colour	Area	
Level-I	Level-II		Area (Km ²)	% of Total
	Open Forest (A)		0.01	0.21
Scrubs	Scrubs (B)		0.23	4.61
	Social Forestry		0.14	2.86
Plantation	Plantation on Backfill		2.03	40.68
	Total Plantation (C)		2.17	43.54
	Total Vegetation(A+B+C)		2.41	48.36
Agriculture	Agriculture Land		0.03	0.62
Waste Land	Waste Land		0.34	6.81
Mining Area	Coal Quarry		0.25	5.01
	Area Under Backfilling		0.89	17.82
	Water Filled Quarry		0.63	12.63
	Coal Dump		0.22	4.46
	Advance Quarry Site		0.02	0.31
	Total Mining Area		2.01	40.23
Settlement	Industrial		0.19	3.88
Water Body	River, Ponds		0.01	0.10
	Total		4.99	100.00

INDEX	
	Mine Lease Boundary
	Railway Line
	Coal Transportation Road
	Other Road

Customer		Mahanadi Coalfields Limited			
Title		Land Reclamation Monitoring of OC Projects			Job No. 561410027
Subject Land Reclamation Status of Jagannath OCP based on Satellite Data (RS-2/L-IV) of the year 2014	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Dy.Mgr.(Geology)		
	Checked	R. Kumar	CM(RSC)		
Approved	N. P. Singh	GM(Geomatics)			
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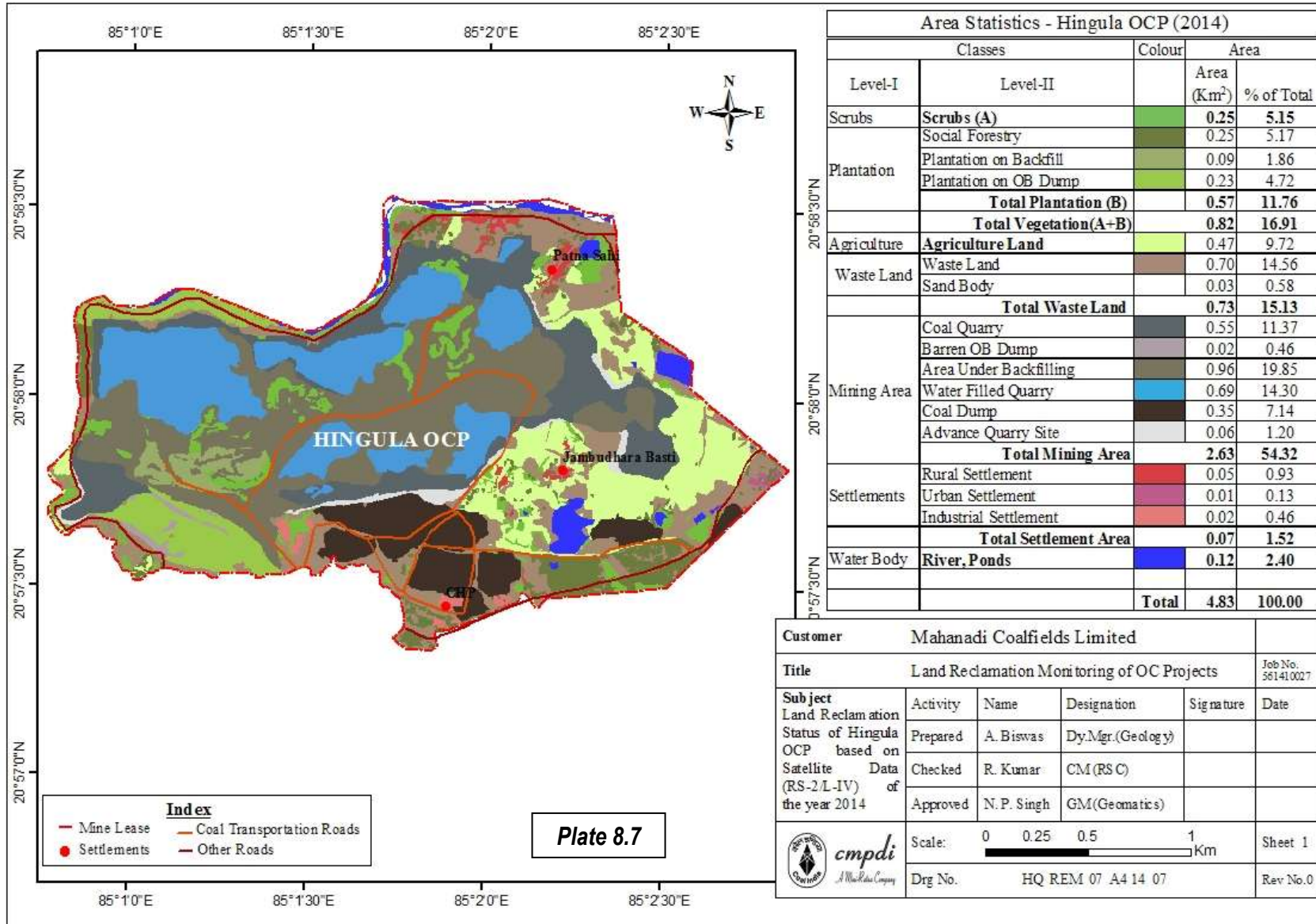
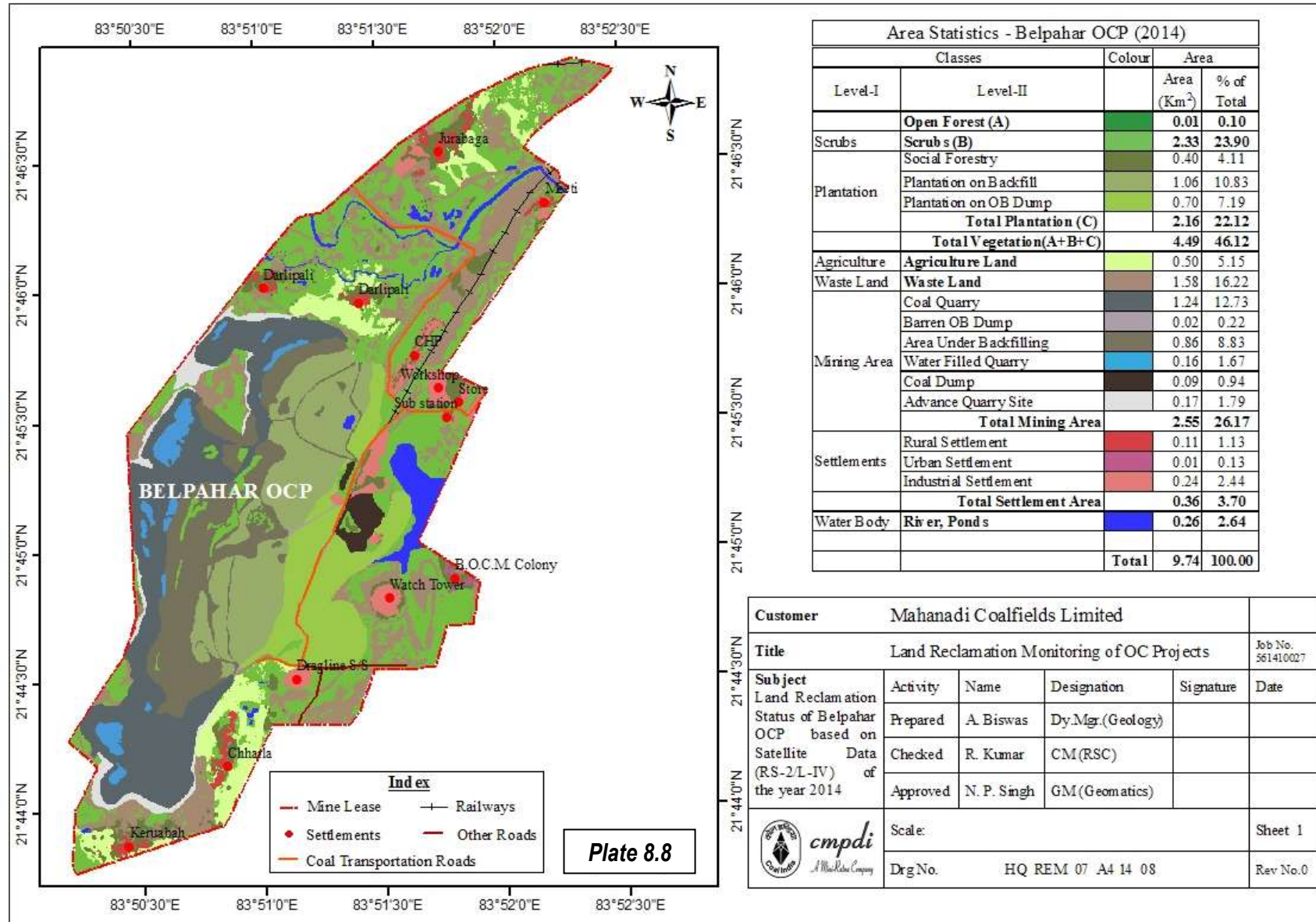


Plate 8.7



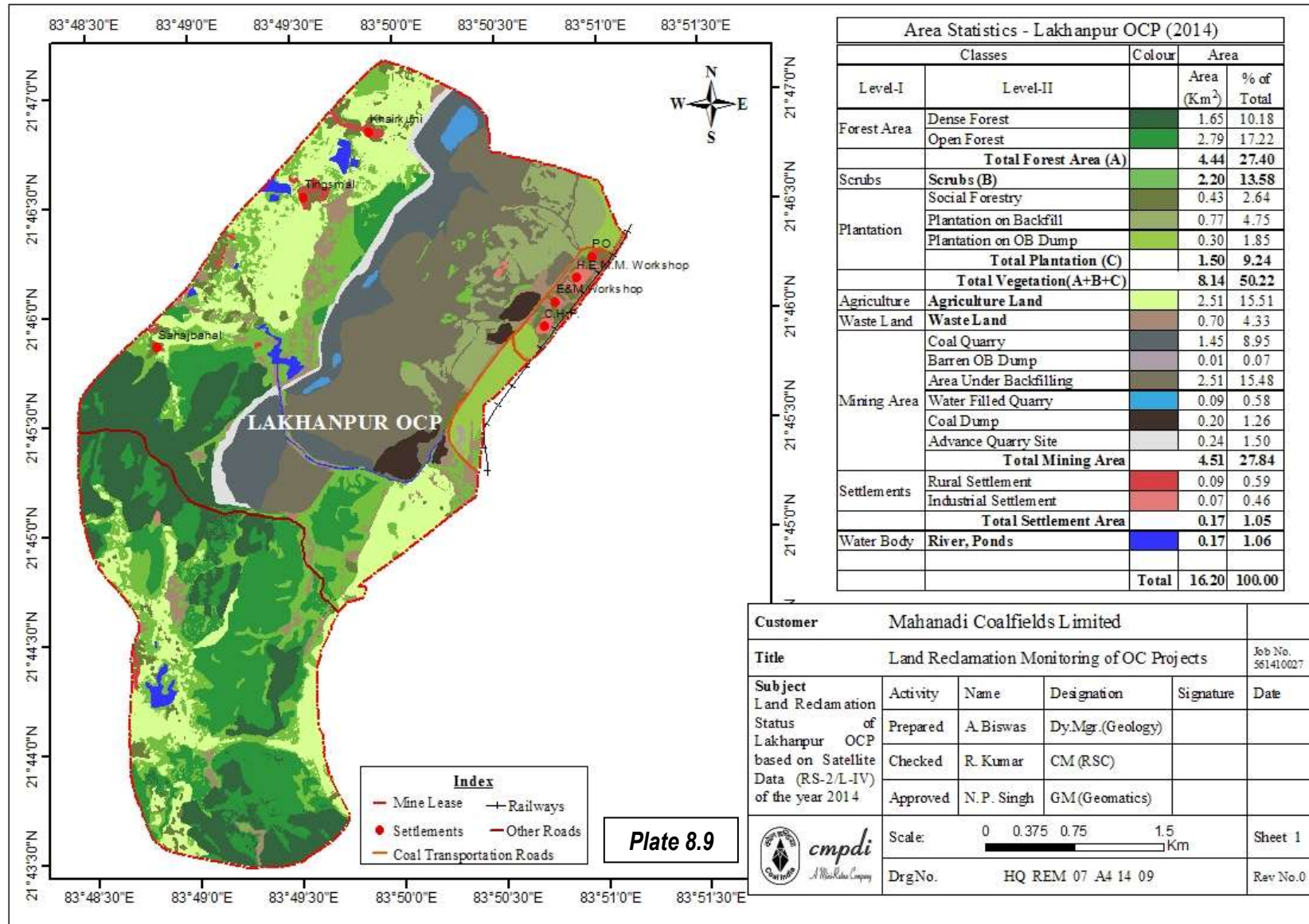


Plate 8.9

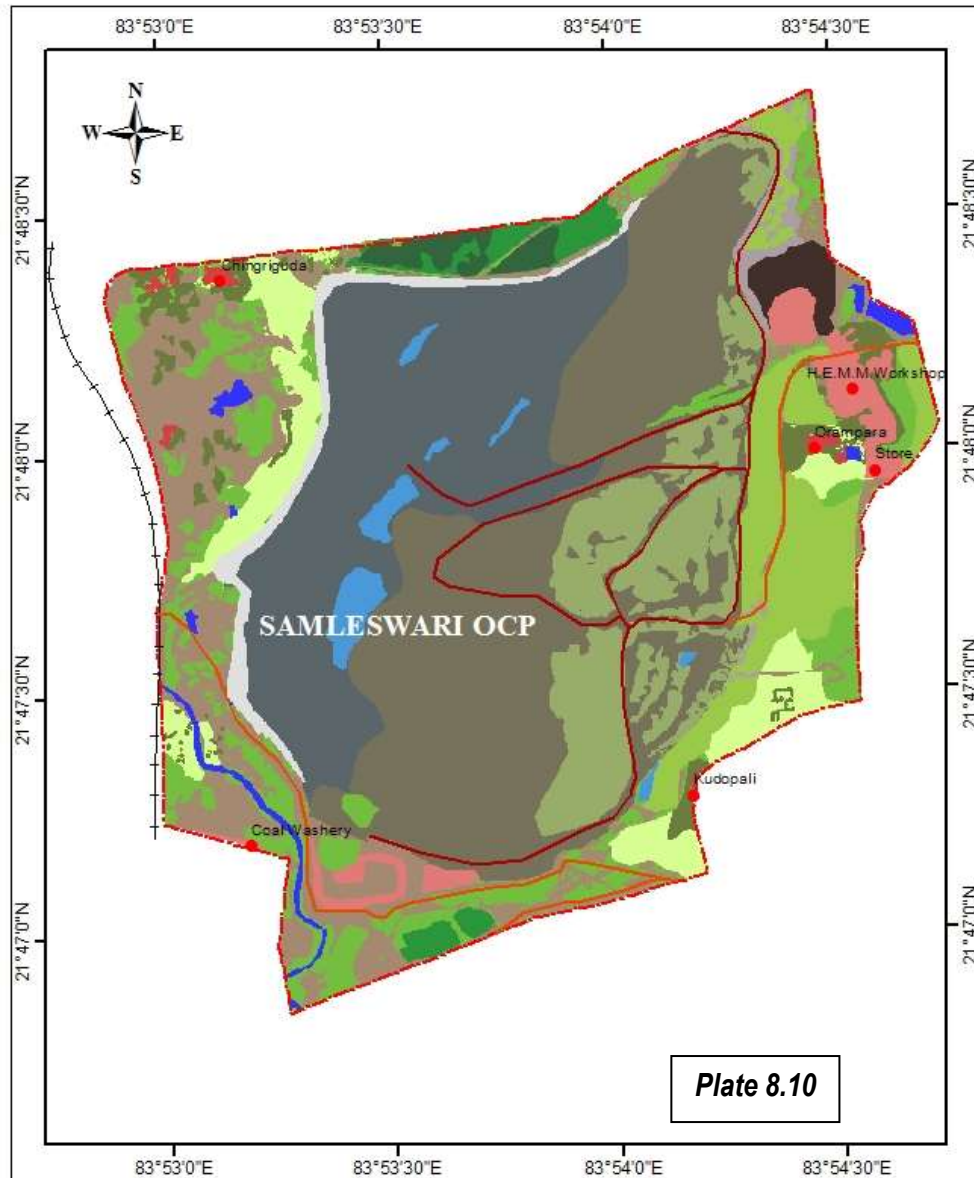


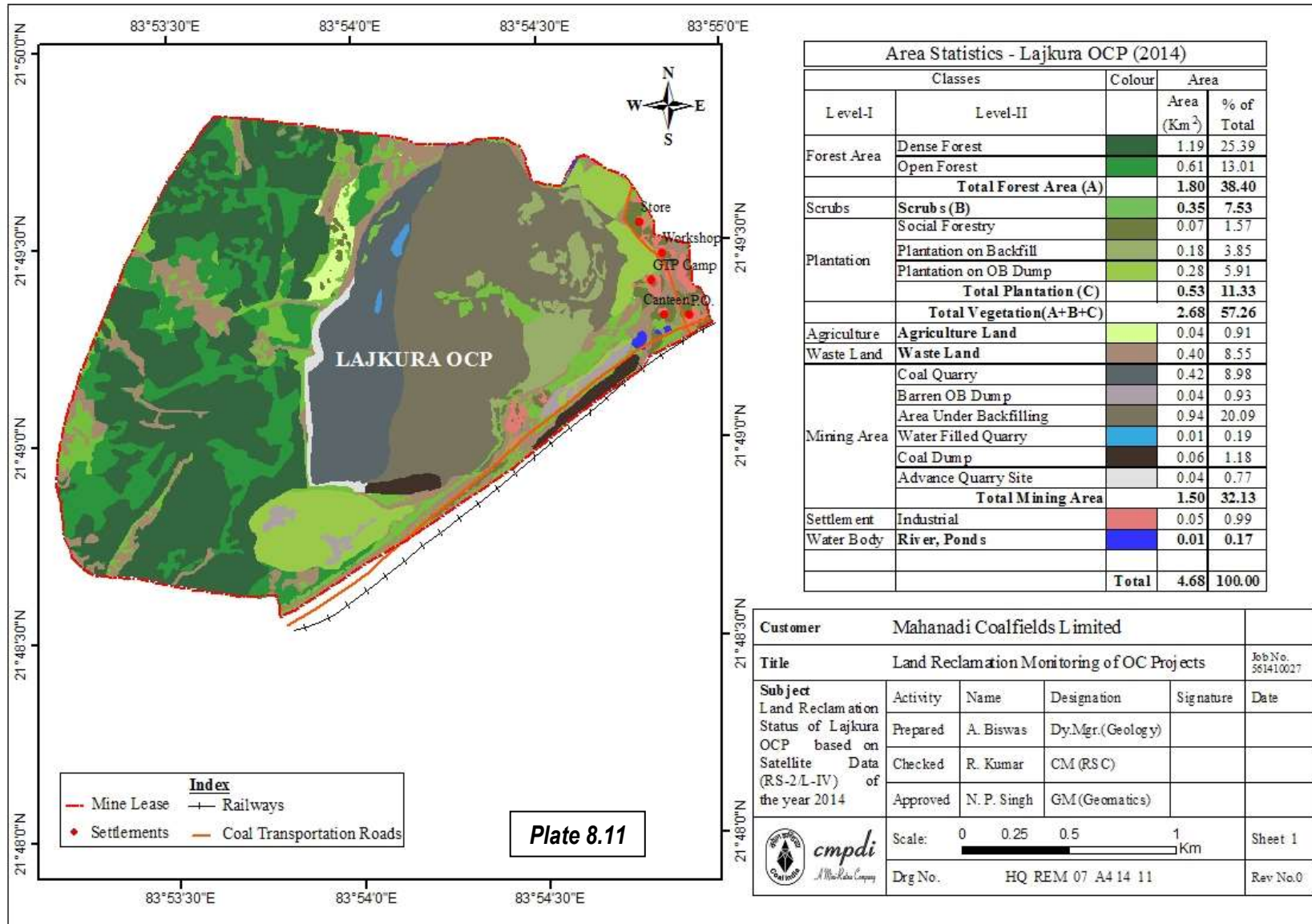
Plate 8.10

Classes		Colour	Area	
Level-I	Level-II		Area (Km ²)	% of Total
Forest Area	Dense Forest		0.07	1.05
	Open Forest		0.11	1.58
Total Forest Area (A)			0.19	2.63
Scrub	Scrub (B)		0.64	8.93
	Social Forestry		0.18	2.47
Plantation	Plantation on Backfill		0.67	9.34
	Plantation on OB Dump		0.48	6.74
	Total Plantation (C)		1.32	18.55
Total Vegetation (A+B+C)			2.15	30.11
Agriculture	Agriculture Land		0.38	5.29
Waste Land	Waste Land		0.88	12.37
	Coal Quarry		1.26	17.71
Mining Area	Barren OB Dump		0.07	0.95
	Area Under Backfilling		1.83	25.64
	Water Filled Quarry		0.10	1.34
	Coal Dump		0.07	0.95
	Advance Quarry Site		0.13	1.84
	Total Mining Area		3.45	48.43
Settlements	Rural Settlement		0.03	0.39
	Industrial Settlement		0.18	2.48
Total Settlement Area			0.21	2.88
Water Body	River, Ponds		0.06	0.91
Total			7.13	100.00

Mine Lease	Railways
Settlements	Other Roads
Coal Transportation Roads	

Customer		Mahanadi Coalfields Limited			
Title		Land Reclamation Monitoring of OC Projects			Job No. 561410027
Subject Land Reclamation Status of Samleswari OCP based on Satellite Data (R.S-2L- IV) of the year 2014.	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Dy.Mgr(Geology)		
	Checked	R. Kumar	CM(RSC)		
	Approved	N. P. Singh	GM(Geomatics)		
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Dwg No.		HQ REM 07 A4 1410			REV No. 0





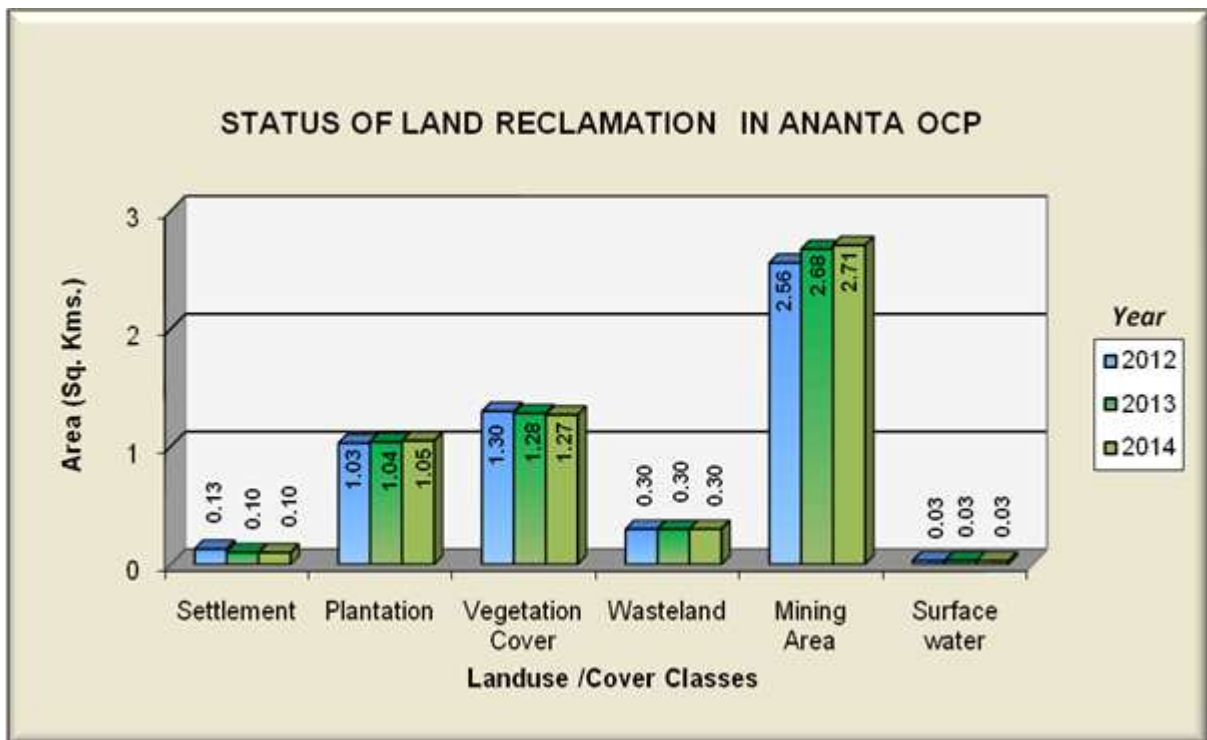


Figure 8.2

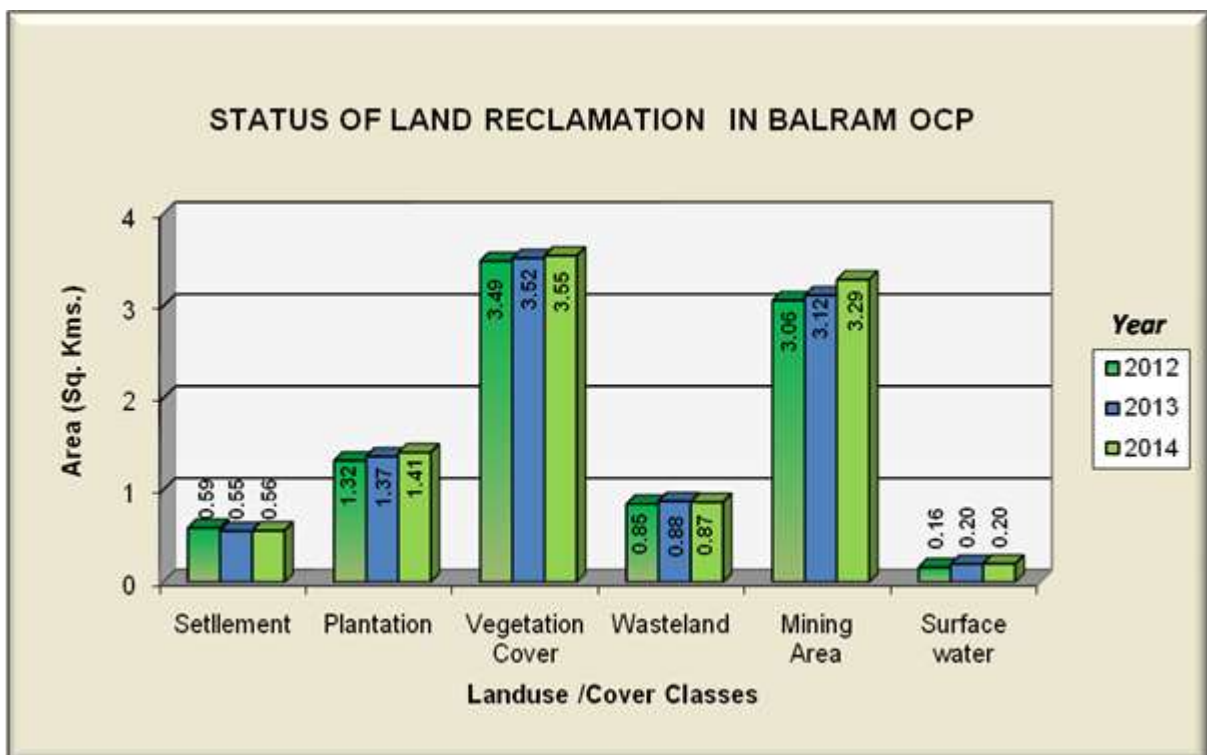


Figure 8.3

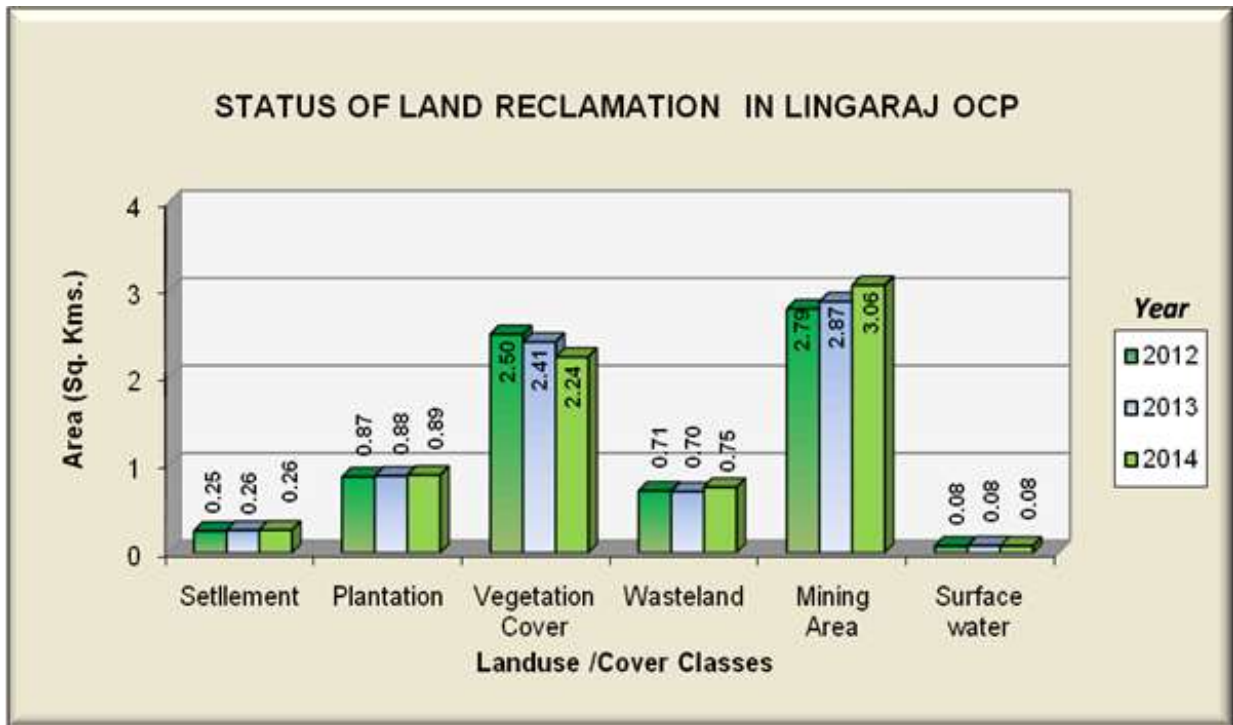


Figure 8.4

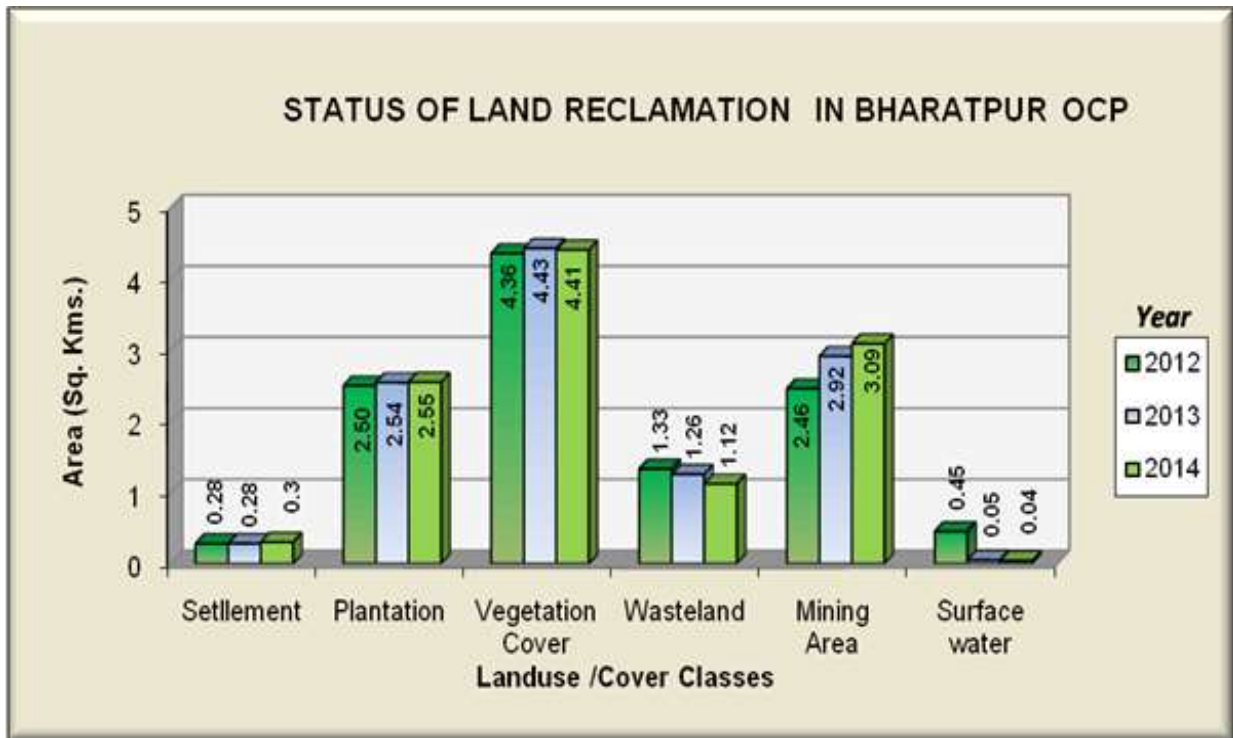


Figure 8.5

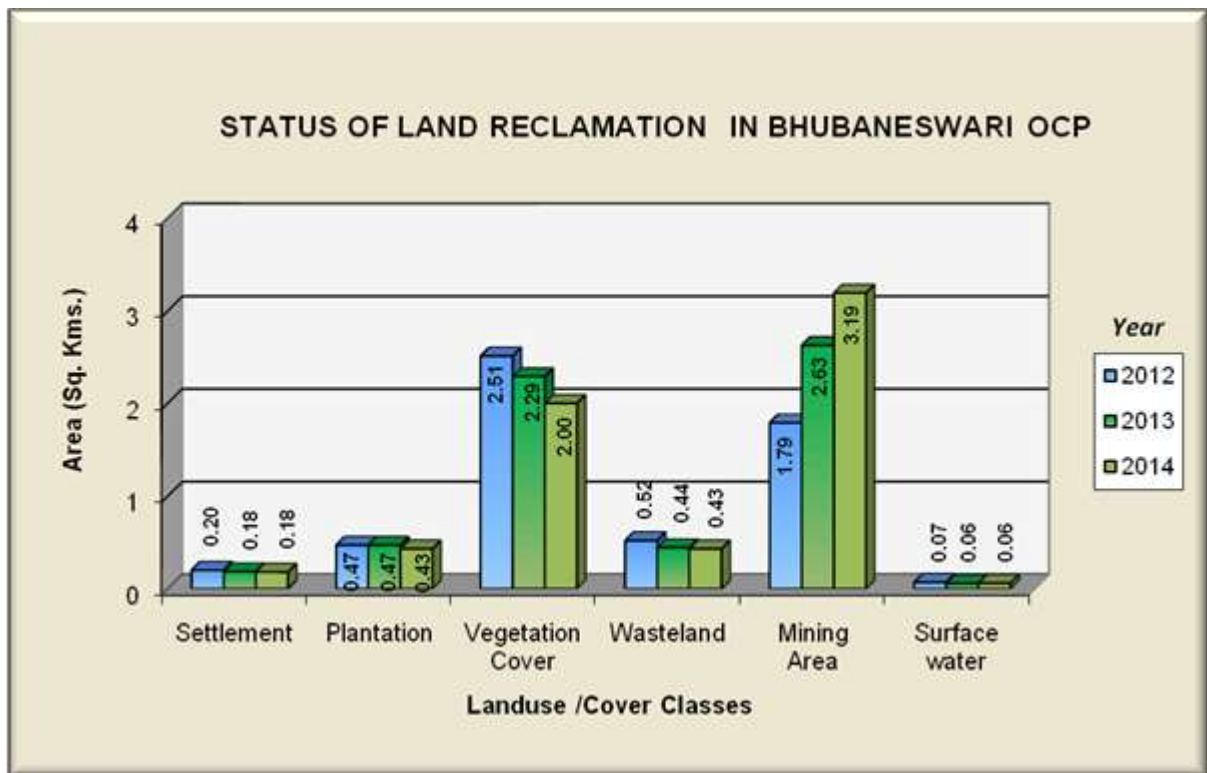


Figure 8.6

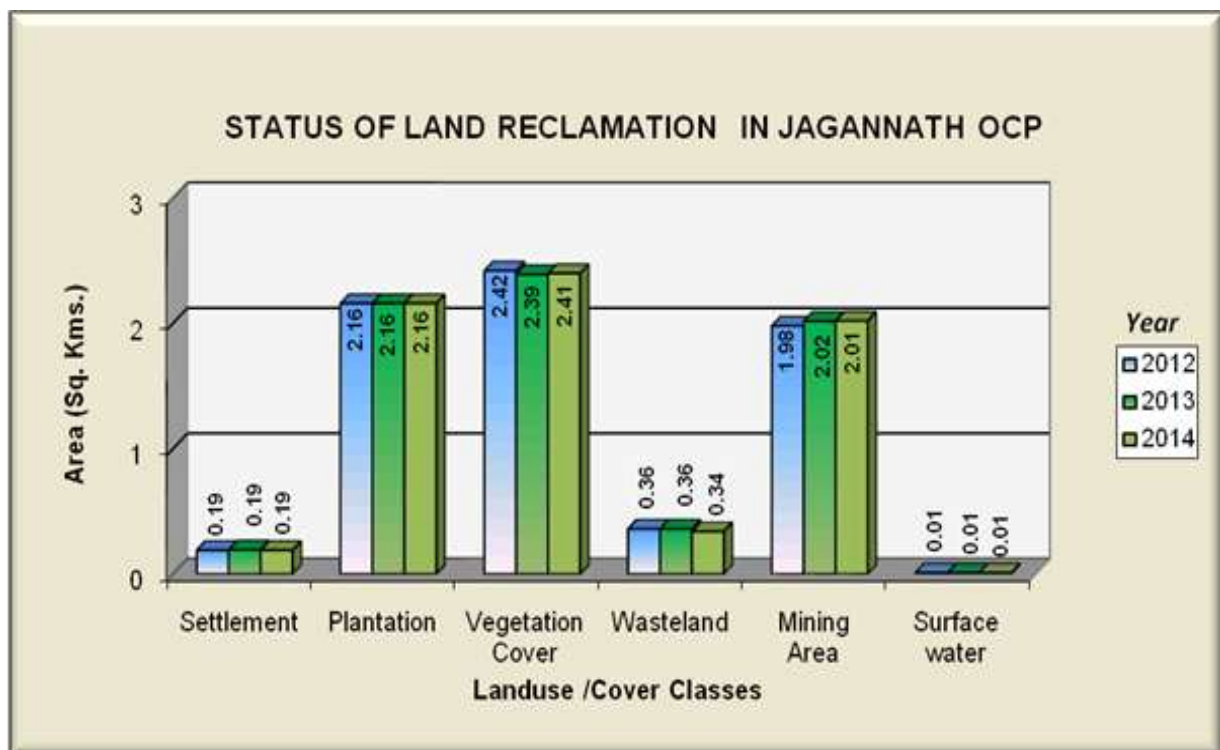


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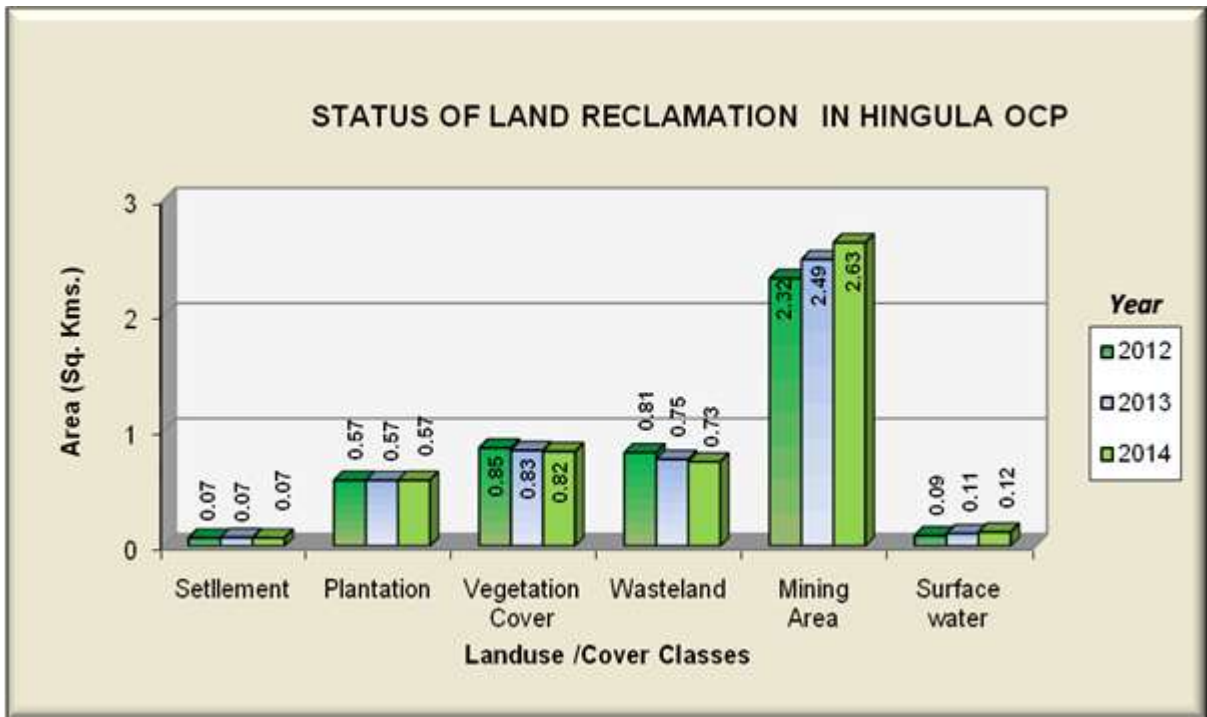


Figure 8.8

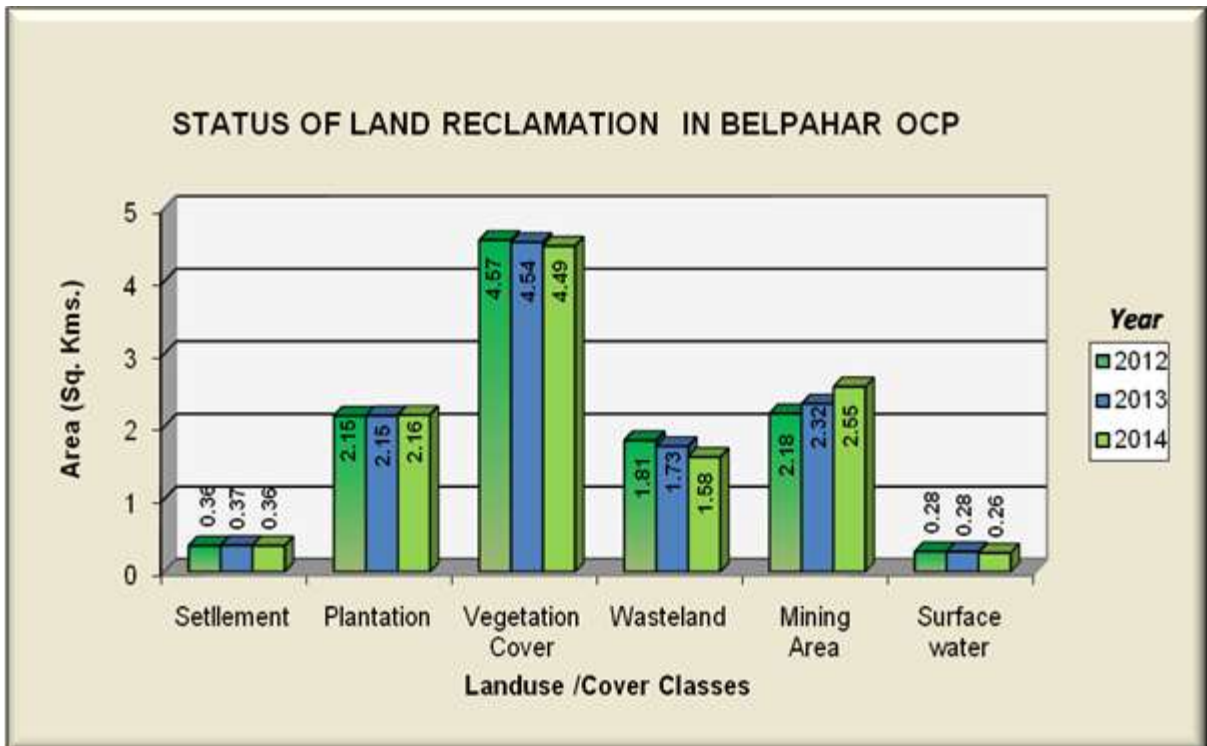


Figure 8.9

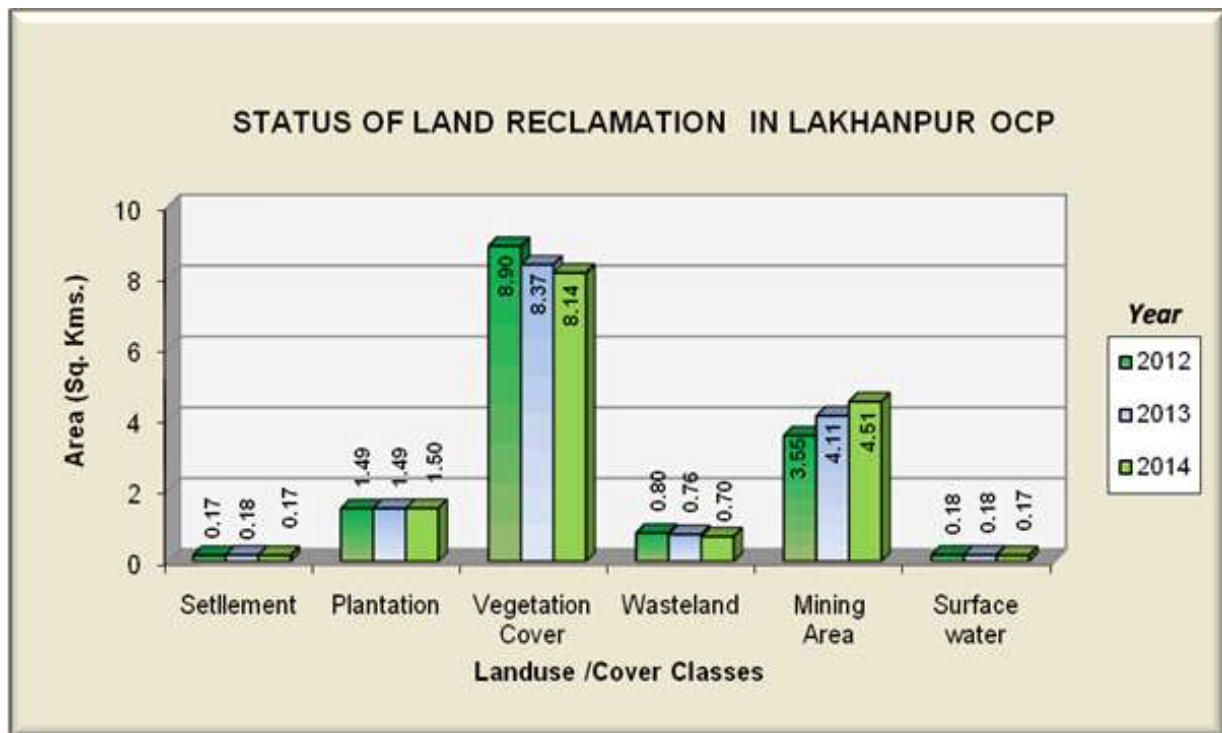


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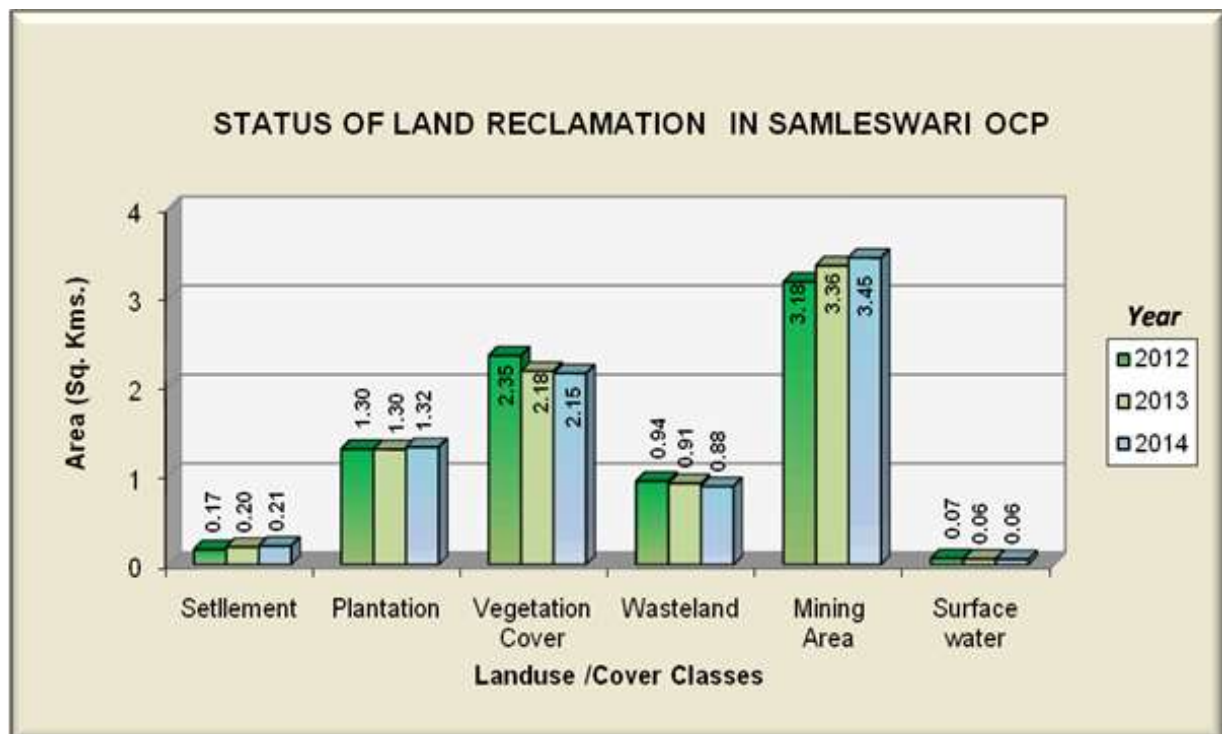


Figure 8.11

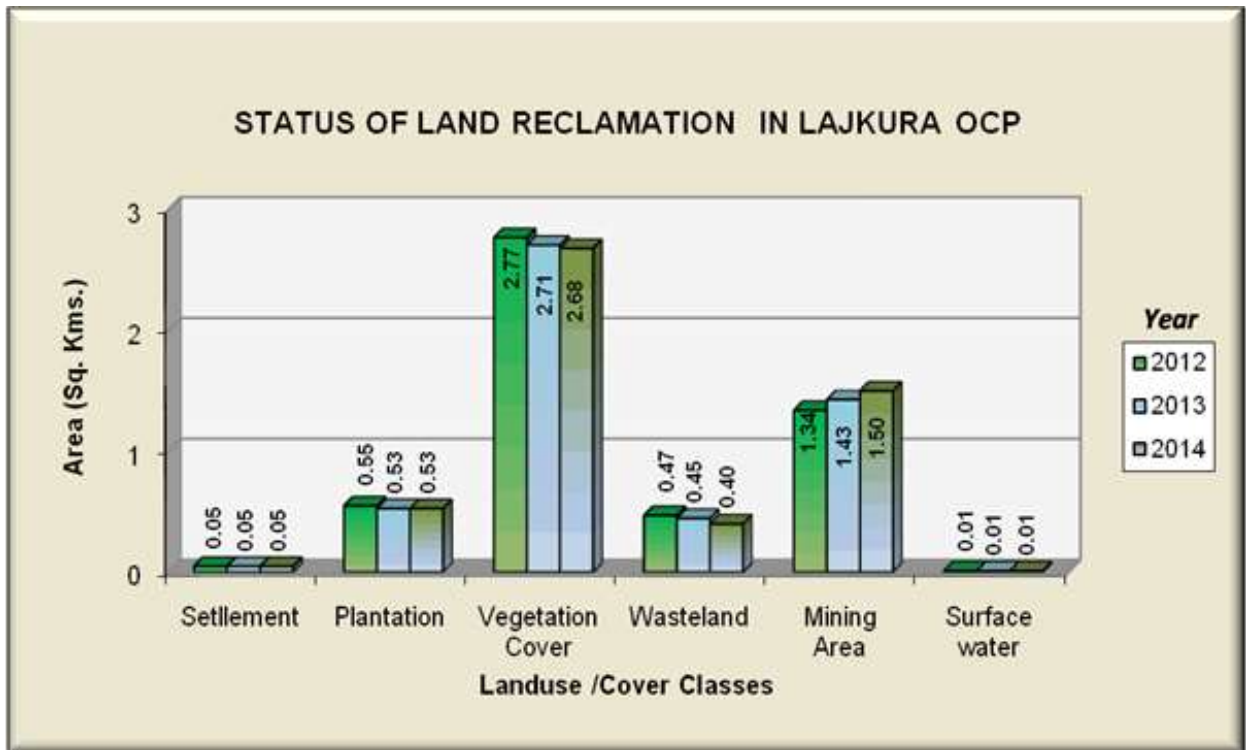


Figure 8.12



Photograph – 8.1: Plantation on Internal OB/Backfill (Ananta OC mine)



Photograph – 8.2: Plantation on External OB (Balram OC Mine)



Photograph – 8.3: Plantation on Internal OB/Backfill (Lingaraj OC Mine)



Photograph – 8.4: Plantation on Internal OB/Backfill (Bharatpur OC Mine)



Photograph – 8.5 : Plantation on External OB (Hingula OC Mine)



Photograph – 8.6: Plantation on Internal OB/Backfill (Belpahar OC Mine)



Photograph – 8.7: Plantation on Internal OB/Backfill (Samleswari OC Mine)



Photograph – 8.8 : Plantation on Internal OB/Backfill at Lakhanpur OC



Photograph-8.9: Plantation on Internal ob/Backfill at Bubaneswari OC



Photograph-8.10 : Plantation at Lajkura Opencast Project

CENTRAL COALFIELDS LIMITED

9.0 Land Reclamation Status in Central Coalfields Ltd.

9.1 Following 5 OC projects producing more than 5 million m³. (Coal + OB together) of Central Coalfields Ltd. have been taken up during the year 2014-15 for land reclamation monitoring:

- Ashok
- Piparwar
- KD Hesalong
- Parej East
- Rajrappa

9.2 Projectwise Land Reclamation status in CCL in the year 2014 is given in Table 9.1 and also shown graphically in Fig 9.1. Area statistics of different land use classes present in OC projects in the year 2014 is given in Table 9.2. Land use maps derived from the satellite data is given in Plate no. 9.1 to 9.5. Changes in land use status are shown in Fig. 9.2 – 9.6 and field photographs showing plantation and backfilled area in mining projects in photo 9.1-9.6.

9.3 Study reveals that 81.55% of excavated mining area is under reclamation by CCL in above 5 OC projects, out of which 59.00% area has been revegetated and 22.55% area is under backfilling.

9.4 After analyzing the satellite data of year 2014, it is evident that plantation carried out on backfilled area, OB dumps as well as under social forestry in all the 5 mines of CCL is 15.70 Km² till the year 2014.

9.5 It may be seen from the Table.9.1 that area of total reclamation has reached 81.55% of the total excavated area till the year 2014.

TABLE – 9.1
Project wise Land Reclamation Status in OC projects of Central Coalfields Ltd
Based on Satellite data of the Year 2013

% Calculated in terms of Total Excavated Area *(Area in Sq. Km)*

Sl. No.	Project		Plantation/ Vegetation		Under Backfilling		Under Active Mining		Total Excavated Area		Total Area under Reclamation		
	Name	Leasehold		ii		iii		iv		ii+iii+iv		ii+iii	
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1	ASHOK	6.75	6.75	1.30	1.30	0.92	0.96	0.92	0.90	3.14	3.16	2.22	2.26
				41.40	41.14	29.30	30.38	29.30	28.48			70.70	71.52
2	PIPARWAR	11.20	11.20	5.03	4.97	0.87	1.05	1.82	1.92	7.72	7.94	5.90	6.02
				65.16	62.59	11.27	13.22	23.58	24.18			76.42	75.82
3	KDH	4.50	4.50	1.45	1.47	1.18	1.26	0.55	0.56	3.18	3.29	2.63	2.73
				45.60	44.68	37.11	38.30	17.30	17.02			82.70	82.98
4	PAREJ EAST	6.20	6.20	0.60	0.66	0.76	0.85	0.51	0.38	1.87	1.89	1.36	1.51
				32.09	34.92	40.64	44.97	27.27	20.11			72.73	79.89
5	RAJRAPPA	19.82	19.82	7.30	7.30	1.70	1.88	1.17	1.15	10.17	10.33	9.00	9.18
				71.78	70.67	16.72	18.20	11.50	11.13			88.50	88.87
TOTAL (CCL)		48.47	48.47	15.68	15.70	5.43	6.00	4.97	4.91	26.08	26.61	21.11	21.70
				60.12	59.00	20.82	22.55	19.06	18.45	53.81	54.90	80.94	81.55

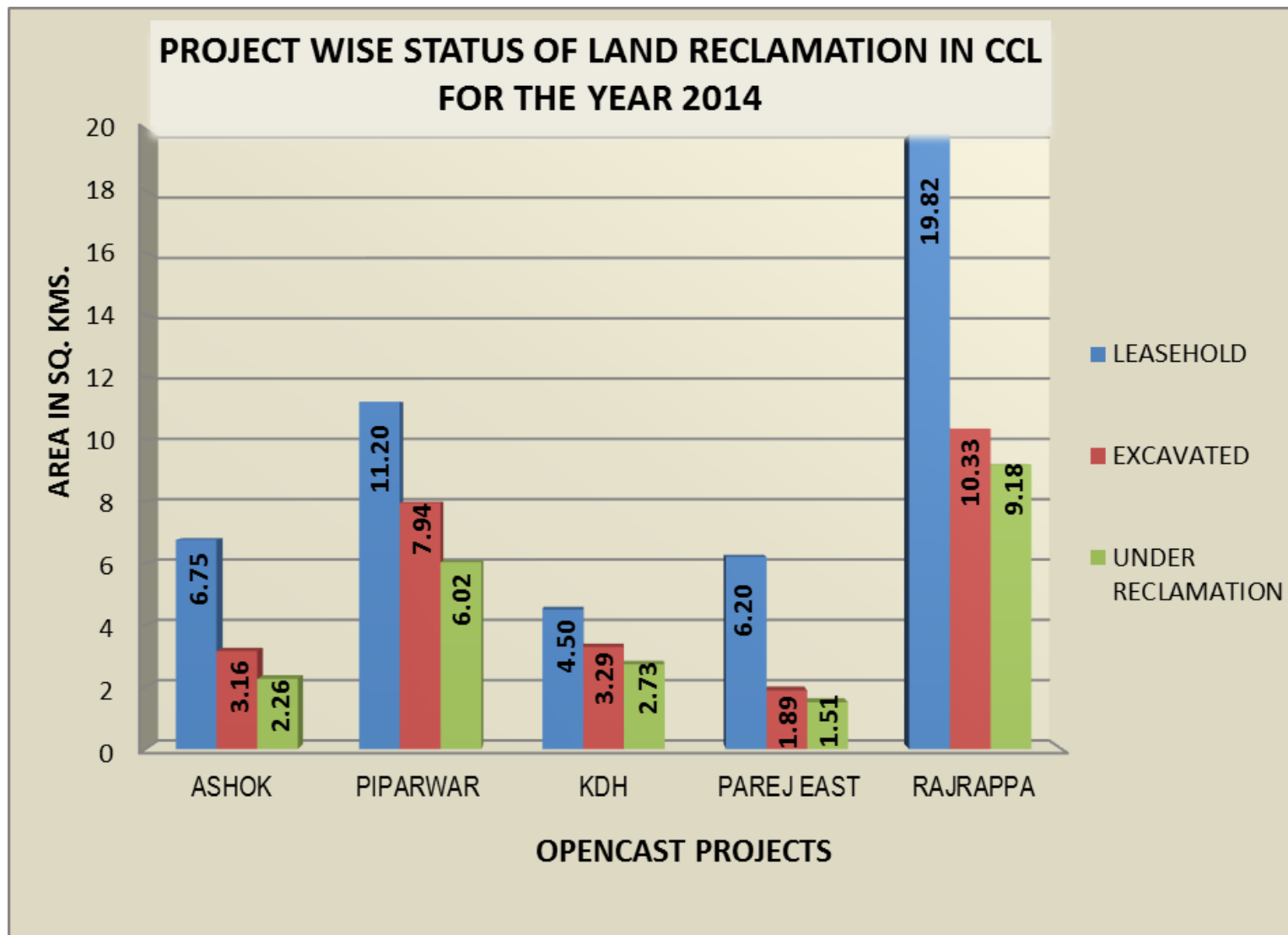





















Fig. 9.1 : Project wise Land Reclamation Status in Year 2013

**Table 9.2 : STATUS OF LAND RECLAMTION IN CENTRAL COALFIELDS LIMITED
BASED ON THE SATELLITE DATA OF THE YEAR 2014**

		(Area in Sq. Km)											
		ASHOK		PIPARWAR		KDH		RAJRAPPA		PAREJ EAST		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest 	0.00	0.00	0.01	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
	Open Forest 	0.67	9.93	0.15	1.34	0.00	0.00	1.50	7.57	1.35	21.77	3.67	7.57
	Total Forest	0.67	9.93	0.16	1.43	0.00	0.00	1.50	7.57	1.35	21.77	3.68	7.59
SCRUBS	Scrubs 	1.39	20.59	0.67	5.98	0.72	16.00	4.97	25.08	1.88	30.32	9.63	19.87
PLANTATION	Social Forestry 	0.34	5.04	2.37	21.16	0.12	2.67	1.95	9.84	0.12	1.94	4.90	10.11
	Plantation on OB Dump 	0.00	0.00	0.80	7.14	0.05	1.11	3.89	19.63	0.03	0.48	4.77	9.84
	Plantation on Backfill 	0.96	14.22	1.80	16.07	1.30	28.89	1.46	7.37	0.51	8.23	6.03	12.44
	Total Plantation (Biological Reclamation)	1.30	19.26	4.97	44.38	1.47	32.67	7.30	36.83	0.66	10.65	15.70	32.39
Total Vegetation	3.36	49.78	5.80	51.79	2.19	48.67	13.77	69.48	3.89	62.74	29.01	59.85	
ACTIVE MINING	Coal Quarry 	0.69	10.22	1.46	13.04	0.15	3.33	0.48	2.42	0.17	2.74	2.95	6.09
	Coal Dump 	0.10	1.48	0.18	1.61	0.20	4.44	0.23	1.16	0.12	1.94	0.83	1.71
	Advance Quarry Site 	0.05	0.74	0.06	0.54	0.02	0.44	0.16	0.81	0.02	0.32	0.31	0.64
	Quarry Filled With Water 	0.06	0.89	0.22	1.96	0.19	4.22	0.28	1.41	0.07	1.13	0.82	1.69
	Total Area under Active Mining	0.90	13.33	1.92	17.15	0.56	12.43	1.15	5.80	0.38	6.13	4.91	10.13
RECLAIMED	Barren OB Dump 	0.13	1.93	0.00	0.00	0.45	10.00	1.31	6.61	0.36	5.81	2.25	4.64
	Area Under Backfilling 	0.83	12.30	1.05	9.38	0.81	18.00	0.57	2.88	0.49	7.90	3.75	7.74
	Total Area under Technical Reclamation	0.96	14.23	1.05	9.38	1.26	28.00	1.88	9.49	0.85	13.71	6.00	12.38
Total Area under Mine Operation	1.86	27.56	2.97	26.53	1.82	40.43	3.03	15.24	1.23	19.84	10.91	22.51	
WASTELAND	Waste Lands 	0.20	2.96	0.26	2.32	0.17	3.78	0.67	3.38	0.17	2.74	1.47	3.03
	Fly Ash Pond / Sand Body 	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.32	0.02	0.04
	Total Wasteland	0.20	2.96	0.26	2.32	0.17	3.78	0.67	3.38	0.19	3.06	1.49	3.07
WATERBODIES	Reservoir, Nallah, Ponds 	0.08	1.19	0.20	1.79	0.12	2.67	0.02	0.10	0.06	0.97	0.48	0.99
	Total Waterbodies	0.08	1.19	0.20	1.79	0.12	2.67	0.02	0.10	0.06	0.97	0.48	0.99
AGRICULTURE	Crop Lands 	0.08	1.19	0.12	1.07	0.00	0.00	0.04	0.20	0.09	1.45	0.33	0.68
	Fallow Lands 	1.07	15.85	1.12	10.00	0.01	0.22	1.20	6.05	0.38	6.13	3.78	7.80
	Total Agriculture	1.15	17.04	1.24	11.07	0.01	0.22	1.24	6.26	0.47	7.58	4.11	8.48
SETTLEMENTS	Urban Settlement 	0.00	0.00	0.07	0.63	0.01	0.22	0.46	2.32	0.16	2.58	0.70	1.44
	Rural Settlement 	0.07	1.04	0.15	1.34	0.00	0.00	0.27	1.36	0.16	2.58	0.65	1.34
	Industrial Settlement 	0.03	0.44	0.51	4.55	0.18	4.00	0.36	1.82	0.04	0.65	1.12	2.31
	Total Settlement	0.10	1.48	0.73	6.52	0.19	4.22	1.09	5.50	0.36	5.81	2.47	5.10
Grand Total	6.75	100.00	11.20	100.00	4.50	100.00	19.82	100.00	6.20	100.00	48.47	100.00	

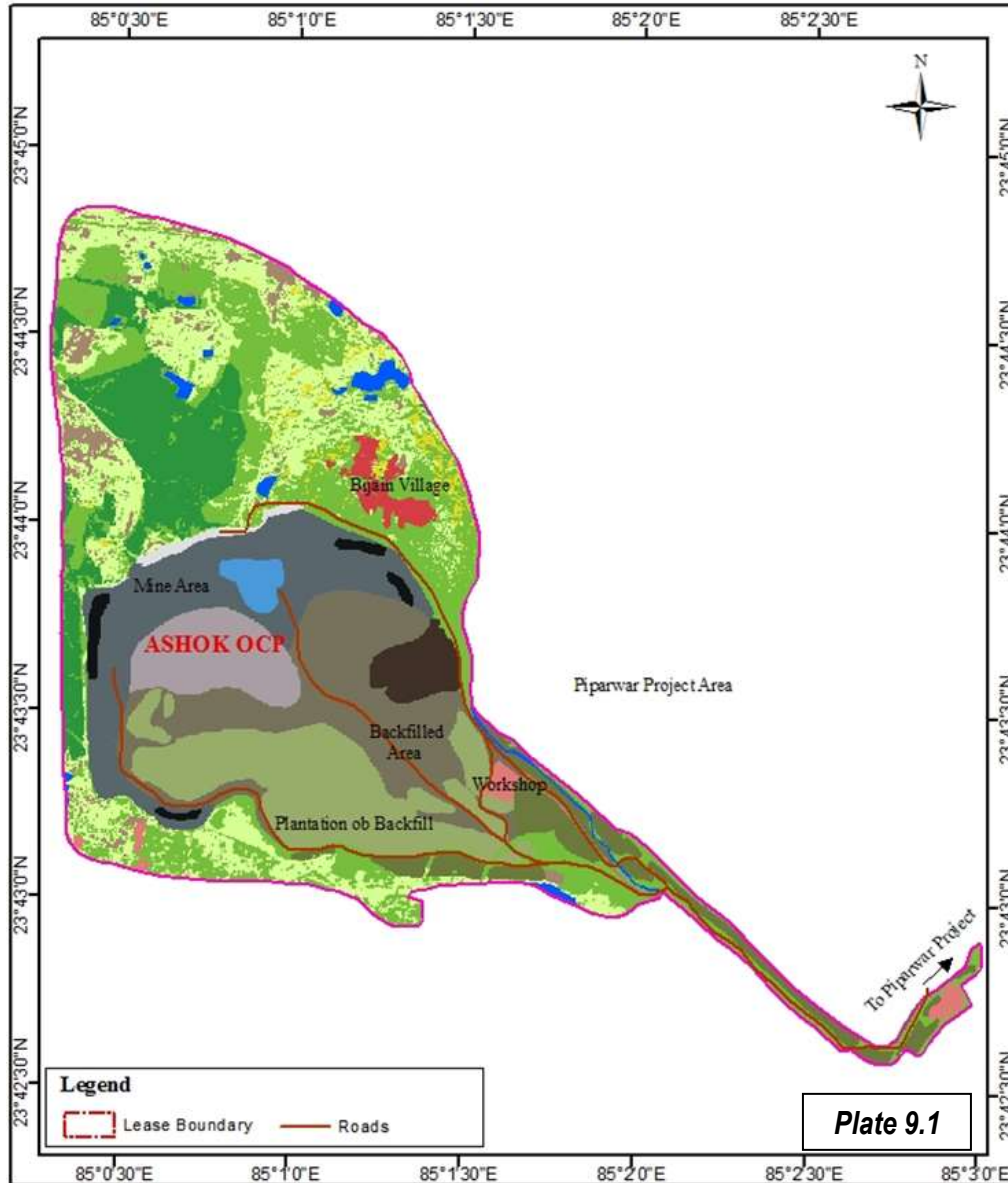


Plate 9.1

Area Statistics - Ashok OCP (2014)				
Classes		Colour	Area	
Level-I	Level-II		Area (Km ²)	% of Total
Forest Area	Dense Forest		0.00	0.00
	Open Forest		0.67	9.93
	Total Forest Area		0.67	9.93
Scrubs	Scrubs		1.39	20.59
	Social Forestry		0.34	5.04
	Plantation on Backfill		0.96	14.22
Plantation	Plantation on OB Dump		0.00	0.00
	Total Plantation		1.30	19.26
	Total Vegetation Area		3.36	49.78
Agriculture	Crop Land		0.08	1.19
	Fallow Land		1.07	15.85
	Total Agriculture Area		1.15	17.04
Waste Land	Waste Land		0.20	2.96
	Sand Body		0.00	0.00
	Total Waste Land		0.20	2.96
Mining Area	Coal Quarry		0.66	9.78
	Barren OB Dump		0.13	1.93
	Area Under Backfilling		0.83	12.30
	Water Filled Quarry		0.06	0.89
	Coal Dump		0.10	1.48
	Advance Quarry Site		0.05	0.74
	Coal Face		0.03	0.44
Total Mining Area		1.86	27.56	
Settlements	Rural Settlement		0.07	1.04
	Urban Settlement		0.00	0.00
	Industrial Settlement		0.03	0.44
Total Settlement Area		0.10	1.48	
Water Body	River, Ponds		0.08	1.19
Total			6.75	100.00

Customer		Central Coalfields Limited			
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject	Activity	Name	Designation	Signature	Date
Land Reclamation Status of Ashok OCP based on Satellite Data (RS-2/L-IV) of the year 2014	Prepared	Hariharal B	Manager(Sys)		
	Checked	R. Kumar	Ch.Mgr(RSC)		
	Approved	N. P. Singh	GM(Geomatics)		
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Drg No.	HQ REM 14 3 A4 05				Rev.No.0

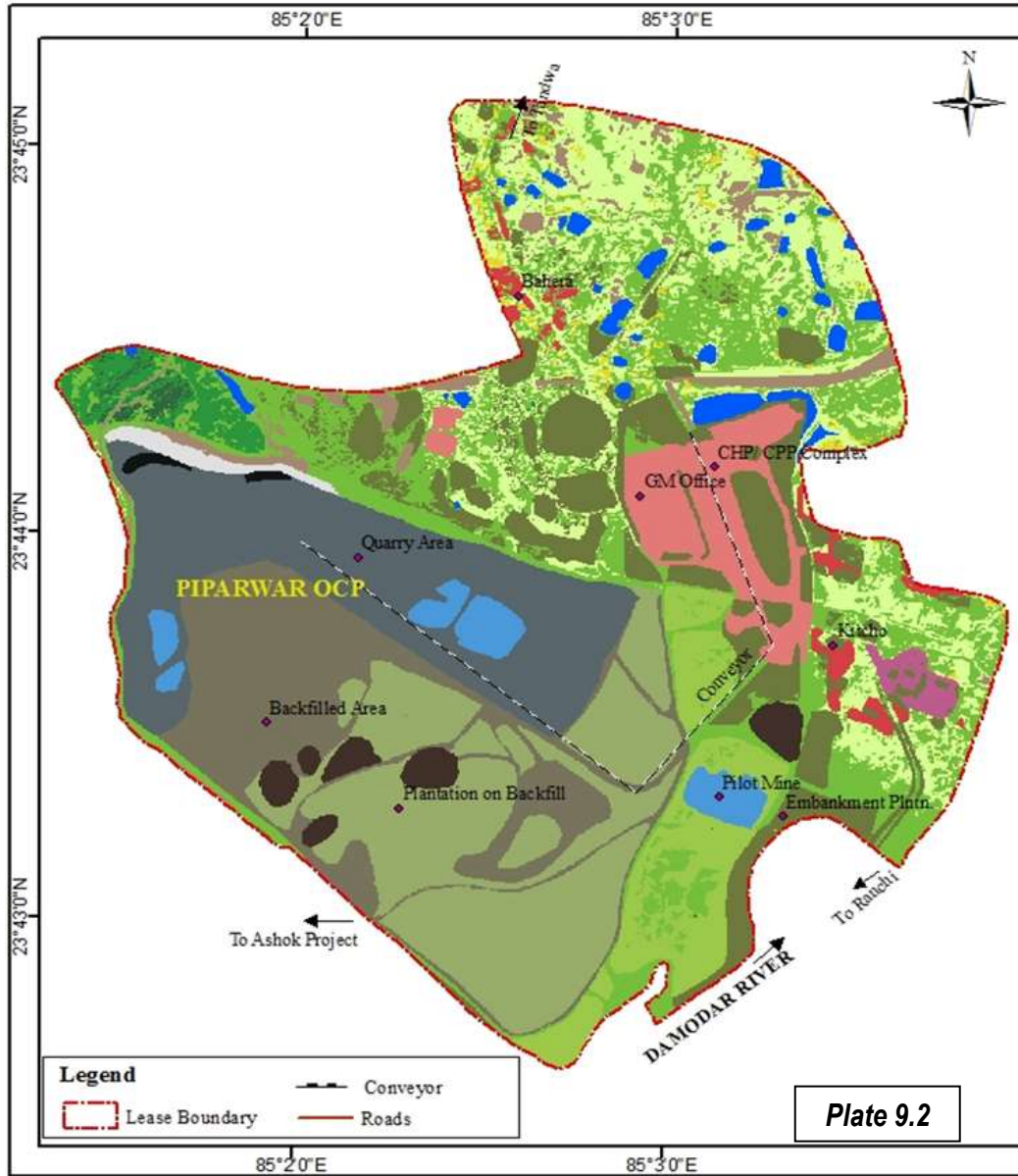
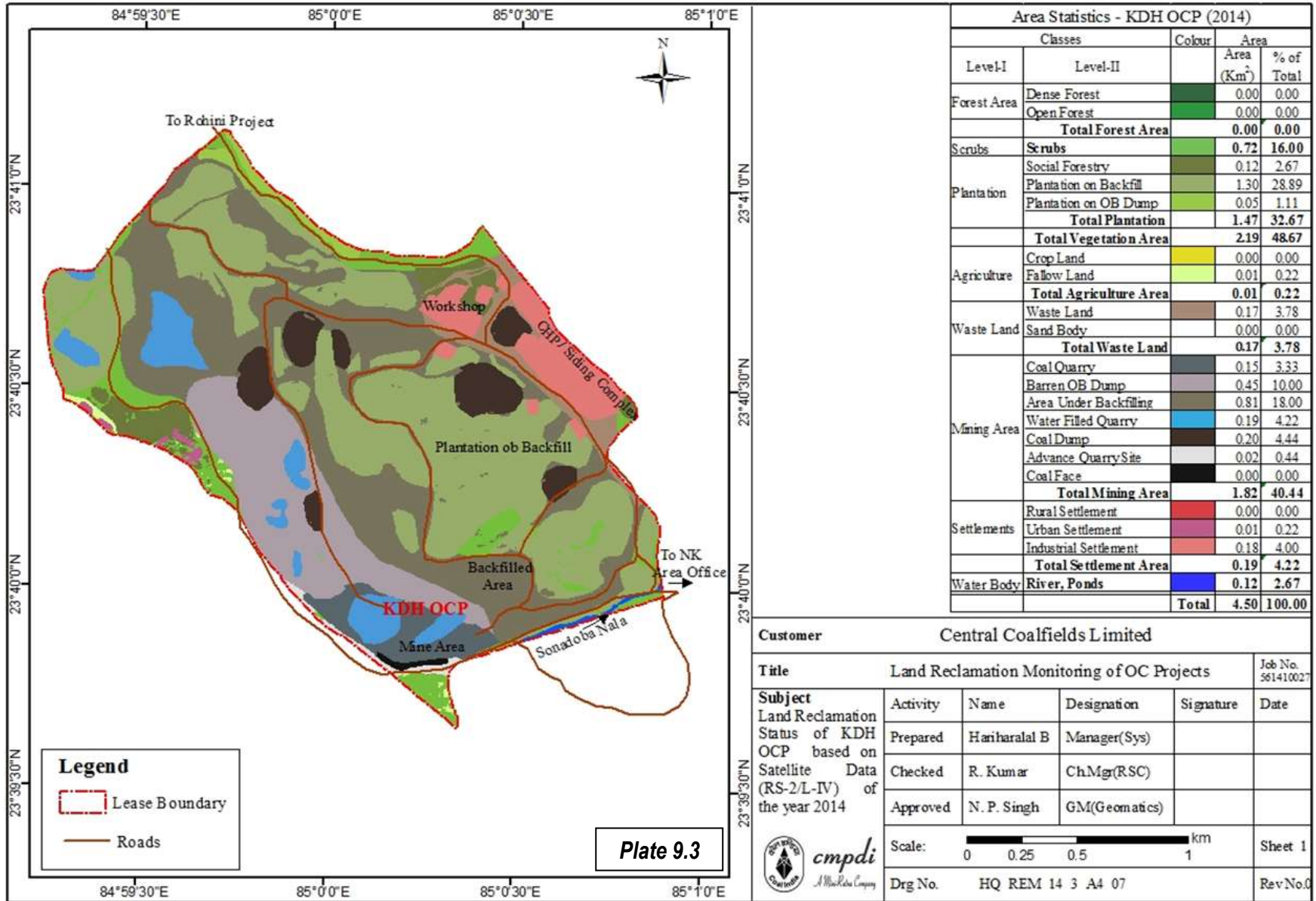


Plate 9.2

Area Statistics - Piparwar OCP (2014)				
Classes		Colour	Area	
Level-I	Level-II		Area (Km ²)	% of Total
Forest Area	Dense Forest		0.01	0.09
	Open Forest		0.15	1.34
	Total Forest Area		0.16	1.43
Scrubs	Scrubs		0.67	5.98
	Social Forestry		2.37	21.16
	Total Scrubs		3.04	27.14
Plantation	Plantation on Backfill		1.80	16.07
	Plantation on OB Dump		0.80	7.14
	Total Plantation		2.60	23.21
	Total Vegetation Area		5.80	51.79
Agriculture	Crop Land		0.12	1.07
	Fallow Land		1.12	10.00
	Total Agriculture Area		1.24	11.07
Waste Land	Waste Land		0.26	2.32
	Sand Body		0.00	0.00
	Total Waste Land		0.26	2.32
Mining Area	Coal Quarry		1.44	12.86
	Barren OB Dump		0.00	0.00
	Area Under Backfilling		1.05	9.38
	Water Filled Quarry		0.22	1.96
	Coal Dump		0.18	1.61
	Advance Quarry Site		0.06	0.54
	Coal Face		0.02	0.18
Total Mining Area		2.97	26.52	
Settlements	Rural Settlement		0.15	1.34
	Urban Settlement		0.07	0.63
	Industrial Settlement		0.51	4.55
	Total Settlement Area		0.73	6.52
Water Body	River, Ponds		0.20	1.79
Total			11.20	100.00

Customer: Central Coalfields Limited					
Title: Land Reclamation Monitoring of OC Projects					Job No. 561410027
Subject Land Reclamation Status of Piparwar OCP based on Satellite Data (RS-2/L-IV) of the year 2014	Activity	Name	Designation	Signature	Date
	Prepared	Hariharalal B	Manager(Sys)		
	Checked	R. Kumar	Ch.Mgr(RSC)		
	Approved	N. P. Singh	GM(Geomatics)		
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Drg No. HQ REM 14 3 A4 06					Rev No.0



Customer Central Coalfields Limited					
Title Land Reclamation Monitoring of OC Projects					Job No. 561410027
Subject Land Reclamation Status of KDH OCP based on Satellite Data (RS-2/L-IV) of the year 2014	Activity	Name	Designation	Signature	Date
	Prepared	Hariharalal B	Manager(Sys)		
	Checked	R. Kumar	Ch.Mgr(RSC)		
	Approved	N. P. Singh	GM(Geomatics)		
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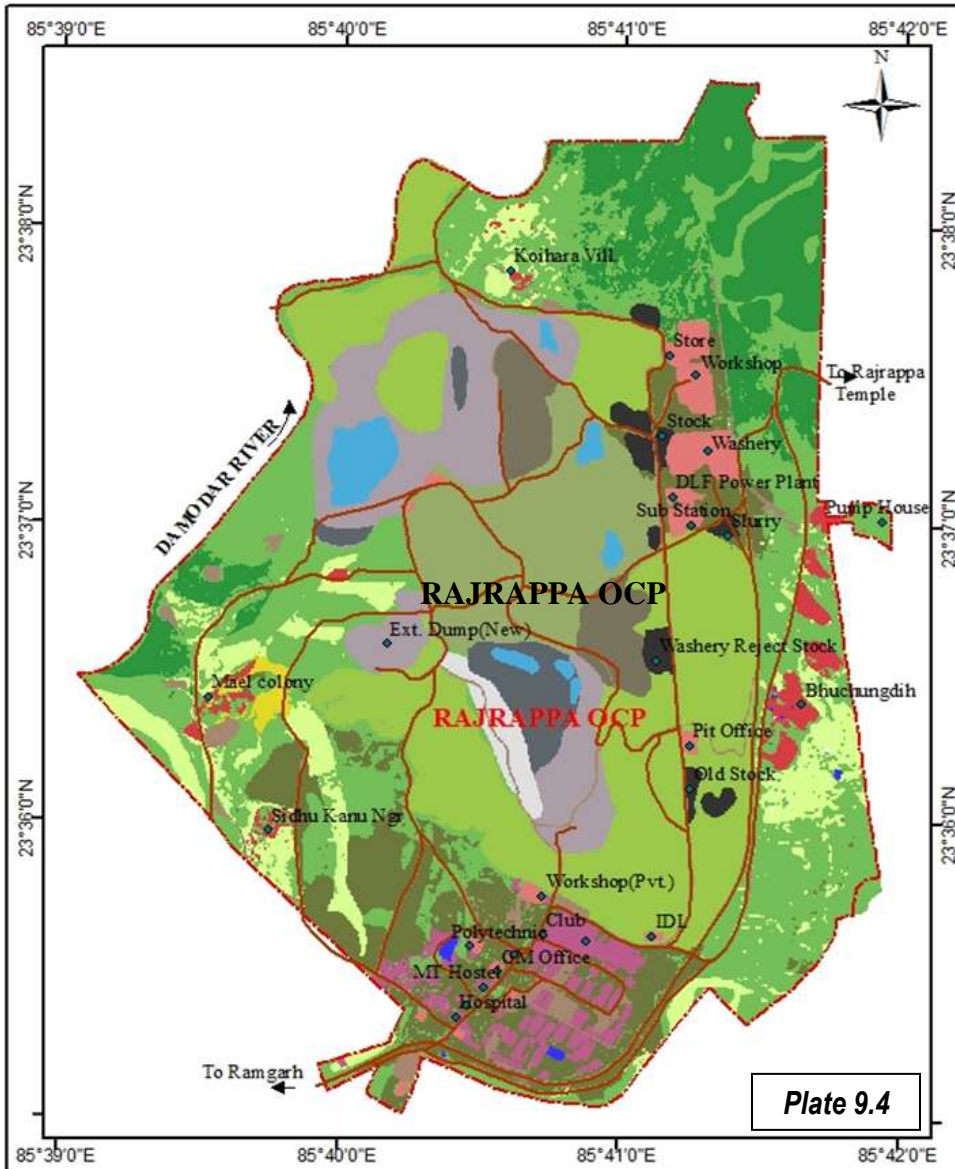


Plate 9.4

Area Statistics - Rajrappa OCP (2014)				
Classes		Colour	Area	% of
Level-I	Level-II		(Km ²)	Total
Forest Area	Dense Forest		0.00	0.00
	Open Forest		1.50	7.57
	Total Forest Area		1.50	7.57
Scrubs	Scrubs		4.97	25.08
	Total Scrubs Area		4.97	25.08
Plantation	Social Forestry		1.95	9.84
	Plantation on Backfill		1.46	7.37
	Plantation on OB Dump		3.89	19.63
	Total Plantation		7.30	36.83
	Total Vegetation Area		13.77	69.48
Agriculture	Crop Land		0.04	0.20
	Fallow Land		1.20	6.05
	Total Agriculture Area		1.24	6.26
Waste Land	Waste Land		0.67	3.38
	Sand Body		0.00	0.00
	Total Waste Land		0.67	3.38
Mining Area	Coal Quarry		0.47	2.37
	Barren OB Dump		1.31	6.61
	Area Under Backfilling		0.57	2.88
	Water Filled Quarry		0.28	1.41
	Coal Dump		0.23	1.16
	Advance Quarry Site		0.16	0.81
	Coal Face		0.01	0.05
	Total Mining Area		3.03	15.29
Settlements	Rural Settlement		0.27	1.36
	Urban Settlement		0.46	2.32
	Industrial Settlement		0.36	1.82
	Total Settlement Area		1.09	5.50
Water Body	River, Ponds		0.02	0.10
	Total		19.82	100.00

Legend

- Lease Boundary
- Roads

Customer		Central Coalfields Limited			
Title	Land Reclamation Monitoring of OC Projects			Job No. 561410027	
Subject Land Reclamation Status of Rajrappa OCP based on Satellite Data (RS-2/L-IV) of the year 2014	Activity	Name	Designation	Signature	Date
	Prepared	Hariharal B	Manager(Sys)		
	Checked	R. Kumar	Ch.Mgr(RSC)		
	Approved	N. P. Singh	GM(Geomatics)		
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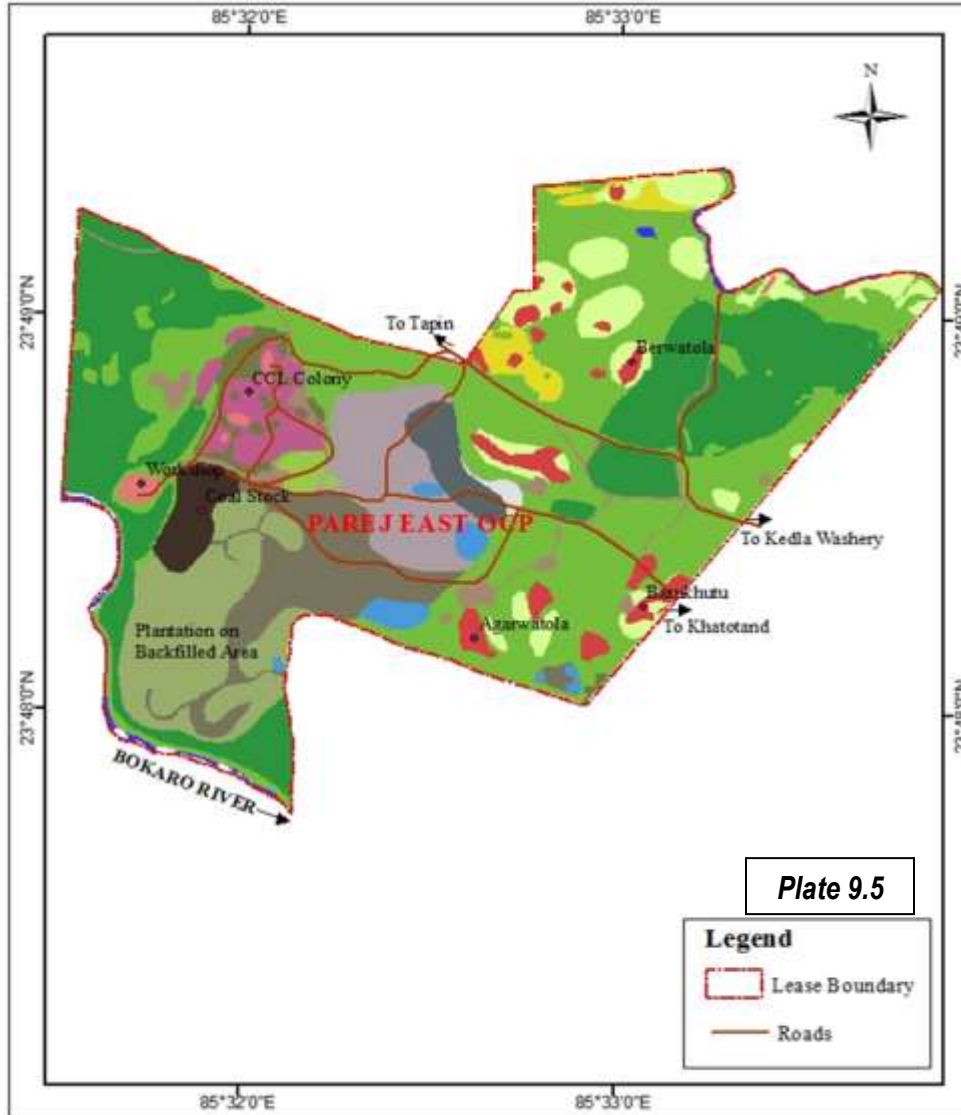


Plate 9.5

Legend
 [Red dashed line] Lease Boundary
 [Brown line] Roads

Area Statistics - Parej East OCP (2014)			
Classes		Colour	Area
Level-I	Level-II		% of Total
Forest Area	Dense Forest	[Dark Green]	0.00
	Open Forest	[Light Green]	1.35
	Total Forest Area		1.35
Scrubs	Scrubs	[Medium Green]	1.88
	Social Forestry	[Dark Green]	0.12
	Total Scrubs Area		2.00
Plantation	Plantation on Backfill	[Light Green]	0.51
	Plantation on OB Dump	[Light Green]	0.03
	Total Plantation		0.54
Total Vegetation Area			3.89
Agriculture	Crop Land	[Yellow]	0.09
	Fallow Land	[Light Yellow]	0.38
	Total Agriculture Area		0.47
Waste Land	Waste Land	[Brown]	0.17
	Sand Body	[Light Brown]	0.02
	Total Waste Land		0.19
Mining Area	Coal Quarry	[Grey]	0.16
	Barren OB Dump	[Dark Grey]	0.36
	Area Under Backfilling	[Dark Grey]	0.49
	Water Filled Quarry	[Blue]	0.07
	Coal Dump	[Black]	0.12
	Advance Quarry Site	[Light Grey]	0.02
	Coal Face	[Black]	0.01
Total Mining Area		1.23	
Settlements	Rural Settlement	[Red]	0.16
	Urban Settlement	[Pink]	0.16
	Industrial Settlement	[Light Red]	0.04
Total Settlement Area		0.36	
Water Body	River, Ponds	[Blue]	0.06
Total			6.20

Customer: Central Coalfields Limited					
Title: Land Reclamation Monitoring of OC Projects					Job No. 561410027
Subject: Land Reclamation Status of Parej East OCP based on Satellite Data (RS-2 L-IV) of the year 2014	Activity	Name	Designation	Signature	Date
	Prepared	Hariharalal B	Manager(Sys)		
	Checked	R. Kumar	Ch.Ngr(RSC)		
	Approved	N. P. Singh	GM(Geomatics)		
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Drg No. HQ REM 14 3 A4 09					Rev No. 0

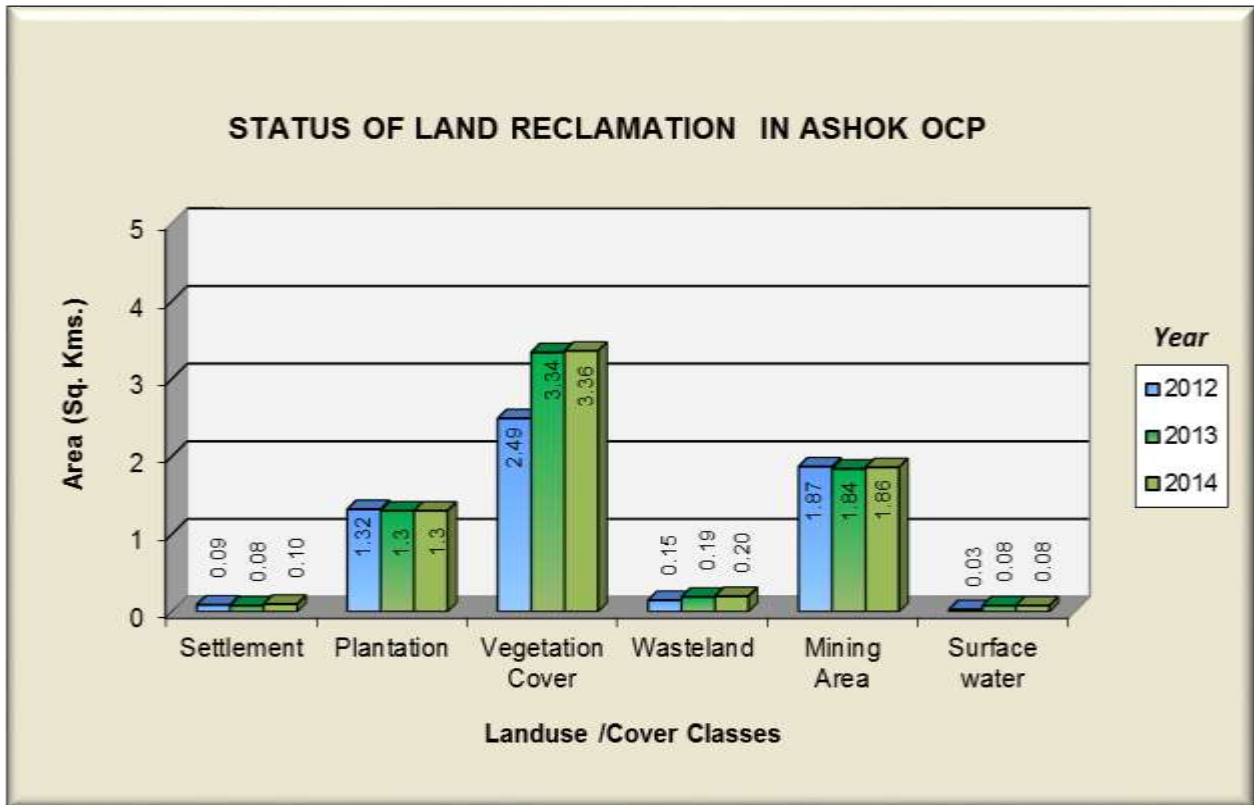


Figure 9.2

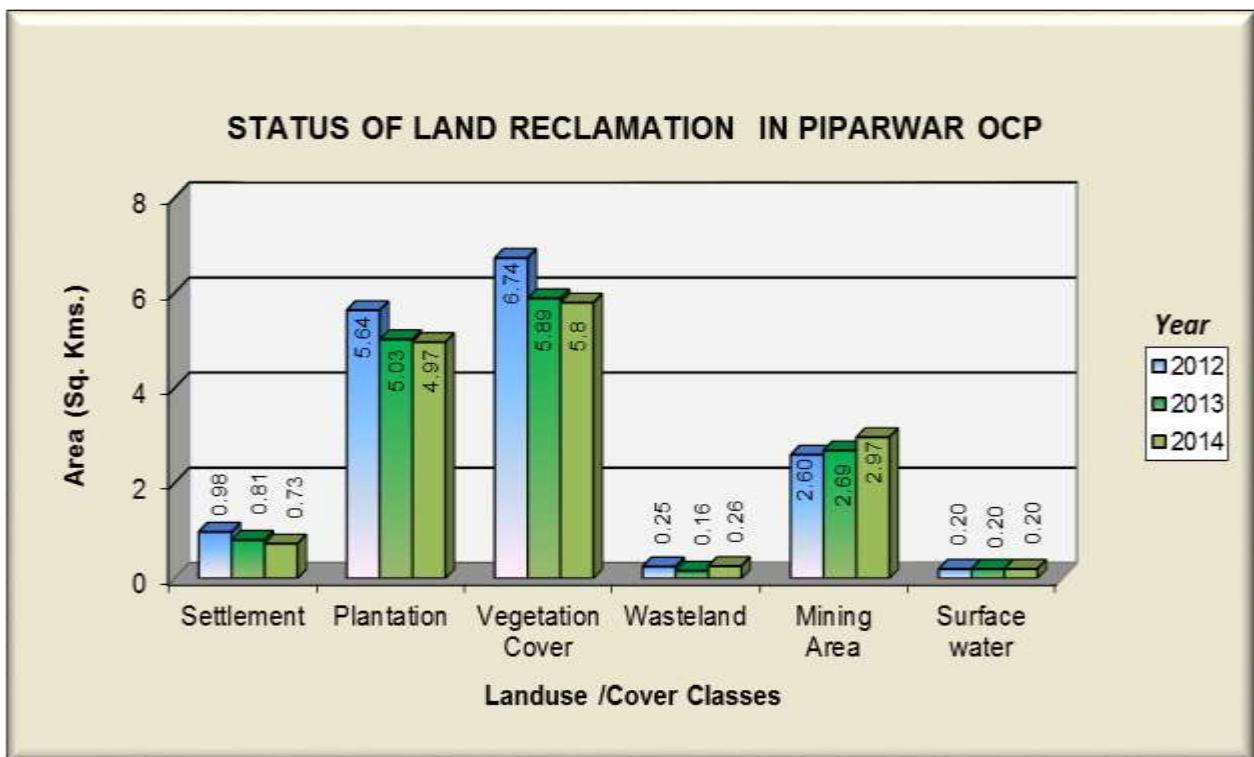


Figure 9.3

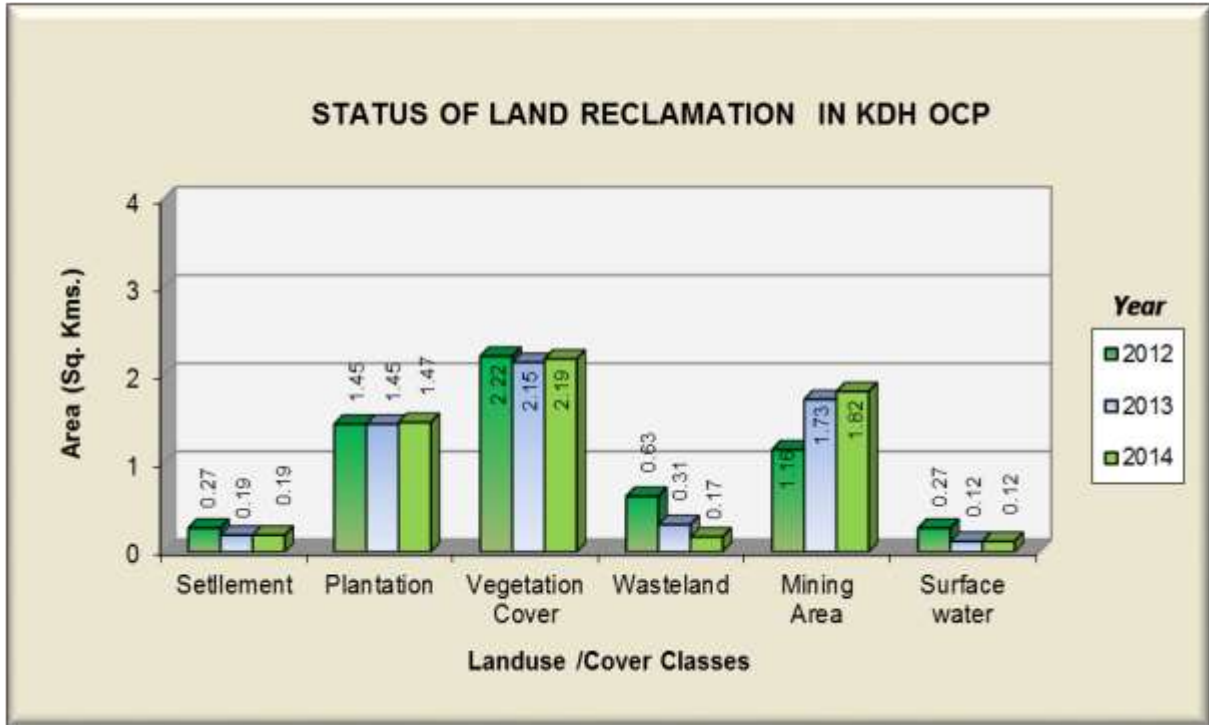


Figure 9.4

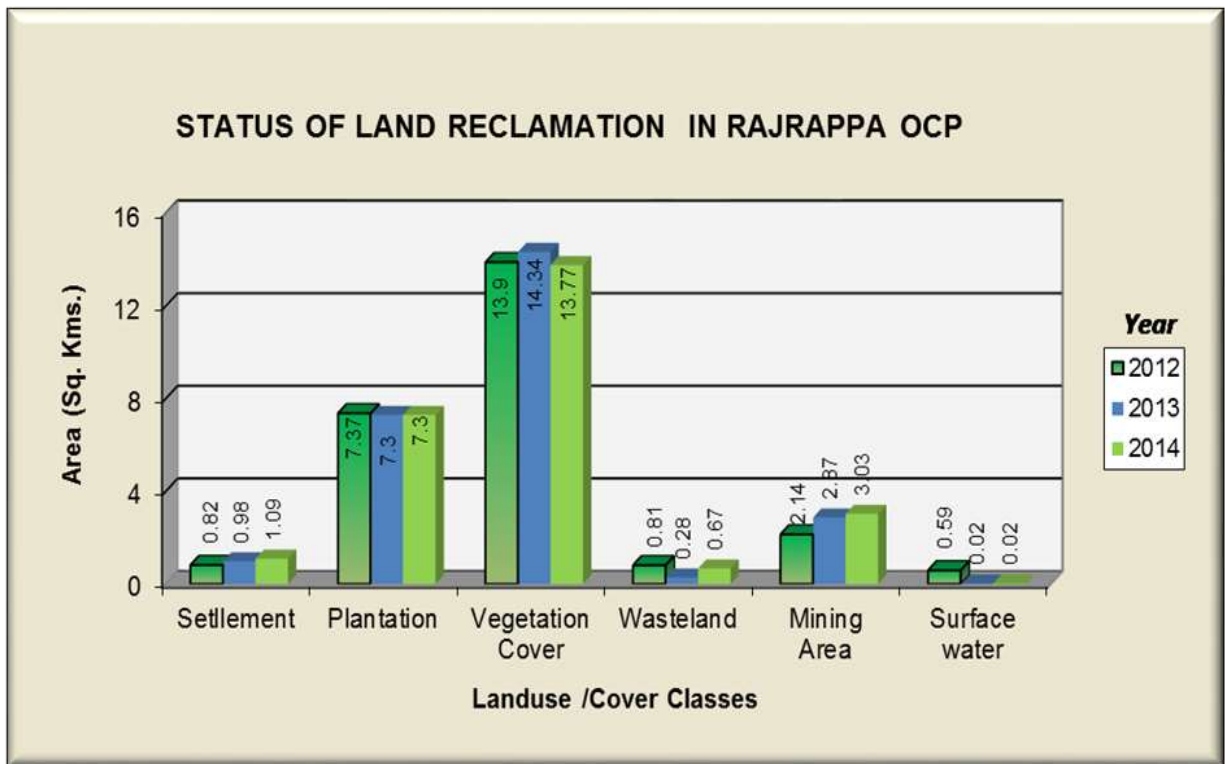


Figure 9.5

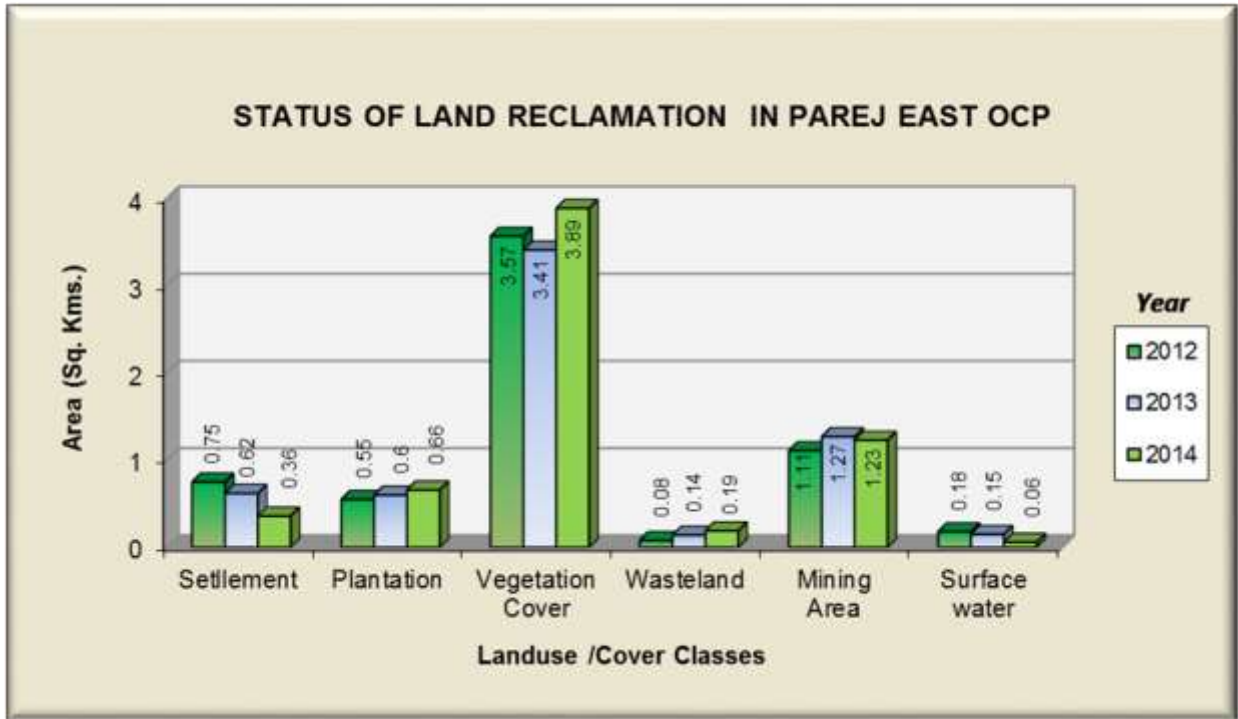


Figure 9.6



Photograph 9.1:Plantation on Backfilled Area -Ashok OCP



Photograph 9.2 : Avenue Plantation- Ashok OCP



Photograph 9.3 : Plantation- Ashok OCP



Photograph 9.4 : Plantation on OB- KD Hesalong OCP



Photograph 9.5 : Plantation on OB- Rajrappa OCP



Photograph 9.6 : Plantation on OB- Parej East OCP

BHARAT COKING COAL LTD.

10.0 Land Reclamation Status in Bharat Coking Coal Ltd.

10.1 Following two OC projects producing 5 million cubic m. or more (Coal + OB together) of Bharat Coking Coal Ltd. have been taken up for land reclamation monitoring for the year 2014-15:

- **Block-II**
- **Muraidih**

10.2 Both the projects, Block-II OC and Muraidih has been mapped during the year 2011, 2012 & 2013 also.

10.3 Project wise Land Reclamation status in BCCL for the year 2014 is given in Table 10.1 and also shown graphically in Fig 10.1. Area statistics of different land use classes present in OC projects in the year 2014 is given in Table 10.2. Land use maps derived from the satellite data is given in Plate no. 10.1 &10.2. Changes in land use status are shown in Fig. 10.2&10.3.

10.4 Study reveals that 84.99% of mining area is under reclamation out of which 19.55% area has been revegetated and 65.35% area is under backfilling.

10.5 After analyzing the satellite data of year 2014 vs. 2013 it is seen that plantation carried out on backfilled area, OB dumps as well as social forestry has not increased in these areas. Only Muraidih recorded an increase of 0.06 km² area in backfill plantation. Availability of top soil seems to be a major issue in Block-II area as the OB dump is mostly rocky in nature. This has to be taken up seriously and efforts are required from the coal company to take up measures for undertaking more plantation activities for environmental protection.

10.6 Out of 2 projects of BCCL considered for monitoring, Block - II is on top for land reclamation (85.75%) followed by Muraidih (83.70%).

Table-10.1

**Projectwise Land Reclamation Status in Opencast Projects of BCCL
based on Satellite Data of the year 2014**

% Calculated in terms of Total Excavated Area

(Area in Sq. Km)

Sl. No.	Project		Plantation/ Vegetation		Under Backfilling		Under Active Mining		Total Excavated Area		Total Area under Reclamation		
	Name	Leasehold		ii		iii		iv		ii+iii+iv		ii+iii	
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1	BLOCK-II	8.68	8.68	0.56	0.58	3.37	3.39	0.68	0.66	4.61	4.63	3.93	3.97
				<i>12.15</i>	<i>12.53</i>	<i>73.10</i>	<i>73.22</i>	<i>14.75</i>	<i>14.25</i>	<i>85.25</i>	<i>85.75</i>		
2	MURAI DIH	5.38	5.38	0.80	0.86	1.45	1.40	0.44	0.44	2.69	2.70	2.25	2.26
				<i>29.74</i>	<i>31.85</i>	<i>53.90</i>	<i>51.85</i>	<i>16.36</i>	<i>16.30</i>	<i>83.64</i>	<i>83.70</i>		
TOTAL (BCCL)		14.06	14.06	1.36	1.44	4.82	4.79	1.12	1.10	7.30	7.33	6.18	6.23
				<i>18.63</i>	<i>19.65</i>	<i>66.03</i>	<i>65.35</i>	<i>15.34</i>	<i>15.01</i>	<i>51.92</i>	<i>52.13</i>	<i>84.66</i>	<i>84.99</i>

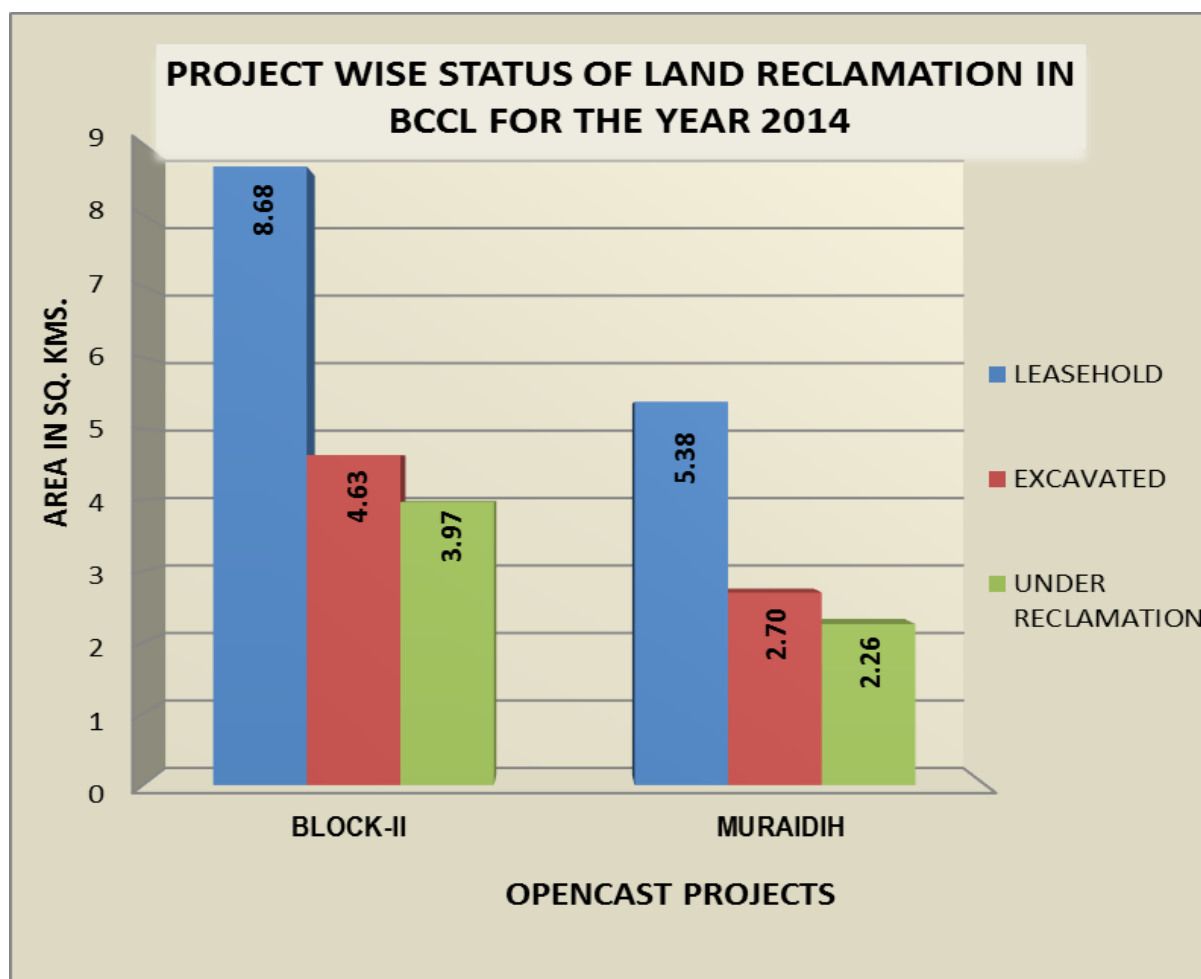






















Fig. 10.1 : Project wise Land Reclamation Status in BCCL

Table 10.2

**STATUS OF LAND USE / RECLAMATION IN OC MINES (> 5 MCM) OF
BHARAT COKING COAL LIMITED BASED ON SATELLITE DATA OF THE YEAR 2013**

		(Area in Sq Km)					
		BLOCK-II		MURAIIDIH		TOTAL BCCL	
		Area	%	Area	%	Area	%
FORESTS	Dense Forest 	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest 	0.00	0	0.00	0.00	0.00	0.00
	Total Forest (A)	0.00	0	0.00	0.00	0.00	0.00
SCRUBS	Scrubs (B) 	2.06	23.73	0.70	13.01	2.76	19.63
PLANTATION	Social Forestry 	0.51	5.88	0.27	5.02	0.78	5.55
	Plantation on OB Dump 	0	0.00	0.3	5.58	0.30	2.13
	Plantation on Backfill 	0.07	0.81	0.29	5.39	0.36	2.56
	Total Plantation (Biological Reclamation) (C)	0.58	6.69	0.86	15.99	1.44	10.24
Total Vegetation (A+B+C)		2.64	30.42	1.56	29	4.20	29.87
ACTIVE MINING	Coal Quarry 	0.28	3.23	0.16	2.98	0.44	3.13
	Coal Dump 	0.23	2.65	0.08	1.49	0.31	2.20
	Advance Quarry Site 	0	0	0.05	0.93	0.05	0.36
	Quarry Filled With Water 	0.15	1.73	0.15	2.79	0.30	2.13
	Total Area under Active Mining	0.66	7.61	0.44	8.19	1.10	7.82
RECLAIMED	Barren OB Dump 	1.91	22.00	0.54	10.04	2.45	17.43
	Barren Backfilled Area 	1.48	17.05	0.86	15.99	2.34	16.64
	Total Area under Technical Reclamation	3.39	39.05	1.40	26.03	4.80	34.07
Total Area under Mine Operation		4.05	46.66	1.84	34.22	5.90	41.89
WASTELANDS	Waste Lands 	0.24	2.76	0.26	4.83	0.50	3.56
	Fly Ash Pond / Sand Body 	0.00	0.00	0.00	0.00	0.00	0.00
Total Waste land		0.24	2.76	0.26	4.83	0.50	3.56
WATERBODIES	Reservoir, nallah, ponds 	0.08	0.92	0.08	1.49	0.16	1.14
	Total Waterbodies	0.08	0.92	0.08	1.49	0.16	1.14
AGRICULTURE	Crop Lands 	0.09	1.04	0.05	0.93	0.14	1.00
	Fallow Lands 	0.93	10.71	1.19	22.12	2.12	15.08
	Total Agriculture	1.02	11.75	1.24	23.05	2.26	16.07
SETTLEMENTS	Urban Settlement 	0.42	4.84	0.33	6.13	0.75	5.33
	Rural Settlement 	0.11	1.27	0.01	0.19	0.12	0.85
	Industrial Settlement 	0.12	1.38	0.06	1.12	0.18	1.28
	Total Settlement	0.65	7.49	0.40	7.44	1.05	7.47
Grand Total		8.68	100.00	5.38	100.00	14.06	100.00

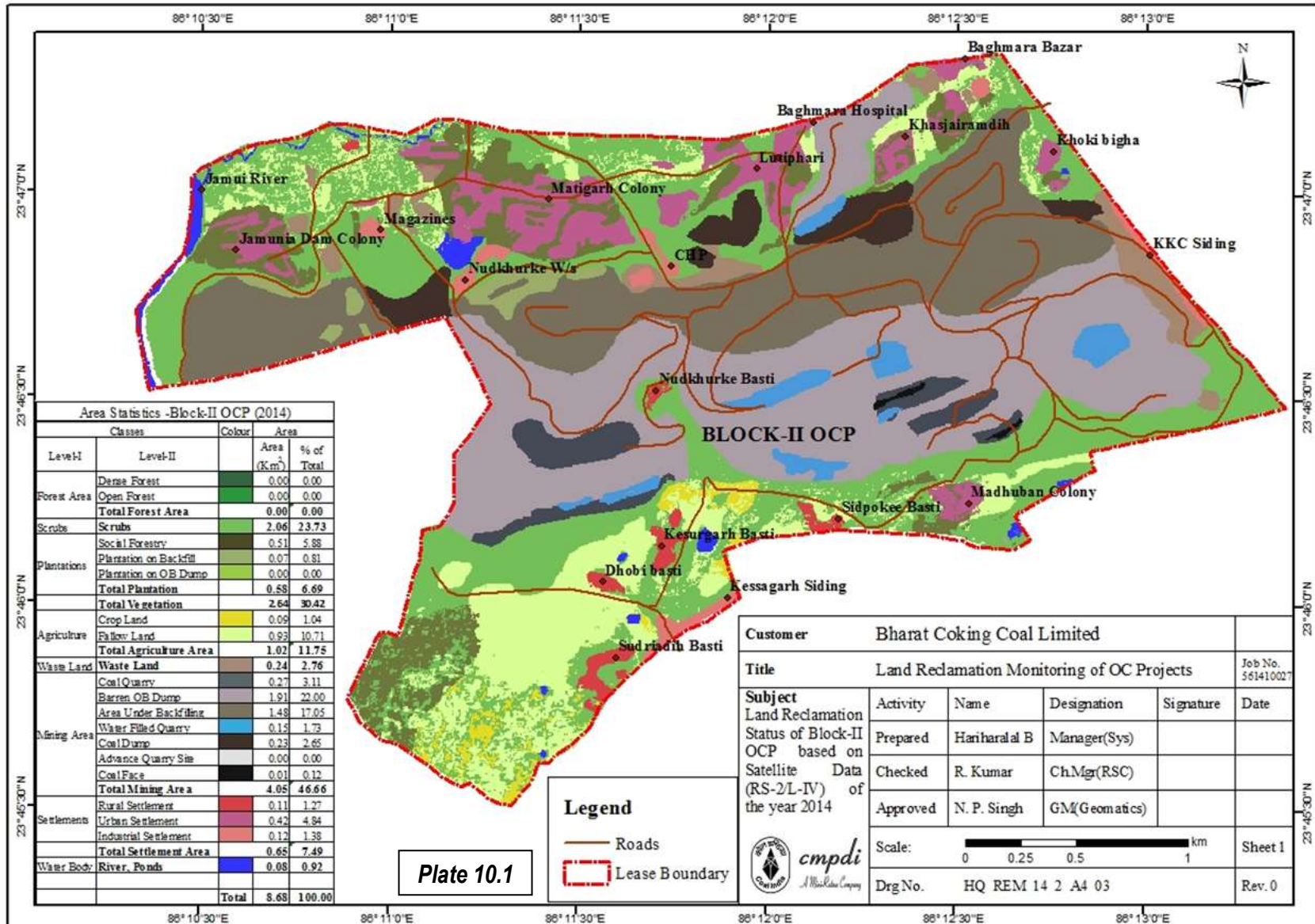


Plate 10.1

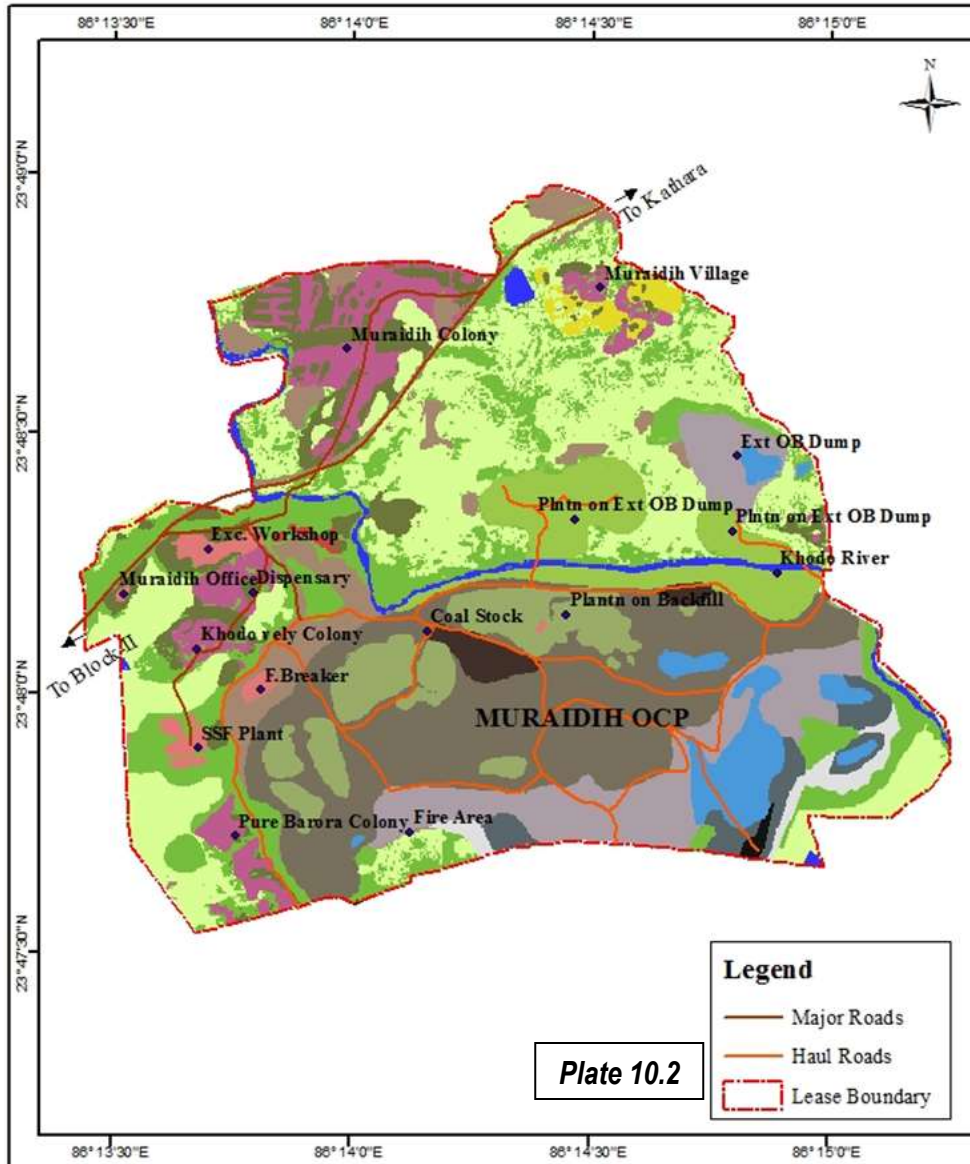


Plate 10.2

Area Statistics -Muraidih OCP (2014)				
Classes		Colour	Area	
Level-I	Level-II		Area (Km ²)	% of Total
Forest Area	Dense Forest		0.00	0.00
	Open Forest		0.00	0.00
	Total Forest Area		0.00	0.00
Scrubs	Scrubs		0.70	13.01
Plantations	Social Forestry		0.27	5.02
	Plantation on Backfill		0.29	5.39
	Plantation on OB Dump		0.30	5.58
	Total Plantation		0.86	15.99
Total Vegetation			1.56	29.00
Agriculture	Crop Land		0.05	0.93
	Fallow Land		1.19	22.12
	Total Agriculture Area		1.24	23.05
Waste Land	Waste Land		0.26	4.83
Mining Area	Coal Quarry		0.15	2.79
	Barren OB Dump		0.54	10.04
	Area Under Backfilling		0.86	15.99
	Water Filled Quarry		0.15	2.79
	Coal Dump		0.08	1.49
	Advance Quarry Site		0.05	0.93
	Coal Face		0.01	0.19
	Total Mining Area		1.84	34.20
Settlements	Rural Settlement		0.01	0.19
	Urban Settlement		0.33	6.13
	Industrial Settlement		0.06	1.12
Total Settlement Area			0.40	7.43
Water Body	River, Ponds		0.08	1.49
Total			5.38	100.00

Customer		Bharat Coking Coal Limited			
Title		Land Reclamation Monitoring of OC Projects			Job No. 561410027
Subject Land Reclamation Status of Muraidih OCP based on Satellite Data (RS-2/L-IV) of the year 2014	Activity	Name	Designation	Signature	Date
	Prepared	Hariharalal B	Manager(Sys)		
	Checked	R. Kumar	Ch.Mgr(RSC)		
Approved	N. P. Singh	GM(Geomatics)			
Scale:		0 0.5 1 km			Sheet 1
Drg No.		HQ REM 14 2 A4 04			Rev. 0

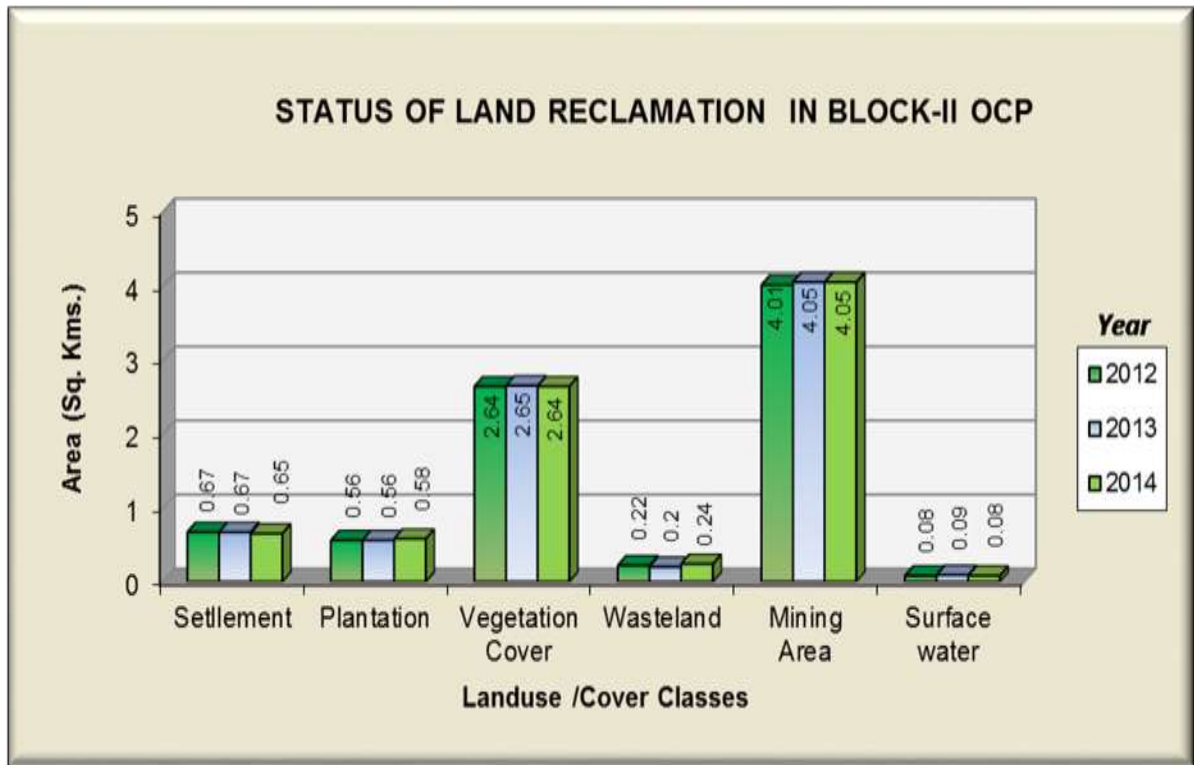


Figure 10.2

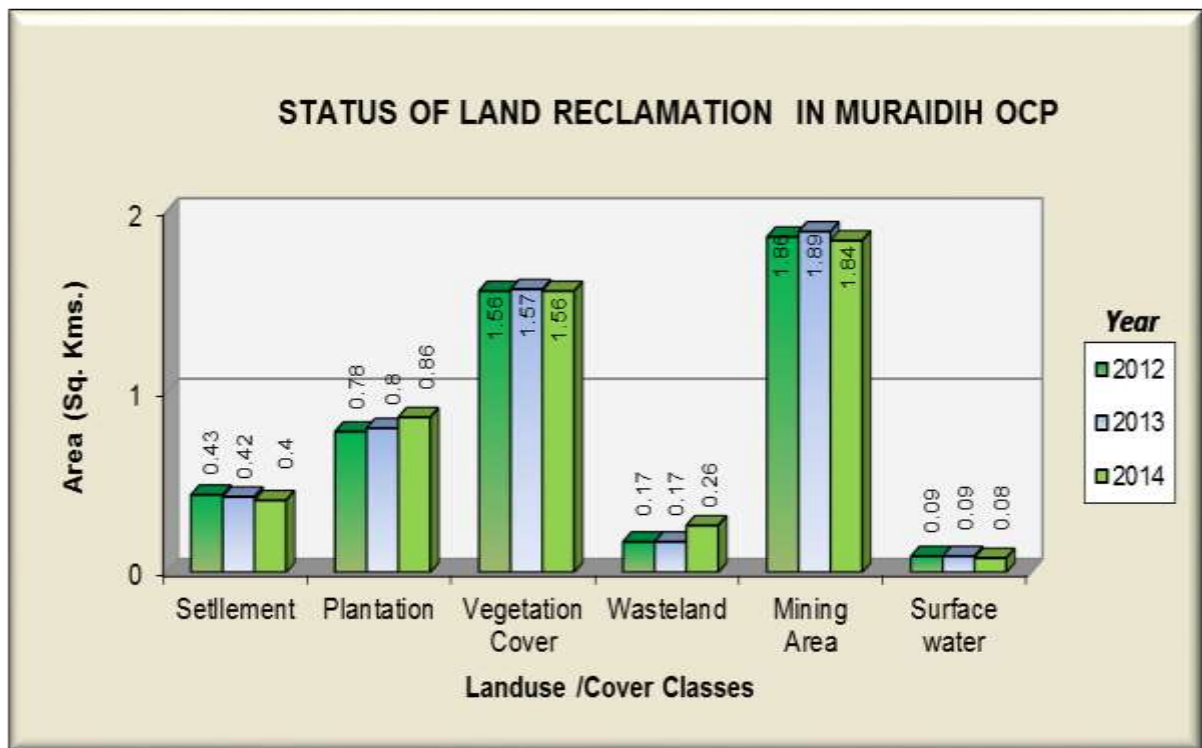


Figure 10.3



Photograph 10.1 : Plantation under Social Forestry in Block-II OCP, BCCL



Photograph 10.2 : Plantation on OB carried out in Muraidih OCP, BCCL

EASTERN COALFIELDS LIMITED

11.0 Land Reclamation Status in Eastern Coalfields Ltd.

11.1 Following two OC projects producing 5 million cubic m. or more (Coal + OB together) of Eastern Coalfields Ltd. have been taken up for land reclamation monitoring for the year 2014 - 15:

- Rajmahal
- Sonapur Bazari

11.2 Both the projects have also been mapped during the year 2010, 2011, 2012 & 2013 for assessing the progress of land reclamation.

11.3 Project wise Land Reclamation status in ECL for the year 2014 is given in Table 11.1 and also shown graphically in Fig 11.1. Area statistics of different land use classes present in OC projects for the year 2014 is given in Table 11.2. Land use maps derived from the satellite data are given in Plate no. 11.1 & 11.2. Changes in land use status are shown in Fig. 11.2 & 11.3.

11.4 Study reveals that 76.71% of mining area is under reclamation out of which 27.42% area has been revegetated and 49.29% area is under backfilling.

11.5 On comparing the status of land reclamation for the year 2014 with respect to the year 2013, it is evident from the analysis that area of land reclamation has increased from 9.96 Km² (Yr. 2013) to 10.77 Km² (Yr. 2014).

11.6 Out of two projects in ECL, Sonapur Bazari tops with 77.08% reclamation followed by Rajmahal OCP with 76.36% reclamation.

Table-11.1

**Projectwise Land Reclamation Status in Opencast Projects of ECL
based on Satellite Data of the year 2014**

% Calculated in terms of Total Excavated Area

(Area in Sq. Km)

Sl. No.	Project		Plantation/ Vegetation		Under Backfilling		Under Active Mining		Total Excavated Area		Total Area under Reclamation		
	Name	Leasehold		ii		iii		iv		ii+iii+iv		ii+iii	
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1	RAJMAHAL	16.38	16.38	2.02	2.04	3.08	3.45	1.83	1.70	6.93	7.19	5.10	5.49
					29.15	28.37	44.44	47.98	26.41	23.64			73.59
2	SONEPUR BAZARI	23.06	23.06	1.81	1.81	3.05	3.47	1.52	1.57	6.38	6.85	4.86	5.28
					28.37	26.42	47.81	50.66	23.82	22.92			76.18
TOTAL (ECL)		39.44	39.44	3.83	3.85	6.13	6.92	3.35	3.27	13.31	14.04	9.96	10.77
				28.78	27.42	46.06	49.29	25.17	23.29	33.75	35.60	74.83	76.71

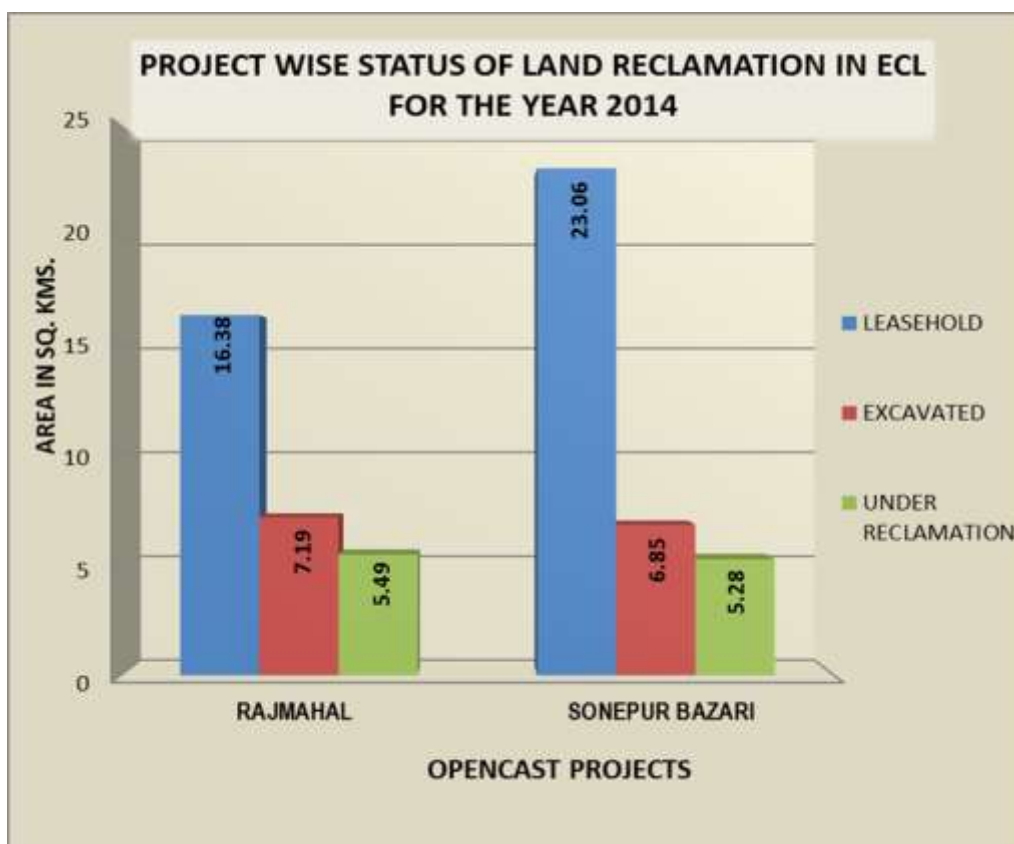
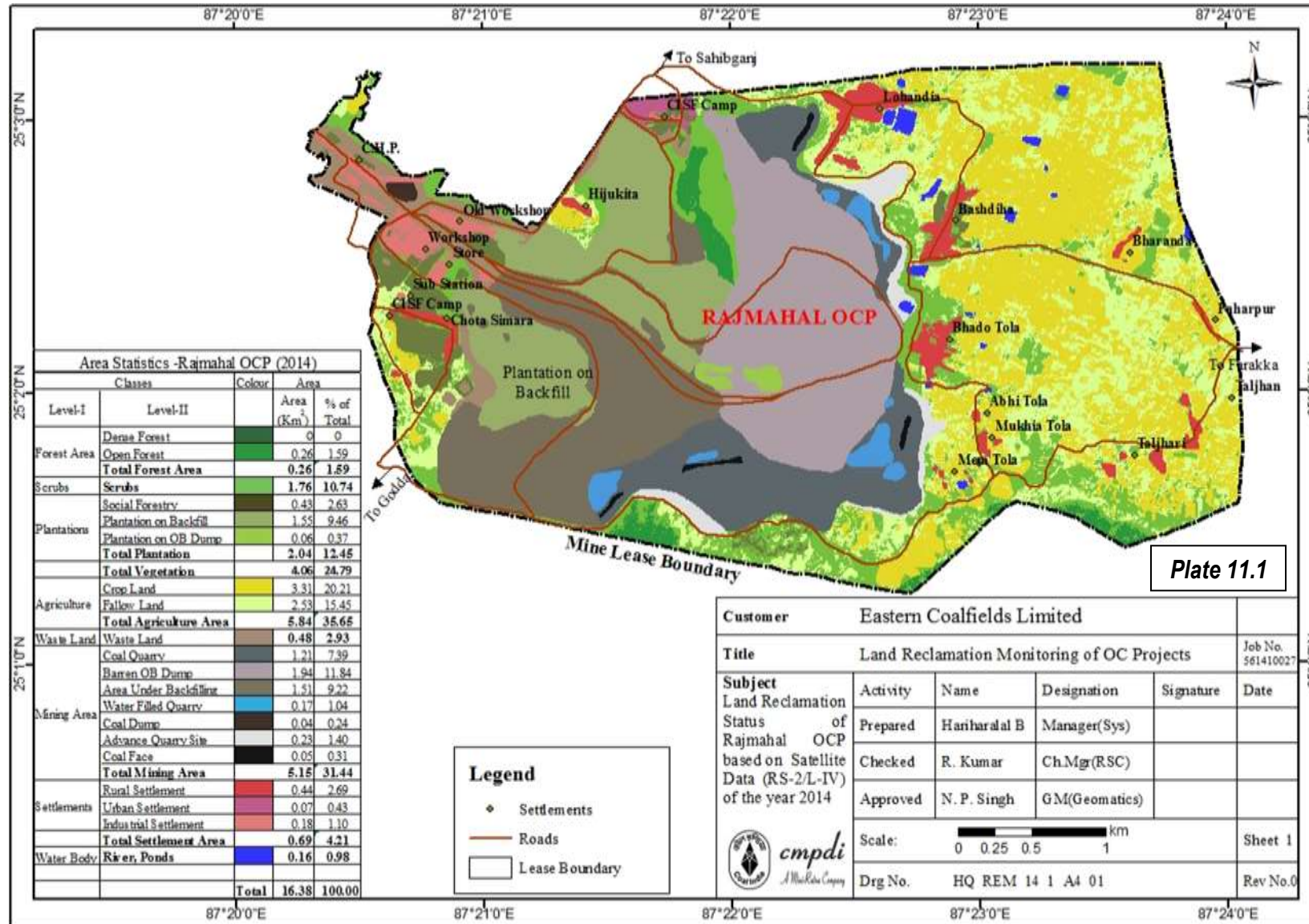


Fig. 11.1:Project wise Land Reclamation Status in 2014

Table 11.2

**STATUS OF LAND USE / RECLAMATION IN EASTERN COALFIELDS LTD.
BASED ON SATELLITE DATA OF THE YEAR 2014**

		(Area in Sq Km)					
		RAJMAHAL		SONEPUR BAZARI		TOTAL	
		Area	%	Area	%	Area	%
FORESTS	Dense Forest	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest	0.26	1.59	0.30	1.30	0.56	1.42
	Total Forest(A)	0.26	1.59	0.30	1.30	0.56	1.42
SCRUBS	Scrubs(B)	1.76	10.78	4.90	21.25	6.66	16.91
PLANTATION	Social Forestry	0.43	2.63	0.88	3.82	1.31	3.33
	Plantation on OB Dump	0.06	0.37	0.35	1.52	0.41	1.04
	Plantation on Back fill	1.55	9.5	0.58	2.52	2.13	5.41
	Total Plantation (Biological Reclamation) (C)	2.04	12.5	1.81	7.86	3.85	9.78
Total Vegetation (A+B+C)		4.06	24.87	7.01	30.4	11.07	28.11
ACTIVE MINING	Coal Quarry	1.26	7.72	1.12	4.86	2.38	6.04
	Coal Dump	0.04	0.25	0.1	0.43	0.14	0.36
	Advance Quarry Site	0.23	1.41	0.21	0.91	0.44	1.12
	Quarry Filled With Water	0.17	1.04	0.14	0.61	0.31	0.79
	Total Area under Active Mining (D)	1.70	10.42	1.57	6.81	3.27	8.30
RECLAIMED	Barren OB Dump	1.94	11.89	1.49	6.46	3.43	8.71
	Area Under Backfilling	1.51	9.25	1.98	8.59	3.49	8.86
	Total Area under Technical Reclamation (E)	3.45	21.14	3.47	15.05	6.93	17.57
Total Area under Mining Operation (D+E)		5.15	31.56	5.04	21.86	10.20	25.87
WASTELAND	Waste Lands	0.48	2.94	0.82	3.56	1.30	3.30
	Fly Ash Pond / Sand Body	0.00	0.00	0.00	0.00	0.00	0.00
Total Wasteland		0.48	2.94	0.82	3.56	1.30	3.30
WATERBODIES	Reservoir, nallah, ponds	0.16	0.98	0.38	1.65	0.54	1.37
	Total Waterbodies	0.16	0.98	0.38	1.65	0.54	1.37
AGRICULTURE	Crop Lands	3.25	19.91	0.78	3.38	4.03	10.23
	Fallow Lands	2.53	15.5	8.43	36.56	10.96	27.83
	Total Agriculture	5.78	35.41	9.21	39.94	14.99	38.06
SETTLEMENTS	Urban Settlement	0.07	0.43	0.09	0.39	0.16	0.41
	Rural Settlement	0.44	2.7	0.32	1.39	0.76	1.93
	Industrial Settlement	0.18	1.1	0.19	0.82	0.37	0.94
	Total Settlement	0.69	4.23	0.60	2.60	1.29	3.28
Grand Total		16.38	100.00	23.06	100.00	39.39	100.00



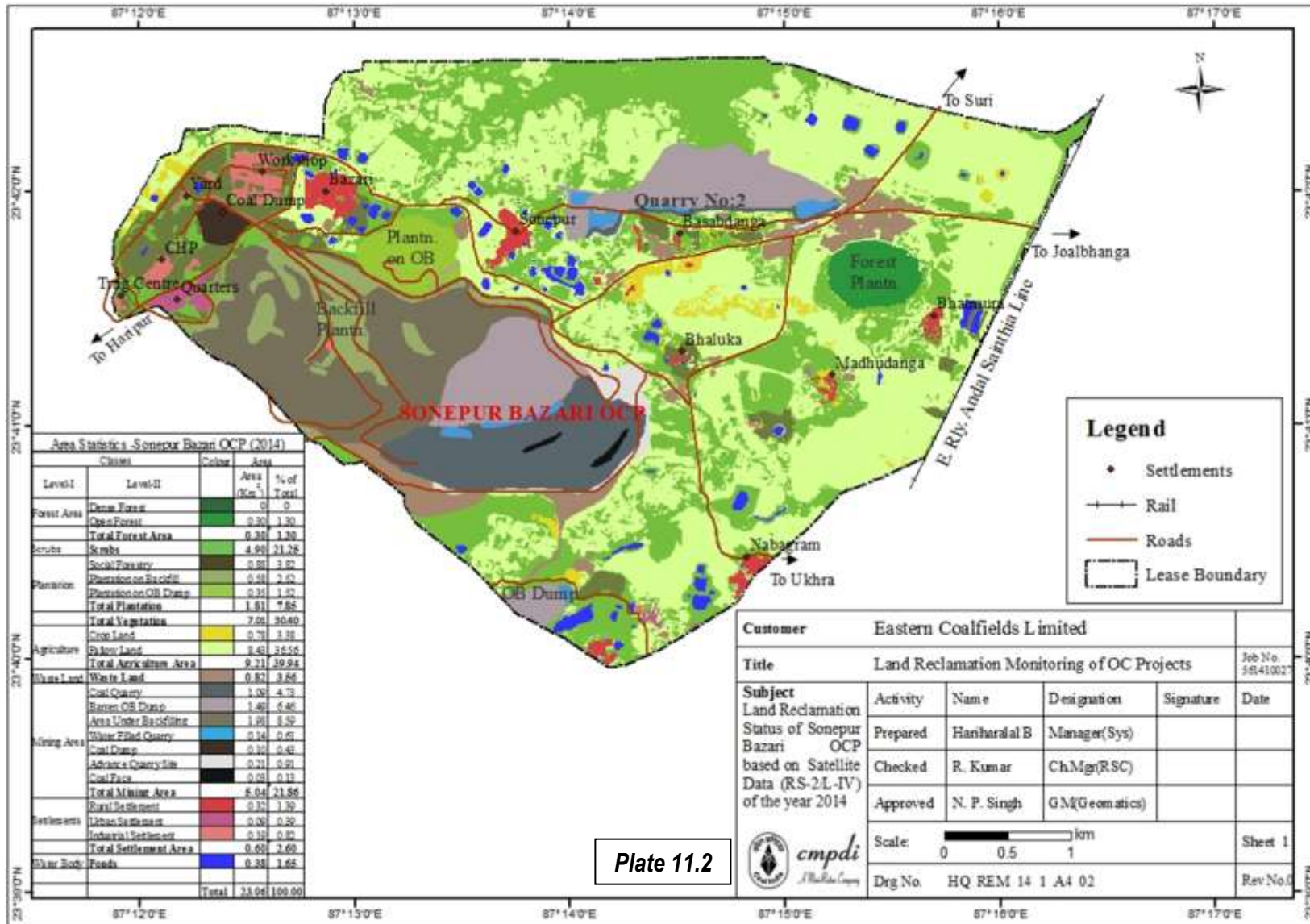


Plate 11.2

Customer		Eastern Coalfields Limited			
Title		Land Reclamation Monitoring of OC Projects			Job No. 561410027
Subject Land Reclamation Status of Sonepur Bazari OCP based on Satellite Data (RS-2L-IV) of the year 2014	Activity	Name	Designation	Signature	Date
	Prepared	Hariharaal B	Manager(Sys)		
	Checked	R. Kumar	ChMgn(RSC)		
Approved	N. P. Singh	GM(Geomatics)			
Scale:		0 0.5 1 km			Sheet 1
Drg No.		HQ REM 14 1 A4 02			Rev.No.0

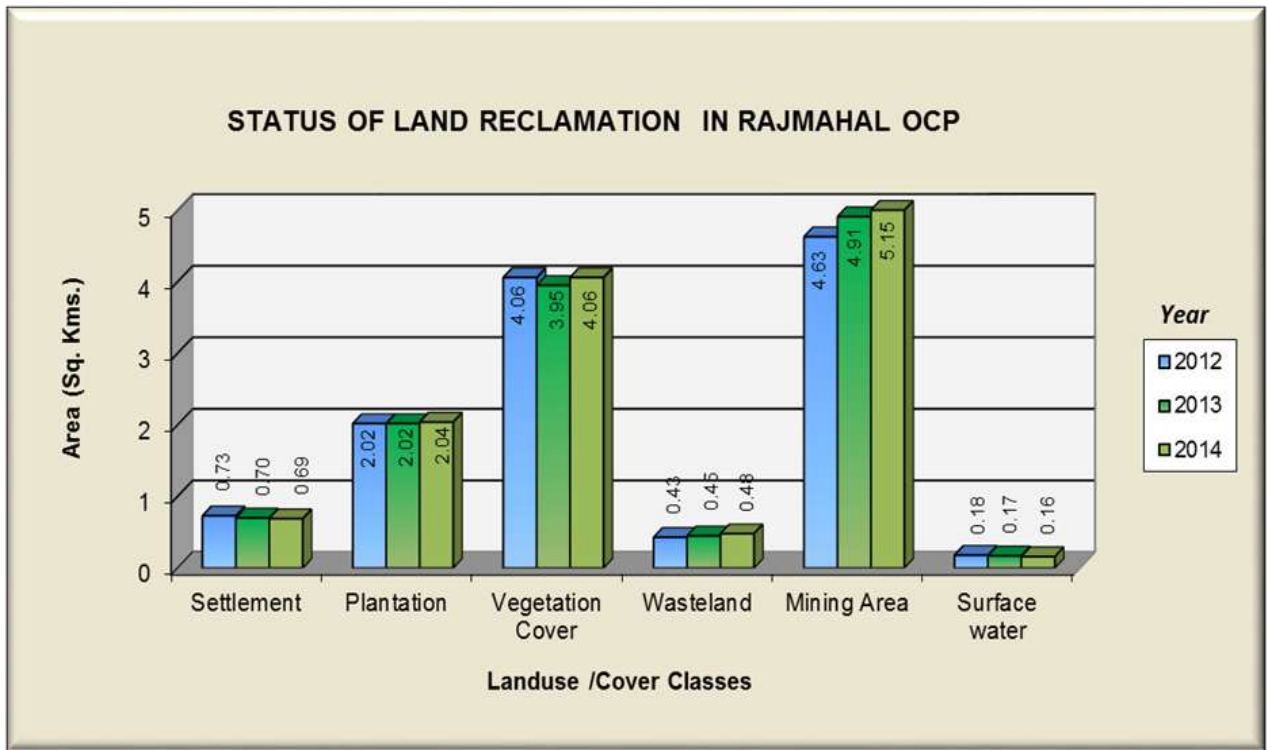


Figure 11.2

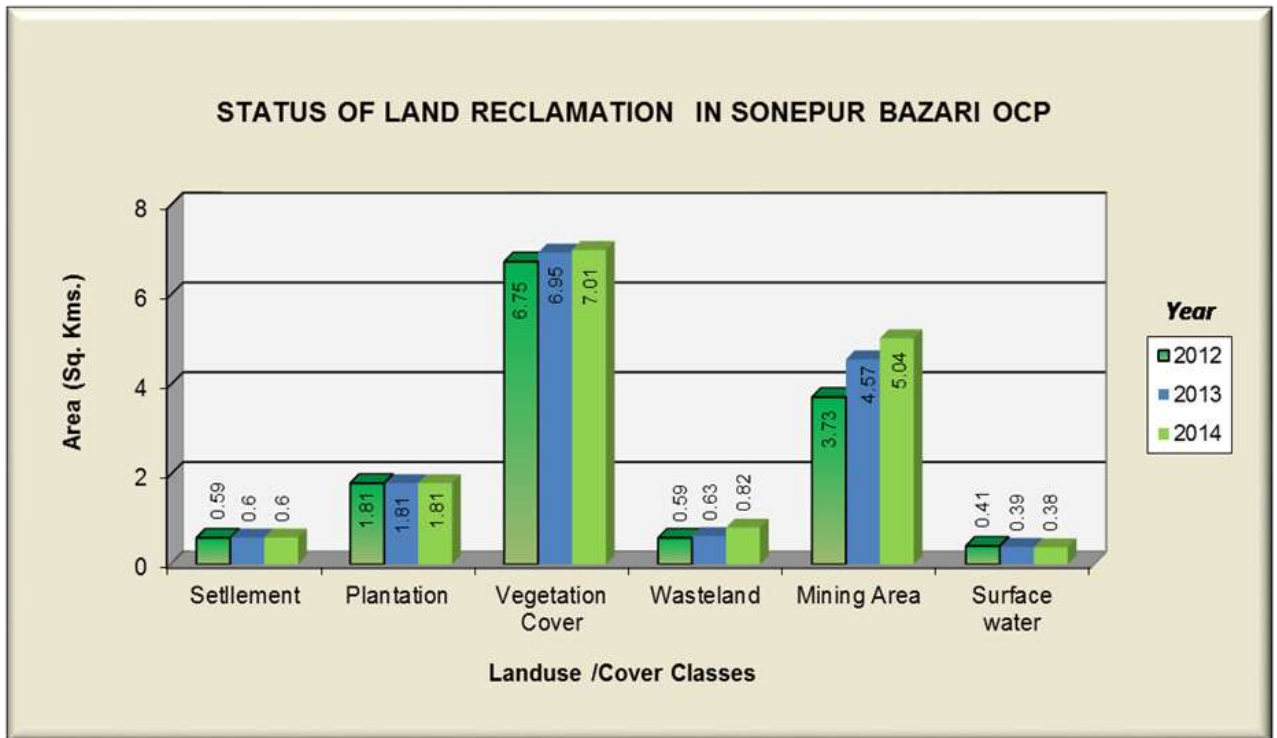


Figure 11.3



Photograph 11.1 : Plantation on OB in Rajmahal OCP, ECL



Photograph 11.2 : Social Forestry in Sonapur Bazari OCP, ECL



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